EVALUATION, SELECTION AND INSTALLATION OF LIQUID WASTE PROCESSING TECHNOLOGY AND THE DECOMMISSIONING OF RADWASTE VOLUME REDUCTION (RVR) EQUIPMENT AT CALLAWAY NUCLEAR STATION

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ABSTRACT

Callaway Nuclear Station is located in Callaway County, Missouri, 80 miles west of St. Louis. The 5,228-acre plant site is also about 10 miles southeast of Fulton on an elevated plateau overlooking the Missouri River to the south. Callaway Nuclear Station is a single unit 1240 MWe Pressurized Water Reactor (PWR), owned and operated by AmerenUE, and has been in operation since October 1984.

In August 2000, Callaway Nuclear Station began evaluating their in-plant liquid waste processing system to determine if the plant's evaporators, which had been used since plant startup, should be replaced with a filter-demineralization system. The primary justification for performing a plant modification was the excessive dose received while operating the plant's evaporators, as well as the cost of maintaining the current plant equipment and processing the residual bottoms from the plant's evaporators.

This project was completed in two phases: Phase One of the project included evaluation, selection and installation of a temporary full size liquid waste processing system. Phase Two of the project included evaluation of the performance of the temporary system, and installation of a permanent system.

For Phase One, Callaway established the following evaluation criteria for the full size liquid waste processing system:

- Personnel exposure
- Processing cost
- Solid waste generation
- Effluent quality
- Equipment reliability
- Vendor experience

Callaway received bids for liquid waste processing systems from three vendors. The technologies that were presented included: ultra-filtration, reverse osmosis, chemical injection and demineralization technologies. The decision was made by Callaway in December of 2000 to install a full-scale liquid waste processing system consisting of an ultra-filter (UF), solids collection system and demineralization vessels. The full-scale ultra-filtration system was installed as a Temporary Modification to the Callaway Plant. Following a two-year operation period, the system's performance was evaluated to determine whether to make it a Permanent Modification to the Callaway Plant. The results of Callaway's evaluation were as follows:

- The Ultra-filtration System (UF) was very effective at removing solids and Co60
- The self contained mechanical filter (solids collection system) worked well to remove the reject from the UF membranes
- Effluent quality matched the performance of the plant evaporators

- The UF was very susceptible to biologic fouling while processing floor drains, significantly reducing flow rates and requiring daily chemical cleanings
- Due to the design of the system and the number of components, operation and continued maintenance of the UF System required much higher dose than anticipated

Primarily due to the maintenance requirements and the associated exposure of the UF system, Callaway decided to re-evaluate chemical addition/demineralization technologies in 2003. After performing a series of tests of a liquid waste processing system utilizing chemical addition and demineralization technologies, and performing several trips to observe and interview other plants using this type of system, Callaway decided to permanently install a demineralization with chemical addition system at the Callaway Plant. Callaway management determined that demineralization with chemical addition technology would be able to effectively process the plant waste water, and would allow them to achieve their established goals with a system that would be much easier to reliably operate and maintain.

The plant also concluded that the location where the UF System was installed was not adequate. The optimum location was determined to be the radwaste truck bay, which would provide more space, an overhead crane, and better access to the influent, effluent, and resin sluicing connections. Using this location however, posed an additional problem for the Callaway Plant. The radwaste truck bay housed a Rapid Volume Reduction (RVR) System that was no longer operational and a significant source term for the area. The RVR required dismantlement, removal from the Callaway site, and final disposal. The high dose rates and significant internal contamination of the system made the project particularly challenging.

The established project schedule was as follows:

- Demineralization and Chemical Addition Equipment Fabrication
  - Start – May 2003
  - End – October 2003
- Dismantlement/Decommissioning of RVR Equipment at Callaway Site
  - Start – October 1, 2003
  - End – October 31, 2003
- Installation of Demineralization and Chemical Addition Equipment at Callaway Site
  - Start – December 1, 2003
  - End – January 7, 2004
- Begin Operation of Demineralization and Chemical Addition Equipment
  - January 7, 2004

INTRODUCTION

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Callaway received bids for liquid waste processing systems from three vendors. The technologies that were presented included: ultra-filtration, reverse osmosis, chemical injection, and demineralization. The decision was made by Callaway in December of 2000 to install and test a prototype ultra filtration and demineralization system. If satisfactory results were achieved, a full-scale liquid waste processing system consisting of an ultra-filter (UF), solids collection system and demineralization vessels would be installed as a Temporary Modification to the Callaway Plant.

