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HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
How Can We Best Apply Our Experience to Future Human Missions? (2)

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APPLYING LESSONS LEARNED FROM THE ISS MAINTENANCE APPROACH TO FUTURE LONG DURATION MISSIONS

Abstract

One lesson learned from the International Space Station (ISS) Program is that Intermediate Level (I-Level) maintenance capability is absolutely necessary. Even in low Earth orbit, the availability of spare Orbital Replacement Units (ORUs) does not guarantee that all maintenance needs can be met. On long duration missions, the need to perform I-Level maintenance will be even more important. Another lesson learned from the ISS Program is that planning for I-Level maintenance is better than reacting to real time I-Level needs.

All NASA Human Space Flight Programs have included the ability for the crew to perform on orbit maintenance to repair hardware and recover functional availability of a system. The maintenance approach thus far was to perform Organizational Level (O-Level) Maintenance. The O-Level Maintenance approach is to remove a failed ORU and replace it with a new ORU. This approach works well when the spacecraft has readily available pre-positioned spares ORUs or a logistics vehicle can launch a spare ORU relatively quickly.

For long duration missions, especially missions that leave low earth orbit, it will be difficult to carry all the required spare ORUs. Thus, an I-Level methodology will be required. The I-Level methodology consists of a crew-member removing a failed ORU and opening it up to perform the repair below the ORU level. One benefit of I-Level maintenance is that Shop Replaceable Units (SRUs) can be flown which will require much less weight and volume as compared to ORUs. I-Level maintenance also adds the flexibility to fly SRUs that can support multiple ORUs. An I-Level maintenance approach will drive initial designs to be more generic and universal. Pumps, valves and filters should be common among all systems. Circuit cards should use as much commonality as possible with the ability to configure or program a generic card to the purpose it must perform. Power supplies should be interchangeable between systems. I-Level designed systems should be maintenance friendly to allow easy crew access to any component that has a failure potential. Crew skills should include test equipment and repair tools to perform most ground-based repairs.

For long duration missions leaving low earth orbit, implementing an I-Level maintenance methodology will greatly improve crew safety and increase the chances of mission success.