Catawba Nuclear Station
Delay Coil Chemical Decon Projects

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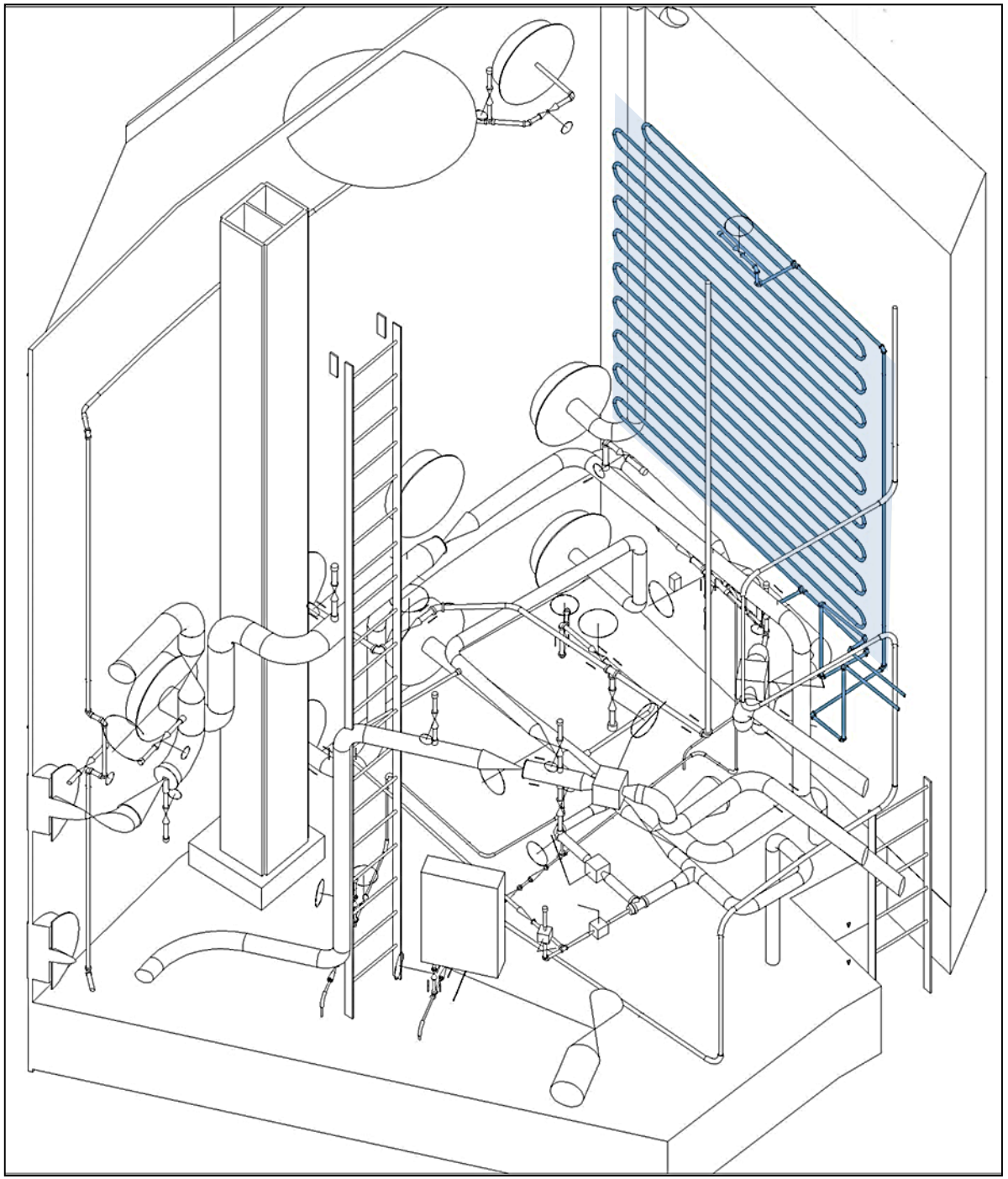
Catawba Units 1 & 2 are four-loop Westinghouse PWRs located in York, SC which is located ~15 miles south of Charlotte. Unit 1 has undergone steam generator replacement but Unit 2 is still operating with the original D5 steam generators. Unit 2 has a considerably higher source term than Unit 1. Unit 1 is an INPO Top Quartile plant while Unit 2 is in the Third Quartile.

Problem Description

- **C**atawba Nuclear Station Units 1 & 2 were constructed with a Hot Leg sample line Delay Coil to provide a forty second N^{16} decay.
- The Delay Coil was made of 167 feet of ½” stainless piping mounted to the wall over an area ~15’ x 10’.
- ALARA estimated the coils contributed ~3 rem per outage.

