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## Ground Operations Demonstration Unit for Liquid Hydrogen Initial Test Results

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NASA operations for handling cryogenics in ground support equipment have not changed substantially in 50 years, despite major technology advances in the field of cryogenics. NASA loses approximately 50% of the hydrogen purchased because of a continuous heat leak into ground and flight vessels, transient chill down of warm cryogenic equipment, liquid bleeds, and vent losses. NASA Kennedy Space Center (KSC) needs to develop energy-efficient cryogenic ground systems to minimize propellant losses, simplify operations, and reduce cost associated with hydrogen usage. The GODU LH2 project has designed, assembled, and started testing of a prototype storage and distribution system for liquid hydrogen that represents an advanced end-to-end cryogenic propellant system for a ground launch complex. The project has multiple objectives including zero loss storage and transfer, liquefaction of gaseous hydrogen, and densification of liquid hydrogen. The system is unique because it uses an integrated refrigeration and storage system (IRAS) to control the state of the fluid. This paper will discuss present the results of the initial phase of testing of the GODU LH2 system.

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