Australian Government

Australian Space Agency

Summary of the investigation report into the accident relating to the Hapith I Rocket at WWOLC, South Australia on 16 September 2021

Purpose

The purpose of this document is to summarise the investigation report into the accident of the Hapith I Rocket at Whalers Way Orbital Launch Complex (WWOLC), South Australia on 16 September 2021.

The investigation was carried out under the *Space (Launches and Returns) Act 2018* (the Act).

This summary is published by the Australian Space Agency (the Agency) on 15 June 2022, on behalf of the Minister for Industry and Science, in the interests of promoting safety in the space sector and transparency with the broader community.

Background

On 12 July 2021, SouthernLaunch.Space Pty Ltd (Southern Launch) was granted a launch facility licence (2/2021) to operate WWOLC to support a test launch campaign of up to three suborbital launches.

Southern Launch advised the purpose of the campaign was, amongst other things, to collect data measuring the impact of the launches on local wildlife, in order to support the South Australian Government's Major Development assessment of Southern Launch's longer-term proposed use of the site for a permanent launch complex.

On 9 August 2021, Taiwan Innovative Space Inc. (tiSPACE) was granted an Australian launch permit (1/2021) to conduct the first test launch of its Hapith I vehicle, referred to as VS01, from Whalers Way.

On 16 September 2021, tiSPACE attempted to launch VS01. During the countdown the launch vehicle caught fire and was destroyed with no injuries to personnel and some damage to pad infrastructure.

Investigation process

The fire, which caused the destruction of the launch vehicle, constituted an accident and triggered the Act's accident investigation provisions under Part 7—Investigation of Accidents.

The object of Part 7 is to prevent other accidents or incidents from occurring. The object is not to apportion blame or determine liability. Part 7 requires, amongst other things, an investigator to be assigned who must provide a report to the Minister.

On 24 September 2021, under section 88, the then Minister for Industry, Science and Technology the Hon Angus Taylor MP, appointed an Investigator, Mr Anthony Murfett (then Deputy Head of the Agency).

The terms of reference for the investigation report included:

(a) a description of the evidence that the Investigator has gathered relating to the likely cause of the accident; and

(b) any recommendations the Investigator considers appropriate to prevent other accidents and incidents occurring.

The investigator was supported by:

- technical personnel from Jacobs Australia Pty Ltd, with expertise in risk mitigation, post flight and recovery plans, rocket engine testing, incident investigations and root cause analysis;
- a Wing Commander from the Australian Defence Force with United States space regulatory experience, and
- the Department of Industry, Science, Energy and Resource's Fraud Detection and Investigation Manager.

The accident investigation report was finalised and provided by the Investigator to the then Minister for Science and Technology, the Hon Melissa Price MP on 21 March 2022.

Findings of the Investigation

No non-compliances against the conditions of the applicable launch facility licence (02/2021), Australian launch permit (01/2021) or the Act were identified.

The Investigator discovered a positive attitude towards safety of personnel on the ground at Whalers Way. The companies had rehearsed situations together numerous times in the lead up to the launch attempts, they used innovative techniques to support Emergency Service crews with drones, and when the fire set in, they quickly chose to sacrifice the launch vehicle rather than risk safety to personnel.

The Investigator found the root cause of the Hapith I destruction on the 16 Sept 2021 was very likely the unintended movement of the first stage thermal blanket into the exhaust of engine one during the engine start sequence, resulting in the thermal blanket combusting. This fire spread through the lower section and quickly upwards, resulting in the structural failure and total loss of the Launch Vehicle (LV), this spread is likely due to inadequate fire suppression mechanisms in the Mobile Launch System and the LV.

The Investigator found that there was a likelihood of greater damage to equipment if the LV toppled in a different direction. The Investigator assessed that there were several directions whereby if the LV had fallen in those directions it would most likely have impacted ground infrastructure.

Recommendations of the Investigator

The Investigator made recommendations to tiSPACE and Southern Launch, relating mainly to thermal protection and fire suppression, and subsequent confirmation to the Agency, through the Office of the Space Regulator (OSR), that certain matters have been addressed.

Recommendations were also made to the Agency. These included providing advice to the Minister on options to amend the legislation to introduce flexibility for the Minister in deciding whether to appoint an Investigator in cases where a vehicle is destroyed or seriously damaged, but a person does not die or suffer serious injury, or there is no damage to third party property, as a result of the

operation of the space object or high power rocket. Further, the Investigator recommended that the Agency consider providing guidance to applicants on the need for an engineering management system.

Observations were also made to the space launch sector more broadly, encouraging a generative safety culture and the conduct of post activity reviews.

The recommendations are repeated below.

