CIF 22-1: Solid-State Thermodynamic Vent System (STVS) for Control of Cryogenic Propellants

Project PI: Adam Swanger (adam.m.swanger@nasa.gov)

Team Members: Andy Kelly (andrew.o.kelly@nasa.gov), Bobby Hughes (robert.w.hughes-1@nasa.gov), Gabor Tamasy (gabor.j.tamasy@nasa.gov), Will Reaves (william.f.reaves@nasa.gov), Felipe Loo (felipe.m.loo@nasa.gov), Mai Harrison (ajchariya.harrison@nasa.gov), Donald Payne (donald.w.payne@nasa.gov), and Colin Mahony (colin.mahony@nasa.gov)

Activity Type: New Start

Primary STMD Taxonomy: TX13.1.4 Propellant Production, Storage and Transfer

Start TRL: 2 **End TRL:** 4

Executive Summary: A Solid-State Thermodynamic Vent System (STVS) is a novel Cryogenic Fluid Management (CFM) technology for spacecraft cryogenic propellant tanks that may reduce boiloff while providing greater control over the propellant condition. By exploiting the vacuum-induced cryocooling (VIC) potential of cryogen-saturated silica aerogel material, an internal STVS heat exchanger (HX) can expel some sacrificial cryogenic propellant to the vacuum of space to produce cooling within the storage tank. This cooling is transferred directly to the stored fluid, thereby reducing boiloff and increasing hold times.

Testing proved the effectiveness of the concept by reducing the liquid nitrogen (LN_2) boiloff rate and tank pressure by roughly 70% and 77%, respectively, during a single pump-down cycle, which sacrificed around 1.8 kg of propellant.