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Maintenance Projects at the Oregon State TRIGA Reactor

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2023 TRTR/IGORR Conference
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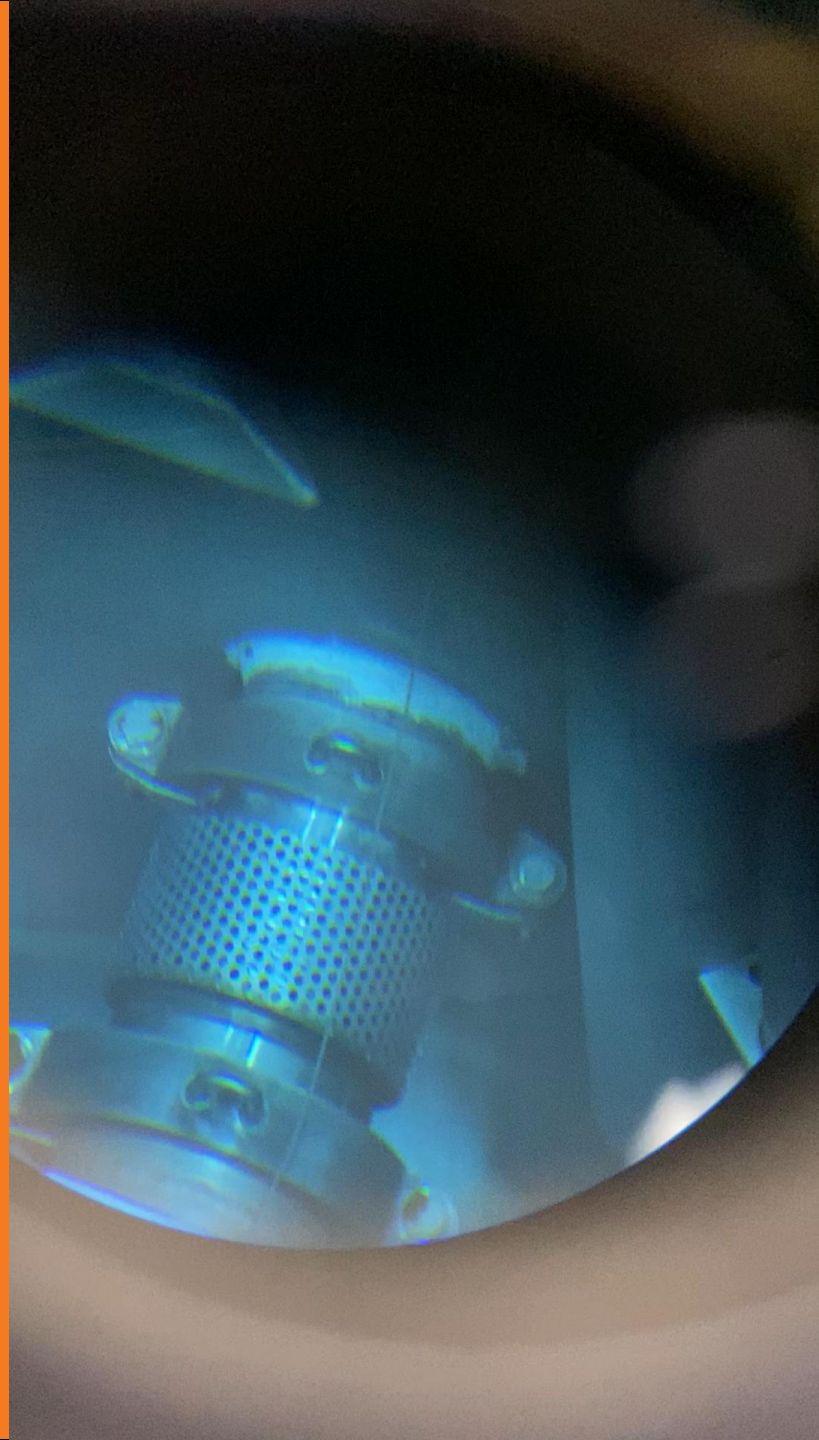
June 18-23, 2023



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Major Maintenance Activities

Two major maintenance activities were performed at OSU that would be considered interesting to the research reactor community:

1) Beam Port #4 Leak Repair
2) Rotating Rack (Lazy Susan) Cleaning

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Layout of Oregon State TRIGA Reactor

