THE STATUS OF THE WASTE REMOVAL SYSTEM FOR THE WEST VALLEY DEMONSTRATION PROJECT

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ABSTRACT

Development work is progressing to identify a Mobilization System for the removal of the sludge layer of the neutralized PUREX High-Level Waste (HLW) and cesium loaded zeolite from complex storage tanks at the West Valley site. Equipment is simulated at a reduced scale, and examined in a One-sixth Scale Model of the West Valley HLW storage tanks. Sludge characterization data has been used to formulate a simulant sludge matching the yield strength of the actual PUREX sludge phase. Experimental results predicting the removal efficiencies of the methods examined to date are reported. The West Valley waste removal development program, conceptual design of the overall HLW removal system and its processing steps to the Slurry-Fed Ceramic Melter (SFCM) for vitrification, planned remote tank modification, and status of the waste removal project are discussed.

BACKGROUND AND HISTORICAL OVERVIEW

Thirty miles south of Buffalo, New York is the West Valley Demonstration Project (WVDP), an approximately 3,345 acre site just outside the town of West Valley. The site has been used for low-level nuclear waste burial, high-level waste storage, and was the site for the first commercial nuclear fuel reprocessing facility in the world. The operation of the site had been managed by Nuclear Fuel Services Co., Inc. (NFS) under a lease with the State of New York from 1963 to 1982. The fuel reprocessing portion of the facility has not operated since 1972. However, during the time of NFS operation, high-level liquid radioactive wastes were generated from the reprocessing of both commercial nuclear reactor fuels and defense production reactor fuels from 1966 to 1972. These wastes are presently stored in on-site underground tanks.

On October 1, 1980 the U. S. Congress passed the WVDP Act, directing the U. S. Department of Energy (DOE) to undertake a high-level radioactive waste management demonstration project at the West Valley site. Under the Act, the DOE is responsible for solidifying the high-level waste in a form suitable for transportation to a federal repository for ultimate disposal. West Valley Nuclear Services Co., Inc. (WVNS) a wholly-owned subsidiary of Westinghouse Electric Corp., is implementing the Project for the DOE. The NFS fuel reprocessing plant operated on the PUREX separation process. However, there are two types of waste stored at the site. The largest volume of HLW stored underground at West Valley is in Tank 8D-2 and contains approximately 2,250 m^3 of supernatant and 170 m^3 of sludge. This tank has a spare (8D-1) that is approximately one-third full of slightly contaminated condensate. Another tank, much smaller in size, contains approximately 35 m^3 of THOREX acid waste resulting from the reprocessing of the thorium/enriched uranium fuel from the Indian Point-1 Reactor.

The supernatant phase of the PUREX waste will be decontaminated to a level which will permit it to be solidified in concrete and disposed of as low-level waste. The radioactive contaminants removed from the supernatant will be combined with the balance of the high-level waste, delivered to a SFCM, and solidified into borosilicate glass. The waste must first be removed from these tanks before it can be vitrified. This paper addresses the task and time table for removing these wastes from in-tank and delivering the wastes to the vitrification facility. A progress report on the overall Project can be found in Ref. 1.

DISCUSSION

Tank Description and Contents

The 8D-2 waste tank is located underground and has been storing HLW since April 1966. Reprocessed PUREX waste was neutralized by the addition of excess sodium hydroxide and was transferred to this carbon steel tank. In addition to the working Tank 8D-2, a full-capacity spare Tank 8D-1 was provided. Each tank is 21.3 m in diameter and 8.23 m in height. Each rests in its own steel pan and is enclosed within a concrete vault. The area excavated for the vaults was back filled to a minimum overburden depth of 2.4 m in order to provide a complete blanket of stiff silty clay with low permeability around the tank vault complex. This fill acts as an added barrier to potential leakage and also attenuates radiation to less than 1 mR/hr at the ground surface.

The internal structure of waste Tanks 8D-2 and 8D-1 is complex. The tank roof is stiffened by a network of girders and rafters. The girders that stiffen the roof are supported by forty-five 200 mm diameter pipe columns. The lower end of these columns is attached to support girders that are held above the bottom of the tank by a series of support plates and 38 mm diameter stay bolts. A plan and elevation view of the bottom internal structure is shown in Fig. 1.

The tank has six 1.2 m diameter columns through which the vault roof support columns pass. This internal structure makes the West Valley storage tank the most complex HLW tank in the world and complicates the task of removing the sludge layer of the PUREX waste.

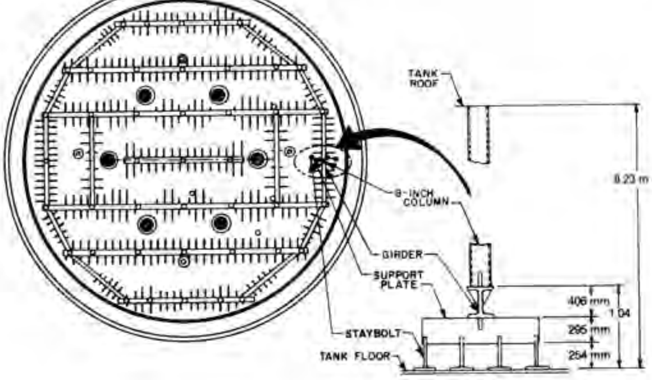

Fig. 1. Tank 8D-1/8D-2 plan & elevation above internal gridwork.