Delay Coil Room

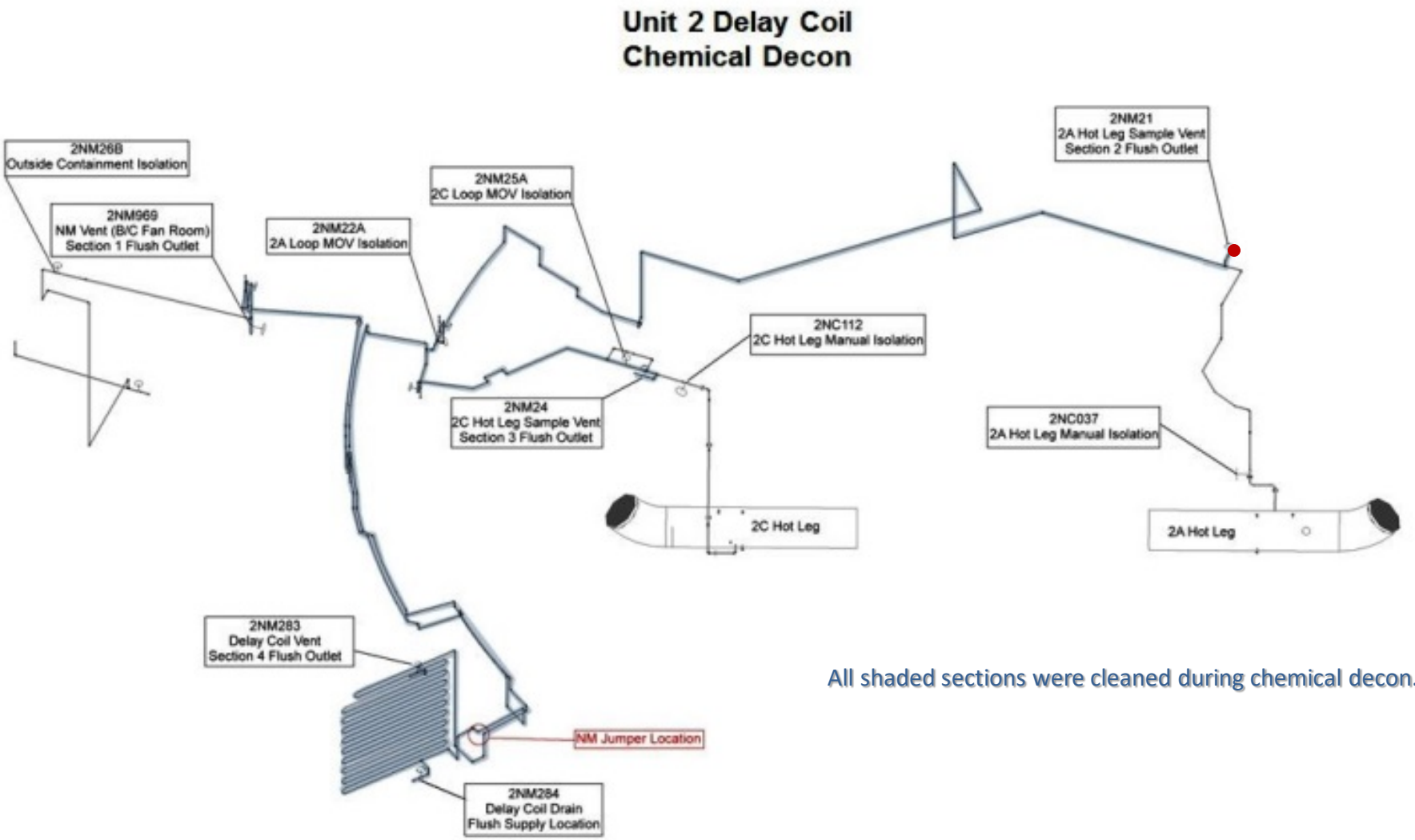
- High Traffic Area
- Significant scope each outage in area with Valves, hangers, Ops penetration testing, and scaffold work.
- The delay coil was the only significant dose contributor in the room.



