Development of an 400 L Integrated Refrigeration and Storage Cryostat for LNG/LCH_4 Research

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Background

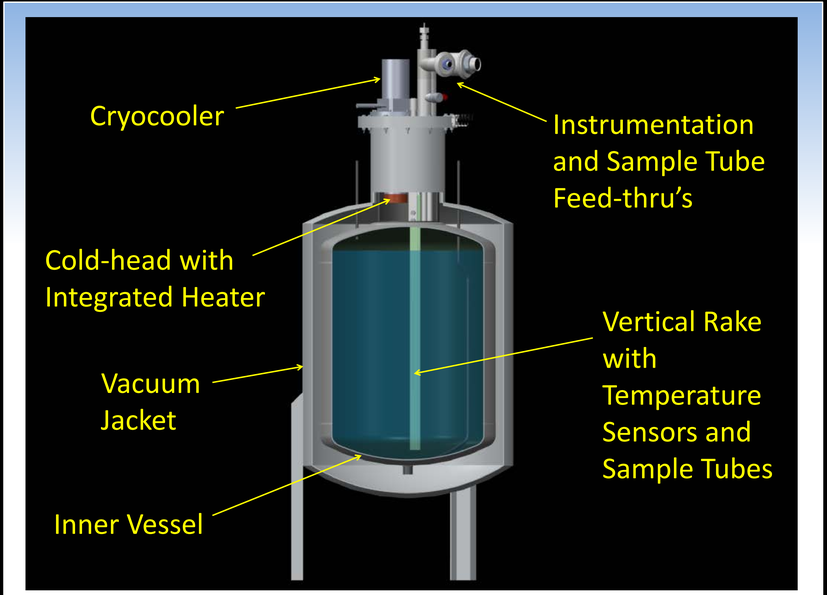
- Many new rocket applications for liquid methane (LCH_4) and/or LNG
- LNG composition varies depending on source location, and "weathers" over time during storage
  - **Bad for predicting and ensuring rocket performance**
- Partnership formed between NASA Propellants Management Office and the Cryogenics Test Laboratory at Kennedy Space Center
  - **Evaluate LNG storage, transfer, operational effects, and potential mitigations, including the use of Integrated Refrigeration and Storage (IRAS)**

Scope

- Modify an existing 400 liter cryostat
- Test stratification and weathering effects during long duration storage by sampling at different levels
- Explore whether IRAS can **mitigate weathering and possibly create densified/slush LNG**

Cryostat Modifications

- Integrate a Gifford-McMahon cryocooler for IRAS (~370 W @ 111 K)
- Individual 1/8" sample tubes at 0%, 25%, 50%, 75% and 100% full marks
- Vertical RTD temperature sensors within the liquid
- Recertify per ASME Boiler & Pressure Vessel Code



Integrated Refrigeration and Storage

- **IRAS:** Interface a cryogenic refrigerator to a cryogenic storage tank via an internal heat exchanger
- Offers full control over the state of the cryofuel using addition & removal of thermal energy, as opposed to addition & removal of mass
- Proven out for large scale LH_2 applications by GODU-LH2 project at NASA KSC
  - Zero Boiloff (ZBO)
  - In-Situ liquefaction
  - Densification and slush production

Status

- July 2018: Cryogenics Test Lab received the modified test cryostat from the vendor
- Currently performing functional check-outs and cold shock with LN_2
- **Exploring potential collaboration and partnership opportunities** for testing in FY19 and beyond

SPACEPORT INTEGRATION & SERVICES

Cryogenics Test Lab KENNEDY SPACE CENTER

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