On both tanks, 8D-1 and 8D-2, two of the nozzles attached to the roof are risers that extend to grade level. At present they are the only points of access to the inside of the tanks which could be used for removal equipment. One 610 mm diameter riser designated M-1 is located near the center of the tank. The other, a 305 mm diameter riser designated N-12, is located approximately 610 mm from the M-1 riser. To use more than one piece of equipment to mobilize the sludge layer will require the installation of new risers. This will be discussed later.

The other waste storage tanks 8D-3 and 8D-4, are used to store the THOREX waste. The THOREX waste totals approximately 31 m^3 and is stored in the 8D-4 tank. The tanks are stainless steel, 3.7 m in diameter and 4.8 m in height. These tanks are also contained underground but in a common reinforced concrete vault. The vault is lined, to a height of 0.5 m, with stainless steel forming an integral pan. Each tank has a 200 mm diameter riser that extends to grade level. Since the THOREX waste in 8D-4 will be removed as a solution, no new access openings will be required for waste removal.

As mentioned before, the neutralized HLW stored in Tank 8D-2 consists of two phases, a liquid phase or supernatant containing approximately 40 weight percent total salts and 60 weight percent water, and a sludge phase which has settled in the bottom of the tank. Radiochemical analyses of the supernatant have shown that the salts consist of 81 weight percent alkali metal nitrates and nitrites and about seven weight percent sulfate. Essentially all the cations are sodium and potassium. Cs-137 (8,100,000 Ci) and its short-lived daughter Ba-137m (7,600,000 Ci) make up greater than 99% of the supernatant radioactivity. Detailed waste radiochemical compositions can be found in Ref. 2.

The chemical composition of the insoluble solid waste in the sludge has been computed based on supernatant radiochemical analysis, theoretical fission yield and nuclear fuel burn-up calculations, NFS material balance and fuel processing records. The major radioactivity in the sludge is due to Sr-90 (7,700,000 Ci) and Y-90 (7,700,000 Ci). This makes up greater than 90% of the radioactivity of the insoluble solids within the sludge.

The sludge layer has also been characterized in situ. A buoyancy probe device was developed to provide a density profile of the supernatant and to determine the depth and contour of the sludge layer. A shear vane device was used to provide information on the shear strength characteristics of the sludge layer. Core samples of the sludge have been taken using a piston type sampler. Details of this test and the equipment used can be found in Ref. 3 and 4. Recently obtained radiochemical analysis on the composition of the sludge sample can be found in Ref. 5. The results were consistent with the previous theoretical calculation and therefore, indicates that the samples obtained are representative of the sludge solids as a whole. The total mass of the insoluble solids is calculated to be 107,600 kg.

The liquid in the THOREX tank, 8D-4, has also been sampled and analyzed. The THOREX waste consists of 71 weight percent salts and 29 weight percent water. The solution is homogeneous with a density of 1.844 g/ml @ 23°C. An average of 810 µg/g of water-insoluble solids were found. It was found that more than one-half of thorium in the tank exist as solid thorium nitrate.

Waste Processing Plan

A Supernatant Treatment System (STS) is required to reduce the volume of high-level radioactive waste which will be vitrified into borosilicate glass. Vitrification into borosilicate glass contains the radioactive particles in a stable form; this process has been developed into a technically feasible and environmentally acceptable method of immobilizing high-level wastes. The glass product is insoluble, resistant to chemical attack, physically durable and well suited for dissipating decay heat and resisting radiation damage. The number of glass canisters produced at West Valley will be reduced by a factor of approximately six by separating the nonradioactive salts contained in the supernatant from both the sludge and from radioactive species (Cs-137) dissolved in the supernatant.

To accomplish this separation, the STS will utilize an ion exchange process based on a cesium-specific zeolite to separate cesium from the other dissolved species present in the supernatant. The current reference approach locates the system on the HLW Tank Farm with most of the radioactive components being placed in the spare underground Tank 8D-1. Process valves, instruments, and interconnecting HLW piping will be located in new shielded trenches in the Tank Farm where flow control to the various processing facilities will be carried out. In the STS process, HLW supernatant is flowed continuously through three ion exchange columns in series, and with a fourth column for maintaining the supernatant treatment in a continuous process. A description of the STS design can be found in Ref. 5.

The supernatant in Tank 8D-2 will be decanted from the sludge layer and transferred to the STS by means of an air-driven submersible diaphragm pump. After the supernatant is decanted from the sludge layer, a mixture of soluble/insoluble solids and interstitial supernatant will remain at the bottom of Tank 8D-2. The reference waste processing approach involves batch washing of the sludge in-tank to remove nonradioactive salts left as interstitial supernatant and soluble sodium sulfate solids. The principal reason for washing the sludge is to reduce its sodium sulfate concentration so the glass produced would have a sodium sulfate concentration less than 0.4 weight percent. The washing process will consist of adding fresh water to Tank 8D-2, blending the sludge and wash water, and after allowing the insoluble solids to settle, decant the wash solution from the sludge and transfer to the STS. The cesium loaded zeolite will be discharged through a bottom discharge valve on the column and dumped to the bottom of spare Tank 8D-1.