History

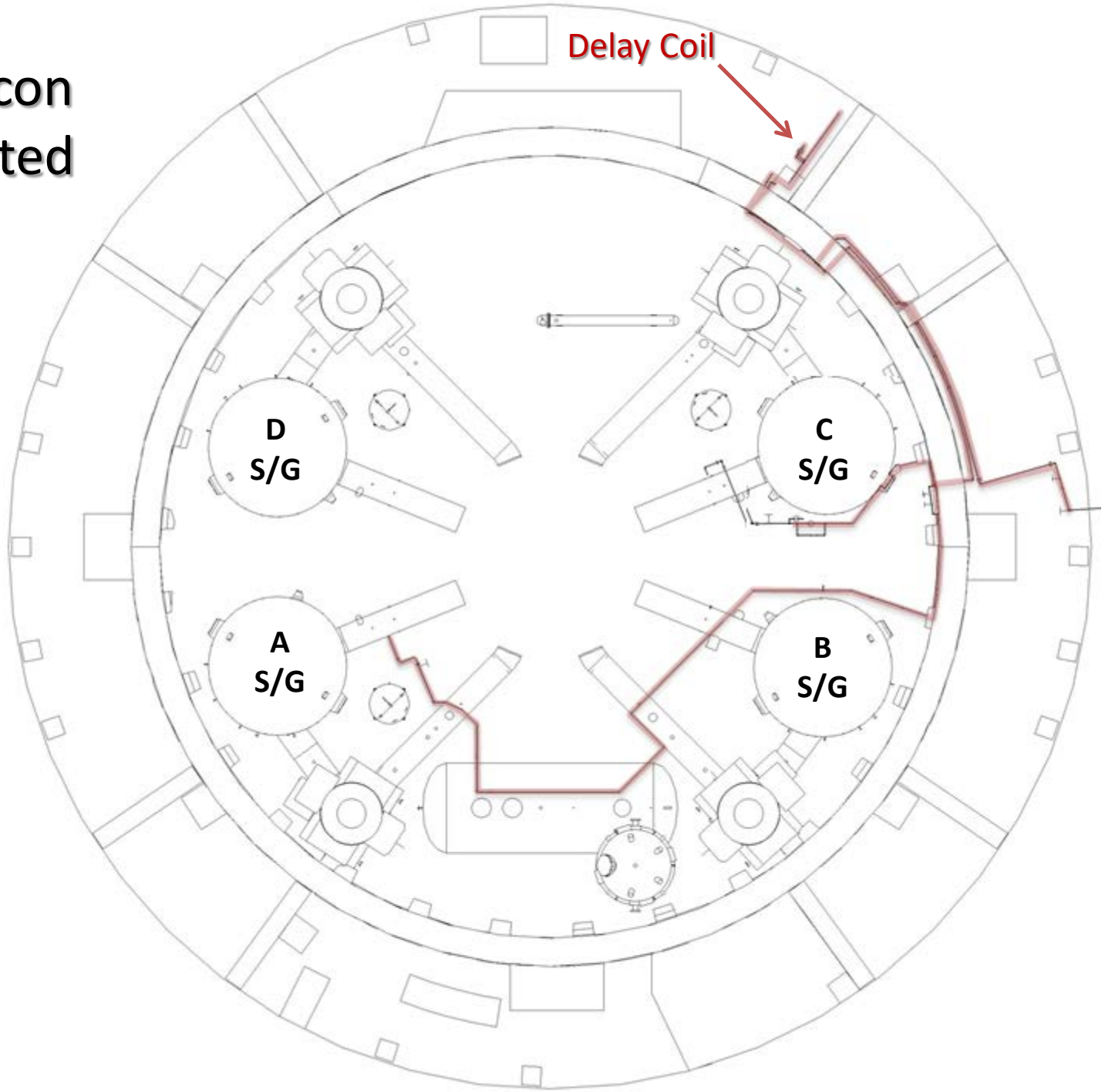
- Since operation the delay coils have been shielded each outage using typical 5’ blankets suspended from a shield frame.
- In 2010 the ALARA Long Range Plan identified the need to install permanent shielding supported by a steel frame.
- In 2012, INPO issued Catawba a Performance Deficiency due to the lack of progress with implement the delay coil shielding mod.
- Radiation Protection began questioning the need for the delay coils and performed dose rate studies and calculations that showed the coils could be safely abandoned.
- The shielding modification was revised to cut and cap the coils in place, allow the coils to decay a cycle and then cutout the delay coils.
- RP learned of a new chemical decon system Westinghouse was marketing for small systems. Catawba had previously used chemical decon successfully for the letdown piping in 2008.
- A new proposal was presented and approved by the ALARA Committee in 2015 to perform chemical decon and abandon the coils in place.

Chemical Decon
Piping Impacted



All shaded sections were cleaned during chemical decon.

