# **Project title: Flight ready Electric Feed System**

A 2018-2019 MME capstone project sponsored by the Portland State Aerospace Society

## **Sponsor contact information**

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## **Project motivation**

PSAS is using low pressure composite propellant tanks in its first liquid fuel rocket. Instead of high pressure "blow down" system, an Electric Feed System (EFS) will be used to provide the necessary pressure to pump the propellants into the engine. The EFS has been prototyped and de-risked in a previous capstone, but was not revised and is not able to be used in flight. This capstone will take the previous capstone's work and optimize it for flight in LV4, PSAS' future liquid oxygen and isopropyl alcohol rocket.

## **Customer needs**

The goal of this project is to create a cryogenic-capable bi-propellant electric feed system with the following criteria:

* Must be compatible with liquid oxygen (LOX) and isopropyl alcohol
* Must safely keep the propellants separated until injection into the engine even in the event of a pump failure
* Must be able to be used on the PSAS engine test stand
* Must be able to operate without overhaul for multiple rocket engine test fires (≥ 10 firings)
* Must handle launch environment, including vibration and an acceleration of 10 g for 20 seconds.
* Should have embedded sensors for data acquisition, feedback, and control
* Should be plumbed efficiently to minimize pressure loss
* Must deliver propellants at 300-500 PSI from a tank at 45-70 PSI.

## **Typical operation or user interaction**

The EFS will be used on the test stand, and eventually in a future PSAS rockets. During each test and flight, the pump will be responsible for safely and consistently delivering pressurized liquid oxygen and isopropyl alcohol to the rocket engine at the correct pressure and mass flow rate.

## **Financial and in-kind support**

PSAS will supply building materials and electrical support for this project. Up to $2,000 for funds are allocated, but cost effective design is highly desired to minimize the overall cost.

## **Special requirements**

* All intellectual property must be assigned to PSAS, and the project will be open source under the CERN OHL v1.2 license.
* Team members must use SolidWorks for CAD work design.
* Chemical safety training will be required for all members handling LOX
* All project design and documentation must be done using git on PSAS' Github pages.
* Shop access will be required for students who will be machining components
* Team members are expected to attend most Tuesday evening PSAS meetings from 7:00pm - 8:00pm. However, at least ONE team member must give an update at PSAS' standard Tuesday evening meeting, either in person in FAB 86-01 or via Google Hangouts.
* All team members must agree to and sign the PSAS New Member Agreement.
* All team members must register for the Base 11 Space Challenge.

## **Deliverables**

* Full and complete documentation including:
  + Background, including research done and theory of operation
  + CAD models for entire pump system
  + Safety analysis and SOPs, including full FMEA of the pump system
  + SOPs for mounting, operation, and requirements
* A functioning prototype that’s been tested for
  + Chemical compatibility
  + Operating temperature conditions
  + Performance and efficiency
  + Vibrational disturbances
  + Control signal data
  + Estimation of reliability