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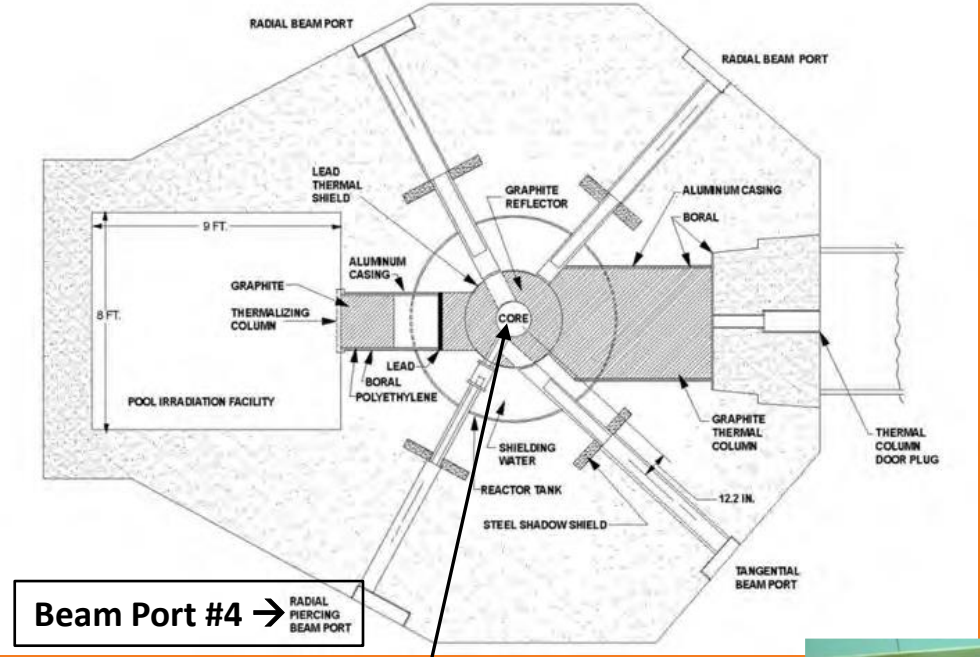

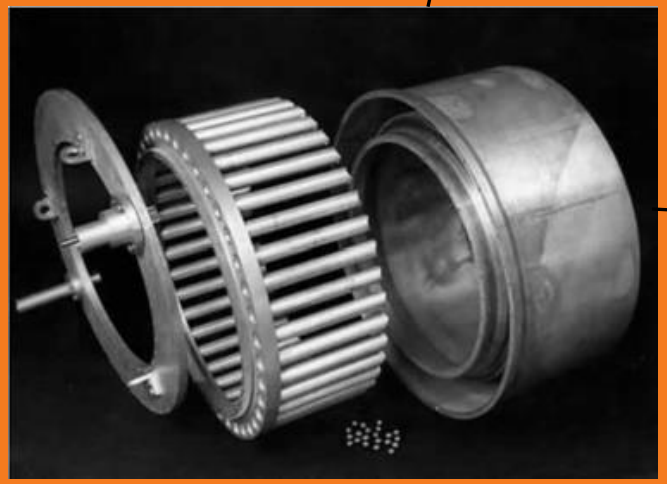

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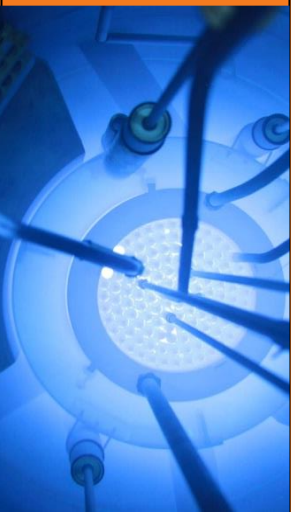
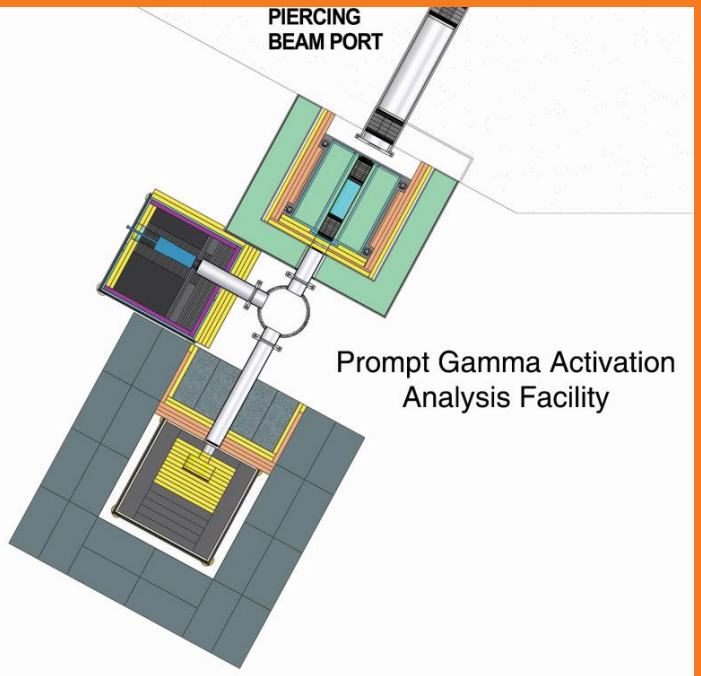
Beam Port #4

- 7/15/19 – Discovery of leak on east side of PGNAA
  - Drain had stopped leaking after reflector replacement outage of 2013
  - After 6 years, leakage returned, experimenter discovered puddle on the floor
  - Analysis of leakage indicated it was fresh reactor water, making bellows the suspect (rate ~30 mL/hr).