Chemical Decon Piping Impacted



Chemical Decon Planning Process

- For Unit 1 we had just 4 months to plan due to changing the project scope from deletion to chemical decon / abandonment.
- Once the contract was approved we had weekly conference calls with Westinghouse personnel. From the site we involved Operations, Engineering, planning, and outage scheduling.
- Westinghouse equipment and personnel arrived on site two days before shutdown. We were able to go through their equipment and stage for the equipment hatch opening.

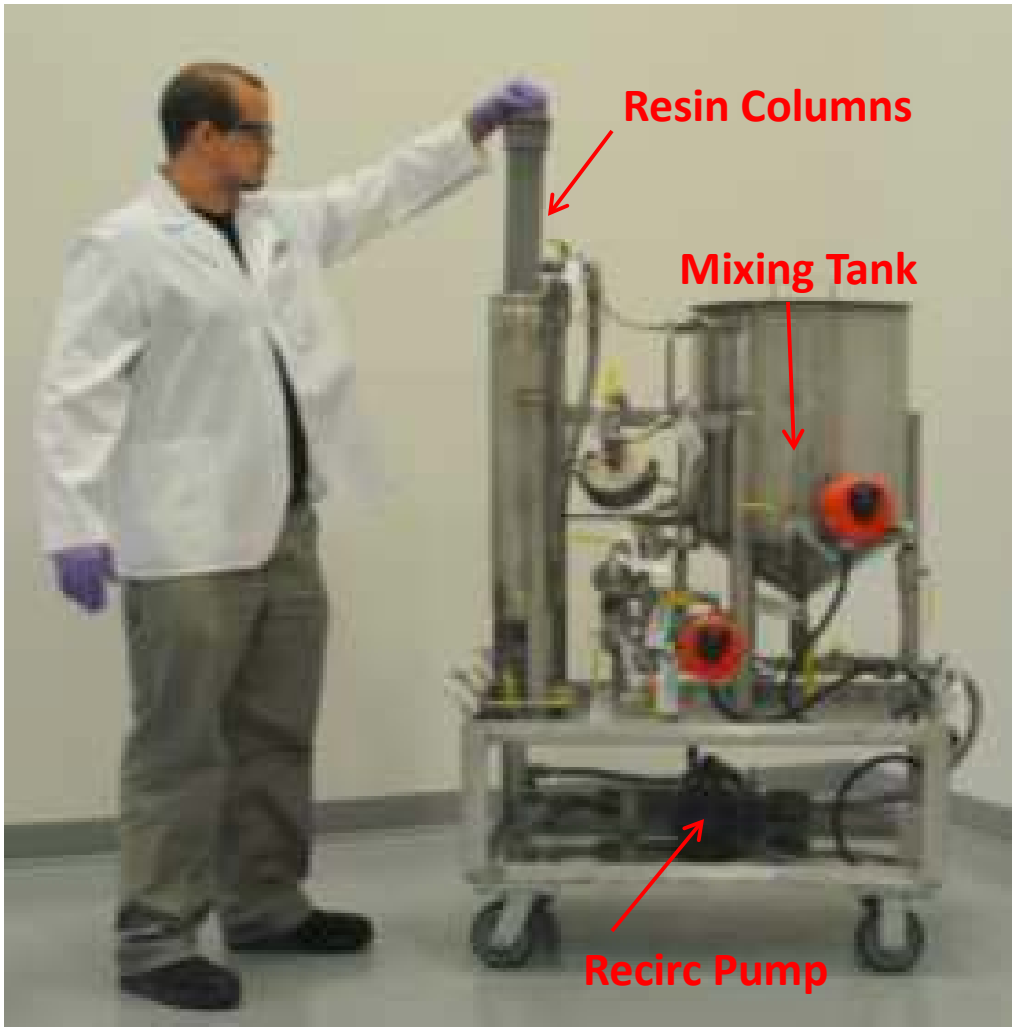
The Decon Process

- Westinghouse uses a Nitrox-E process with Potassium Permanganate and Nitric Acid.
- The Westinghouse decon skid is a compact design with a 3'x4' foot print and can be moved by hand. It has two filter cartridges, a mixing tank with heaters, and a recirculating pump. It is designed to clean small plant systems with capacities up to 100 gallons.
- Required Utilities: Instrument Air, Demin Water, 120 & 480 VAC.
- We chose to place the skid on the refuel floor and route the decon hoses through fire penetrations into lower containment where the piping is located. We routed ~400 feet of rubber hose. After the initial connections, all flow control was performed at the skid.
- The sample line piping layout covered ½ of the lower containment area. There was ~550 feet of NM piping cleaned with a total volume less than 10 gallons.