Testing with the prototype system went well, and a full-scale system was installed in August 2000. Following a two-year operation period, the system's performance was evaluated to determine whether to make it a Permanent Modification to the Callaway Plant. The results of Callaway's evaluation were as follows:

- The Ultra-filtration System (UF) was very effective at removing solids and Co60
- The self contained mechanical filter (solids collection system) worked well to remove the reject from the UF membranes
- Effluent quality matched the performance of the plant evaporators
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The plant also concluded that the location used to install the UF System was not adequate. The optimum location was determined to be the radwaste truck bay, which would provide more space, an overhead crane, and better access to the influent, effluent, and resin sluicing connections. Using this location however, posed an additional problem for the Callaway Plant. The radwaste truck bay housed a Rapid Volume Reduction (RVR) System that was no longer operational and a significant source term for the area. The RVR required dismantlement, packaging, removal from the Callaway site, processing, and finally, permanent disposal. The high dose rates and significant internal contamination of the system made the project particularly challenging.

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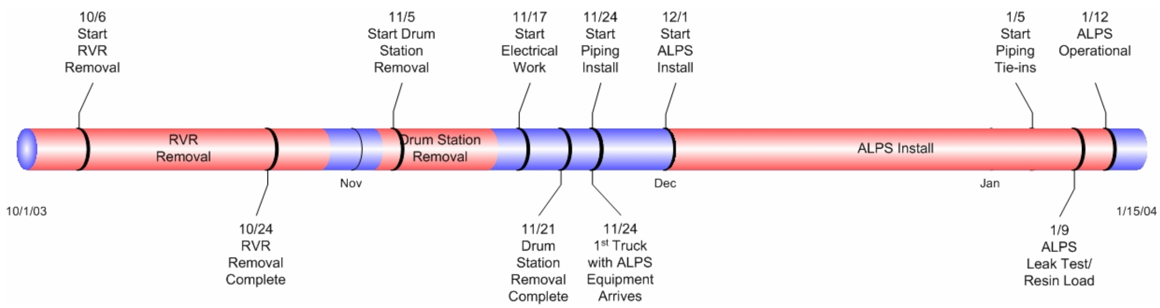
  - End – January 7, 2004
- Begin Operation of Demineralization and Chemical Addition Equipment
  - January 12, 2004

