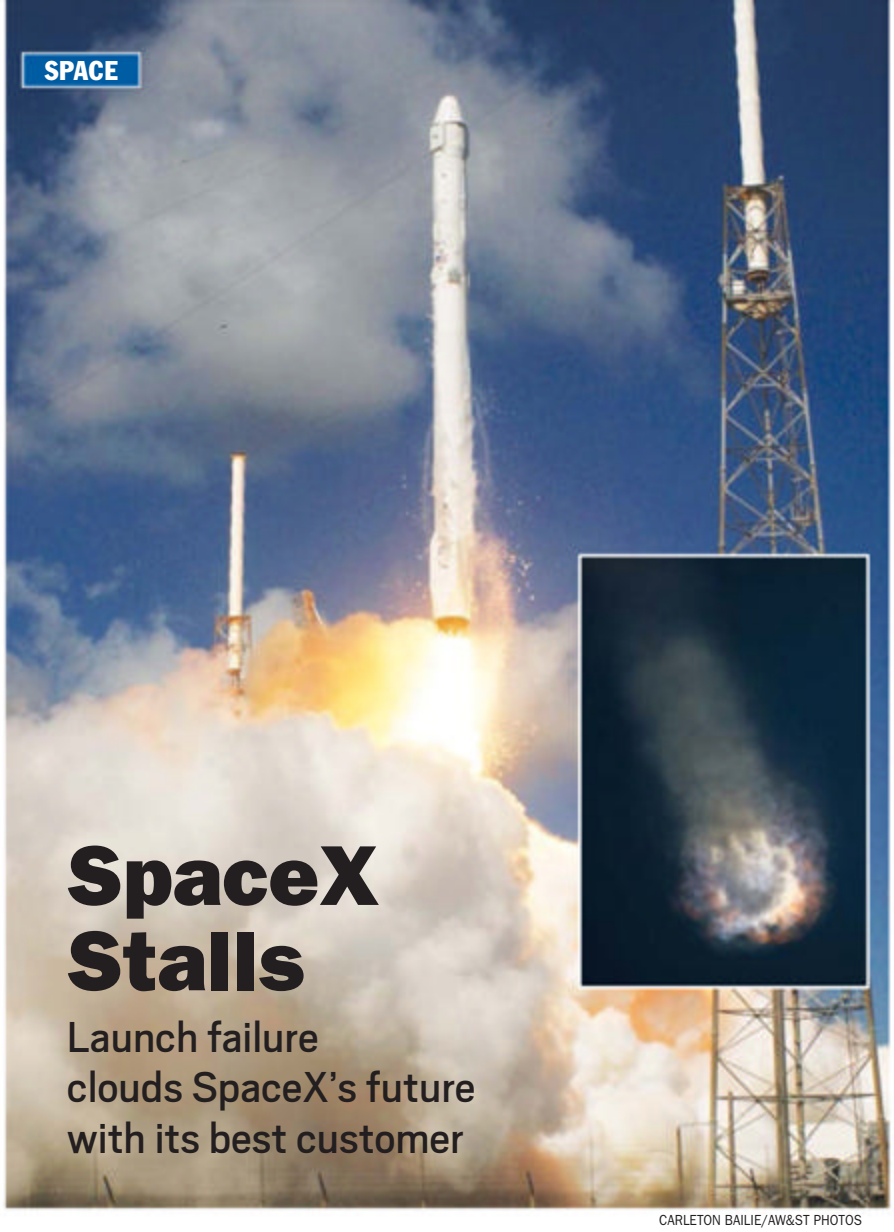


SpaceX Stalls

Launch failure clouds SpaceX's future with its best customer

CARLETON BAILIE/AW&ST PHOTOS

Frank Morring, Jr., and Amy Butler Washington and Mark Carreau Houston

Failure of its flagship Falcon 9 launch vehicle on a crucial NASA mission puts the brakes on momentum SpaceX was enjoying as it moved toward launching humans and expensive national security payloads for the U.S. government.

While the International Space Station (ISS) crew can live without the more than 5,500 lb. of pressurized and unpressurized cargo that fell in fragments after SpaceX's seventh commercial resupply mission to the orbiting science lab exploded June 28, the mishap leaves NASA without its own cargo route to the station and seriously hampers resupply overall.

It also adds uncertainty to the space agency's plans to begin using commercial vehicles to deliver astronauts to the ISS, since it had selected a crew version of the SpaceX Dragon cargo vehicle as a candidate for the job. And it may complicate the U.S. Air Force plan to bring the Falcon 9 into competition with United Launch Alliance (ULA) for military missions.