Beam Port #4 Bellows Connection

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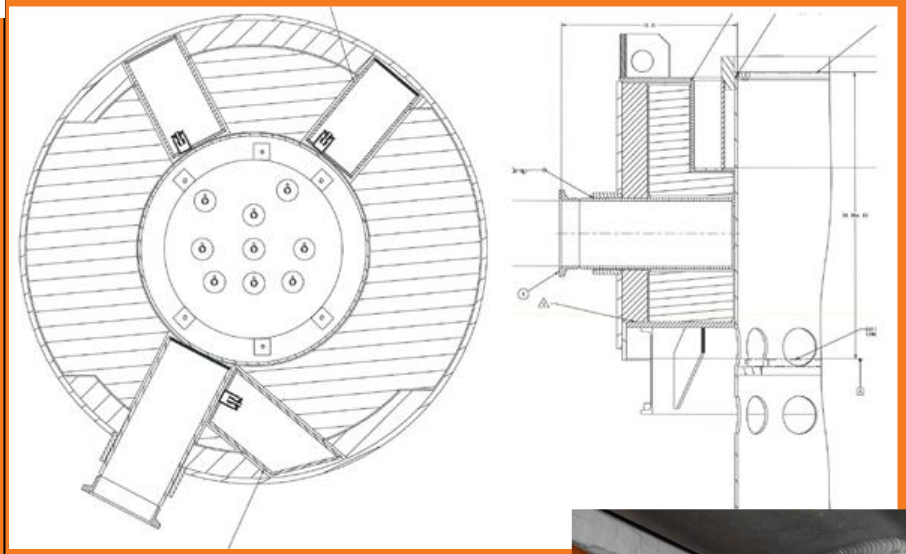