After the sludge is washed to an acceptable sulfate level, the remaining insoluble solids will then be hydraulically resuspended with additional water and homogenized to produce a consistent feed to the vitrification process. The homogeneous mixture of sludge will be transferred batchwise to the Vitrification Cell. In the cell, the sludge in 8D-2, THOREX waste from 8D-4, and cesium loaded zeolite in 8D-1, along with the glass formers, will be blended in the Feed Concentrator Makeup Tank for delivery to the SFCM. The waste/glass former mixture is melted and the resulting glass will be poured into canisters in a continuous process. A processing flow sheet is shown in Fig. 2.

of the processing and management of low-level and TRU wastes at the West Valley Site can be found in Ref. 7.

Conceptual Design of High-Level the Waste Removal System

At present, the low-pressure, high flow, in-tank recirculation technique used at Savannah River Plant (SRP) is the preferred method for sludge mobilization at the West Valley site. A description of the method presently used at the SRP can be found in Ref. 8. This method resuspends the sludge by in-tank recirculation using the existing supernatant and/or water. In addition, this procedure makes it possible to deliver the waste to the vitrification process at any desired rate while the waste tank contents are maintained at a reasonably uniform composition and a relatively constant concentration. An important feature of this technology is the waste does not leave the tank during of agitation. The only time waste is removed from the tank is for the purpose of transfer to the Vitrification Cell.

The low pressure system uses deep-well long-shafted centrifugal pumps, modified for installation and use in a highly contaminated environment. The pumps operate with a given flow rate through one or two opposing nozzles while rotating on a turntable at 0.2 to 0.5 rpm to provide 360° coverage.

The basic concept of the low-pressure sludge slurrying system is to immerse the sluicing pump in the sludge layer so that a recirculating mixture of sludge and supernatant or water, will serve as feed

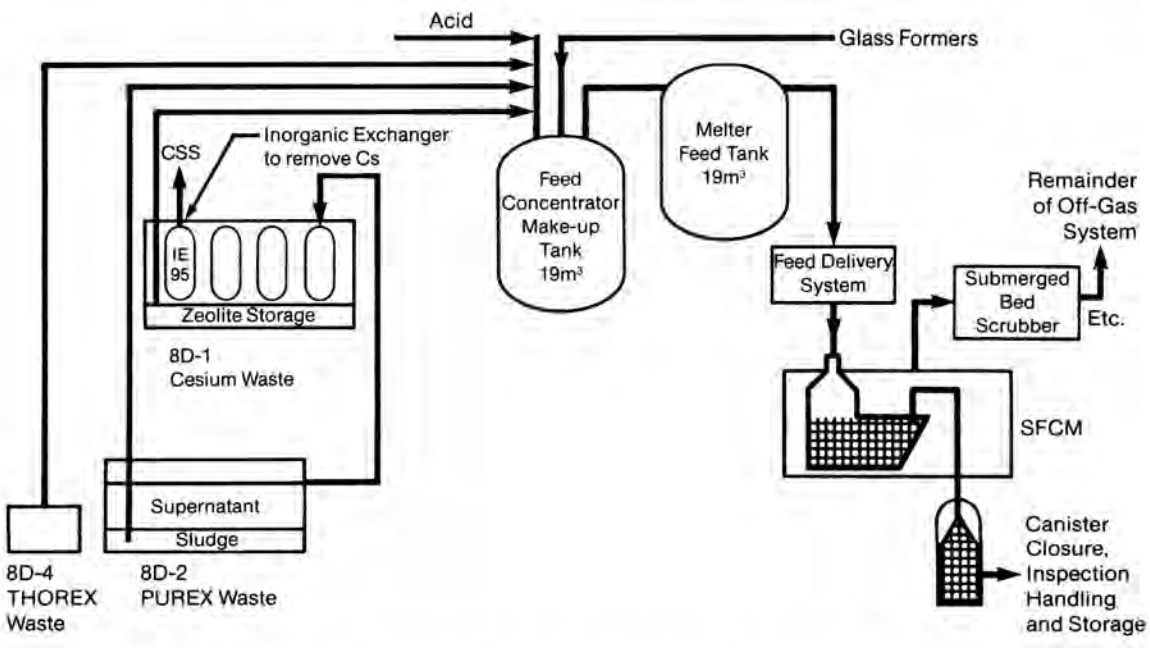

Fig. 2 West Valley HLW processing flow sheet.

The decontaminated supernatant will be transferred from the Tank Farm to the existing Process Building where it will be volume reduced in an evaporator and solidified as low-level waste using the Cement Solidification System (CSS). A description

to the pump. This method homogenizes the sludge by recirculating the tank slurry and uses the sludge to help scour the tank bottom and internal structure. A separate long-shafted centrifugal pump very similar in design, will be used for sludge removal and for feeding the vitrification process. This pump will be a variable speed pump in order to handle the expected wide range of solids concentration, especially towards the end of the waste removal campaign. The flow rate of the transferred slurry will vary with the solids concentration to prevent the solids from settling in the transfer line. The variable speed will control flow and therefore eliminate a flow control valve. Figure 3 shows a conceptual view of the HLW Removal System installed in the West Valley tank.