For now, the Falcon 9 is grounded while a mishap review board set up under the company's FAA launch license looks for the root cause of the failure under the leadership of Hans Koenigsmann, SpaceX vice president for mission assurance.

Near term, the grounding has impacted the planned Aug. 8 Falcon 9 launch of the U.S.-European Jason-3 ocean-surface spacecraft from Vandenberg AFB, California, and sent the mission partners on both sides of the Atlantic back to the drawing board to arrange a new launch date, according to the U.S. National Oceanic and Atmospheric Administration.

The failure also leaves a full manifest of commercial SpaceX customers without a ride to space until its cause it determined (see page 23).

Gwynne Shotwell, SpaceX president and COO, says it will take "months" to find and fix the problem. An apparent overpressurization in the second-stage liquid oxygen tank shortly before first-stage separation drew early attention from SpaceX engineers.

"The first-stage flight remained nominal," she says. "We do not expect this to be a first-stage issue. We saw some pressurization indications in the second stage which we will be tracking down and following up on."

The Falcon 9 explosion (inset) shortly after the June 28 launch to the ISS sends ripples across the spaceflight industry worldwide, with public and private payloads scrambling for rides to orbit.

SpaceX investigation teams organized around propulsion, avionics and other engineering disciplines are examining more than 3,000 telemetry channels, including onboard video, and building a fault tree for analysis. Company officials say the impact on future launches will depend on the progress and findings of the investigation.

The Falcon 9 was the third ISS-resupply vehicle to fail since an Orbital ATK Antares blew up shortly after liftoff from Wallops Island, Virginia, on Oct. 28, 2014. A Russian Progress cargo-carrier failed to dock with the station on April 28. NASA officials say there are sufficient supplies on board to support a six-person crew until October, even if no more cargo is delivered. Three more crewmembers are scheduled to launch July 22 to maintain the research pace on the ISS.

Another Progress mission was set for launch early July 3, but its cargo offers little direct relief for the loss of the cargo atop the failed Falcon 9. However, containers of water packed in the Progress could take some pressure off the aging filtration system that recycles urine and condensate into drinkable water for the crew.

A replacement filtration bed was part of the lost cargo. Mike Suffredini, NASA's ISS program manager, says there is no near-term danger of depleting the onboard water supply because

the filtration system already there is still functioning. There are adequate supplies of processed water on board, he says, and a Japanese H-II Transfer Vehicle "loaded heavily" with water is scheduled to arrive in August.

Also lost was an International Docking Adapter (IDA) NASA was sending up to accommodate its two planned commercial crew vehicles, Boeing's CST-100 and the crew version of the Dragon. There is another IDA available, and parts to build a replacement, but the Falcon 9 mishap is a serious disruption to the work of getting the "Crew Dragon" ready to fly to an ISS docking by the end of 2017 as planned.

William Gerstenmaier, associate administrator for human exploration and operations, says NASA deliberately chose to segregate cargo and crew as it developed commercial routes to low Earth orbit because more risk is acceptable in cargo.

"One of the advantages of the overall program is we can learn from this event on cargo," he says. "While it is unfortunate, it is still recoverable. We can understand what occurred with the SpaceX team, and this information can be really important as we move forward into the crew designs and flight."

NASA is already fighting a rearguard action in Congress to win enough funding to stay on schedule for a December 2017 first flight of at least one of the commercial crew vehicles in development. House and Senate lawmakers have cut the $1.24 billion NASA says it needs in fiscal 2016 to meet the 2017 deadline.

The cargo resupply crunch may be eased in October, if ULA and NASA can advance from December to October a planned delivery with an Orbital ATK Cygnus mounted as a stopgap on an Atlas V. Gerstenmaier says that may be possible if range scheduling and other issues can be resolved. It will be next spring at the earliest before the Orbital ATK Antares vehicle may be ready to return to flight with the Russian RD-181 engine selected to replace the AJ26 engine blamed in that company's failure, he says.

While NASA sees a way to work around the SpaceX failure, it comes at a terrible time for the company's campaign to win work for the Pentagon and U.S. intelligence community.

In May, SpaceX finally earned its certification from the Air Force to compete for national security payloads with ULA, which has held a monopoly on national security missions since it was formed in 2006. USAF is scheduled to issue a request for proposals (RFP) in July for a launch to place the Air Force's first GPS III into orbit, likely in 2017. It will be the first competition in which SpaceX is certified to take on ULA.