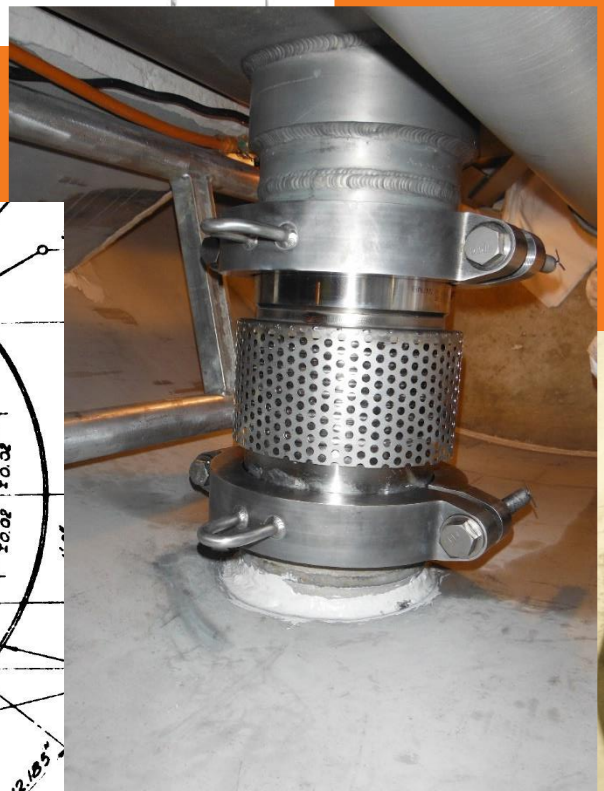

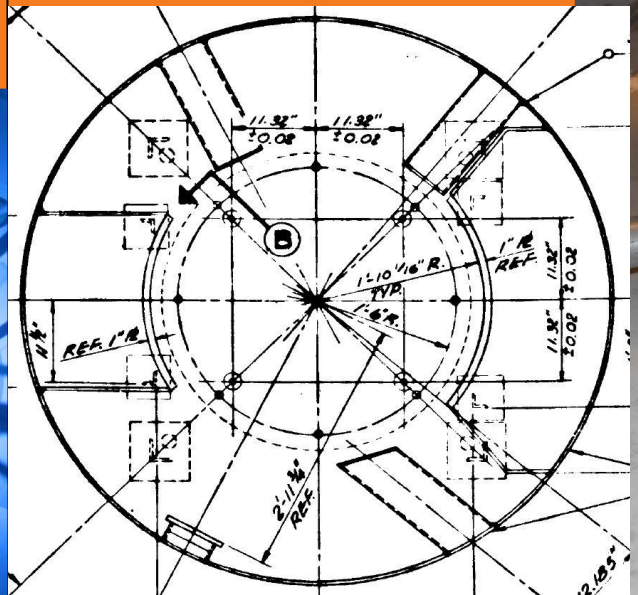

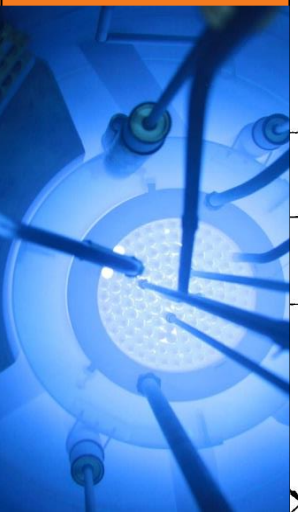

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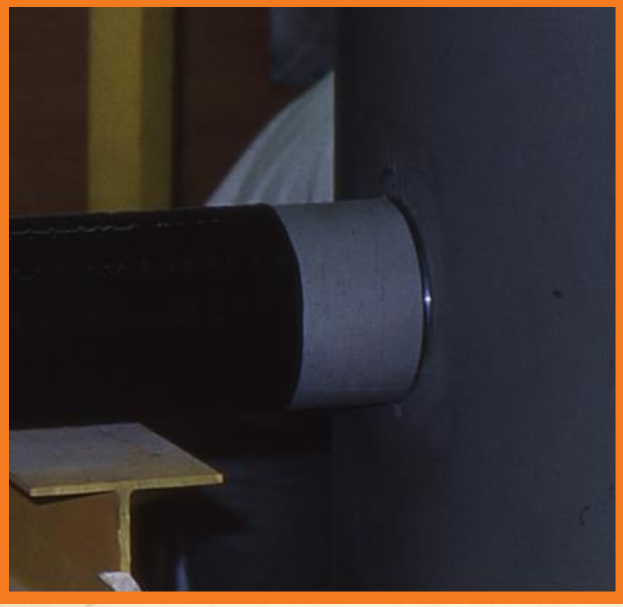
How to Seal Leak?

Beam port has a gap between tank and pipe embedded in the bioshield.

Bellows couples to tank via 3” pipe stub welded to inside of tank.

Leak must be sealed within this pipe stub or the leak will continue to propagate in gap.



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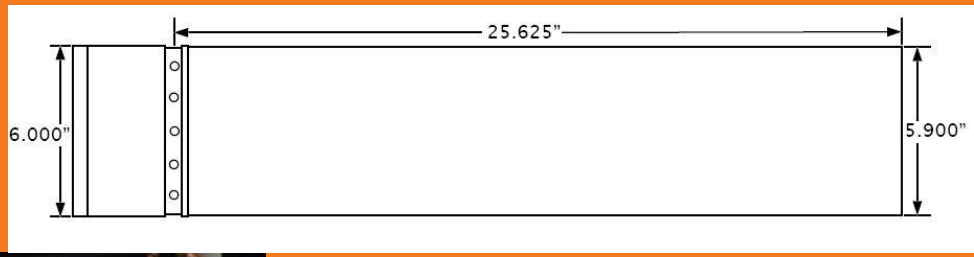
Seal Plug

King Machines (local machine shop) gave us the idea of a plug that radially injects epoxy. Head of plug would pneumatically inject epoxy at 3” pipe stub. Front of plug would be air-filled to keep functionality of beam port #4.



PGNAA Disassembly (Summer 2021)

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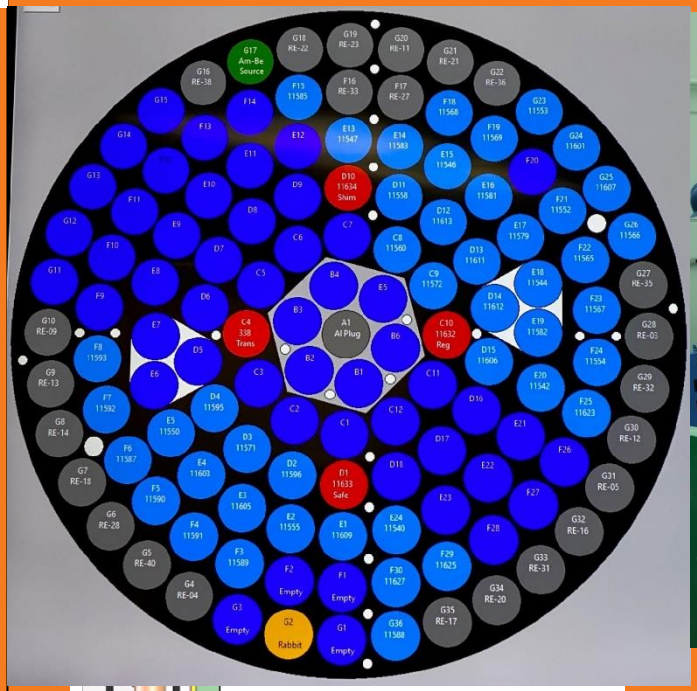

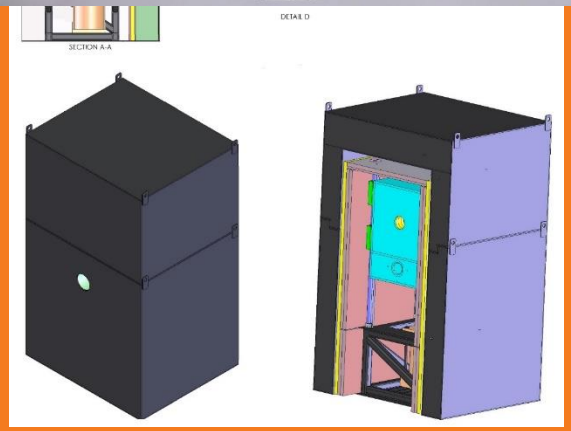

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Collimator Removal

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Beam Port #4

- Plug fill, insertion and injection. How did it do?

