Removal of the 340 Vault from the Hanford 300 Area using Disodium Phosphate – 14343

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ABSTRACT

The 340 Facility housed the Waste Neutralization Facility, a tank system fed by the radioactive liquid waste system (RLWS) from hot cell and radiochemical laboratory facilities throughout the 300 Area at Hanford, Washington. The facility was first built in 1953 and was originally used to store waste until it was transported to the 200 Area tank facilities by rail car. The above ground facility was demolished in 2011. The 340 facility (including associated spill sites) was added to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions as established in an Interim Record of Decision (IROD) and Action Memorandum (AM). The IROD directs a remedial action for the 340 facility, associated waste sites, associated underground piping and contaminated soils resulting from past unplanned releases. The AM directs a removal action through physical demolition of the facility, including removal of the vault. Both CERCLA actions are implemented in accordance with U.S. EPA approved Remedial Action Work Plan, and the Remedial Design Report / Remedial Action Report associated with the Hanford 300-FF-2 Operable Unit. The selected method for remedy was to conventionally demolish above grade structures, then to remove the below grade vault as a single 1100 TON unit. This requires the excavation of the entire below grade structure so that the vault is on a 1.2m (4LF) tall soil pedestal. Four (4) 900mm (36in) diameter casings were jacked into place with the internal soil being augered out of the casing as it was advanced. Once fully installed, the auger was removed and the casing was filled with grout. Each casing had a metal pedestal form installed on the top prior to installation. Once installed, a grout pad was placed using the metal pedestal forms to form a grout beam connecting the bottom of the vault to the top of the casing. While placing the final casing excavation encountered significant contamination from a break in the sump in line with the final casing. Disodium phosphate was injected underneath the vault along and through the casing to sequester the strontium contamination in the soil and prevent the contaminants migration to the water table, located approximately 3-10 feet under the casing. A fifth casing is to be installed as an excavation method solely, no structural value is expected to be achieved, however the casing should allowed a more controlled excavation of the high radiation soils. A lift system for the entire vault shall be erected, this system is based upon the use of Pull Up Gantries (PUGs). The soils in between the casings shall be excavated in series and the lift beams shall be installed between each of the casings to transfer the load of the vault over to the lift system in a staged method so as not to overload the soil pedestal and allow for settlement of the vault. Once the load of the vault has been completely transferred to the lift system, the casings shall be removed and the soils underneath the vault shall be over excavated by 600mm (2LF). A Controlled Density Fill (CDF) pad shall be placed. A slide track system shall be installed to allow for the installation of a 25 TON pan which shall function as an IP-1 Container bottom. A soft sided IP-1 container shall be installed over the remainder of the

vault and the pan shall be filled with a light weight Styrofoam impregnated grout that shall be placed inside the pan. The vault will then be placed on a twenty-four line, double wide, self-powered Goldhofer for transfer to the onsite CERCLA Disposal Cell (ERDF Facility), approximately 33 km (20 miles) away.

INTRODUCTION

The 340 Vault removal project has three major technical challenges which had to be overcome in order to successfully complete the project. One technical challenge was to remove highly contaminated soil from underneath the 1,066 ton structure, while transferring the structure from bearing on the native soil, to a temporary construct of four (4) 900mm (36in) diameter casings, to the lifting frame which allows the structure to be placed on a Goldhofer trailer. The highly contaminated soil was located approximately 4 meters (12LF) above the high water table of the Columbia River. The second technical challenge was to immobilize the contaminated soil with to prevent contamination spread into the river. The third major technical challenge was to lift the structure in one piece. In order to do that, the four (4) 900mm (3LF) diameter casings had to be removed after the installation of a lifting frame in between each of the casings without damaging the lift system or the vault. This challenge has to be met in order to allow for the IP-1 package to be installed underneath the vault and to allow the Goldhofer transportation system access to accept the load.

