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322-R2U2 Engineering Assessment - August 2015

M. Abri, D. Griffin

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**Engineering Assessment
and Certification of Integrity
Lawrence Livermore National
Laboratory**

322-R2U2 Tank System

Abri Environmental Engineering, Inc.

August 2015

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Engineering Assessment and Certification of Integrity of the 322-R2 Tank System

1. Background

This Engineering Assessment and Certification of Integrity of retention tank system 322-R2 has been prepared for tank systems* that store and neutralizes hazardous waste and have secondary containment. The regulations require that this assessment be completed periodically and certified by an independent, qualified, California-registered professional engineer. Abri Environmental Engineering performed an inspection of the 322-R2 Tank system at the Lawrence Livermore National Laboratory (LLNL) in Livermore, CA. Mr. William W. Moore, P.E., conducted this inspection on March 16, 2015. Mr. Moore is a California Registered Civil Engineer, with extensive experience in civil engineering, and hazardous waste management.

This report has been prepared consistent with the scope of work, dated February 26, 2015.

The technical assessment for 322-R2 tank system has been reviewed by Mr. William Moore, P.E., who has certified the tank system for the following:

- sufficient structural integrity,
- acceptability for transferring and storing hazardous waste,
- compatibility with the stored waste, and
- suitability of tanks and containment system design so they will resist collapse, rupture, or fail.

The retention tank and the liftstation in this tank system were originally assessed and certified by an Independent Professional Engineer in May 1997, Chow Engineering Inc., "*Engineering Assessment and Certification of Integrity of the 322-R2U2 Tank System*", May 1997; and July 2000, Uribe and Associates, "*Addendum #1 to Engineering Assessment and Certification of Integrity of the 322-R2U2 Tank System*", July 2000, respectively. The tank system was subsequently assessed and certified by Abri Environmental Engineering, Inc. in April 2010, "*Engineering Assessment and Certification of Integrity, Lawrence Livermore National Laboratory, 322-R2 Tank System*", April 2010.

This document will be kept on file by the Lawrence Livermore National Laboratory (LLNL) Environmental Functional Area (EFA). Original hard copy documentation of the relevant manufacturers' information for the tank system are also kept on file by the LLNL EFA.

* *Tank system* is defined in 40 CFR 260.10 as "a (one) hazardous waste storage or treatment tank and its associated ancillary equipment and containment system." In the text of this report, *tank system* is used to include all the tanks and associated ancillary equipment (e.g., "the 321-R2 tank system").

2. Description of the 322-R2 Tank System

The 322-R2 tank system consists of one vertical tank installed in a below grade concrete vault, one liftstation located inside Building 322, one sump pump, one liftstation pump, two filter canisters located inside Building 322 (B322), single wall secondarily contained piping, and appurtenances. The tank system includes a pH neutralization process that has a submersible pump, sodium hydroxide injection system, pH sensor control panel, and recirculation piping.

The liftstation consists of a 338 gallon open top, flat bottom stainless steel tank measuring 32 inches wide by 34 inches deep by 72 inches high. The liftstation was in good condition at the time of the inspection. The liftstation is provided with a submersible centrifugal pump controlled by automatic level switches. The tank system is also provided with two filter canisters that are used to remove particulates from the wastewater before it is pumped to the retention tank.



Figure 1. Liftstation Located Inside of Building 322

Tank 322-R2U2 is a centrifugally formed single walled, domed top, cylindrical, fiberglass tank. The tank was in good condition at the time of the visual inspection. The

vertical tank has a dish bottom, a capacity of 1,000 gallons, and measures 72 inches in diameter by 85 inches high. The tank has a manway measuring approximately 24 inches in diameter at the top center of the tank. Tank 322-R2U2 is located on the southwest side of B322 within an in-ground, epoxy coated reinforced concrete vault. The vault is covered by galvanized steel grating sections that are supported by two steel H-beams that span the vault, see **Figure 2**. The entire vault area is covered by a roof.