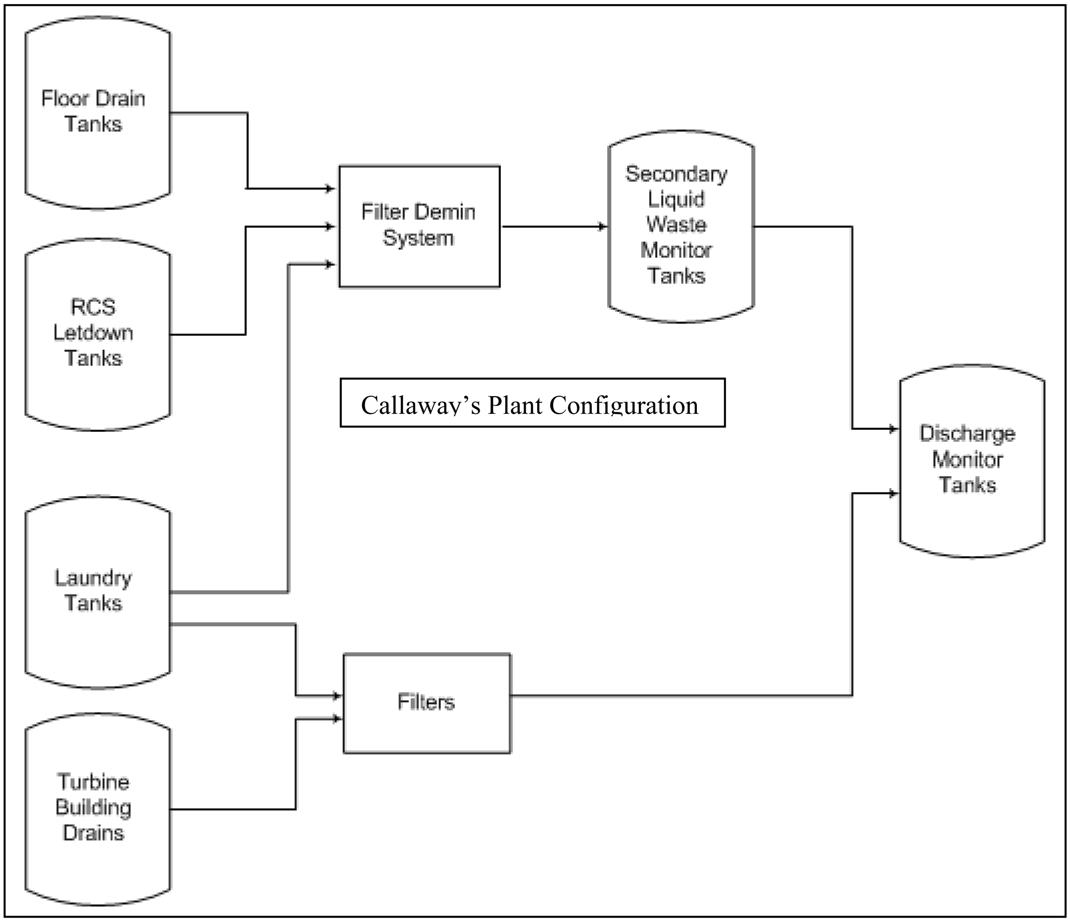


Callaway's Plant Configuration

Callaway's liquid waste streams fall into 4 main categories:

- Secondary liquid waste (turbine building drains, condensate polisher regeneration system)
- Laundry water from in-plant laundry decon facility
- Reactor Coolant System (RCS) letdown
- Floor and equipment drains

RCS letdown and floor and equipment drains are processed through the in-plant liquid waste processing systems and transferred to a monitoring tank. The plant has two 17,000-gallon monitor tanks for holding water for sampling. These tanks are then transferred to two 100,000-gallon discharge monitor tanks (DMTs) where they are sampled prior to discharge. Secondary liquid waste and laundry water is processed through filters to remove solids and sent directly to the DMTs.



Callaway's Plant Configuration

The following chemistry is typical of the floor drains and RCS letdown at Callaway Nuclear Station.

Typical Chemistry Influents		
	Floor Drains	RCS Letdown
pH	6.5	6.9
Conductivity	150	15
Cs137	1 E-3	9 E-4
Co60	7 E-4	1 E-5
Co58	1 E-4	1 E-4

Callaway has a separate department for radwaste operations consisting of two supervisors and 12 technicians. The department is responsible for operating the liquid waste and RCS offgas processing equipment, changing plant filters and demineralizer beds, and packaging and shipping solid radwaste. The plant also planned to operate any vendor supplied liquid waste processing systems.

Phase One - Evaluation, Selection and Installation of a Full Scale Liquid Waste Processing System

Callaway Nuclear Station has used an HPD Evaporator to process radioactive liquid waste from their floor and equipment drains since plant startup in 1984. The plant's evaporator was capable of processing 30 gallons per minute (gpm) and was a very effective method to process liquid waste. Based on benchmarking trips to other plants, however, Callaway felt they could install a filter-demineralizer system that would perform as well or better than the evaporator, and for lower cost and less dose. Disposal costs for evaporator bottoms were a significant component of the total operating expense. In addition, as the plant aged, corrective maintenance was becoming more and more common, further increasing the cost and dose of operating the evaporator.

Based upon evaluations by Callaway management of their evaporator's performance, Callaway began to research alternative methods to process their liquid waste. Callaway researched and received information from three vendors that provided ultra-filtration, reverse osmosis, and demineralization with chemical injection technologies. Callaway decided to divide the process into two phases- a temporary installation with a test system, followed by a permanent installation if the system performed as expected. For Phase One, Callaway established the following evaluation criteria for the filter-demineralization system:

- Personnel exposure
- Processing cost
- Solid waste generation
- Effluent quality
- Equipment reliability
- Vendor experience

After evaluating the three competing proposals, the decision was made by Callaway Management in December of 2000 to install a prototype membrane system consisting of a 0.03um ultra-filter (UF), a solids collection system, and 5 one-cft demineralization vessels. One of the primary reasons the UF system was chosen was because it was projected to have the lowest operating dose. The UF system could be operated almost entirely from a remote location, and was expected to have longer media life, reducing the need to sluice. The reverse osmosis system was also expected to have low operating dose, but it was a much more complicated system that would be more difficult to operate. The chemical injection system was expected to have the highest dose since it could not be operated remotely and would require filter changeouts and more frequent media sluices. Of the three systems, the chemical injection system had the most operating experience, which was positive from most plants.

