NASA robotic refueling mission departs station

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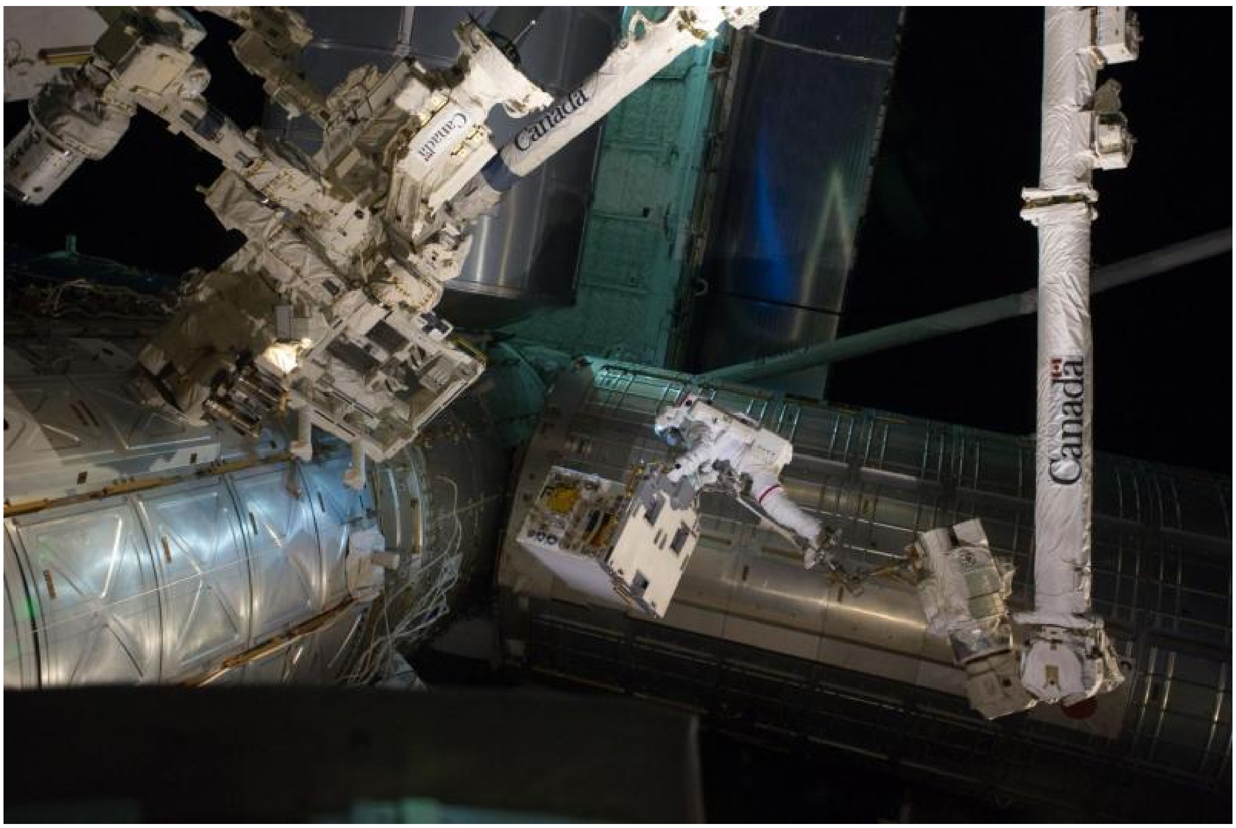

Astronaut Mike Fossum's spacewalk for the Robotics Refueling Mission Payload on July 12, 2011. Credit: NASA

The International Space Station serves as an orbiting test and demonstration laboratory for scientific experiments to be performed inside and outside the space station. The experiments are inherently transient with typical life cycles of about one to five years. Once their test objectives are accomplished, they are removed to make way for new experiments.