Westinghouse Mini-Skid

During the first project on Unit 1 we started changing resin columns out at 1 r/hr. We were quickly going through the supply and had to increase our criteria to 2 r/hr.

During the Unit 2 project we decided to increase the change-out criteria to 5 r/hr. Resin column changes were taking 2-3 mrem each



Lessons Learned

First Project on U-1

- We needed more heaters. Our containment air temp was ~60 degrees which made it difficult to heat the solution to 200º. Skid has 4 kw built in. We spent a lot of effort and dose trying to retain the heat. We eventually had to add a 10kw inline heater to achieve the required temperature.
- Had to utilize a supplemental diaphragm pump to get flow. We believe part of the problem was with the kerotest valves checking closed. Westinghouse had the diaphragm pump with the skid as a contingency.
- Need a heavy duty shield to store spent resin columns. We used a lead-lined 55 gal drum that did not provide sufficient shielding.
- We needed better tooling for changing the resin columns.
- The off-the-shelf shield frame for the skid was not high enough. We needed to customize the frame for the actual workers.
- We spent too much time on the first project gathering dose rate information to evaluate decon success. Based on those surveys we discovered all sections of the piping cleaned up equally and locating the highest dose rate at every location was not necessary.
- Cost 750 mrem to perform the Unit 1 decon.

Unit 1
Results

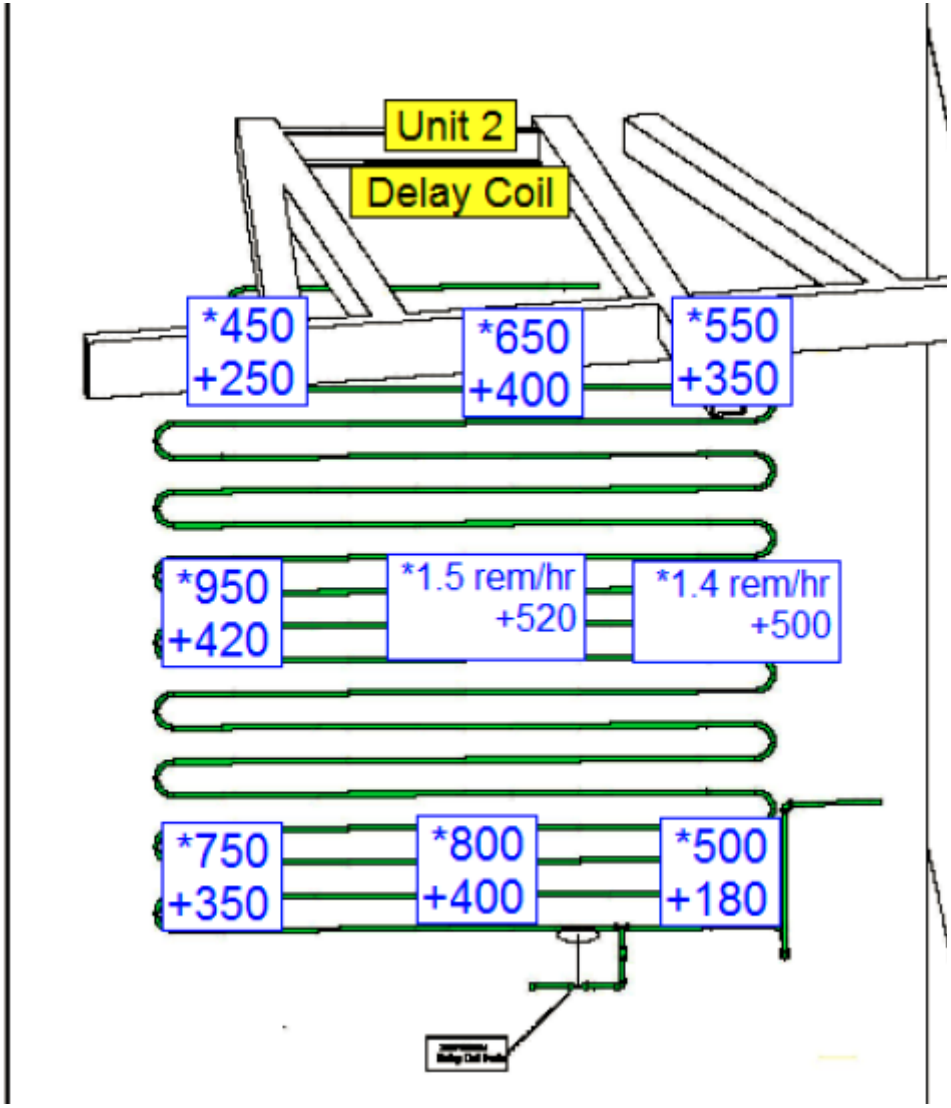
- Achieved 95% reduction in dose rates. 5 mrem/hr contact was the highest dose rate on delay coil following decon.
- All work associated with the abandonment jumper installation cost 60 mrem.
- We have nearly one year run time without the delay coil on U-1 and are very satisfied with the decision to abandon it. We expected to see small increases in chemistry sample dose rates and we did. A Hot Leg sample taken during post mod testing was 12 mr/hr on contact when taken and dropped to 10 mr/hr 1 minute later. The average dose rate on the effluent monitor increased from 3 mr/hr to 4 mr/hr.