Figure 2. B322-R2U2 Retention Tank

The in-ground vault is the secondary containment for the tank. The epoxy coated secondary containment measures 10 feet-5 inches long by 8 feet wide and 9 feet deep. Tank 322-R2U2 sits on an 8 feet long by 6 feet 8 inches wide and 6 inches high concrete pad in the vault. The secondary containment is provided with a sump measuring 2 feet by 2 feet by 2 feet deep, see **Figure 3**.



Figure 3. Secondary Containment Sump

Secondary containment for piping conveying waste to the tank is located in a separate secondary containment area that drains into the retention tank secondary containment vault. Piping and valves are constructed of schedule 80 CPVC material.

The retention tank, the secondary containment vault, and the liftstation and associated piping are inspected daily when in use for evidence of leaks. Leaks will be contained within the secondary containment, and will trigger an alarm.

3. General Use of the Tank System

The tank system is used to collect, store for 90 calendar days or less, and neutralize rinsewaters from various plating shop operations inside Building 322. As a part of the plating process, metal parts are dipped into DI water baths or rinsed using DI water, the wastewater is gravity drained to the lift station. The waste is then pumped into the 322-R2 tank system outside the building. A pH neutralization process is used to neutralize the wastewater before it is sent to an evaporator as part of a water recycling process. The evaporator or any other ancillary equipment related to the water recycling process is not part of this engineering report. The neutralization unit operates as follows:

The pH of the rinsewater in 322-R2U2 is monitored by a pH sensor and a recirculating submersible pump. Sodium hydroxide is automatically injected into the tank if the pH of the wastewater is less than 6. A control panel displays the pH of the wastewater continuously.

4. Hazardous Characteristics of Contained Waste

The rinsewater handled in the tank system may exhibit the characteristics of toxicity. The wastewater is primarily DI water and could be contaminated with toxic metals depending upon the operations. **Table 1** shows the expected range of concentrations that could be present in the wastewater. The pH could range between 2.0 and 10.5.

Table 1. Hazardous Constituents of the Waste Stream

Constituent	Concentration (parts per million)	Constituent	Concentration (parts per million)
Silver	7.5 - 130	Nickel	47 - 1900
Total chromium) (total)	17 - 200	Lead	22 - 9900
Copper	27 - 590		

5. Description of the tank system components

5.1. Retention Tank

The 322-R2U2 underground storage tank is single wall, centrifugally cast dished bottom, domed top, and is made of fiberglass reinforced plastic (FRP). The tank is manufactured by Raven Industries, Inc. The tank's specifications are outlined in **Table 2**.

Table 2. Tank Specifications

Description	Specification
Dimensions:	72 inches diameter x 85 inches high
Maximum Capacity:	1000 gallons
Material of Construction:	Fiberglass reinforced plastic (FRP)
Design Pressure:	Atmospheric
Operating Pressure:	Atmospheric

The tank is equipped with the following:

- One two inch FRP mushroom vent located on top of the tank,
- One 24 inch diameter manway located on top of the tank,
- One 2 inch inlet attached to the tank approximately one foot from the top of the tank.

The tank is held in place by six $\frac{3}{4}$ inch diameter stainless steel bolts through angle brackets bonded to the side walls at the base of the tank.

5.2. Liftstation

The liftstation in the 322-R2 tank system is constructed by LLNL of 3/16 inch thick 304 stainless steel that has a flat bottom and open top. The liftstation is also used as a rinse station in the metal plating operations. The liftstation specifications are outlined in **Table 3**.

Table 3. Liftstation Specifications

Description	Specification
Dimensions:	32 inches wide x 34 inches deep x 72 inches high
Maximum Capacity:	338 gallons
Material of Construction:	304 stainless steel, 3/16 wall thickness
Design Pressure:	Atmospheric
Operating Pressure:	Atmospheric

The liftstation includes the following:

- One 2-inch diameter schedule 80 CPVC inlet pipe located 4 inches from the bottom of the vessel,
- One 48 gallons per minute submersible pump,
- One canister containing a stainless steel basket,
- One canister containing a 50 micron filter sock to remove particulates from the wastewater.

Automatic On and Off liquid level switches operate the pump. The liftstation pump automatically turns on when the liquid level is 8 inches deep, and shuts off when the liquid level is 5 inches deep.