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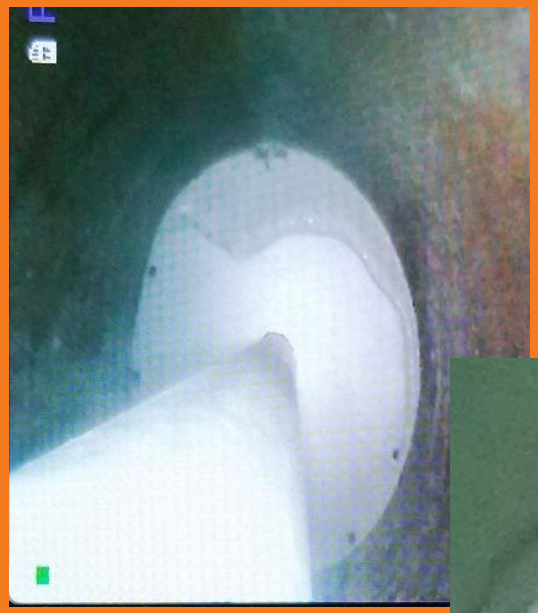
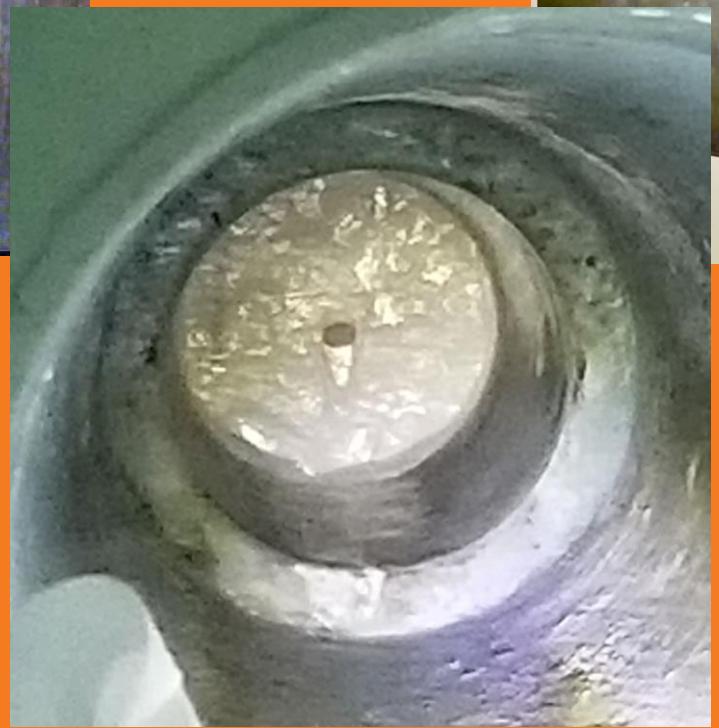
Initial Attempt No Good

- So close! Leak continues through small gap. Epoxy not viscous enough.





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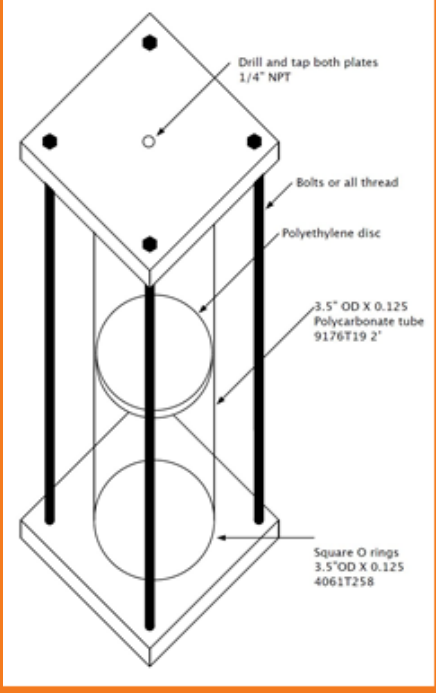
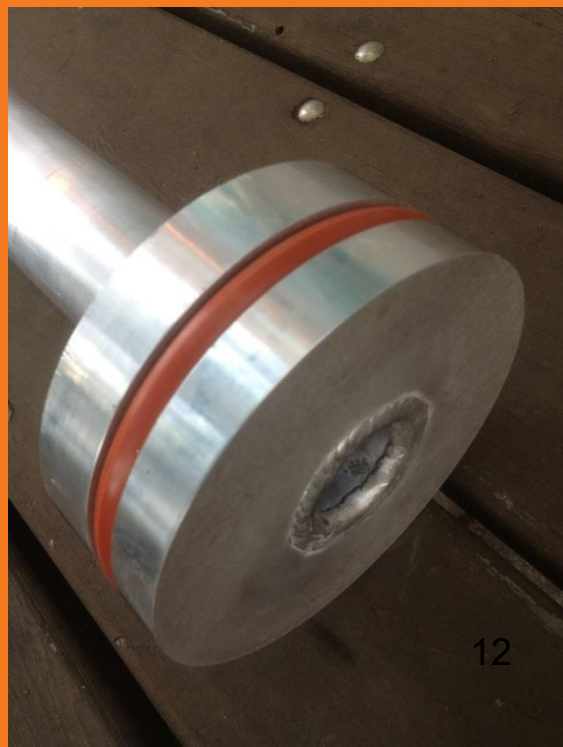
Second Attempt