The prototype UF system was installed in February of 2001 and preliminary testing was completed by March. The plant then decided, based on the test results, to install the full scale system with the same membranes, plus the full size demineralization vessels, and all the associated shielding, piping and controls. The plant decided to lease the system, and would only maintain a vendor technician on-site long enough to train the plant technicians. Callaway installed the UF System under a Plant Temporary Modification Procedure and located the UF System at the 2031 Level of the Plant. The system was run in conjunction with the plant evaporator until 2002, when the bottoms mixing motor failed on the evaporator. It would have required significant dose and expense to return the evaporator to service. Since the UF system had proven it could effectively process water, the decision was made to abandon the evaporator and rely on filter-demineralization processing alone. From then until December 2003, the UF system was the sole method of processing liquid waste.

Phase Two – Permanent System Installation

Liquid Waste Processing System Evaluations

After a two-year operation period, the Ultra-filtration (UF) system's performance was evaluated at Callaway to determine whether to make it a permanent installation at Callaway Nuclear Station.
The significant results of this evaluation were:

- The UF system was very effective at removing solids and Co60

- The self contained mechanical filter (solids collection system) worked well to remove the reject from the UF membranes
- Effluent quality matched the performance of the plant evaporators
- The UF was very susceptible to biologic fouling while processing floor drains, significantly reducing flow rates and requiring daily chemical cleanings
- Due to the design of the system and the number of components, operation and continued maintenance of the UF System required much higher dose than anticipated

The UF system was proven to be very effective at processing the water at Callaway. Both the FDT and RHUT waste streams contain high levels of Cs, a portion of which is a fine particulate. The membranes had a high DF for Co60, Co58, and for particulate Cs137. The remaining radioisotopes were effectively removed in the demineralizers. The reject from the membranes was removed from the recirc loop with a mechanical filter. This method worked well if the system had sufficient time to fully clean the recirc loop. 24-48 hours usually worked best to fully clean up the system.

Callaway had significant problems with biological fouling of the membranes early on in the testing phase. After experimenting with several different approaches, the most effective cleaning method found was to allow the membranes to soak in hydrogen peroxide. While very effective, the cleaning process normally required about 3 hours to perform, and then the system needed time (usually overnight) to recirc through the filter to complete the cleanup. This had to be done everyday when processing floor drains. Letdown water could be processed for considerably longer without requiring cleaning. Even with this cleaning, Callaway was only able to achieve 18 gpm when processing floor drains, which would decrease to about 8 gpm after 10 hours of processing. Letdown water could normally be processed at 25-30 gpm.

Callaway had also experienced several problems with component failures by this time. Several pumps and pressure transducers failed over the 2-year period. The first SCS that was installed developed a leak and needed to be replaced. The flow meter installed with the system never worked from the start. Unfortunately, most of these components were located in high dose areas, making maintenance and replacement very difficult.

Permanent system choice
In January of 2003, Callaway again compared the alternative liquid processing technologies based on their experience with the UF system. They visited several other plants to observe their systems and ask about their experience.

Callaway ruled out a reverse osmosis unit due to the complexity of the system, leaving a choice between converting the current system into a permanent installation, and installing a demineralization with chemical addition system. The plant felt the major advantages of each system were:

UF System	**Demineralization with Chemical Addition System**
Proven to work on Callaway waste streams	Much simpler system with fewer components
Technicians were trained and experienced with operating	Does not require down time for cleaning
Can be remotely operated	Lower dose to operate

The plant performed a series of lab tests on plant waste utilizing demineralization with chemical addition to get a better idea if this type of system would work with the Callaway waste streams. The tests all indicated that this technology should be effective at processing the waste. Several improvements had also been made in the chemical addition system during the time period. The system no longer required filters for removing the coagulant, but used charcoal now instead. Several other changes were made in the shielding and piping to reduce general area dose.

Due primarily to all of the problems Callaway experienced with maintenance on the UF system, Callaway management decided to permanently install a demineralization with chemical addition system at the Callaway Plant. Callaway felt this type of system would allow the plant to achieve their established goals. The chosen system design would also be much easier to operate and maintain for the Callaway Plant.

Summary of UF Experience

The UF system performed very well at Callaway until November 2003. The plant proved that the technology worked and could be successfully deployed in a full-scale system. The plant began experiencing severe problems last November, however, when the membranes began to fail. Unfortunately, due to erratic indications, it was not determined that a membrane had failed until mid-December. At that point, one of the membrane sets was isolated, and the system again made good water for a short period of time until the remaining membranes also started to fail. Another set was isolated, and the effluent of the system was sent through an in-plant filter housing to remove the particulate cesium that was passing by the membranes. With the UF system and a 0.1 um cartridge filter, the plant was able to process acceptable water, but only at a 5 gpm rate. By this point, the plant was very backlogged on water and was only able to keep up with new influents. Fortunately, the new demineralization with chemical injection system was nearly complete, and was operational the first week of January.