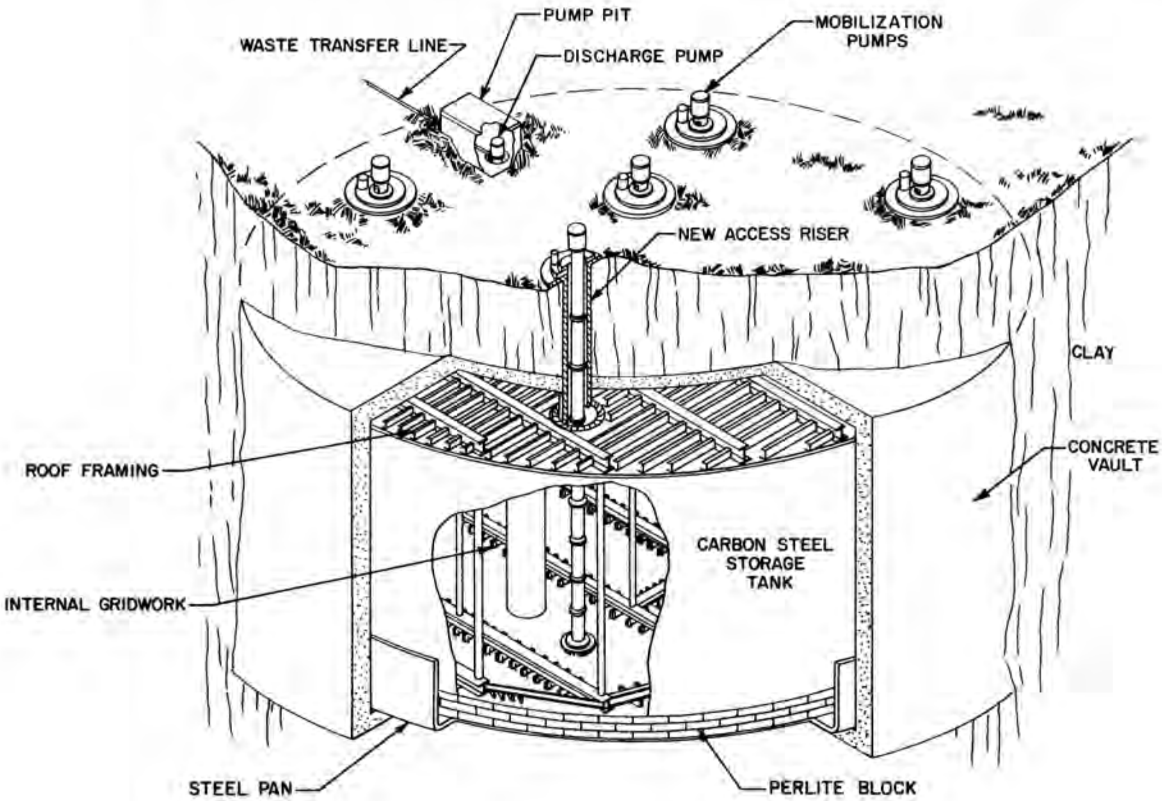

Fig. 3. West Valley conceptual HLW removal system.

The present Project Plan is to process the supernatant before the mobilization and solidification of the sludge and THOREX waste. To do this, a location for storing the cesium loaded zeolite was needed until the start of vitrification. At present, the approach is to store the loaded zeolite in the spare 8D-1 tank and remove it, when required, in the same manner as planned for the removal of the 8D-2 sludge. The loaded zeolite will be transferred as a slurry, to the Vitrification Cell, using the same type of long-shafted removal pump to be used for sludge removal. In-cell it will be blended with the sludge and THOREX waste for feed to the SFCM. Although the THOREX waste in Tank 8D-4, contains solids, it appears that the removal of this waste will be straightforward. The solids can be dissolved by the addition of dilute nitric acid, and therefore this waste stream will be transferred as a liquid.

Due to of the high radioactivity of the waste, vitrification is performed in a remote access cell. The entire vitrification process will be performed remotely, using cranes and manipulators with television monitor viewing. Under this constraint, the diversion of waste from one transfer line at the tank farm to either one of two feed tanks is not practical within the Vitrification Cell. Therefore, all waste transfer diversions will take place outside the cell in a shielded valve pit. Waste lines from Tanks 8D-1, 8D-2, and 8D-4 will meet within the valve pit where waste from the various tanks will be diverted to the two separate lines feeding each of the batch tanks in the cell. Design criteria are presently being formulated to allow the design and construction of the waste transfer system. Waste line drainage back to the tank farm after each batch transfer is an important criteria. To supplement back drainage, an automatic water flush system shall be installed to keep the process line free of solids after each transfer. Instrumentation, automatic sampling system and valving criteria for this transfer system are being developed and final design will start at the end of Calendar Year 1985.

Waste Mobilization Equipment Development

The WVDP is utilizing the substantial amount of information and experience on HLW removal available from the E. I. duPont de Nemours and Company Savannah River Plant (SRP) in Aiken, South Carolina and Rockwell Hanford Operations (RHO) in Richland, Washington. Both SRP and RHO have developed sludge removal equipment for their specific applications.