- We have to inject more epoxy in order to properly seal off leak (epoxy needs to inject into weephole)
- Designed new injection method involving a “paste pot” and retrofitting a plug we initially used as a seal plug for beam port #4 during the 2013 reflector replacement.
- Before injection, a pressure test was performed with the seal plug to determine if pressure could build up against reactor head pressure.
- At this point, we were able to determine the actual leak location!





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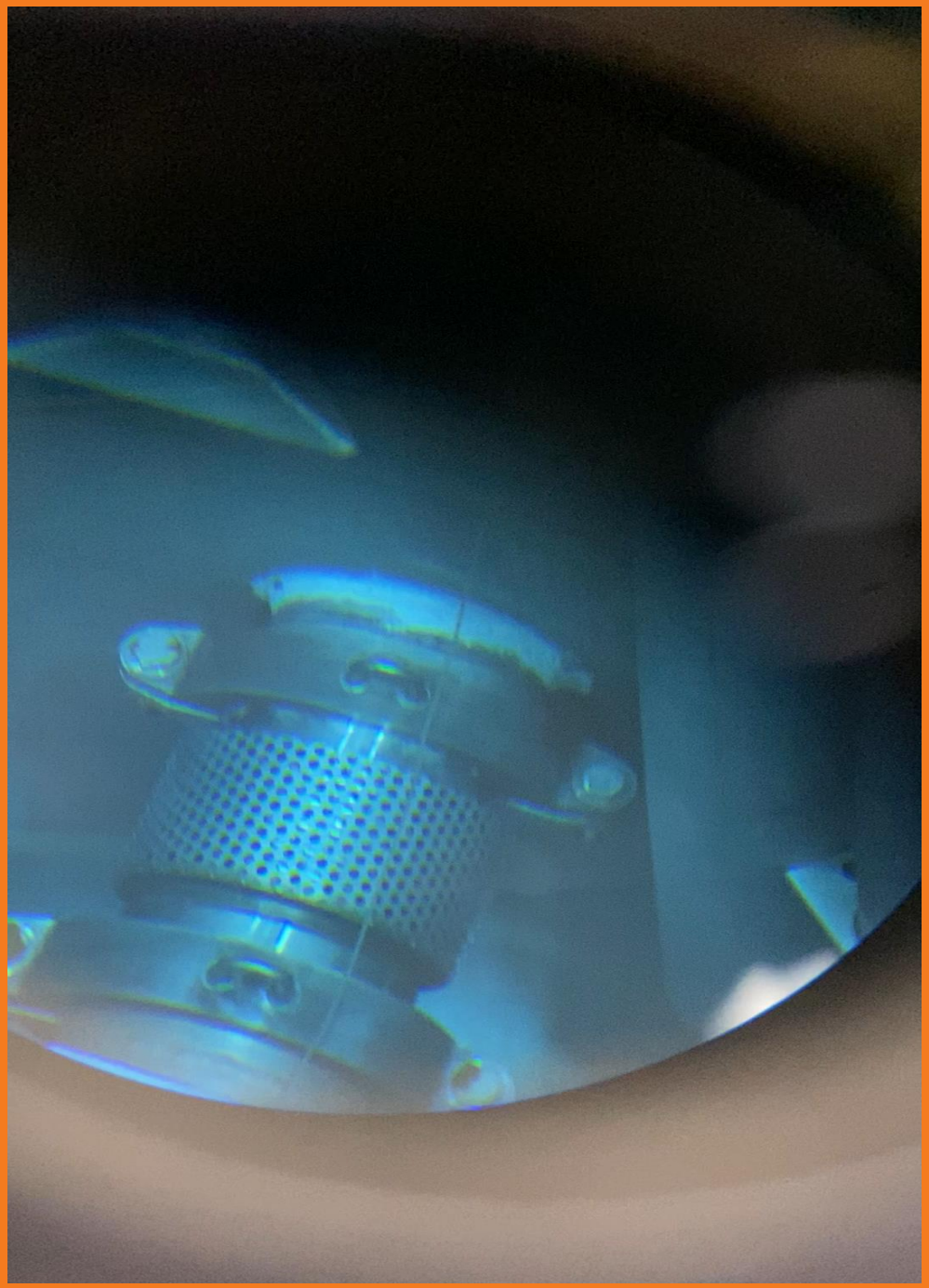

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Second Attempt

Radial seal plug installed in front of first attempt and more epoxy was pneumatically injected to seal leak.