It is unclear what impact the failure will have on SpaceX's bid for the work. SpaceX had been viewed as likely to have a good chance because the duel is structured as a series of pass/fail criteria, followed by a price shoot-out. The Falcon 9's pricing is far below anything cited by ULA for the Atlas V.

"At this time it's too early to assess any impact that the Space X launch failure has on future DOD launch missions," said an Air Force spokeswoman. "The department is firmly committed to smoothly transitioning our launch enterprise with a continued strong focus on maintaining assured access to space for National Security Space missions."

The Air Force intends to issue a second RFP in September for another GPS III launch, according to Col. Doug Pentecost, who is overseeing the procurement. In total, the service plans to compete launch services for up to five GPS III launches, as well as those for the Space-Based Infrared System, a National Reconnaissance Office satellite, the AFSCP-9 mission and, possibly, the final Defense Meteorological Satellite Program spacecraft.

The U.S. national-security launch program was already facing uncertainty over its use of Russia's RD-180 rocket engine to launch the Atlas V. The ongoing conflict in the Eastern Ukraine that started with Russia's occupation of the Crimean Peninsula has triggered congressional pressure to drop the RD-180 and to apply restrictions on how many more of them can be acquired.

Byron Callan, an aerospace analyst with Capital Alpha Partners, predicts the SpaceX mishap "most likely will lead to continued purchases of Russian RD-180 rocket engines in order to preserve two sources of space launch this decade until new rockets and/or propulsion systems are available next decade."

Overall, the launch failure triggered a common response among those in and out of government.

"We expected through the commercial cargo program we would lose some vehicles," says Gerstenmaier. "I didn't think we would lose them all in a one-year time frame, but we have. I think there is no negligence here, no real problem. It just shows the challenges facing engineering and spaceflight in general."

"We've said it before," notes Will Marshall, the CEO and cofounder of Planet Labs, which has now lost 34 of its small "Dove" Earth-observation spacecraft flying as secondary payloads on the failed Antares and Falcon 9. "Space is hard."

Feast or Famine

Falcon 9 failure highlights weaknesses in commercial launch market

Amy Svitak Paris

At a time when Russia's heavy-lift Proton has lost the confidence of the commercial market, the June 28 failure of a Space Exploration Technologies (SpaceX) Falcon 9 rocket raises long-standing questions as to how many launch vehicles the market needs to remain healthy, and how many it can sustain over time.

Up to now only rockets with strong government backing have been able to survive on the roughly 20-25 commercial geostationary satellites launched to orbit each year. Even the most successful—the European Ariane 5, which has not suffered a failure since 2002 and which launches five or six times a year—needs annual subsidies from its government backers to break even, despite maintaining a regular 50% share of the commercial market.

Some 15 years ago, Boeing bought into the commercial launch market, pitting the Delta IV against Lockheed

Martin's Atlas V and competing against Proton and Ariane 5. After the market bottomed out in the early 2000s, the U.S. government decided the two companies could not remain viable on their own, and encouraged the creation of a monopoly through the joint venture that is now United Launch Alliance.

And the conundrum persists, as commercial fleet operators struggle to establish a midpoint between an oversupply of vehicles—which affords lower prices—and a dearth of options for lifting large spacecraft to geosynchronous orbit. As a result, some operators have encouraged the entry of rockets that have helped to drive down launch costs but also have put the players at higher risk, given that the margins are insufficient to survive a failure.

The demise of the all-commercial Sea Launch joint venture comprising Boeing, RSC Energia of Russia and Yuzhnoye of Ukraine is an example. The company, whose Zenit launcher suffered a mishap at an inopportune time—and which had no government support to fall back on—left shareholders either unable or unwilling to come up with the funds needed to return to flight.

Proton, too, has had several launch failures in the last five years, and customers have shied away from the vehicle, which is currently grounded as Russian investigators probe the cause of a May mishap.

With the Falcon 9's entry into the commercial market almost two years ago, SpaceX has been viewed as a lower-cost option than either Proton or Ariane 5. The depth of the desire of the commercial market to sustain a third launcher—given that China and India are off-limits to Western launches—was demonstrated in 2013 by Luxembourg-based fleet operator SES, which agreed to launch a satellite atop a new version of the Falcon 9 rocket that had never proved the ability to deliver payloads to geosynchronous orbit.

SES has continued its support, volunteering to be the inaugural customer for a new uprated version of the Falcon 9 that had been scheduled to launch in September. But with the June 28 launch failure, all bets are off as to when the rocket can return to flight.

