



Contribution ID: 43

Type: **Contributed Oral**

C3Or2A-01: Transient Liquefaction on the Lunar or Martian Surface Operational Demonstration

Wednesday 12 July 2023 11:00 (15 minutes)

As developments of local production of cryogenic fluids on the Lunar or Martian Surface progress, it is important to understand transient system responses to help with the balancing of process plant power and understanding system level operations. During the Cryogenic Fluid In-situ Liquefaction for Landers (CryoFILL) testing, a series of transient oxygen liquefaction tests were completed. These tests included varying liquefaction flow rate, environmental temperature, tank fill level, and effective cryocooler lift while allowing the tank pressure to respond to the input controls. An additional transient test was run at the 90% fill level to determine the impact of injecting the gaseous oxygen at the bottom of the tank, allowing the vapor to bubble up through the liquid. Tests were run in a cyclical nature varying one variable at a time. The control variable was set in a manner to increase tank pressure for a period of time and then subsequently changed in a manner to decrease the tank pressure back to its original value with multiple cycles run for all tests. Tank pressure and system temperature responses were tracked as a function of time with an emphasis on repeatability. Results indicate that of the four variables tested, the environmental temperature is the least important. As expected, the bubbling of the liquefaction gas significantly decreased the pressurization and depressurization rates in the tank at the 90% full level.

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Session Classification: C3Or2A: Aerospace Applications III: In-Space Fluids Systems