**Contract No:**

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**Disclaimer:**

# SR19039 – All Metal Vacuum Scroll Pump Development for Tritium

## Facility Need

Currently the Savannah River Site tritium gas processing mission relies on a pumping train combination of a Normetex scroll pump backed by a Metal Bellows MB-601 diaphragm pump. Both of these pumps have wetted components that are "all-metal" so that no polymers or elastomers that can degrade due to tritium gas exposure are exposed to the process fluid. Normetex, the original all-metal vacuum scroll pump manufacturer, has gone out of business. Another French based company, Eumeca, has "spun off" from the Normetex company and is now producing the original, 9 cfm all metal Normetex vacuum scroll pump. It should be noted that Normetex, now Eumeca, is currently the only supplier of a functional all metal vacuum scroll pump to meet the SRS tritium gas processing requirement.

The SRS Tritium Facility need is for an alternate supplier of all metal vacuum scroll pump that can be considered equivalent to the 9 cfm all metal Normetex/Eumeca vacuum scroll pump, preferably a U.S. based supplier. Identifying an alternate supplier of this component will reduce the vulnerability of being reliant on a single source, non-U.S. based supplier for the production and processing of tritium gas to meet U.S. Defense needs. In addition, identifying an alternate supplier could also create competition that may ultimately result in a cost reduction.

## Potential Benefits

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

## Project Summary

This project is a continuation of work already done with Air Squared of Broomfield, CO in the mid 2000's and in 2015-2016 to develop an all metal vacuum scroll pump that can be considered equivalent to the Normetex all-metal vacuum scroll pump in regard to performance and function. In FY19, a procurement specification was generated and an order placed with Air Squared to fabricate a 3rd Generation All Metal Vacuum Scroll Pump. Baseline flow rate and ultimate vacuum testing of a spare Normetex pump was performed so that performance comparison could be made with the 3rd Generation Air Squared Development Pump. In December of 2019, the 3rd Generation Air Squared Development Pump was tested at Air Squared's facility in Broomfield, CO. While the pump was found to not meet the 60 psig design pressure requirement, the pump did perform acceptably in regard to flow rate and ultimate vacuum. Work is currently underway by Air Squared to work with the bellows manufactuer, Servometer, to develop a pumping chamber containment bellows to meet the 60 psig pressure requirement.

**SR19039**

**Status**

Started in FY19, continuing in FY20

**Technology Readiness Level**

| | |
|---|---|
| Start of FY20: | 5 |
| End-of-FY20 Forecast: | 6 |
| End-of-FY15 Actual: | 5.5 |

**Financial**

| | |
|---|---|
| FY20 Project Cost: | $46.1K |
| Cumulative Total Project Cost: | $88.6K |
| FY20 Authorized Amount: | $59.6K |

**Credits**

Principal Investigator: Kipp Neikirk
Facility Engineering Lead: Bobby Lowery
Contributor: Paul Foster

## Milestones/Findings/Accomplishments

| Project Milestone | Expected End | Actual End |
|---|---|---|
| Development Pump Specification Generated and Approved, Purchase Order Placed with Air Squared | 2/28/19 | 4/8/10 |
| Design of Prototype Development Pump Approved | 5/25/19 | 5/31/19 |
| Pump Test System Operational, Baseline Testing Complete | 8/30/19 | 9/20/19 |
| 3rd Generation Pump Fabrication Complete, 3rd Generation Pump Evaluated at Air Squared | 11/29/19 | 12/23/19 |
| Additional Funding Secured, Order Placed for New, Higher Pressure Rate Bellows | 2/13/20 | 2/27/20 |
| Higher Pressure Rated Bellows Fabricated, Evaluated at Air Squared, Deficiencies Still Found, Corrective Action Underway | 7/30/20 | 8/14/20 |
| Submit Year End Summary Report | 9/19/20 | 9/20/20 |

