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EXTENDING ISS LIFE BEYOND 2030

Abstract

The United States On-orbit Segment (USOS) of the International Space Station (ISS) was designed to meet a 15-year on-orbit life. Since the first hardware was launched in 1998, the ISS would have reached its end of life in 2013. With the realization that the ISS would be needed well into the next decade, a multi-disciplinary effort was undertaken to extend the life through 2028 and to show further extension to 2040 is not only feasible but achievable. Currently, NASA and the international partners have agreed to extend ISS operations through 2030. This collaborative effort ensures that the ISS will continue to serve as a hub for scientific research, international cooperation, and educational endeavors for the next decade. Maintaining a continuous human presence in Low Earth Orbit (LEO) is desirable for testing new LEO, lunar, and deep-space technologies; conducting scientific research in micro-gravity for the benefit of life on Earth; and enabling a seamless transition of capabilities to one or more commercially owned and operated destinations.

This paper provides an overview of the ISS life extension project with a focus on the analytical approach used to assess the primary structure. This approach includes future operations planning, critical location screening, dynamic load simulation, optical property degradation studies, thermal analyses, spectra generation, crack model idealization, and fracture analyses. Structural life results and identification of the most critical on-orbit events are presented.

Also addressed are life extension approaches for other affected sub-systems, including:

1. Secondary Structure.

2. Materials. Consider environmental exposure to atomic oxygen, ionizing and gamma radiation, fluids, etc. Life limited materials, wear, and usage effects are considered.

3. Environmental Control and Life Support Systems, including oxygen supply and generation, water recovery and management, and regenerative hardware. Evaluations determine which hardware can run to failure or are assessed for life extension.

4. Electrical power system. Power generation and balance analyses are performed considering hardware degradation and increasing power demand.

5. Logistics and maintenance. Determine critical spares required to maintain functionality, consider supply chain health, obsolescence issues, onboard stowage availability, and up-mass capability.

The successful life extension results instill confidence to safely operate, maintain and enhance the ISS beyond the current decade. Extending the operational life of the ISS maintains an international presence in LEO and avoids a gap in capability necessary to fulfill the exploration and research needs of NASA, international partners, and industry without interruption until a commercial space station is operational.