SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Systems I (1)

Author: Mr. G. Ayyappan
Indian Space Research Organization (ISRO), India

Mr. Sri S. Somanath
Vikram Sarabhai Space Centre (VSSC), India
Mr. V. Ganesan
Vikram Sarabhai Space Centre (VSSC), India
Mr. Ramakrishnan Sundaram
Indian Space Researh Organisation, India

DEVELOPMENT OF A LARGE LIQUID CORE STAGE L110 FOR GSLV MK-III - TECHNOLOGICAL CHALLENGES

Abstract

GSLV Mk-111 Vehicle uses a massive liquid stage with clustering of the Vikas engines for the Trans atmospheric flight. Technological challenges involved in qualifying the Vikas engines for the longer burn duration include realization of improved strength ablative composite throat with double ply orientation winding to reduce the charring rate and also enhanced burning life. Independent Tankages of 4 metre class are realised for storing the oxidizer-N204 and fuei-UH25 of 50 cubic metre capacity each using the state of art aluminium materiai-AA2219. Twin engines have to be simultaneously ignited using the common Command system module giving reference pressure by keeping the transport delays to minimum. New torroidal shape water tank configuration made with a catch tank for better expulsion efficiency. Propellant flow to the engines through the single outlet at bottom with the manifolding is also an achievement of technological excellence. Base region of the stage propulsion bay to be totally heat protected by flexible multilayer Thermal Boot. EGC actuations in pitch and yaw axes for both engines giving fine control of the vehicle during flight. Nozzle Closure System is also introduced in LllO engine for protecting the engine during the strapon operation. Ground qualification testing of the engine for extended burn duration established 20on engine performance. Sub assembly level vibration tests prior to hot tests proved the integrity of stage structures. Development hot tests carried out with required burn duration has validated the performance and assembly sequence. Tuning of Gas generator propellant regulators for obtaining the minimum differential thrust during tail off regime has been completed with theoretical analysis. The engines response characteristics exhibited better matching during stage level hot tests. Establishing the ground test facilities and instrumentation systems for the tests which were complex and difficult was another challenge. Monitoring of flight measurements of about 440 channels during the tests was a herculian task. The results of modeling and evaluation of heat flux and jet load to estimate the margin on jet deflector MS plates indicated technical maturity in the simulation of actual conditions. Quality in design and fabrication of large metallic structural hardware like core thermal shroud and core base shroud indicated the soundness of LllO stage among its contemporaries.