Contract No:

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Disclaimer:

SR19021 – Tritium Aging of Regenerated LANA.75 (SRNL-STI-2019-00610)

Facility Need

The Tritium Facility has used LANA.75 as a hydride to store tritium for over two decades. The beds store significant quantities of tritium but have a limited service life due to radiolytic decay of tritium to He-3 within the metal matrix. He-3 has a very low solubility in the metal as it becomes trapped and alters the crystal structure of the hydride. The altered structure, in turn, causes the formation of a heel of trapped hydrogen isotopes and reduces the reversible capacity of the hydride under normal processing conditions. Depending on the conditions, up to half of a hydride bed's tritium inventory could be tied up in the hydride heel. Furthermore, with sufficient tritium exposure, the bed will lose the ability to deliver He-3 free tritium. When either bed reversible capacity impacts process throughput or the bed can no longer deliver He-3 free tritium, it is replaced at significant cost and effort to the facility. Depending on location in the facility, beds are replaced after 8-12 years of service.

Hydride bed replacement involves an expensive and arduous process involving several tasks. First, new hydride and beds need to be purchased. Second, the newly purchased hydride composition and performance must be verified before use in the facility. Third, before a replacement bed can be installed, the tritium heel on the old bed must be exchanged with deuterium, creating thousands of liters of gas to be processed through the Thermal Cycling Absorption Process (TCAP). Fourth, the new beds need to be activated to remove oxides from the hydride. Fifth, physical bed replacement involves entering open glovebox maintenance which requires numerous manhours of preparation to ensure the safety of personnel and the facility. Sixth, when the old beds are replaced there is not a clear path for disposal of the old beds. Finally, once installed, each new bed must undergo in-bed-accountability calibrations.

SR19021

Status

Started in FY19, continuing in FY20

Technology Readiness Level

Start of FY15:	6
End-of-FY15 Forecast:	6
End-of-FY15 Actual:	6

Financial

FY19 Project Cost:	$281K
Cumulative Total Project Cost:	$281K
FY20 Authorized Amount:	$320K

Credits

Principal Investigators:	Greg Staack, David James
Facility Engineering Co-Leads:	Jared Clark, Paul Foster, S. Schaufler
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Potential Benefits

- [x] Cost Reduction
- [ ] Defect Reduction
- [ ] Error Reduction
- [ ] Mission Diversification
- [x] Mission Viability
- [ ] Obsolescence Solution
- [x] Process Optimization
- [x] Safety

Project Summary

Tritium Aging of Regenerated LANA.75 is a multi-year project. Activities include: tritium aging of a LANA.75 sample regenerated in 2018, regenerating a second tritium-aged LANA.75 sample, and verifying the thermal stability of LANA.75 under regeneration conditions.

During FY19, the Task Technical Plan (TTP) addendum providing testing guidance for monitoring tritium aging of the regenerated LANA.75 sample was approved. A desorption isotherm at 150 °C was collected on the regenerated LANA.75 sample. A second desorption isotherm at 150 °C is scheduled to be collected along with additional desorption isotherms at 80 and 120 °C.

Fabrication, pressure testing, and leak testing of the high temperature test cell for regeneration of the second tritium-aged LANA.75 sample was completed. Selection of the second LANA.75 sample to be regenerated is anticipated in FY20.

Thermal stability testing of LANA.75 material was completed. Hydrogen desorption isotherms at 80, 100 and 120 °C were collected prior to and after a lengthy annealing process (200 hours combined over two weeks) at 750 °C. The isotherms showed similar performances for all temperatures. However, the plateau region for the isotherms after the annealing process were flatter, suggesting that the annealing process was beneficial to the hydride. Sample analyses, including XRD, SEM, ICP and particle size distribution, are ongoing.

Milestones/Findings/Accomplishments

Project Milestone	Expected End	Actual End
Fabricate high temperature test cells	12/18	6/19
Monitor tritium aging of regenerated sample	3/19	6/19
Isotope exchange, passivate, recover second sample for regeneration	6/18	Delayed to FY20
Perform thermal stability testing	12/18	9/19
Submit year-end report/project summary	9/19	9/19

Future Work

- Track tritium-aging of regenerated LANA.75 sample over several years.
- Initiate regeneration of second LANA.75 sample.
- Report results of thermal stability testing.