A description of the equipment used at these facilities and their application at West Valley can be found in Ref. 4 and 8.

In the testing of large equipment involving fluid flow it is customary to build small models which are geometrically similar, all significant dimensions are reduced to the same ratio or scale, as the large prototype or in our case the the existing system. By utilizing the development experience of Savannah River Laboratory (SRL) for evaluating the performance of mobilization equipment in a scale model of Tank 8D-2 and 8D-1, we are measuring the effectiveness of that equipment, as a function of both operating conditions and configuration, to resuspend and remove the West Valley waste stored in Tanks 8D-1 and 8D-2. The modeling theory and simulator pump design criteria that SRL has successfully used to identify pump parameters for sludge removal from underground HLW tank are being used.

A One-sixth Scale Model has been constructed which is geometrically similar to the 8D-1 and 8D-2 tanks. Scale model testing supports the West Valley Sludge Mobilization Program by modeling the resuspension and effective mixing of the sludge in Tank 8D-2. The One-sixth Scale Tank Model is used for examining mobilization equipment and procedures by simulating this equipment at the reduced scale and testing them using a simulated sludge. Efforts will determine the number of optimum locations for mobilization equipment and length of operation required to both resuspend and homogenize the bulk of the Tank 8D-2 sludge. Using the scale model as an engineering tool, we can predict the flow behavior of existing equipment in our tank on the basis of experiments with the scale model.

When it was proposed that the cesium loaded zeolite be stored in the spare Tank 8D-1, the West Valley Scale Model has become a very valuable engineering tool to the Project. Testing in the model has begun to determine the number of pumps, their location, and procedure to resuspend the zeolite in Tank 8D-1 for the purpose of its removal for transfer to vitrification. It had been postulated that if Tank 8D-1 was to be used as the storage location for the cesium loaded zeolite, a modified tank bottom would simplify the zeolite removal process and would be much less complex than 8D-2 sludge removal. The scale model was used to evaluate this concept.

The One-sixth Scale Model was mocked up to represent Tank 8D-1. Each of the tanks' bottom structures are identical; however, the tank tops are a mirror image of each other. Therefore, test hole locations at the scale model, which had been set up for 8D-2, are actual 180° from that actual location in Tank 8D-1. For example, a simulated pump place in the model may be at 45° location when it is being tested, but would be at the 225° mark location on the top of Tank 8D-1.

Fresh zeolite, matching the same particle size as that to be used in the STS, was added to the model with water and removal efficiency were examined. Tests were performed using both the existing tank bottom structure and with a simulated false bottom installed. It is the objective of the scale model tests, for both sludge and zeolite removal, to strive to achieve a degree of cleanliness which would be a balance between what is easily achievable and what would be exceptionally clean.

Scale Model Test Results

As mentioned previously, the West Valley scale model is being used for the examination of waste removal from both the 8D-1 and 8D-2 tanks. Tank 8D-2 for sludge removal and Tank 8D-1 for zeolite removal. Testing in the scale model has been ongoing since August 1984 and the results of the tests performed to date have been very promising in terms of meeting Project waste removal requirements. The first requirement is the removal of at least 90% of the waste from the tank by sluicing alone. Final tank cleanout or decontamination will be performed using a mild acid (i.e. oxalic acid) to dissolve any remaining waste and remove incrusted waste from the walls and columns.

With STS schedule leading the way in terms of waste processing, the examination of effective removal of zeolite from Tank 8D-1 needed to be resolved quickly. A simulated false bottom was fabricated, zeolite was purchased and tests were performed using the tank model as is, and then with the false bottom installed. Below is a summary of the results from the test with the existing bottom.

- O As many as five Savannah River type mobilization pumps will be required for effective zeolite removal from an unmodified tank bottom.
- O By sluicing with five pumps and no process optimization, over 90% of the zeolite was removed from the unmodified tank bottom.
- O Assuming 90% of the activity on the remaining zeolite can be solubilized with oxalic acid, as has been shown at SRL, theoretically greater than 99% recovery of activity was achieved.

Next, a test was performed with the false bottom installed. It was the object of this test to remove at least as much zeolite as the first test, but accomplish it using fewer mobilization pumps. This was not achieved. By not attaining complete tank coverage with the mobilization pumps discharge jet, due to the reduced number of pumps, the zeolite was pushed to the outer area of the tank. Once the zeolite was pushed beyond the pump penetration points, it would settle out because the complete tank was not being agitated and therefore could not be picked up by the removal pump.

Since the simulated false bottom covered the tank complex bottom grid work, it was thought that the pump jet would cover a much greater distance than it was capable within the gridwork. As shown by the test results this was not the case. Therefore, it was obvious that more than one pump, and maybe as many as five, would be needed to remove the zeolite from a modified tank bottom.

Based on these results, it was concluded that bottom modification adds little to zeolite removal efficiency. Furthermore, due to the cost, schedule implications to STS, and potential for large radiation dose accumulations to the installation work force, we are not modifying the bottom of Tank 8D-1. We are presently moving forward to design the Zeolite Removal System based on no bottom modifications. Testing is continuing to optimize zeolite removal efficiencies by examining various operating conditions and equipment characteristics. Mobilization pump rotational direction and speed, number of discharge nozzles on the pump, discharge nozzle angle, type of spray nozzle and its discharge spray angle are all being investigated to optimize zeolite removal by sluicing.