Unit Two Delay Coil Project
Sept 10, 2016

- Same Scope as Unit One
- Implemented improvements from U-1 Project
  - Used 8500 lb shield to store spent resin columns
  - Improved tooling and extension poles for changing resin
  - Added portable heaters to delay coil room
  - Diverted Rx Bldg cool return air away from coils
  - Added stainless cables to resin columns to allow extension pole with hook to be used for change-outs.
  - Custom designed shielding after Westinghouse personnel arrived to provide input.

Unit 2 Delay Coils

- Much higher source term on Unit 2.
- U-2 still operating with original D5 S/Gs
- Dose rates 3-4 times higher than the previous U-1 coils.
- Dose rates up to 1.5 r/hr.

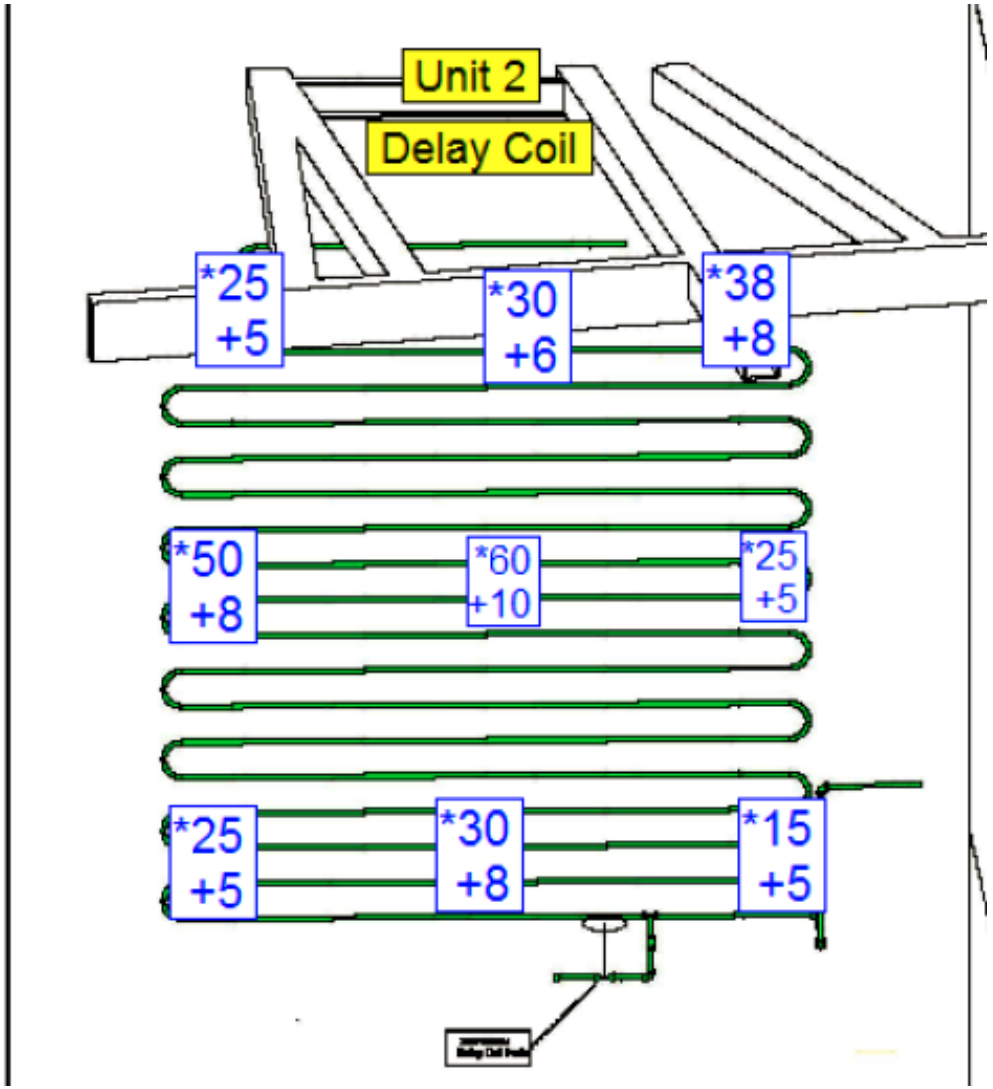


Decon Project

- Set-up took 1 shift to route hoses and install skid.
