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ARTEMIS I MISSION: TASI CONTRIBUTION AND MAIN RESULTS

Abstract

Between November and December 2022, after more than one decade spent in the design, qualification and acceptance activities, the European Service Module (ESM) has been launched as part of the Artemis 1 Orion stack in its first historical mission, for a voyage around the Moon. The mission has been followed by a dedicated ESA engineering support team that, shared between the ESM Mission Evaluation Rooms in NASA and in ESA, has cooperated to take the decisions and to conduct the investigations open during the flight. In addition to the possibility to overview the performances of the integrated system during the whole mission and its capability to respond to the various launch and environmental conditions and to the various configuration adjustments, the support activity has also given an unique opportunity to assess the behavior of each single subsystem, the mutual interactions with the other subsystems, the effects of the environments, the responses to the commands and to the reconfiguration operations. Furthermore a number of test cases have allowed to check specific design aspects to explore margins, conservatisms, limits and to check redundancies and tolerances. In its role in the ESM project, TASI has developed the Consumable Storage System (CSS), the Thermal Control System (TCS), and the Structure up to the qualification and the acceptance. The CSS has the task to store and deliver to the Crew Module (CM) through the Crew Module Adapter (CMA) the resources (Water, Nitrogen and Oxygen) needed to support the human life on board; the TCS has the task to keep proper temperature levels through the ESM and provide the heat rejection capability to the entire Orion stack; finally the structure has provided the elements to withstand the loads and host all the equipment needed by the ESM. This paper intends to present an overview of the TAS systems accommodated in the ESM and to discuss their main performances during the mission and their adaptation to the different mission and environmental conditions. It will report about their responses to the gas requests into the cabin, to the different Solar Arrays positions and the different vehicle attitudes; it will report about the coolant loop adjustments with different control modes and different set points; it will report about the heaters' activation and capability to control the thermal environment and will finally present the matching between expectations and predictions and actual behavior.