Figure 1: Aerial Photo of 340 Facility circa 2009

HISTORY

The 340 Facility housed the Waste Neutralization Facility, a tank system fed by the radioactive liquid waste system (RLWS) from hotcell and radiochemical laboratory facilities throughout the 300 Area at Hanford, Washington. See Figure 2. The facility was first built in 1953 and was originally used to store waste until it was transported to the 200 Area tank facilities by rail car. The above ground facility was demolished in 2011. The 340 facility (including associated spill sites) was added to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions as established in an Interim Record of Decision (IROD) and Action Memorandum (AM). The IROD directs a remedial action for the 340 facility, associated waste sites, associated underground piping and contaminated soils resulting from past unplanned releases. The AM directs a removal action through physical demolition of the facility, including removal of the

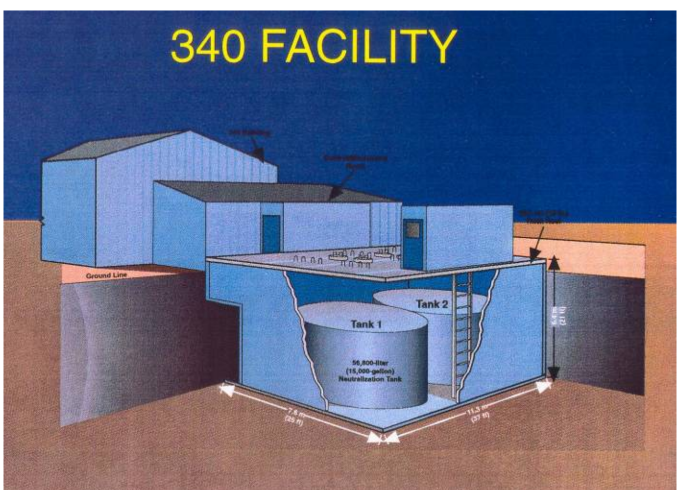

Figure 2: Artist's Rendering of 340 Facility Cutaway

vault. Both CERCLA actions are implemented in accordance with U.S. EPA approved Remedial Action Work Plan, and the Remedial Design Report / Remedial Action Report associated with the Hanford 300-FF-2 Operable Unit.

PROJECT OVERVIEW

The selected method for remedy was to conventionally demolish above grade structures, then to remove the below grade vault as a single 1100 TON unit. This requires the excavation of the entire below grade structure so that the vault is on a 1.2m (4LF) tall soil pedestal. Four (4) 900mm (36in) diameter casings were jacked into place with the internal soil being augered out of the casing as it was advanced. Once fully installed, the auger was removed and the casing was filled with grout. Each casing had a metal pedestal form installed on the top prior to installation. Once installed, a grout pad was placed using the metal pedestal forms to form a grout beam connecting the bottom of the vault to the top of the casing. While placing the final casing excavation encountered significant contamination from a break in the sump in line with the final casing. Disodium phosphate was injected underneath the vault along and through the casing to sequester the strontium contamination in the soil and prevent the contaminants migration to the water table, located approximately 3-10 feet under the casing. A fifth casing is to be installed as an excavation method solely, no structural value is expected to be achieved, however the casing should allowed a more controlled excavation of the high radiation soils. A lift system for the entire vault shall be erected; this system is based upon the use of Pull Up Gantries (PUGs). The soils in between the casings shall be excavated in series and the lift beams shall be installed between each of the casings to transfer the load of the vault over to the lift system in a staged method so as not to overload the soil pedestal and allow for settlement of the vault. Once the load of the vault has been completely transferred to the lift system, the casings shall be removed and the soils underneath the vault shall be over excavated by 600mm (2LF). A Controlled Density Fill (CDF) pad shall be placed. A slide track system shall be installed to allow for the installation of a 25 TON pan which shall function as an IP-1 Container bottom. A soft sided IP-1 container shall be installed over the remainder of the vault and the pan shall be filled with a light weight Styrofoam impregnated grout shall be placed inside the pan. The vault will then be placed on a twenty-four line, double wide, self-powered Goldhofer for transfer to the onsite CERCLA Disposal Cell (ERDF Facility), approximately 33 km (20 miles) away.

Vault Weight Transfer

Once the vault was excavated to a depth of 9m (30LF) leaving the vault atop a 1.2m (4LF) soil pedestal the installation of load transfer methodology began. Four (4) 900mm (36in) diameter schedule 100 casings were jacked into place with the internal soil being augered out of the casing as it was advanced. Once fully installed, the auger was removed and the casing was filled with grout. Each casing had a metal pedestal form installed on the top prior to installation. Once installed, a grout pad was placed using the metal pedestal form with internal bladder to form a grout beam connecting the bottom of the vault to the top of the casing. While placing the final casing excavation encountered significant contamination from a break in the sump in line with the final casing. A redesign of the casing installation system had to occur to eliminate dust from the augering system spreading contamination. Furthermore the strontium plume would travel with any water added as a dust control measure down to the groundwater level and eventually into the river. Therefore a method for binding the strontium in place had to be developed to protect the river from this potential contamination.