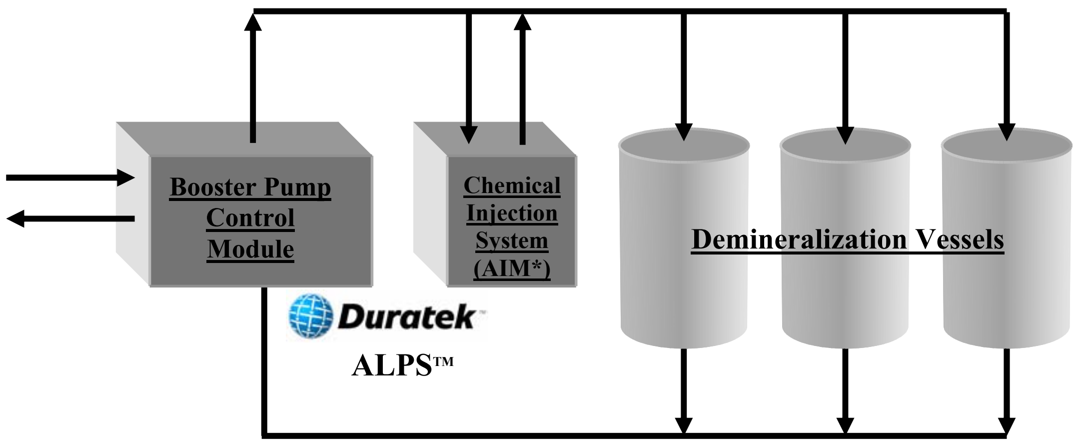
The cause for the membrane failures is not known for sure. The expected life is 3-5 years, so they were nearing their end of life. Since they all failed within a short period of time, the frequent exposure to hydrogen peroxide may have also shortened their life. Due to the amount of biologic growth on the membranes, however, it is impossible to say how much peroxide the membranes were actually exposed to over their life.

Some of the lessons learned by the plant while using the UF system were:

- Biological activity should be minimized in the waste stream. This would reduce the time required to clean the system and possibly prolong the life of the membranes.
- Maintenance and dose reduction must be factored into the design. Pumps and sensors must be located away from the high dose components to allow easy maintenance or replacement. The membranes must be positioned so as to facilitate easy replacement. The sample sink must be better shielded or positioned to allow frequent sampling without accumulating significant dose.
- Membrane failures can be difficult to detect and can occur without any warning. Individual permeates samples should be filtered and analyzed periodically to check for particulate activity.
- Four membrane sets are not sufficient for 30 gpm capacity. Based on the experiences of other plants, the system would be better sized with six membranes.

New System

The permanent on-site liquid waste processing system Callaway selected to install, utilizes demineralization with chemical addition technology to remove ionic impurities and suspended particulate from liquid radioactive waste. The chemical addition system optimizes the performance of the demineralization system by precisely controlling and varying the chemical injection rate as the waste stream characteristics change. The permanent demineralization system with chemical addition consists of demineralization vessels, chemical injection system, radiation shielding, and a control module. The basic flow characteristics are illustrated below:

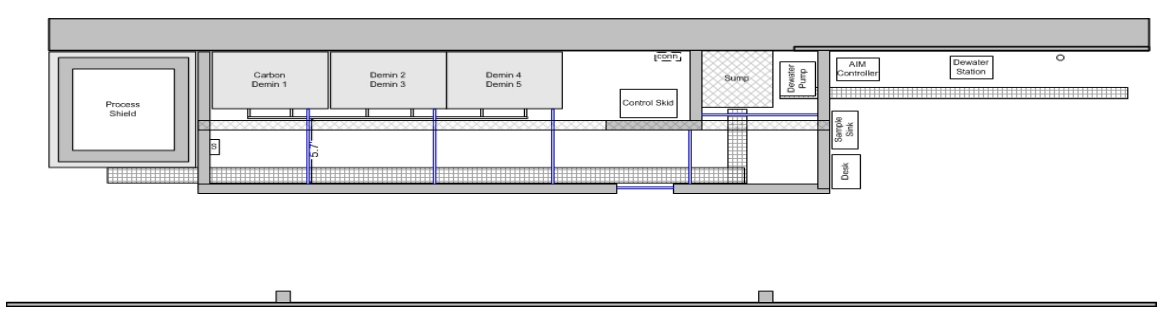


*Patented Advanced Injection Method (AIM)

