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UNDERSTANDING ISS ANOMALIES IN THE FRAME OF DEVELOPING RELIABLE AND SUSTAINABLE SPACE STATIONS IN THE FUTURE

Abstract

In recent years, space leaders have started planning the future of space activities, with governmental consortiums developing stations in low Earth orbit, lunar orbit, and beyond. The design and operation of these future stations is mainly relying on the previous experiences gained with the International Space Station since its launch in 1997. By identifying the most commonly occurring incidents, as well as operational workarounds and solutions taken by the flight controllers, these issues can be already solved in the design of the future space station hardware and software. The goal is to minimise system outage times, and reduce operator workload as much as possible, irrespective of whether the operator is a crew member or ground personnel. The requirement of minimised system outage becomes especially relevant for commercial space station projects, where degraded or unavailable systems can result in direct impacts on system provision, and the overall of the mission. On the other hand, minimising operator workload becomes relevant for crewed missions beyond cislunar space, where instantaneous ground response to anomalous behaviour is not possible, providing an autonomous and reliable system in which most of the potential scenarios will be considered. In the scope of present-day ISS operations, incidents are captured in the form of anomaly reports. Analysing these reports can reveal which of the current systems are most susceptible to failures, and to which particular failure modes, thus informing design decisions in terms of increasing redundancy and/or reliability.This paper analyses the anomalies observed during the ISS lifetime and proposes solutions to the most critical and most commonly occurring issues, on both system and operational levels. Utilising this experience will enable future station projects to operate more efficiently, with less anomalies, and consequently less maintenance costs, and thus have higher scientific and/or commercial return.

Keywords: space station, anomalies, sustainability, safety, risk analysis