- Westinghouse provided a Chemist and a Project Manager. RP was responsible for routing hoses, making connections, and operating plant valves once Ops clearances were complete. The site provided material handling needs as well.
- Decon took 2-3 shifts. Unit 2 had a more stubborn crud layer that required 3 cycles.
- We had established a goal to get coils below 50 mrem/hr on contact.

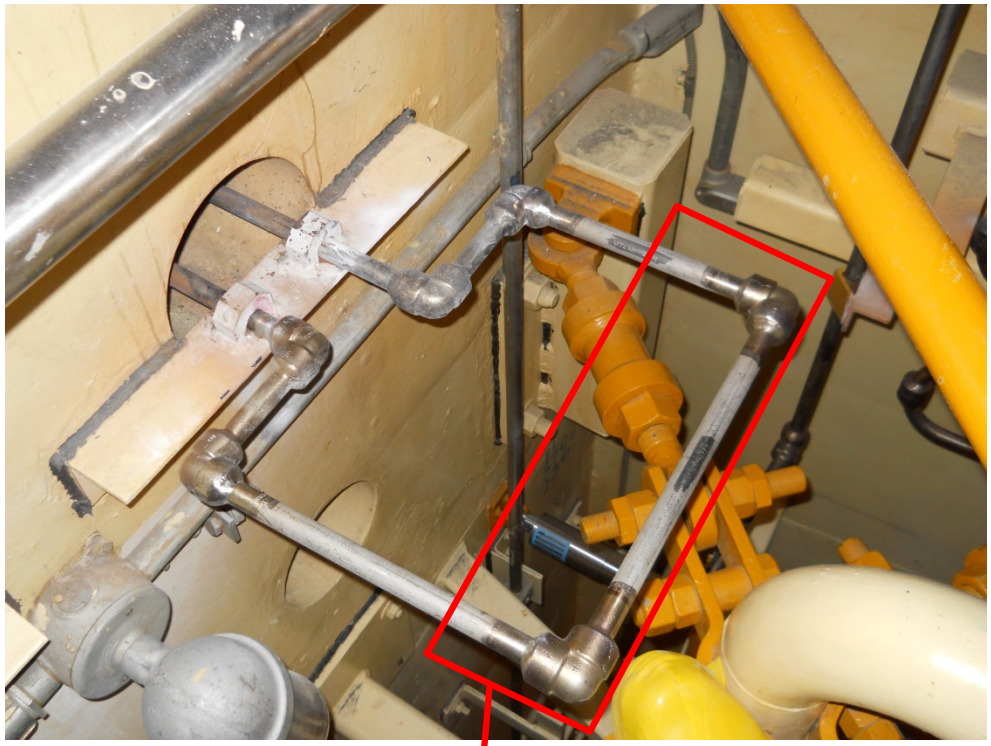
Final Results

- Achieved 96% reduction in dose rates.
- Although Unit 2 had higher dose rates, final dose to complete was 300 mrem less than Unit 1 project.
- Post mod surveys show deletion of coils had only a minor impact on sample line dose rates outside containment and minimal 10% or 1 mr/hr increase on Hot Leg samples.



The Final Product

After chemical decon, the delay coil was cut and capped to abandon it in place. The only remaining in-service portion of the sample line remaining in the area is a three foot section added to connect the delay coil inlet and outlet.

