

22nd SYMPOSIUM ON SPACE ACTIVITY AND SOCIETY (E5)
Habitation Throughout the Solar System (1)

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COMMAND AND CONTROL CONCEPTS FOR LONG DURATION HUMAN SPACEFLIGHT

Abstract

Human presence throughout the solar system presents unique challenges related to command and control capabilities. To date, all crewed missions have had nearly continuous real-time contact with Mission Control for troubleshooting and emergency situations. Mission Control has also borne the responsibility of maintaining the health and operability of onboard systems and subsystems to allow the crew to focus their time on activities that require human attention onboard. However, during a long duration manned flight to Mars, an asteroid or beyond, communication round trip light times will increase to 15 minutes or more depending on relative changes in the orbits of Earth, the spacecraft, and destination. Mission Control will slowly lose the ability to command and monitor vehicle systems in real-time during the out-bound mission, requiring gradual handover of these functions to the onboard crew. Mission Control will take on a new identity, providing more consultative services to the crew, while the crew will assume the majority of the roles of the Flight Control Team. In addition to daily operations of vehicle systems, crew members will be required monitor and control several vehicle descents/dockings/ascent as well as surface excursions during the long duration mission. Therefore, the crew vehicle must have a dedicated area modeled after Mission Control able to provide adequate situational awareness, command capability, conferencing between crews and/or Earth, and troubleshooting resources. Several in-depth studies of crewed interplanetary missions have been conducted to date by NASA and other space agencies, yet command and control roles, responsibilities, and functions are scarcely mentioned and not yet explored in detail. The proposed paper will clearly define the command and control functions required during each phase of the long duration crewed mission, describe how the roles and responsibilities will be allocated during each mission phase, and provide design recommendations for an onboard command and control module with the capabilities of performing as a ‘miniature Mission Control’ as required.