Disodium Phosphate

Disodium phosphate was chosen because phosphate forms an insoluble complex with heavy metals (such as Strontium) that stay insoluble over a wide range of pH and conditions. This insolubility renders the heavy metals immobilized and unable to be leeched out beyond the treated soil.

Previous testing on the Hanford site by the Pacific Northwest National Laboratory of the disodium phosphate to act as a chemical wall showed that a concentration above 500ppm to a maximum of 5,000ppm provided satisfactory results and was still a practical solution to pump through standard equipment. The material disodium phosphate used at the 340 Vault project was mixed in water at a ratio of 0.02kg/L (0.2lbs/gal). This ration equates to a concentration of approximately 5,000ppm. It was determined to use the maximum concentration recommended in order to increase the probability of a successful implementation.

A mock up test with performance criteria was developed and performed. The mock up used a similar delivery system to validate that the solution would not bind up or inhibit flow through the actual delivery system and through the soil at different times. The mock up tank, and pump were different sizes than the actual delivery system, however the hoses and sprinkler heads were the same as the actual delivery system. This allowed the team to verify that the flow rates were sufficient to properly wet the soils for dust control. This also allowed the team to ensure that the solution would not change state overnight or during cure that would form blockages in the delivery system.

The delivery system was comprised of three independent systems. System 1 had a 2650L (700 Gal) tank to an automatic pump with recirculation capacity, then through a 37mm (1-1/2in) hose to a 12mm (1/2in) manifold distribution system down the length of the casing. Injection ports were installed down the length of each casing allowing for application of the solution ahead of the casings and internal to the casing. System 2 had a 2650L (700 Gal) tank to an automatic pump with recirculation capacity, then through a 37mm (1-1/2in) hose to a splitter with one end going to a fire hose nozzle for general application and one end going to a sprinkler head feeding the discharge chute of the auger system. System 3 was a 18,900L (5,000 Gal) water truck fed to a remote water cannon for general application.

The disodium phosphate was injected in front of the cutting head at a rate of 95L (25Gal) per 0.6m (2LF) of casing advancement. This added sufficient solution to the estimated soil face to minimize dust as the soil was disturbed. Each of the up to seven (7) injection ports down the length of the casing injected 95L (25Gal) of solution to completely douse the soil as it progressed down the auger flights. The need for so many injection ports was due to the fact that overnight the soil would dry out and become “flighty” again. The numerous ports provided more than sufficient coverage to ensure that soil reaching the discharge chute was sufficiently wetted. Once at the discharge chute two sprinkler heads aimed at the top of the paddle box doused the entire box with solution eliminating any dust. The general application through a remote water cannon allowed for the site to be presoaked prior to any manned entry in the area. The general application through a fire hose allowed for specific areas of concern to be wetted during manned entry into the radiological zones without wetting of personnel’s PPE or requiring the use of rain suits. This minimized Industrial Hygiene concerns related to heat stress during the summer time operation.

Vault Lift

Once the soil underneath the vault had been excavated and the entire weight of the vault was transferred off the soil and onto the four (4) casings a lift system is erected around the vault. See Figure 3: Isometric Drawing of the 340 Lift System. Seven (7) W27x258 Lower Lift Beams are floated underneath the vault via a cantilevered rigging system. Each Lower Lift Beam is connected by eight (8) 37mm (1-1/2in) bolts to a W36x302 Connecting Beam running perpendicular to the Lower Lift Beams. This Connecting Beams sits beneath a 2.4m (8LF) Undercut Girder which is 18.3m (60LF) long. The Connecting Beams hang from four (4) 75mm (3in) thick Dywidag All Thread Rods from the Undercut Girders. These Undercut Girders span the length of the vault and project the weight of the vault onto four (4) W40x431 Transport Beams. Two (2) Transport Beams sit on each side of the vault. Eight (8) Pull Up Gantries (PUGs) then lift the whole system high enough to remove the temporary casings and install a concrete pad underneath the system so that an IP-1 Pan and the Goldhofer transport system can be installed underneath.