The plant and vendor started the detailed planning for the new system nine months prior to the start of installation. The vendor worked closely with Radwaste, HP, and Engineering to continually revise and improve the design until all of the requirements were met. Callaway learned many lessons from the temporary installation that it tried to incorporate into the permanent design. Some of the considerations during this process were:

- **Minimize dose to the radwaste operators, as well as other personnel in the operating area**. This was accomplished by encasing the pressure vessels in ten-inch concrete vaults, with an additional 3 inches of steel shielding on the first vault. There was also an additional ten-inch concrete wall positioned around the entire system to minimize dose to the rest of the truck bay.
- **Permanent System Design that would allow for maximum future flexibility**. All of the plant connections are routed to a single hub that is centrally located. There is adequate space in and
- around the system for future expansion. The new system was also designed as a vendor supplied skid, allowing it to be installed as a black box to facilitate future changes.
- **Provide a safe, neat, functional environment**. Hard piping was used wherever possible, and stainless steel flex hose was used everywhere else. All valves and connections were located in low dose areas where they would be easy to operate. The equipment required for sluicing and dewatering media was also incorporated into the design.
- **Ensure all periodic maintenance or component replacement could be accomplished easily and with low dose**. All components that could conceivably fail or require maintenance are located outside of the main shield.

The following diagram illustrates the final layout of the permanently installed demineralization with chemical addition system:



Permanent Liquid Waste Processing System Location

The plant also concluded that the location used to install the UF System was not adequate. The optimum location was determined to be the radwaste truck bay, which would provide more space, an overhead crane, and better access to the influent, effluent, and resin sluicing connections. Using this location however, posed an additional problem for the Callaway Plant. The radwaste truck bay housed a Rapid Volume Reduction (RVR) System that was no longer operational and a significant source term for the area. The RVR required dismantlement, packaging, removal from the Callaway site, processing, and final disposal. The high dose rates and significant internal contamination of the system made the project particularly challenging. Since the RVR was no longer operational, it was not possible to flush out the components prior to dismantling. This further complicated the project by requiring the components to be shipped intact, and then decontaminated off site prior to final disposition.

Callaway's established goals for the RVR Removal Project were as follows:

- Remove and dispose of all associated RVR equipment from the Callaway Site
- Minimize the number of contractors required on and off site to perform project scope
- Complete the project safely and with minimal dose

The RVR Removal Project Scope included the following:

- Evaluate the RVR in the installed condition and prepare a dismantlement procedure for the plant
- Determine the segmented RVR's component sizes, dose rate, and material of construction
- Engineer/Design/Fabricate and shield the necessary shipping containers to receive the segmented RVR components
- Dismantle the RVR
- Load the segmented RVR components into the designated shipping container and transport to an off-site processing facility for final processing and burial as required.
- Clean the vacated RVR area and prepare for the installation of the permanent liquid waste processing system

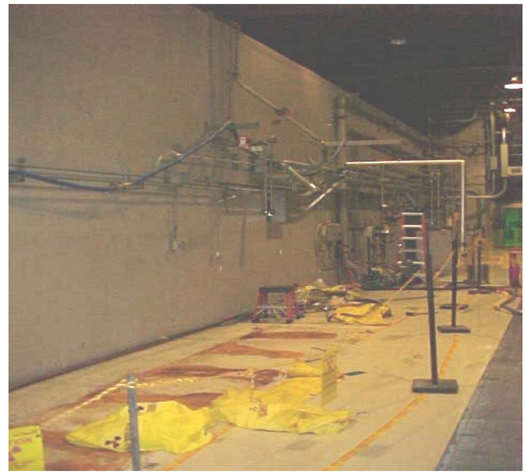
Callaway management determined that the established goals for the RVR Removal Project could be best achieved by involving the vendor that would perform the off site processing and disposal in the upfront planning and engineering process. The plant also felt it would be beneficial to use the same vendor that was supplying the permanent liquid waste processing system, as they were qualified and experienced in decommissioning projects, and also operated and owned a waste processing facility. By selecting the same vendor to perform both projects, Callaway was also able prevent problems that occur when transitioning project phases from one vendor to another.

By selecting a qualified single source supplier to perform both projects the following advantages were recognized:

- One vendor arranged and performed the packaging program, transportation logistics and shipping of the dismantled RVR from the plant site, and the same vendor delivered the fabricated demineralization with chemical addition system to the plant site. This ensured that transportation and logistic problems were minimized, as well as reducing the total cost.
- One vendor provided dismantlement and disposition of the RVR, and the same vendor custom built the demineralization with chemical addition system to fit in the vacated RVR area. This ensured that the RVR area constraints were fully understood by the vendor providing the custom

- built shielding and demineralization with chemical addition system, which minimized the potential for fit-up and installation errors.
- Since the chosen vendor was experienced in off-site processing of contaminated materials as well as on-site processing of liquid waste, unanticipated waste forms that were encountered during the RVR dismantlement could be removed from the site and processed by the same vendor in a seamless manner, thus minimizing project delays.