Although most of the scale model testing to date has been associated with zeolite removal, enough experimental data has been compiled on sludge removal to be able to make some preliminary conclusions.

- O Less than half the sludge can be removed from Tank 8D-2 using one single discharge mobilization pump installed in the only existing riser (M-1) large enough for its installation.
- O To obtain the most efficiency sluicing from any one mobilization pump, the pump must operate as close to the tank floor as possible and discharge under the girder support plates.
- O The six large (1.2 m diameter) columns, through which the vault columns pass, appear to cause the greatest interference to the pump discharge jets since they extend to the tank floor.
- O The number of mobilization pumps required to resuspend the same volume of sludge is quite dependent on relative location of the pumps.
- O As many as five mobilization pumps appear to be required to resuspend the entire sludge layer at one time. This number may be needed to wash the sludge to the required sulfate level.
- O Greater than 95% of the sludge can be removed from the tank using three mobilization pumps by removing and relocating pumps from riser to riser over the entire removal operation.
- O By using Savannah River type mobilization pumps with the optimum operating conditions and in-tank configurations, the goal of removing greater than 90% of the sludge by sluicing will be met.

Simulant Sludge Development

The problem in testing for the removal of the sludge from 8D-2 is the limited information on the physical properties of the sludge itself. This is not a problem when testing with zeolite because we are testing the same material as we will be removing. Based on the results of the in situ sludge characterization tests a simulant Kaolin clay sludge was formulated to match the peak yield strength and apparent viscosity of the actual 8D-2 sludge. The development of a simulant sludge was performed at the Westinghouse Research and Development Center based on the experience at SRL. Kaolin clay slurries have been used at SRL to simulate their actual sludge because it has rheological properties similar to chemically simulated PUREX sludge and different rheology can be simulated by varying the water content of the kaolin slurry. Other advantages are that kaolin clay is insoluble, nonabrasive, nontoxic, cost effective and ecologically acceptable.

To match the West Valley sludge dry kaolin clay from the Thiele Kaolin Company is mixed with water at approximately a 30 weight percent clay concentration. The clay slurry is then sheared at a constant shear rate until the fluids viscosity, or more importantly the yield strength, increases to the required strength. The flow behavior of the Kaolin clay slurry is characteristic of a pseudoplastic and has rheopexy behavior. A pseudoplastic fluid is a fluid which decreases in viscosity with an increase in shear rate and rheopexy is a fluid whose viscosity increases with time as it is sheared at a constant rate. The clay slurry exhibits a very distinct yield strength like the actual 8D-2 sludge. Once the yield strength is exceeded and flow begins, the fluid has a pseudoplastic characteristic. This yield strength is matched to the measured yield strength of the 8D-2 sludge.

As the clay slurry is sheared over time samples are taken and yield strengths and viscosity measurements are made using a Brookfield viscometer. Using a Brookfield viscometer LV-4 spindle and assuming the fluid is Newtonian, measured apparent viscosities are approximately 3,300 poise and yield strengths approaching 350,000 dynes/cm^2. These are the approximate values presently being tested in the scale model. The West Valley simulant sludge is significantly different than that used at SRL. The reported yield strengths for the simulant sludge used at SRL are significantly lower than the simulant being tested at West Valley.

Once the clay slurry reaches the required shear strength it is transferred to the scale model and fed at one side of the model in the approximate location the actual sludge was added to Tank 8D-2. Figure 4 shows the simulant sludge topography after it has been added to the tank model. Fresh water is added to the tank filling it to the top of the tank's bottom girder. This represents an approximate total sludge height of approximately one metre in the 8D-2 tank. The simulator pumps are operated and slurried sludge is removed batchwise in the location of the future pump out point.

After five batch transfers more than 98 weight percent of the clay sludge was removed. The profile of the remaining sludge is shown in Fig. 5. From this figure it can be seen that the tank model was cleaned very effectively during this test.

Tank Modifications to Support Waste Removal

As seen from previously mentioned Fig. 4 and 5, that with more than one mobilization pump operating simultaneously the tank can be cleaned to the Project objective of at least 90% waste removal by sluicing alone. To use more than one mobilization pump in 8D-2 will require the remote installation of new tank access risers. The task of installing new risers in a highly radioactive tank is a fairly involved operation but is well within the realm of present day capabilities. In support of the WVDP, RHO at Richland, Washington has been contracted to design, procure, fabricate, and demonstrate a system and method whereby new risers can be installed in Tank 8D-2. Due to the high radiation field, this task must be accomplished remotely.

At Hanford, a demonstration will take place on a full-scale tank mockup. The equipment well then be shipped to West Valley and trained WVNS personnel will install a new riser on Tank 8D-1 in September of this year. The concept being designed involves excavating down to the roof of the concrete vault through a construction caisson centered over the new riser location. A casing would be installed on the vault roof using a crane and back filled to provide for radiation shielding leaving the inside of the casing open for the remaining operations on the tank roof.

A turntable mechanism carrying a high pressure water jet nozzle is lowered into the casing to make a circular, tapered cut through the 610 mm thick concrete vault roof. The plug is then hoisted to the surface.