On Feb. 19, a NASA experiment—a test module called Raven—was successfully launched on SpaceX-10/Dragon and installed on the exterior of the station, where it will test autopilot technologies for spacecraft. As the Raven payload took its perch on the station, another Satellite Servicing Projects Division (SSPD) creation—the Robotic Refueling Mission (RRM) payload, departed. Aboard the Dragon trunk in which Raven arrived, RRM made its way back to Earth on March 19, where it reentered the atmosphere. Though both payloads were and are critical to the advancement of satellite servicing, after RRM served its purpose and accomplished its objectives, it was time for RRM to leave the station and make way for new experiments.

RRM has established a firm legacy in demonstrating satellite servicing capabilities and that on-orbit servicing is technologically ready for implementation. RRM launched in July 2011 aboard the final space shuttle flight and was the last payload to be removed from the shuttle cargo bay by an astronaut. It was subsequently mounted outside onto a Express Logistics Carrier built at NASA's Goddard Space Flight Center in Greenbelt, Maryland. RRM demonstrated and tested the tools, technologies and techniques needed to robotically refuel and repair satellites in space that were not designed to be serviced.

The Robotic Refueling Mission was an essential bridge between the manned servicing carried out in the Hubble Servicing Missions and robotic servicing that will be demonstrated in the upcoming Restore-L mission," said Ben Reed, deputy division director for SSPD. "Our team worked very hard to develop the suite of RRM tools and experiments and are extremely pleased to see what they accomplished. We are eager to apply the lessons learned from RRM to the Restore-L mission as well as future servicing efforts."

The year was 2010 when planning for RRM began. The fourth Hubble Space Telescope servicing mission had just ended. The space shuttle was in the twilight of its career, scheduled for retirement in 2011. The hundreds of engineers at Goddard who had supported servicing Hubble were not sure what a future without shuttle would hold. A team, led by the "father of servicing" Frank Cepollina, began brainstorming how to continue servicing without shuttle. With no time to waste, Cepollina's team determined that the future of servicing would rely on robotics and the space station robotic arm was the best mechanism to test and develop robotic servicing techniques. Eighteen months later—extremely quick for a project of this complexity—RRM was in the cargo bay of space shuttle Atlantis, ready to launch and demonstrate to the world that robotic servicing had come of age.

"The space station is on-orbit and already has a robot," said Frank Cepollina, the previous associate director of the SSPD. "Space station was tailor-made for RRM and worked beautifully as a testbed for servicing."

The washing machine-sized RRM payload housed four unique tools that were used by the station's twin-armed Canadian "Dextre" robot to accomplish the precise, complex tasks needed to refuel a satellite. These tasks included cutting and peeling back thermal blankets, unscrewing multiple caps, accessing valves and transferring a simulated satellite fuel. In January 2013, with this fluid transfer in space, RRM confirmed that current-day robotic technology could refuel a triple-sealed satellite fuel valve, transferring 1.7 liters of ethanol.

In separate launches in 2013 and 2014, two new task boards and a tool were sent to the space station as part of RRM "Phase 2." The task boards further demonstrated activities vital to servicing free-flying satellites. Similarly, the new tool, the Visual Inspection Poseable Invertebrate Robot, or VIPIR, exhibited state-of-the-art near and midrange inspection using an articulable, "snake-like" borescope tool.

Through these two phases and multiple days of operations, the RRM team has bonded and consistently performed under pressure. Together they created a payload and completed a mission critical to the future of satellite servicing. Currently, they are developing and working to execute a third phase of RRM, which will continue to advance the technology necessary for robotic refueling. RRM 3 will focus specifically on servicing cryogenic fluid and xenon gas interfaces which will support future scientific missions as humans extend their exploration further into our solar system.

"Space station was a wonderful facility to test our technologies, and we know that RRM's departure will make room for another great experiment," said Jill McGuire, RRM project manager. "We are proud of what we accomplished with RRM, and are excited to contribute to the next stages of enabling robotic satellite servicing."

Provided by NASA

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