The following eight (8) recommendations were made to tiSPACE:

i. Be prepared to provide detailed assurances to OSR (as part of its assessment of future applications under the Act) that the thermal protection material is unlikely to be the cause of any future fire.

ii. Consider additional fire suppression options, such as CO2 quenching, to protect the LV, while not risking safety to people or property.

iii. Be prepared to provide detailed assurance to the OSR (as part of its assessment of future applications under the Act), that, in order to reduce the risk of future failures and anomalies investigation and rectification of the cause for failure of all first stage engines to start, has occurred.

iv. Consider verifying the safety of any changes to first stage LV design via a static test firing in launch configuration.

v. Consider improvements to its Safety Management System to ensure review of the outcomes/repairs of an aborted launch for the identification/assessment of new hazards or changes to existing hazards prior to conducting another launch attempt.

vi. Consider providing information in relation to maintenance as part of future applications under the Act.

vii. Consider implementing an engineering/maintenance management system to ensure all repairs or modifications are carried out by suitably qualified personnel, and verified by supervisors, with a record of fault, fix, technician, and supervisor endorsement.

viii. Review its approach to planning and implementation of launch campaigns, allowing additional time for reflection and decision making as appropriate, particularly where there is an off-nominal event.

The following nine (9) recommendations were made to Southern Launch:

i. Consider having electrical generator shut-down controls co-located or operated via a common control.

ii. Consider additional fire suppression options, such as sufficient water deluge, to protect the LV, while not risking safety to people or property.

iii. Consider increasing the size of the Range Operations Point (ROP) to accommodate all emergency response stakeholders during emergency response planning/management.

iv. Consider physically separating oxidizer (shut-off) line from other lines to minimise potential hesitation to identify correct line for shut-off during an emergency.

v. Provide CFS [Country Fire Service] (or other firefighting organisations on site) with a walk around inspection of the launch site prior to launch, for the purpose of identification of emergency controls/shut-off valves/controls and other matters to support responding to a fire.

vi. Consider updating its engineering/maintenance management system to ensure all repairs or modifications to its facilities are carried out by suitably qualified personnel, and verified by supervisors, with a record of fault, fix, technician, and supervisor endorsement.

vii. Consider providing information in relation to maintenance as part of future applications under the Act.

viii. Review the need for equipment to be located at the launch site. For equipment identified as required at site, conduct an assessment to ensure that hazards associated with a potential LV fire or detonation at the launch site are managed so far as reasonably practicable (e.g. use of shielding etc).

ix. Review their approach to planning and implementation of launch campaigns, allowing additional time for reflection and decision making as appropriate, particularly where there is an off-nominal event.

The following five (5) recommendations were made to the Agency:

i. In all future applications for launch, the Regulator be satisfied there is sufficient fire suppression options to protect the LV and address the risk of Bushfire, while not risking safety to people or property – consistent with its assessment under the Act.

ii. Consider preparing options to amend the definition of 'accident' involving a space object under the legislation in order to introduce flexibility for the Minister in deciding whether to appoint an Investigator in cases where a vehicle is destroyed or seriously damaged, but a person does not die or suffer serious injury, or there is no damage to third party property, as a result of the operation of the space object or high power rocket.

iii. Consider providing guidance to applicants on the need for engineering/maintenance management system for ground infrastructure, and any repairs, to ensure all repairs or modifications are carried out by suitably qualified personnel, and verified by supervisors, with a record of fault, fix, technician, and supervisor endorsement.

iv. In the event of an Investigation being conducted under the Act, consider suggesting future Launch Permit holders be prepared to provide launch or telemetry data in a format able to be opened using standard software and labelled to allow for interpretation by the Investigator (file types such as .xls, mp4 and .csv for example). This data would represent the virtual 'blackbox' for the LV.

v. Consider whether to provide advice to the Minister on updating legislation and/or provide guidance to support and/or clarify the protection of information provided to the Investigator remotely and/or voluntarily.

The following five (5) observations were made to the space launch industry more broadly, based on the investigation.

i. The space industry is encouraged to highlight its positive safety culture where events, even those of minor or no consequence, are reported and reviewed for their bearing on safe

operations. A positive safety culture supports the ongoing success of the Australian space industry.

ii. Post activity review – an opportunity to reflect. The space industry is encouraged to conduct post activity reviews to enable adequate reflection and learnings to improve activities in the future. The excitement to move fast, innovate, and demonstrate must be matched by a discipline to reflect on an occurrence, and determine what, if anything needs to change. This approach supports future success.

iii. In undertaking launch activities, the space industry must be mindful to manage expectations around pressure to launch, and ensure planning and implementation of launch campaigns allows additional time for reflection and decision making as appropriate.

iv. The space industry should continue to highlight how its activities support the broader community, and work closely with all stakeholders to support the safe conduct of the activity. This should include community engagement to showcase the benefits of Australian space activities and the rigorous approach taken to safety and demonstrate active engagement with stakeholders so all views are taken into consideration especially those from local communities.

v. The space industry, along with the Agency, should continue to highlight that failure and learning lessons is part of the innovation process – and part of the 'journey' of the Australian space industry. The space industry and Agency should also reinforce that while failure may occur, safety is always the first consideration.

Conclusion

The Agency, through the OSR, has considered the recommendations, and efforts by tiSPACE and Southern Launch to address them, in its assessment of the application to relicense the Whalers Way Orbital Launch Complex (WWOLC) and permit launch of VS02 and VS03 against the criteria of the Act for the granting of a launch facility licence and Australian launch permit respectively.

The Agency, through the OSR, will continue to consider the recommendations to tiSPACE and Southern Launch, as appropriate, for any future applications for launch activity under the Act.

The Agency, through the OSR, will disposition the 5 recommendations to the Agency, and promote the 5 observations to industry, as appropriate.