The tank roof is partially supported by 200 mm channel rafters skip welded to the exterior of the roof. These rafters are on 380 mm centers. Assuming the rafters are accurately positioned, a 710 mm riser will necessitate the removal of two sections approximately 890 mm long.

flanges and weld-prep the roof on a 711 mm nominal diameter circle. The new riser is then lowered onto the tank with a boom crane and released. The gantry is again used to lower the robot into the new riser. This time, the robot is equipped with a MIG torch to make the roof to riser fillet weld. Now the robot operates under preprogrammed instructions to make the four or five passes necessary to make the weld. An arm mounted camera is then used to make a visual inspection of the weld. The robot, gantry and other equipment will then be moved off the side, clear of the centerline.

The boom crane lowers a riser shielding plug into the new riser, but maintains support of the plug weight. The plug and riser will be bolted together and the riser pulled upward with a Hydra-Set, a precision, load positioning device. This operation removes the new riser weight from the tank roof. While the preload is maintained, the annulararea between the riser and the casing will be pumped full of grout through the casing hoist holes.

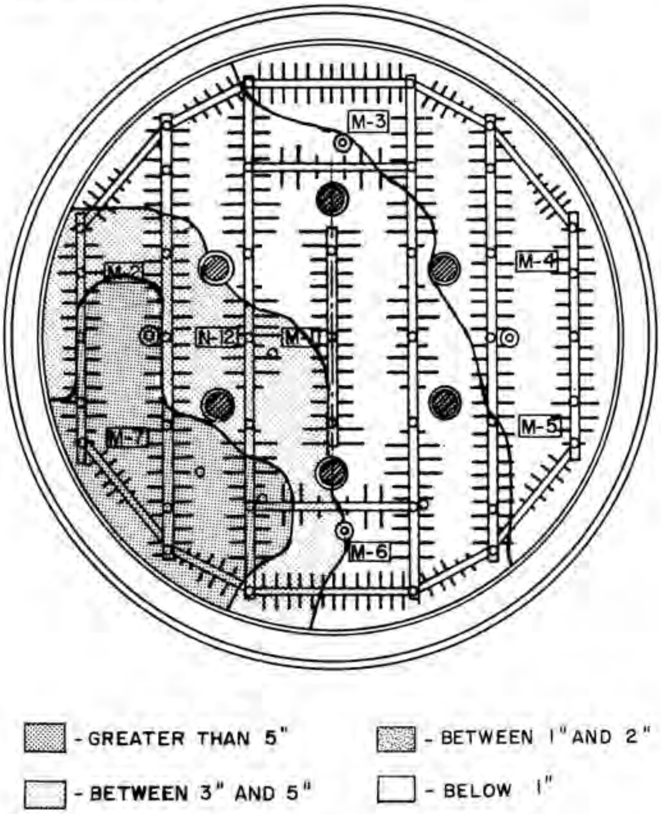

Fig. 4. Model 8D-2 topography after simulant sludge addition.

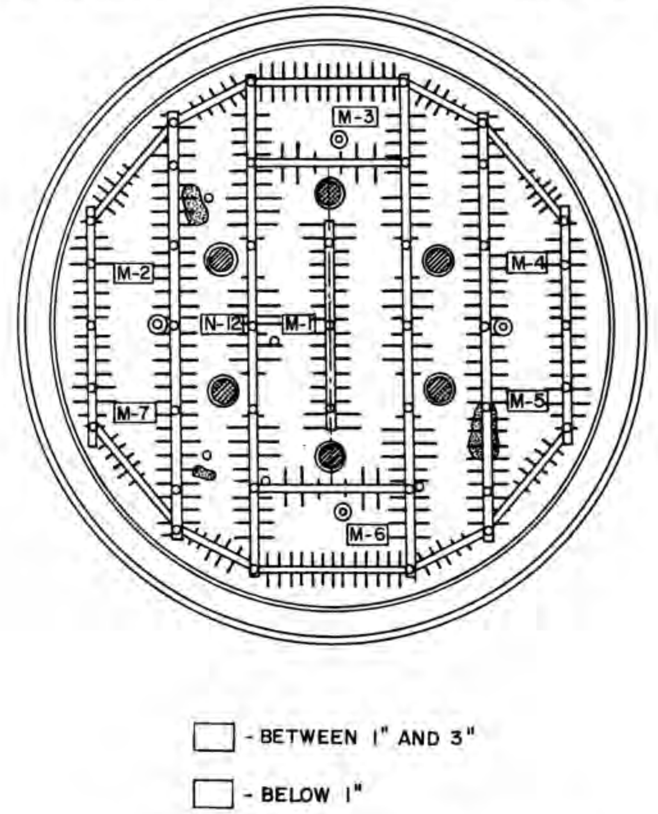

Fig. 5. Model 8D-2 simulant sludge topography after sluicing.

A gantry will be used to lower an industrial robot into the vault area. The robot, equipped with a remotely regulated flame torch, will cut away the upper part of two rafters leaving the lower channel flange behind on the roof plate. The robot can be operated in either a programmed or a manual mode. By far the most difficult step is removing the rafter section without prematurely violating the integrity of the roof.