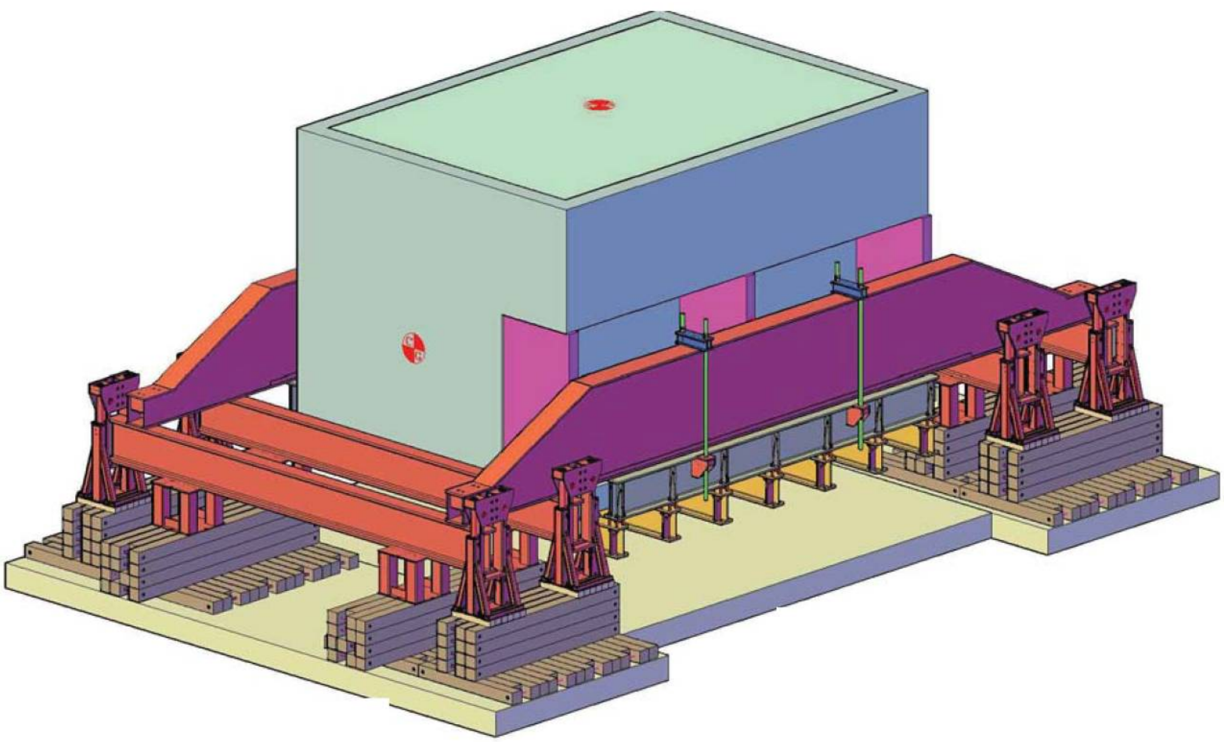

Figure 3: Isometric Drawing of 340 Lift System

Transport and Offload

Once the Goldhofer has been correctly positioned underneath the 340 Vault and the Lift System, the Goldhofer will be raised to assume the weight of the combined systems. An IP-1 container is placed on top of the 340 Vault and attached to the lower metal pan which has been filled with Elemix Grout. Elemix Grout is a grout with Styrofoam pellets impregnated throughout the grout to lighten the grout from 2.4kg/L (150 pcf) to 0.5kg/L (32pcf). The Elemix Grout provides macroencapsulation for long term disposition as well as some shielding for transportation requirements.

The securement requirements for transportation have been determined to include shear tabs between the Goldhofer and the IP-1 Pan as well as a 1.5m (5LF) securement girder across the top of the vault to prevent movement of the internal contamination in case of overturn. See Figure 4: Isometric Drawing of 340 Transportation System.