RVR Installed at Callaway



RVR Removed

Project Results and Lessons Learned

As a result of using a single source supplier to perform the scope of both projects- Liquid Waste Processing System Design and Installation, and the RVR Removal, Callaway successfully dismantled and removed the RVR from the Callaway site and installed the permanent system within the projected schedule timeline, and was able to meet the established personnel exposure goals. Total dose received by the plant was 420 mrem, just 20 mrem more than budgeted. The project was also completed on time- just 3 weeks to completely disassemble and ship all of the components.

Although the overall project goals were achieved, there were still lessons that were learned during the course of the project that should be mentioned. They were as follows:

1. All sealand containers are not created equal. There were several shipping containers used during the project to remove the dismantled RVR from the Callaway site. Each container had a specific purpose or was designated for a specific component shipment. Two of the containers were 20-foot long open top sealand containers. During the loading of the open-top sealands, the assumption was made that the dimensions of the top opening was consistent for all open-top sealands. The first of the sealands was loaded and removed from the radwaste truck bay. When the second sealand was brought into the truck bay area and the top removed, it occurred to the on-site packaging specialist that the top openings might not be exactly the same. Since the RVR component to be loaded into the second sealand was very large, dimensions of the sealand top opening were taken and it was determined that the component would not fit (1 inch too tall) as planned. As a result of this oversight, the RVR component required additional downsizing in order to fit into the container. This resulted in additional time and effort expended by the craft labor that was unplanned. Although the additional exposure associated with the additional cutting was negligible, using the designated sealands out of sequence and not confirming the dimensions prior to the loading evolution, could have resulted in significant personnel exposure and schedule delays.

2. Residual waste remaining in RVR – Even though the RVR equipment had been retired in place for a number of years the assumption had been made that the equipment was functional enough to allow rinsing and flushing the internals. As the project start date approached, it was determined that the RVR was no longer functional to any degree and rinsing/flushing on the internals could not be performed. By not being able to rinse/flush the internals, the dose rates on the RVR equipment could not be reduced prior to dismantlement and residual waste existing inside the RVR from the last time it was used could not easily be removed. This posed a significant problem with regard to personnel exposure and schedule. Since the single source supplier providing support for the dismantlement and shipping of the RVR for off-site also owned and operated a fixed based facility with a radioactive materials license, Callaway and the supplier, revised the dismantlement procedure to allow segmentation as necessary while containing the waste. The supplier also redesigned the shipping containers and added shielding to accommodate the elevated radiation levels from the residual waste. The residual waste was shipped to the vendors fixed based facility and removed from the RVR equipment and processed in a controlled environment. Although this problem was overcome without impact to the schedule and exposure, it resulted in just in time planning efforts by Callaway and logistical changes by the supplier.

3. Weights depicted on drawings were inaccurate – The original drawings for the RVR were used to determine weights and dimensions of the system components. Due to the high dose rates from the RVR, it was not possible to take detailed measurements. Many of these figures turned out to be inaccurate, especially the weights. To prevent any spread of contamination, sealands were brought into the Radwaste truck bay and set on the floor using the overhead crane. When Callaway tried to lift the first sealand to put it back on the truck however, the weight was far greater than expected, and was over the capacity of the crane. The sealand had to be placed on rollers and dragged out of the truckbay so it could be loaded with a mobile crane. To prevent this problem with the remaining sealands, they were left on the truck while they were loaded. This made the rigging more challenging however, as it significantly decreased the height to the crane.

4. Not enough preplanning for rigging- Callaway did not still have the original rigging equipment that was used to install the RVR. Slings were used to rig all of the components that were moved with the overhead crane. This proved to be difficult however with some of the larger pieces, as there was not much clearance from the top of the sealands to the overhead crane. Some of the delays experienced could have been avoided if the rigging plan was more thoroughly developed ahead of time.

5. Dose rate projections were not conservative enough- It was not possible to directly survey the bottom of the RVR assembly, which would be expected to have the highest dose rates. It was estimated that the highest dose rate would be 3R, which was based on internal surveys. The actual dose rates were as high as 5R on contact. This required the shielding in the sealand to be re-engineered, which caused height problems for loading the components, and weight problems for transportation.