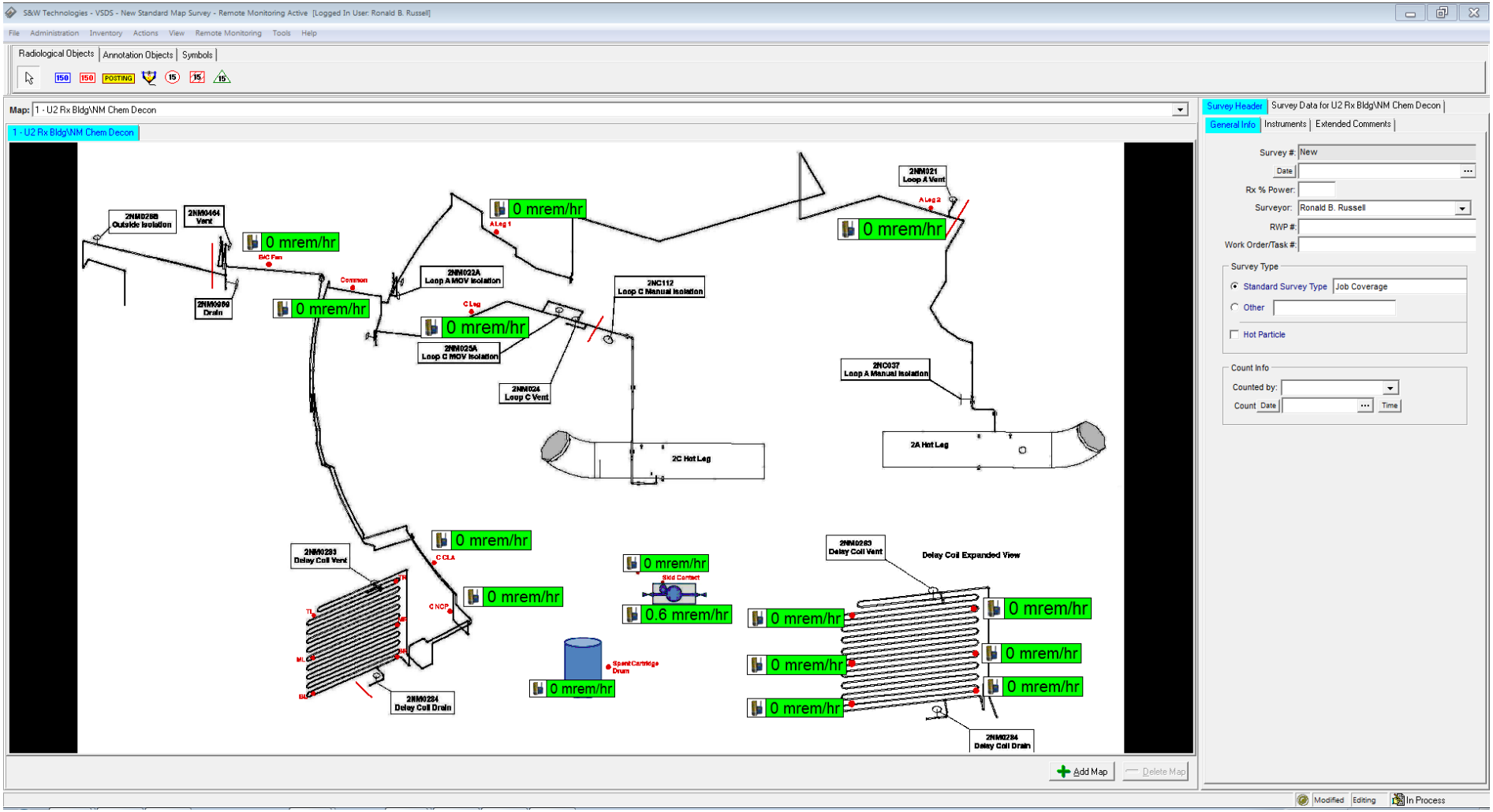


New Jumper to Bypass the Delay Coils

Overall Successes on U-2

- Higher building temperature (~10 degrees) allowed quicker heat-up for the 2nd project. We had spent ~200 mrem trying to overcome the cool temps during the 1st project.
- Having a heavy duty shield saved ~150 mrem during the Unit 2 project.
- Relied heavily on teledosimetry to track progress of cleaning, filter loading, and storage shield. We installed 15 dosimeters and provided Westinghouse personnel with a laptop at their workstation in containment. Used extension poles to hang dosimeters.
- Better Tooling and adding the stainless cables to the resin columns made changeouts much more efficient.

Live Dose Rate Monitoring During Decon Using DMC2000s & GEDDs



Summary

- Catawba will save 2.5 – 3.0 rem each outage by performing chemical decon and abandoning the Delay Coils. This was one of the top two initiatives on the ALARA Long Range Plan.
- Chemical decon allowed us to cancel five Temp Shielding Requests during each outage when decon was performed. We expect recontamination of the sample lines but our goal was to clean and abandon the delay coils. We obtained a 96% reduction in dose rates through chemical decon.
- The chemical decon & abandonment versus deletion saved $150k in mod cost and dose savings just for implementation.
- The benefits received are beyond that of dose reduction and mod cost. We eliminated a safety concern, no future manpower expense to install shielding, and favorable evaluations when looking at CRE reduction efforts.