Characterizing the failure as a "hiccup," SpaceX President and Chief Operating Officer Gwynne Shotwell says the investigation could take time.

"It certainly isn't going to be a year; I imagine a number of months or so," she told a news conference following the launch failure.

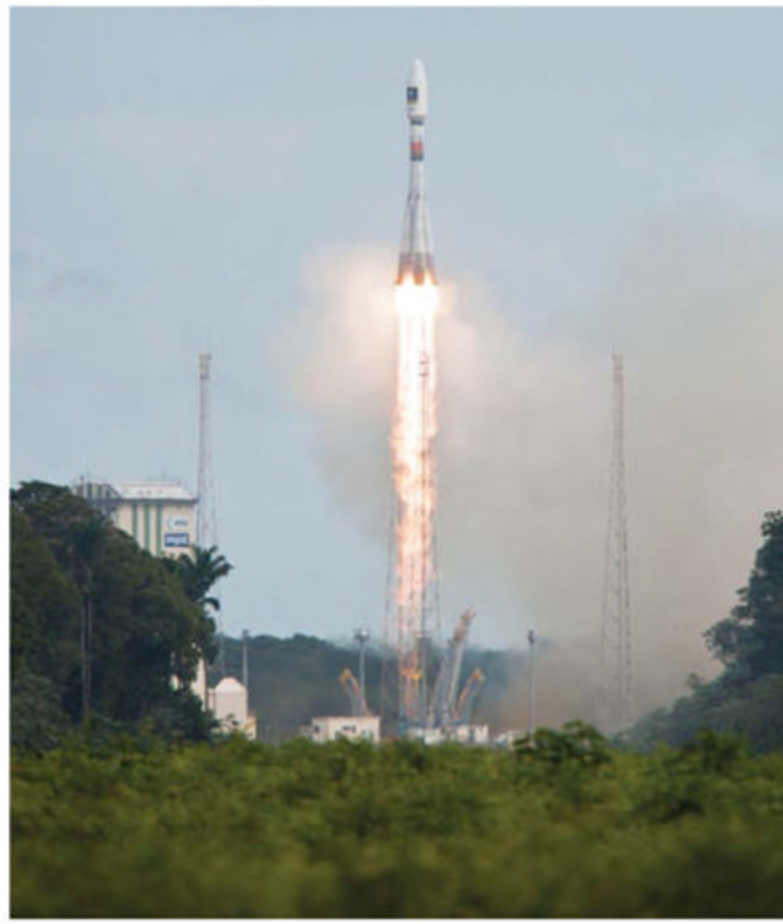
Meanwhile, several commercial customers of SpaceX are counting on the company to lift communications satellites to orbit this year. In addition to SES, these include New Jersey-based Orbcomm, which hopes to see the balance of its machine-to-machine comsat fleet orbited this fall, and the combination of Paris-based fleet operator Eutelsat and Asia Broadcast Satellite of Bermuda, which are planning a dual-launch of new Boeing-built all-electric satellites by year-end atop Falcon 9.

SpaceX is also on the books to begin launching Iridium's next-generation fleet of low-orbiting communications satellites early next year, while rival Inmarsat is counting on the rocket maker to lift its fourth Global Xpress K_a-band broadband satellite in 2016.

In parallel, several of these companies, notably Inmarsat and Eutelsat, are awaiting launches of commercial spacecraft atop Russia's heavy-lift Proton, which in May suffered its sixth launch failure in five years. With Proton and SpaceX grounded, and with Ariane 5 booked until mid 2017, the global commercial satellite industry is facing a dearth of options for getting large spacecraft to orbit.

Meanwhile, Arianespace has been selected by startup fleet operator OneWeb to launch hundreds of small Internet satellites atop 21 Soyuz rockets between 2017-19. OneWeb founder and CEO Greg Wyler says the bulk of these missions agreed to under a $1-billion-plus contract are expected to lift off from launch sites in Kazakhstan and northern Russia via Arianespace's Russian Starsem affiliate. In choosing Arianespace, Wyler said reliability was a deciding factor, given that he plans to launch more than 600 small K_u-band spacecraft in the span of two years.

"Soyuz will launch the bulk of it for us. They have three launch pads and it is super important for us to have multiple launch pads," he said June 25 at a press conference where he announced the selection. "We can't be stuck, with a system of this size, without absolute reliability of knowing when we can launch."



ARIANESPACE

With Soyuz, Arianespace can launch from the Baikonur and Guiana Space Center facilities on the same day.