Permanent System Installation

After the RVR was removed, Callaway had a significant amount of work to accomplish prior to the vendor installing the new liquid waste processing system. Some of the more significant activities included:

- Deconning the floor and walls where the RVR was installed
- Removing the remaining conduit and piping on the wall from the RVR
- Removing the Drum Labeling and Inspection Station that was installed when the plant was built

To coordinate the installation, Callaway established a team with representatives from Radwaste, HP, Engineering, Work Control, the processing system vendor, and the on-site contractor that performed most of the work. This team was very effective at planning the work and resolving problems as they came up. The plant was able to adhere to the schedule and was ready for installation of the permanent system to begin on December 1. The vendor had completed fabrication of all the components and was also able to start installation on December 1. Installation proceeded very smoothly and only minor problems were encountered.

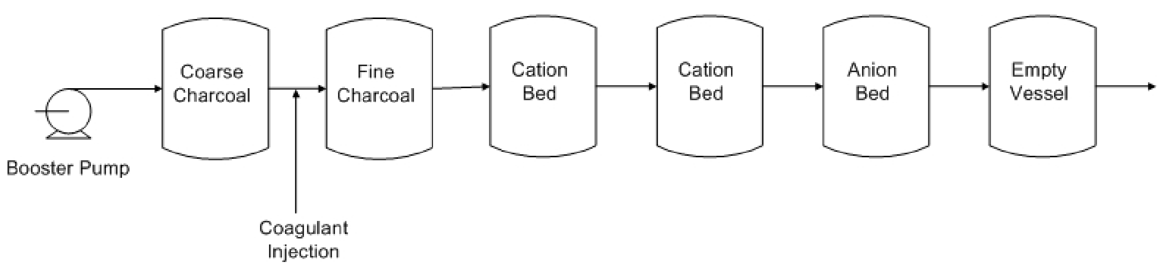
Testing

The plant and the vendor both completed their portion of the installation within a few days of each other. The new system was fully operational on January 9. The next few days were spent performing leak tests, loading media, and lining up the plant systems. Operational testing was started on January 12.

Callaway encountered several in-plant problems initially during the operational testing. The flow path to the new liquid waste processing system utilized several sections of in-plant piping that were not normally used. Several plant valves leaked by and water was unintentionally sent to other plant tanks. This was not unexpected however and the test procedure planned for this contingency by using flow meters to check for flow with the lineup dead headed. The plant valve leaks were quickly found and isolated. The floor drain tank pumps were also unable to supply adequate suction pressure to the booster pump located on the vendor supplied demineralization system. This was corrected by removing the filter from the plant filter housing. By the end of the day the operational testing was complete and water processing began. The plant was able to supply water to the new liquid waste processing system from any plant tank at 30 gpm.

Operational Experience

By the time the new system was ready, the plant had built up a significant backlog of water due to the problems with the old UF system. Processing began around the clock with dedicated radwaste and chemistry support. The new system began producing good water right from the start with particulate activity less than MDA. 78,000 gallons were processed during the first week, completely clearing the backlog of water. The system configuration was:



Sample results showed that the new system performed similarly to the UF system. The coarse charcoal bed had a small DF for Co. The fine charcoal bed had a high DF for Co, and a small DF for Cs. The remaining ionic isotopes were removed in the cation and anion beds. The final vessel was initially left empty and will be later filled with either a zeolyte or another anion bed as needed.

Callaway is currently operating the system under the direction of a vendor technician. The vendor technician will remain on site for approximately three months to allow adequate time to train all of the plant technicians and develop operating experience.

The following table provides processing information to date for the demineralization system with chemical addition located at Callaway Nuclear Station.

Period	Gallons Processed	Personnel Exposure	Secondary Waste Generated	Particulate Activity
Jan 12th to Date	93,000	TBD	0	MDA

Photos of the Permanently Installed System are provided below:

The following pictures illustrate the final installation of the ALPS™ System at Callaway Station

This photo depicts the installed Duratek ALPS™ System at Callaway Nuclear Station. The Demineralization Vessels are contained in the concrete vaults to the far left of the photo. The blue flexible hose supports another Callaway project and is not part of the ALPS™ System.

The below photo depicts the Duratek ALPS™ Sample Sink and AIMS Chemical Injection System to the far right. These components are located to provide maximum-shielded protection to the operator.

This photo depicts the valve gallery of the installed Duratek ALPS™ System. Flexible hoses are custom cut after all hardware is installed to minimize hose lengths in accordance with Regulatory Guide 1.143 Revision 2, and ANSI/ANS-40.37.