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Success!

A full 360 degree seal was achieved. During epoxy injection, bubbles were seen emanating from the bellows, then bubble flow stopped.

~2 liters of epoxy were injected.

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Beam Port #4 Decommission

Unfortunately, the second successful attempt came at a cost: the epoxy disk effectively killed the flux coming out of beam port #4. Subsequent tests showed that the neutron flux was no longer viable. Beam Port #4 was fully decommissioned in March 2023. PGNAA parts were moved to the previously vacant Beam Port #1.

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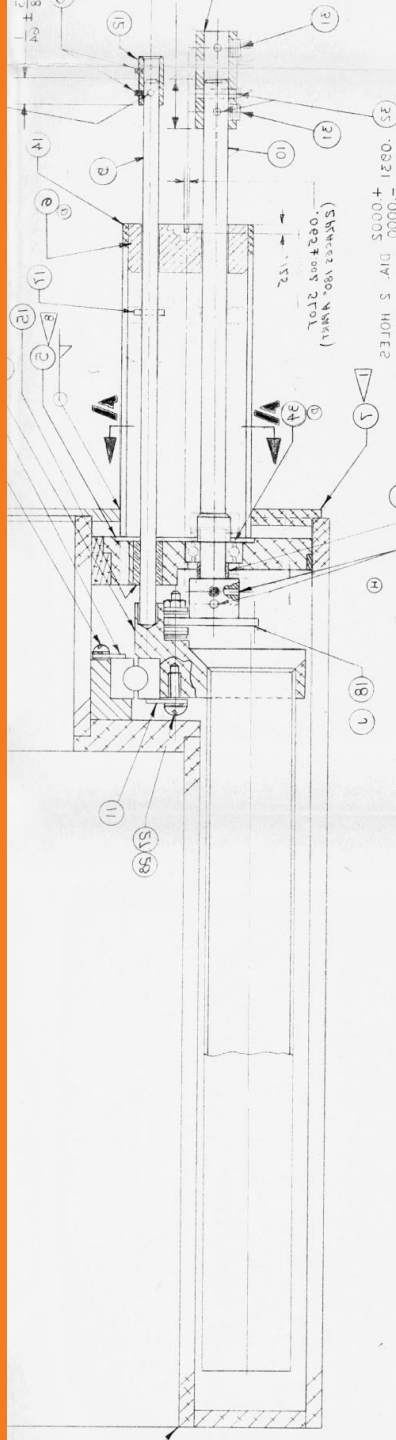
Lazy Susan Cleaning

In the summer of 2022, the lazy susan rotating rack began experiencing various issues: sample tubes sticking to the bottom of the rack, and motor stoppages during operation. Both issues were attributed to the oiling regimen. For years, the staff used small amounts of WD-40 to oil the rack.



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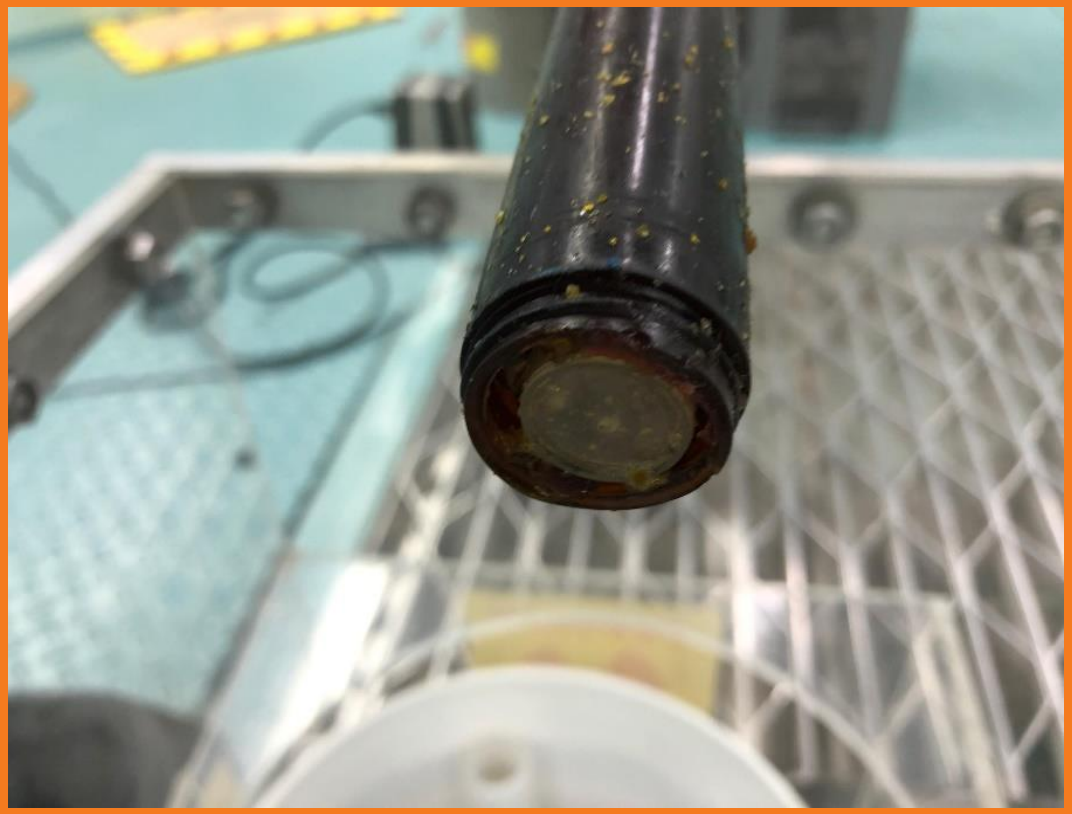
Oil Becomes Glue

