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C1Po1B-01 [14]: Robotic Refueling Mission 3—An Overview

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Robotic Refueling Mission 3 (RRM3) is an external payload on the International Space Station (ISS) to demonstrate the techniques for storing and transferring a cryogenic fuel, specifically methane, on orbit. The RRM3 Source Dewar was filled with ˜19 kg (˜42 liters) of liquid methane on October 28, 2018 and has been maintained with zero boil-off using a mechanical cryocooler since that time. RRM3 was launched from the Kennedy Space Center on SpaceX Commercial Resupply Service (CRS) 16 on December 5, 2018 and berthed on the ISS Express Logistics Carrier on December 15. Methane is transferred from the Source Dewar to a Receiver Dewar through one of three transfer lines—one hardline that was established when the system was built and two flexible lines that will require robotic operation prior to the transfer. RRM3 was designed and built at NASA Goddard Space Flight Center (GSFC). Initial testing was performed at GSFC using liquid nitrogen and liquid argon. Final testing and flight fill of methane was performed at the NASA Kennedy Space Center (KSC) because KSC has the necessary facilities and expertise for handling a combustible cryogen. This paper gives an overview of the process and challenges of developing the payload and the results of its on-orbit performance.

Authors: Dr BREON, Susan (NASA Goddard Space Flight Center); Mr BOYLE, Robert (NASA Goddard Space Flight Center); Mr FRANCOM, Matthew (NASA Goddard Space Flight Center); Mr DELEE, C. Hudson (NASA GSFC); Mr FRANCIS, John (NASA Goddard Space Flight Center); Dr MUSTAFI, Shuvo (NASA Goddard Space Flight Center); Dr BARFKNECHT, Peter (NASA Goddard Space Flight Center); Ms MCGUIRE, Jill (NASA Goddard Space Flight Center); Ms KRENN, Angela (NASA Kennedy Space Center); Dr ZIMMERLI, Gregory (NASA Glenn Research Center); Dr HAUSER, Daniel (NASA Glenn Research Center)

Presenter: Dr BREON, Susan (NASA Goddard Space Flight Center)

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