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ASSESSMENT ON THE FAILURE OBSERVED IN A LIQUID FUEL TANK IN AN ABORTED
MISSION OF A GEOSYNCHRONOUS VEHICLE

Abstract

The first attempt to launch the Geosynchronous vehicle with the indigenous Cryo upper stage (on 19th August 2013) was aborted at T - 1Hr. 45 minutes, due to the leak observed in the second stage fuel tank, during the pre-flight pressurization. The tank was fabricated with AFNOR AA 7020 material and the leak originated in the aft end ring of the tank. The leak was later found to be due to a through crack failure, below the shear lip under the aft flange. The length of the crack was 180 mm (approx.) in the circumferential direction. The tank has undergone two successful Proof Pressure Tests (PPT), before being integrated with the launch vehicle. Though the tank has withstood the proof pressure twice, it failed under a lower pressure during the pre-flight pressurization. Based on detailed investigation of the failure region, the reason for this was later found to be Stress Corrosion Cracking (SCC). This study attempts to address the probable reason for the stresses that induced the SCC. Detailed stress analysis followed by linear elastic fracture mechanics approach was used to assess the failure. The two possible scenarios of crack initiation were also considered in this analysis i.e. crack initiating from inner surface and from outer surface. It is worth noting that, the two scenarios are significantly different, since the nature of bending moment at this location is such that the crack emanating from inner surface will be opened, whereas the crack from outer surface will be closed by the bending stress. Hence, results of the fracture analysis for these cases were studied. In addition, the difference in the stress field at the failure location, due to presence of Thrust frame (in flight condition), which is not assembled in the PPT condition is also brought out in this study.