5.3. Secondary Containment for 322-R2U2 tank

The inground secondary containment vault for the tank is constructed of reinforced concrete that is coated with Amerlock-400 epoxy. The secondary containment measures 10 feet 5 inches by 8 feet wide by 9 foot high walls with maximum capacity of 5,513 gallons. The secondary containment vault is in an area that is covered and protected from the elements.

2 feet by 2 feet by 2 feet sump on the northwest corner of the vault has been constructed as an integral part of the secondary containment. The sump contains a 1/6 horsepower submersible pump that has been provided with automatic level switches.

LLNL has installed a camera to monitor the secondary containment area immediately below the tank where unaided visual inspection is difficult, see **Figure 4**.



Figure 4. Access for Installed Camera to View the Area under the Tank

The camera shows the area on a monitor that is installed in a panel above the secondary containment vault, see **Figure 5**.



Figure 5. Monitor Showing the Area under the Tank

LLNL employees were replacing the monitor at the time of the inspection. Abri Environmental Engineering, Inc. staff revisited the tank system and confirmed that the camera was operating on 4/13/2015.

5.4. Secondary Containment for liftstation

Secondary containment for the liftstation is provided by a six inch below grade floor inside Building 322. The capacity of the secondary containment system is 7,925 gallons. Other non-wastewater operations share the secondary containment system in Building 322.

5.5. Seismic and Wind Restraints

Tank 322-R2U2 has been provided with wind and Zone 4 seismic restraints to prevent permanent displacement in any direction by wind, or seismic event (lateral motion, overturning, or uplift) equal to or greater than those recommended for a low-hazard facility.

The tank bottom is elevated from the concrete pad by a 6 inch high collar that extends the entire circumference of the tank except for an opening for the tank discharge pipe. Six $\frac{3}{4}$ inch diameter stainless steel bolts secure the tank against wind and/or seismic forces. The tank is secured to the reinforced concrete base by the bolts that are mounted through six $\frac{3}{4}$ inch thick stainless steel clamps, which secure the braces that are bonded to the base of the tank, see **Figure 7**.



Figure 6. Retention Tank Restraint

The liftstation is placed in the secondary containment trench and is held in place by metal grating that restricts its lateral movement, see **Figure 7**.



Figure 7. Liftstation Restraint

5.6. Piping

The waste conveying pipes for the tank system consist of 1 inch and 2 inch CPVC pipes with steel support brackets. The CPVC piping is chemically resistant to the aqueous waste handled in the tank system.

The wastewater is transferred from the liftstation inside Building 322 in two inch CPVC piping connected to tank 322-R2U2 via a two inch inlet secured into the top of the tank. The piping inside the secondary containment vault area includes drain lines, sump return line, and piping to empty the contents of the tank. The piping for the tank system is single wall and any leak from the piping will accumulate in the secondary containment vault. The piping system outside of the building that is located outside the vault secondary containment is secondarily contained by a separate secondary containment area that drains into the vault. The associated piping in Building 322 is secondarily contained by the trenches in the building.

5.7. Pumps

There are four pumps associated with the 322-R2 tank system, a sump pump, a liftstation pump, a recirculating submersible pump and a sodium hydroxide injection pump. The sump in the vault contains a Little Giant Model 5MSP-505176, 1/6-horsepower submersible sump pump that is used to transfer any collected wastewater in the sump to tank 322-R2U2.

The 48 gallon per hour submersible liftstation pump is located on the floor of the liftstation, and is automatically controlled by two level switches. The power to the liftstation pump is interrupted when the liquid level in the 322-R2U2 reaches 90% of full capacity.

5.8. Valves, Fittings, and Filters

The threaded FRP half and full couplings used in the 322-R2 tank system are manufactured from corrosion-resistant vinyl ester resin and are bonded to the tank. Other valves and fittings associated with the tank system are made of CPVC and are compatible with the waste stream.

There are two polypropylene canisters inside Building 322 that are used to remove particulates and debris from the wastestream. One canister houses a stainless steel screen and the other contains a 50 micron polypropylene filter sock, see **Figure 8**.



