

Preface

ISRO'S Pad Abort Test

ISRO successfully demonstrated Pad Abort Test (PAT) of Crew Escape System (CES) on 5 July 2018. This test was first in a series of technology development related to human space flight planned from Indian soil in 2022. The test is essential to verify the emergency escape measure designed for astronauts to break away from the main vehicle in case of any eventuality at the launch pad and to land at a safe distance. CES with a Crew Module (CM) weighing 12.6 tonnes lifted-off smoothly from the Sounding Rocket Complex Pad at Sathish Dhawan Space Centre, Sriharikota; the flight duration was 260 s. Once the vehicle soared skywards and took a flight path over the Bay of Bengal, CM alone was separated from CES and brought back to ground with the help of parachutes. CM separated at 3 km altitude and attained 10 g acceleration using specially designed quick-acting solid motor engines (5 nos). Suitable boats were deployed to recover CM. All parameters to assess the performance of the entire mission duration were recorded using 330 sensors. The mission performance was excellent and the objectives were successfully demonstrated.

During the design and development phase of CES, quite a few problems were encountered in some of the

key technology areas and appropriate decisions were made to overcome them. Data collected during the flight reassured that the corrective measures taken were indeed in the right direction. The flight also helped understand the critical technology areas in such a complex mission.

In order to disseminate the experiences from a such complex mission in several critical technology areas like aerodynamics, structures, aero-thermal, special escape motors, mission aspects, parachute system, grid fin, etc. 12 articles are presented in this special issue. The challenges faced in quality assurance and also in a few selected technology developments areas are included. I hope that the readers would get an insight into the complexities associated with such cutting-edge technologies related to human space flight and also get answers to some of the questions they may have. This successful CES mission no doubt is a first leap towards the ambitious 'Gaganyaan', the Human Space Mission of India.

I thank the Chief Editor, *Current Science* for publishing this special issue. I also thank Dr K. Sivan (Chairman, ISRO and Secretary, DoS) and S. Somanath (Director, Vikram Sarabhai Space Centre) for their support.

B. N. Suresh

Foreword

On 5 July 2018, a special mission of Pad Abort Test consisting of Crew Escape System demonstrator with a Crew Module lifted-off from Sounding Rocket Complex Pad at Sathish Dhawan Space Centre, Sriharikota. This mission was the precursor to one of the decisive technologies related to Human Space Flight programme planned in 2022. The main objectives of this mission were to demonstrate: (i) Crew Escape System capability during launch pad abort; (ii) To determine sufficient static margin with multiple jet-on and jet-off phases; (iii) Self re-orientation of Crew Module aided by aerodynamics; (iv) Parachute systems. During vehicle ascent phase, the Crew Module alone was separated from the Crew Escape System at an altitude of 3 km, and descended softly with the help of parachutes into the Bay of Bengal. During the entire mission, the health as well as the performance of the vehicle was monitored and recorded with the help of more than 300 sensors.

In the course of journey towards the mission, challenging technological issues were encountered in the design as well as in the realization phases. All the issues were properly addressed and overcome by apposite decisions.

Significant amount of data collected from the flight revealed that the decisions on the technical issues were in the right direction. Further, the flight data provided the valuable information about the complex key areas.

The exhilarating experience and knowledge gained from this successful mission opened up new challenging areas that need to be shared with the researchers and scientists across the globe. Towards this, 12 manuscripts comprising a wide spectrum of critical areas are prepared as a special issue. I hope that the readers will be benefited and understand the complexities associated with the key technologies to enrich their knowledge.

I thank the Chief Editor, *Current Science*, for publishing the findings on Pad Abort Test as a special issue. My sincere thanks to Dr B. N. Suresh who spent valuable time to shape all the manuscripts at par with the international quality as a Guest Editor. The support provided by Dr K. Sivan, Chairman, ISRO, Secretary, DOS at each and every phase to the highest degree is well acknowledged.

S. Somanath