Over the years, the WD-40 began to ooze into the rack's tubes which caused TRIGA tubes to stick to the bottom. This caused multiple problems, such as a broken grapple tool, as well as broken TRIGA tubes upon withdrawal.



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Lazy Susan Cleanout

Staff decided to repeat an evolution initially performed in 1990: soak the Lazy Susan with Simple Green (~8 gallons) over a weekend, then rinse and clean the rack.

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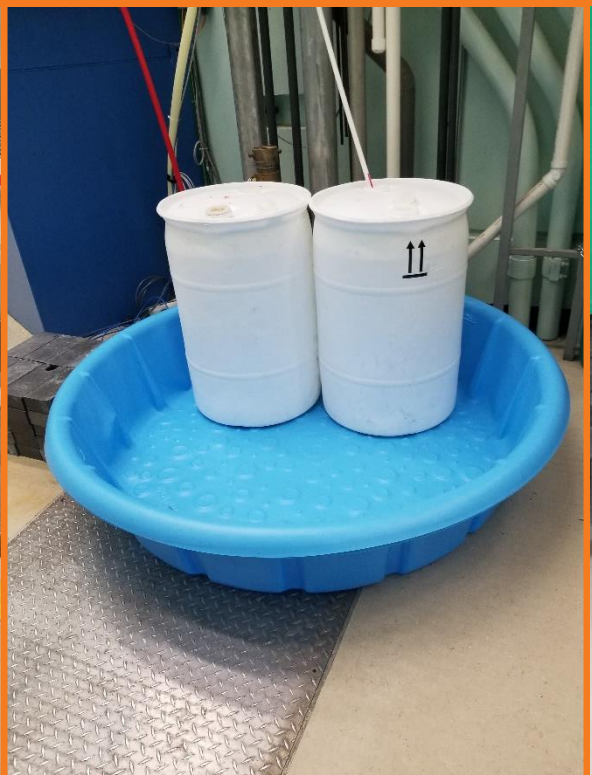
Lazy Susan Cleanout

Simple Green was sucked out using a pump, then staff performed two rinses with DI water. Liquids were pumped into two 30 gallon waste drums. First drum had readings over 100 mR/hr on the side of the drum and necessitated building a brick shielding cave.



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Scrubbing/Vacuuming

Staff performed an inspection with an endoscopic camera, found decent amount of debris. Built scrubbing tools using PEX and dryer vent brush. Built a makeshift vacuum with a HEPA filter and a Home Depot bucket (which failed) then a short metal bucket.

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Lazy Susan Relubricated

Staff experienced difficulty trying to find a suitable lubricant that was also available due to supply chain issues. Ended up choosing Santolube OS-124, which was billed as radiation-resistant. Per the TRIGA Maintenance Manual, we poured ½ cup of oil down the driveshaft.

After a few weeks of operation, the motor began to stick and was difficult to turn by hand. We discovered that Santolube is viscous at our operating temperature of 40 C (370 cSt) and may have increased in viscosity after neutron bombardment.

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Ongoing Issues

The Lazy Susan is still operable but requires constant “exercise”. If the motor is run at least once a week, it seems to keep the oil smooth enough to avoid motor stoppages.

½ cup of oil was too much. For months, oil continued to seep into the rack tubes. We performed subsequent rack cleanings but this time we used cloths dabbed with acetone. We found acetone did a great job at dissolving and removing the oil residue.

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Lessons Learned

Beam Port Repairs:

Make sure you're happy with viscosity of epoxy before injecting/sealing. There is a small window before the epoxy is too thick to inject. If we had waited longer for the epoxy to thicken, we may still have a viable beam.

Lazy Susan Cleaning:

If you need oil, make sure you can find a good supplier.

Find a good balance between rad-hardness and viscosity.

Don't over-oil!

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Questions?