Another turntable mechanism, this one equipped with a pneumatic grinder, is lowered down to the tank roof. It will grind away the lower rafter

Since all radiation leak paths are now blocked, the riser-to-casing welds can be completed manually.

After the welding is complete the crane hook is disengaged and a containment tent is erected at grade level over the new riser work area. The shield plug is then withdrawn through the roof of the tent.

The smaller turntable, now rerigged with the water jet nozzle is lowered into the riser with the gantry hoist. The turntable magnets will then be used to bring the contaminated cutout to the surface disposal. The shield plug is reinstalled through the tent roof and all equipment is dismantled and moved to the next location.

This completes the new riser installation. The new riser will have a minimum pass-through diameter of about 650 mm, providing adequate clearance for a nominal 610 mm mobilization pumps. All loads placed on the riser flange will be transferred to the vault roof, keeping the tank roof load to a minimum. Except for the possible contamination of the roof cut out turntable, all of the machinery will be reusable for the other riser installations.

zeolite, and THOREX waste will be transferred for vitrification. Vitrification is scheduled for 18 months and should be completed by April 1990.

The total estimated cost of the waste removal project is $9.7 million. This total breaks down to $1.1 million in design, $6.8 million in construction, $1.8 million in contingency.

SUMMARY

The technology and experience for HLW removal from underground storage tanks is available from other DOE facilities. However, the waste removal objectives of those facilities are different than the objectives at West Valley. A scale model test facility has been designed, constructed, and is presently in operation, to develop a West Valley Waste Removal System. By using a scale model of the West Valley waste tank as an engineering tool, existing technologies can be evaluated at a reduced scale and optimized to meet the WVDP objectives without reinventing the wheel. A Waste Removal Project Plan is being implemented and is on schedule to meet vitrification requirements. Waste characterization activities are supporting simulant sludge development. Development testing will be completed in mid-FY 1986 with final design to begin in early FY 1986. Estimated costs for the West Valley waste removal project are $9.7 million and is scheduled to be completed by the end of FY 1988.

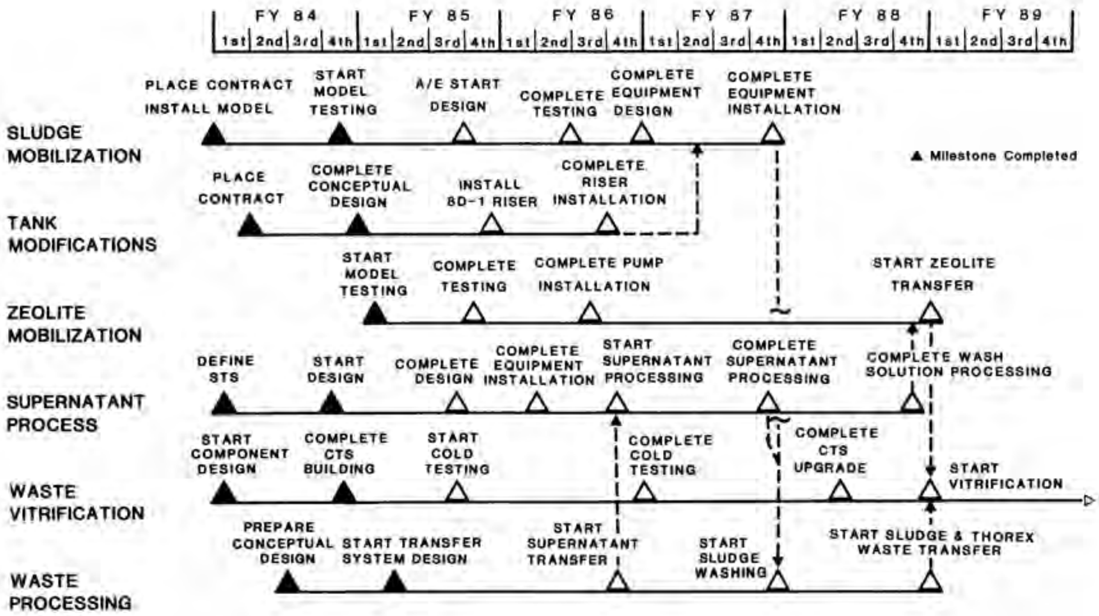

Fig. 6. West Valley waste removal project schedule.

SCHEDULE, COSTS, AND STATUS

A Waste Removal Project Schedule is shown on Fig. 6. At present the critical path lies through the design, installation, and operation of the STS. Since supernatant processing is scheduled to start August 1986, zeolite removal equipment needs to be specified earlier than the equipment for sludge mobilization in order that interface design and construction activities can be fulfilled. Development testing for zeolite removal will be completed in October of 1985 and testing for sludge removal completed in March of 1986.

The remote riser installation system will be demonstrated at West Valley in September 1985. New Tank 8D-2 risers will be installed the following spring and completed by June 1986. Final design is scheduled to begin in August 1985 with final design for the complete Waste Removal System to be completed by September 1986.

Upon completion of supernatant processing, August 1987, sludge washing will begin. At this time, the Sludge Mobilization System will be started. The sludge will be washed, wash solutions processed, and the sludge will be prepared for transfer to vitrification. In September of 1988, the sludge,

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