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Converting an MPLM to a PMM

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The **Multi-Purpose Logistics Module (MPLM)** are pressurized modules for transporting equipment, supplies and experimental devices to and from the International Space Station (ISS). An MPLM is carried in the cargo bay of a Shuttle and attached to the Unity or Harmony modules on the ISS for the duration of a mission, usually about 10 days. From there, supplies are offloaded, and finished experiments and waste are reloaded. The MPLM is then returned to the Space Shuttle payload bay for return to Earth. Three modules were built, Leonardo, Raffaello and Donatello. The modules were provided to NASA under contract by the Italian Space Agency. Each MPLM was built to be on-orbit a maximum of one month at a time.

The Italian Space Agency chose the names of the modules because they denote some of the great talents in Italian history:

- Leonardo da Vinci, an extraordinary inventor-scientist, civil engineer, architect, artist and military planner and weapons designer
- Donatello di Niccolo Di Betto Bardi, one of the greatest sculptors of all time and one of the founders of modern sculpture
- Raffaello Sanzio, an artist whose work stands alone for its visual achievement of human grandeur, both in clarity of form and ease of composition.

The MPLM concept was originally created for Space Station Freedom. Initially, they were to be built by Boeing, but in 1992, the Italians announced that they would build a "Mini-Pressurized Logistics Module". After the 1993 redesign of Freedom, the length was doubled and it was renamed the "Multi-Purpose Logistics Module".

Construction of the Leonardo module began in April 1996 at the Alenia Aerospazio factory in Turin, Italy. Leonardo was delivered to Kennedy Space Center (KSC) from Italy in August 1998 by a special Beluga cargo aircraft. Raffaello arrived at KSC in August 1999. The MPLM Donatello was delivered to KSC on Feb. 1, 2001.

The cylindrical module is approximately 21 feet long and 15 feet in diameter, weighing almost 4.5 tons. It can carry up to 10 tons of cargo. The MPLM has the capacity to carry

16 large containers (racks) of supplies such as food, clothing, spare parts and research equipment to the ISS. As of July 2010, the MPLMs have performed a combined total of 10 missions. The MPLM Donatello will not fly before the retirement of the Space Shuttle. The MPLM Raffaello was used for three of the ten MPLM flights and Leonardo was used for seven. Each module was designed to perform a maximum of 25 missions.

The MPLM Leonardo is being modified to turn it into the Pressurized Multipurpose Module (PMM), which will remain permanently attached to the ISS following the STS-133 mission. The Space Shuttle is the only vehicle or rocket that has the capacity to carry the MPLM to the ISS. With the planned retirement of the Space Shuttle in 2011, NASA has found another use for the MPLM. With the modifications of the MPLM into a PMM the ISS will have another permanent module as part of the ISS that will be used as a storage module.

The modifications will ensure that the PMM can survive the harsh environment of space for many years. To convert the MPLM Leonardo into the PMM, NASA is performing the following modifications: removal of the grapple Y fixture, removal of Remote Operated Fluid Umbilical (ROFU) components, replacement of Common Berthing Mechanism (CBM) seal, installation of new forward end cone Micro Meteoroid Orbital Debris (MMOD) shields, feed through seal replacement, installation of visiting vehicle retro-reflectors, and modifications of the Multi-Layer Insulation blankets underneath the MMOD shields. The estimated cost of the MPLM modifications is between \$20 to \$40 million.

In this internship I was part of the Launch Package Engineers (LPE) from the Johnson Space Center (JSC) working at the Launch Site Integration Office at KSC. The LPE serve as intermediary between the JSC Launch Package Team and the KSC Mission Management Team to keep JSC informed about the operations at KSC. They are responsible to keep JSC informed about what happens with the International Space Station (ISS) hardware that is being processed at KSC.

The LPE work closely with the KSC Mission Management Team every day to stay informed of the progress in the processing of the International Space Station (ISS) hardware that will then be launched on the Space Shuttle. The LPE follows the ISS hardware through the entire processing period at KSC and during the on-orbit integration with the rest of the previously assembled ISS.

The Launch Package Engineers support many meetings and telecons on a daily basis to help resolve any issues that may occur during the processing of the International Space Station (ISS) hardware.

It takes organization, technical competence, and good communication skills in order to successfully perform this function between KSC and JSC and across multiple workers that need the information on a daily basis.

This internship was an unforgettable experience and a good work experience that will help me in the future. I want to say thank you to the INSPIRE and OLC Team and to my mentor Ronald Caswell. I am grateful for all that I have learned from Ron.