Figure 8. Canister On the Left Contains a Stainless Steel Basket; Canister On The Right Contains a 50 Micron Filter Sock. Drain on the Floor Discharges into the Secondary Containment.

5.9. Controls and Instrumentation

The tank Level Alarm Panel is located on the south inside wall of Building 322, see **Figure 9**. The level detectors are mounted on the tank exterior and are set at 90%, 75%, 50%, and 25% of the tank capacity. The level detectors relay the liquid level information through electro-magnetic signals to the Level Alarm Panel for display. The 90% level sensor also de-energizes the pump on the liftstation when the liquid level in the tank reaches the 90% level, and actuates a tank-full indicator light on the panel.



Figure 9. 322-R2U2 Retention Tank Control Panel

A leak monitor switch mounted in the sump provides the signal to the Sump Pump Alarm Panel, located above ground on the north side of the 322-R2U2 tank, whenever there is liquid in the sump. This activates a red warning light and an audible alarm, see **Figure 10**.



Figure 10. Sump Pump Alarm Panel

A control panel displays the pH of the wastewater continuously as a part of the wastewater neutralization process, see Figure 11.



Figure 11. Sodium Hydroxide Injection Pump and Neutralization System Control Panel

6. Corrosion Protection Measures

Components of the 322-R2 tank system that come in contact with the wastestream are fabricated of corrosion-resistant materials or are sufficiently protected from corrosion. The materials of construction of the tank, liftstation, pumps, piping, and ancillary equipment are resistant to chemical attack from the wastestream. The estimated annual corrosion rate is negligible for the materials used in the 322-R2 tank system.

6.1. Retention Tank

Retention tank 322-R2U2 is a fiberglass reinforced plastic tank with vinyl ester laminate. According to the manufacturer's information, tanks handling sodium hydroxide should include a synthetic veil of Nexus® as well. It was not clear whether B322-R2U2 included the synthetic veil. Therefore, LLNL used ultrasonic inspection of the tank to determine the thickness of the tank (see Appendix A) and compare with the original minimum design thickness. The ultrasonic inspection included measuring tank wall and bottom thickness at 13 points. Based on the ultrasonic inspection of 0.38 inches minimum tank wall thickness, and minimum design tank wall thickness of 0.22 inches, it was concluded that the current operations are not corroding the tank walls and bottom.

Internal visual inspection of the empty tank was conducted. No evidence of corrosion, pitting or any other sign of deterioration was observed.

6.2. Liftstation

The liftstation is constructed of 304 stainless steel. The liftstation material is compatible and chemically resistant to the wastewater. Visual inspection of the liftstations revealed no sign of corrosion or deterioration.

6.3. Piping, Valves, and Pumps

The wastewater piping associated with the 322-R2 tank system is manufactured of CPVC. The gaskets, valves, seals, and fittings associated with the 322-R2 tank system that come in contact with the stored or transported wastewater are fabricated of compatible corrosion-resistant materials.

6.4. Secondary Containment

Interior surfaces of the tank vault secondary containment including the inground sump, and the secondary containment for the liftstation that could potentially come in contact with the wastewater, are coated with a corrosion-resistant epoxy coating.

Visual inspection of the 322-R2U2 tank secondary containment vault revealed no damaged and delaminating epoxy coating.

The secondary containment meets the regulatory requirements at the time of this report.

7. Age of Tank System

Retention tank 322-R2U2 and its associated components have been in service since October 1996. The components of the tank system were new at the time of the installation, therefore, the tank and its components are approximately nineteen years old.

The liftstation and its associated components have been in service since July 1999. The components of the system were new at the time of the installation, therefore, the liftstation and its associated components are approximately sixteen years old.