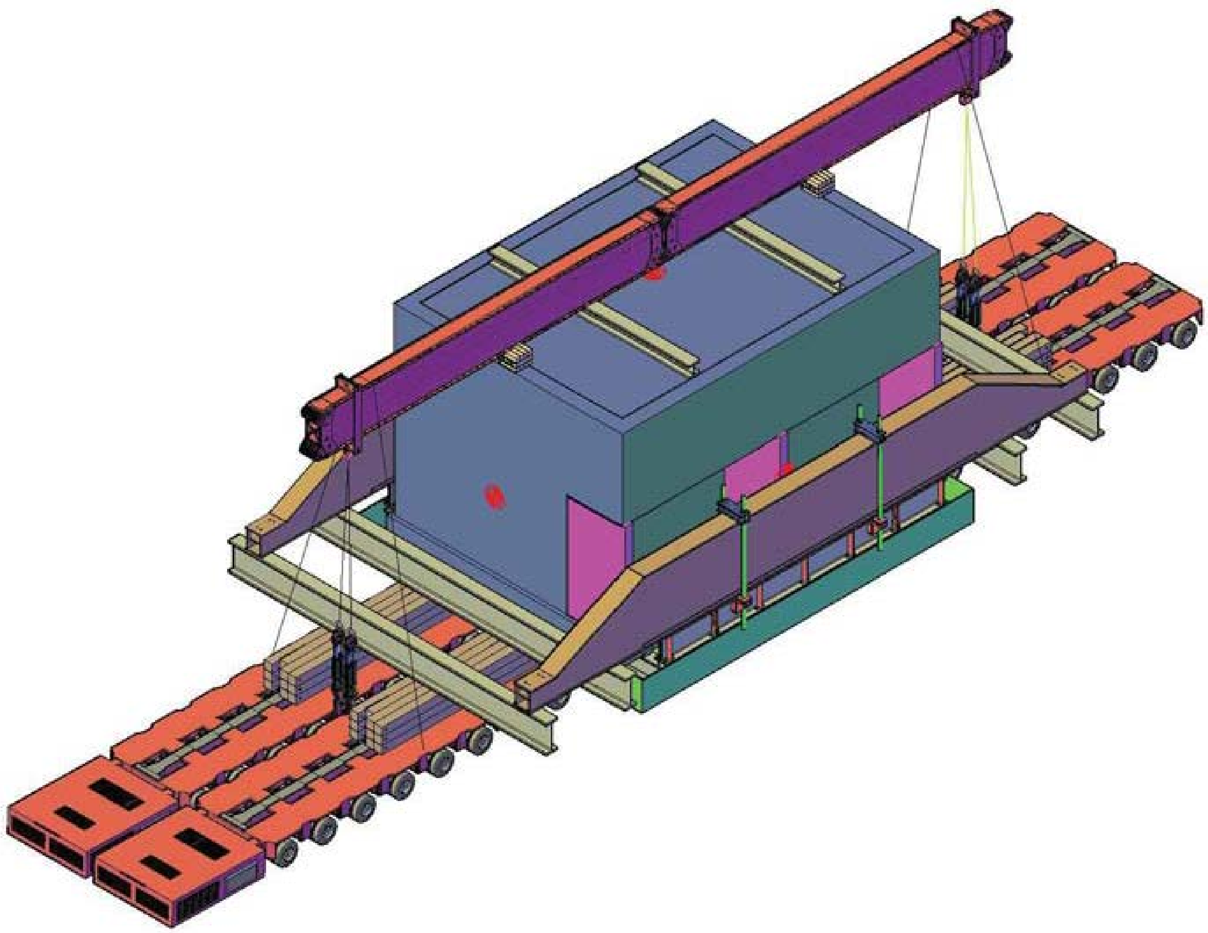

Figure 4: Isometric Drawing of 340 Transport System

CONCLUSION

The installation of the horizontal casings allowed for the soil pedestal supporting the 340 Vault to remain mostly intact so that the vault slab was fully supported during this phase of the project. This also allowed for the casing to be precisely placed so as to maximize the support of the large grout filled tanks inside the vault to be completely supported through the entire load transition process.

The use of disodium phosphate allowed for a larger amount of dust suppression to be used while mitigating the potential effect of driving contamination through the soil to groundwater and therefore to the river. Without the use of disodium phosphate this project would have had to have been completely redesigned using a completely different approach, therefore threatening the schedule and cost performance for the company and the client.

Transitioning the load from the casings to the lower lift frame though the use of the casing / auger method combined with the use of a remote controlled miniature excavator allowed for safety and potential exposure to be maximized and minimized respectively. This keeps the workers as safe as possible using the As Low As Reasonably Achievable (ALARA) model for exposure to all of the various hazards. The vault could then be fully supported on the lower lifting frame and raised as a single unit onto the Goldhofer transportation device.

REFERENCES

1. *Removal Action Work Plan for 300 Area Facilities*, DOE/RL-2004-77, Rev. 2

2. *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, DOE/RL-2001-47, Rev. 3