

SPACE OPERATIONS SYMPOSIUM (B6)
New Operations Concepts and Commercial Space Operations (2)

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LEOP OPERATIONS FOR GEOSTATIONARY COMMUNICATIONS SPACECRAFT INJECTED
INTO A SUB-GEOSYNCHRONOUS TRANSFER ORBIT

Abstract

ISRO's Polar Satellite Launch Vehicle(non-cryogenic) was used to launch a communication spacecraft for the first time on July 15, 2011. The spacecraft was GSAT-12, with a mission goal to provide communication service for 7 Years minimum, with 12 Ext-C Band transponders. The mission was realized by optimizing the spacecraft configuration and weight to 1410 kg, injection into sub-Geosynchronous Transfer Orbit(sub-GTO: 284km x 21000km, 18° inclination) and a new strategy of mission operations which have been detailed in this paper. The spacecraft bus was configured (I-1K bus) to achieve the mission goal within launch constraints. LEOP operation plans were drawn taking into account spacecraft configuration requirements, constraints of reduced orbital period(6.1 hours) and altitude, network station visibilities and Earth Sensor(ES) visibility. Gyro-calibration in GSAT-12 made use of ES whose optimal use was constrained by the low altitude. Appropriate roll-sun-pointing orientation was achieved through post-separation automatic command sequence to enable direct earth acquisition to provide maximum ES data for Gyro-cal. The reduced orbital period put enormous constraint on time available for preparatory operations before orbit-raising maneuvers. A new operational strategy was arrived at for Propulsion activities related to the opening of Gas Tank Latch Valve. Also, the optimal orbit-raising strategy adopted for GSAT-12 was new. It was a 5-burn strategy which required first two maneuvers to be carried out near Perigee crossing with spacecraft velocity 9.6 km/s. Planning the operations for these maneuvers with limited network visibilities available was another challenge. The perigee maneuvers were tightly planned considering the near equatorial ground stations of Hassan and Biak. A new TTC antenna configuration was implemented to eliminate antenna null regions. Studies related to Energy balance and thermal impact of sun load during the Perigee-burn orientation were carried out. Operations were grouped/staggered preferentially as per mission requirement, over a well-defined timeline with adequate planning for contingency operations. The operations also ensured solar power generation from the auto-deployed Solar Arrays which were 90 deg away from sun-pointing orientation. Time Tagged and Configurable Command Blocks of the Telecommand Processor were utilized in several of the operations. Removal of Latch Valve Blocks also necessitated a change in the operations. GSAT-12 launch and LEOP operations were completed as per plan with the spacecraft positioned at 83 deg East. The optimal mission planning and operations has ensured a life of around 11 years for the spacecraft, thus providing a highly viable low-cost platform for I-1K bus communication missions.