8. Data Sheet for 322-R2 Tank System

Retention Tank


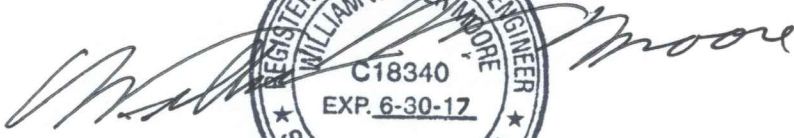
EFA tank identification number:	322-R2U2
Plant Engineering tank identification number:	322TLW01
Tank volume:	1,000 gallons
Dimensions:	72 inches (diameter) by 85 inches (high)
Tank manufacturer:	Raven Industries
Tank model number:	EF704
Primary containment material:	Fiberglass reinforced plastic (FRP)
Thickness of the primary containment material:	7/32 inch
Secondary containment material:	Reinforced concrete
Secondary containment coating:	Epoxy coating
Secondary containment dimensions:	10 feet-5 inches by 8 feet by 8 feet-11 inches
Secondary containment volume:	5,513 gallons
Operating pressure:	Atmospheric
Seismic zone:	Zone 4
Stored material:	Plating rinsewater
Date of installation:	October 1996

Liftstation

EFA tank identification number:	322-R2O8
Tank volume:	338 gallons
Dimensions:	32 inches (wide) by 34 inches (deep) 72 inches (high)
Tank manufacturer:	LLNL
Tank model number:	N/A
Primary containment material:	304 stainless steel
Thickness of the primary containment material:	3/16 inch
Secondary containment material:	Reinforced concrete
Secondary containment coating:	Epoxy coating
Secondary containment volume:	7,925 gallons
Operating pressure:	Atmospheric
Seismic zone:	Zone 4
Stored material:	Plating rinsewater
Date of installation:	July 1999

9. Technical Certification of the 322-R2U2 Retention Tank

Retention tank 322-R2U2 has been found to have sufficient structural integrity and is acceptable for the transferring and storing of hazardous waste as explained in Section 4 of this report. The tank and containment system are adequately designed to achieve the requirements of the applicable regulations. This certification is valid for five years only as long as the tank system is operated and maintained in accordance with applicable regulations for hazardous waste storage tank systems.

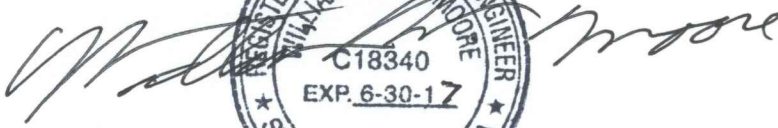
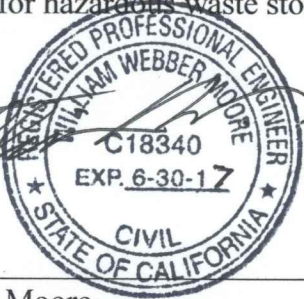


William W. Moore
California-Registered Professional Engineer
Abri Environmental Engineering, Inc.

Date 8/1/2015

10. Technical Certification of the 322-R2O8 Liftstation

Liftstation 322-R2O8 has been found to have sufficient structural integrity and is acceptable for the transferring and storing of hazardous waste as explained in Section 4 of this report. The liftstation and containment system are adequately designed to achieve the requirements of the applicable regulations. This certification is valid for five years only as long as the tank system is operated and maintained in accordance with applicable regulations for hazardous waste storage tank systems.

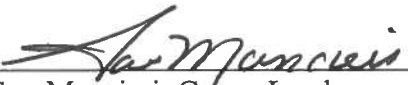



William W. Moore
California-Registered Professional Engineer
Abri Environmental Engineering, Inc.

8/1/2015
Date

11. Certification of the 322-R2 Tank System

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



Sav Mancieri, Group Leader
Environmental Support & Programmatic Outreach Group
Environmental Functional Area
Lawrence Livermore National Laboratory

8-12-15

Date

12. References

1. Chow Engineering Inc., “*Engineering Assessment and Certification of Integrity of the 322-R2U2 Tank System*”, May 1997
2. Uribe and Associates, “*Addendum #1 to Engineering Assessment and Certification of Integrity of the 322-R2U2 Tank System*”, July 2000
3. Abri Environmental Engineering, Inc., “*Engineering Assessment and Certification of Integrity, Lawrence Livermore National Laboratory, 322-R2 Tank System*”, April 2010