## PDRD Project Status

The development pump procurement specification was generated and approved in late December of 2018. Purchase order placement was anticipated by late February. The official Air Squared proposal amount was higher than estimated. Additional Tritium operational dollars were secured to pay for the 3rd Generation Development Pump from Air Squared. The purchase order was placed in early April of 2019. The Prototype Pump Design Submittal was received and approved by SRNL R&D Engineering (Kipp Neikirk) and Tritium Engineering (Bobby Lowery) in May of 2019. Work was done to make the previously fabricated pump test system operational again at 723-A, including conducting baseline testing at 723-A, using a spare Normetex pump. This was done so that baseline data would be available for comparison purposes with the Air Squared pump scheduled to be fabricated by the end of October, 2019. The prototype pump was fabricated and tested at Air Squared in December of 2019. Based on initial pressure testing of the pump/pumping chamber containment bellows, the containment bellows was found to "distort" at 50 psig, rendering the bellows and pump inoperable. The requirement was for the pump to be able to withstand 66 psig without sustaining damaged and still be able to function properly. Based on discussion, it was decided to performance test the 3rd Generation Development Pump at Air Squared in December with a spare, original bellows (which had been found to distort at 50 psig) so that performance could be verified and so that the prototype pump could be tested on the Air Squared test rig as well as SRS pump test rig. The testing found the pump to perform properly (albeit with the spare bellows that didn't meet the 60 psig design pressure requirement) on both the Air Squared test rig and the SRS pump test rig.

During the pump evaluation work at Air Squared, Servometer, the bellows manufacturer, was contacted. Feedback from Servometer was that they could make a pumping chamber containment bellows that could withstand 66 psig without deformation and that would function properly in the pump. Based on this feedback, additional funding was secured and an order was placed with Air Squared in February of 2020 to pursue design, fabrication, and testing of a higher pressure rated bellows. The new, higher pressure rated

bellows was received and evaluated at Air Squared in August. It passed initial leak testing, operated properly for 10 hours in the pump, and withstood the 66 psig test pressure without deformation. However, during operation after the 66 psig pressure test, the bellows developed a leak/crack in the pumping chamber containment bellows. Work is underway between Air Squared and Servometer to develop and manufacture a 60 psig design pressure rated bellows that will function properly in the pump.

In order to fully accept and verify acceptable performance of the 3rd Generation Air Squared All Metal Vacuum Scroll Development Pump, it has been proposed by Air Squared to ship the 3rd Generation Development Pump to SRS for full evaluation from a performance and reliability standpoint with the original bellows installed in the pump. It is quite possible that, based on design of the Air Squared All Metal Vacuum Scroll Pump, that the pump/bellows may never be able to be rated for a 60 psig design pressure. As part of the work being planned for FY21, a design pressure for the prototype pump with the original bellows would be established (most likely 40 or 45 psig). In addition, in FY21 research could be done to determine what installations in the SRS Tritium Facilities could be suitable "as-is" for the lower design pressure rated pump and which installations would require additional pressure protection to implement the lower design pressure rated pump. In parallel, Air Squared, at their expense, has proposed to continue to work with Servometer in developing a 60 psig design pressure rated bellows that would function acceptably in the pump. If this effort is successful, the 3rd Generation Air Squared Development pump could be sent back to Air Squared for installation of the new, higher pressure rated containment bellows and then sent back to SRS for evaluation and testing.

## FY21 Milestones/Future Work

| Project Milestone | Expected End | Actual End |
|---|---|---|
| "Virtual" Acceptance Testing at Air Squared (due to Covid) | 10/16/20 | TBD |
| Pump Test System Made Operational at 723-A | 10/21/20 | TBD |
| Acceptance/Receipt Acceptance Testing at SRS | 10/30/20 | TDB |
| Prototype Pump Performance Testing Complete at 723-A | 12/31/20 | TBD |
| Pump Endurance Testing Complete at 723-A | 2/26/20 | TBD |
| Final Testing and Evaluation Report Generated and Issued | 4/2/20 | TBD |