Paper ID: 31321
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66th International Astronautical Congress 2015

HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Flight & Ground Operations of HSF Systems – Joint Session of the Human Spaceflight and Space Operations Symposia (4-B6.5)

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ON ORBIT CHANGES AND NEW SCENARIOS FOR NODE 2 AND 3 AND CUPOLA: HOW TO BE PREPARED FROM THE DESIGN PHASE

Abstract

Node 2, Node 3 and Cupola have been launched several years ago, at the time of the Space Shuttle. The International Space Station logistics refurbishment was still based on ATV, MPLM and HTV in addition to the Russian contribution. Since that time, several changes occurred: Space Shuttle retired, an upgraded MPLM, PMM, is permanently providing on orbit stowage and both MPLM and ATV performed their final flight. On the US side, the ISS refurbishment is now based on Space-X and Cygnus-PCM; new advanced and innovative element like the BEAM are ready to be "tested" on the ISS. The retirement of the Shuttle and the imminent arrival of Orion require changes that were clearly not planned at the time of the design phase. The Nodes, for their functional role, resulted to be the most critical elements capable to accommodate most of the reconfiguration needs. After one year of redesign for considering the new on orbit needs and objectives, 2015 is the year of the on orbit reconfiguration in order to get prepared to the new challenge. The Node 2 will accommodate the new docking ports for Orion, losing a berthing logistic port on zenith, Node 3 is accommodating permanently PMM and temporarily the BEAM, followed by other experiment modules. The new scenarios impacts relevantly the Temperature and Humidity Control system (adding fans, reversing flow), it implies routing of several additional wires both internally and externally in area not design for EVA activities, the sampling systems is also affected, safety and accessibilities implies several modification both in terms of movement (like ARED relocation) and in terms of removal of parts mandatory only for launch (brackets). The overall modification will result in several EVA spacewalks, Robotics operations, IVA reconfiguration activities and last but not least several flights to consider the logistics and deliver the hardware. It is a unique occasion to flow down lessons learned coming from years of data collection for on orbit design improvements (for example associated to acoustic, to thermal analysis, to failure events). The planning, manifesting, crew training and on orbit integration also linked with current on orbit configuration are a unique exercise of concurrent engineering that up to now has resulted to be very effective. Aim of the paper is to address the extent of the modification and the lessons learned derived from this unique experience to insert in future program a proper level of operational flexibility.