THE WALL STREET JOURNAL.

http://www.wsj.com/articles/spacex-probe-into-blast-focuses-on-fueling-issues-1477042203

BUSINESS

SpaceX Explosion Investigation Focuses on Fueling Snafu

Preliminary results point to operational procedures, not a manufacturing flaw

An explosion on the launch site of a SpaceX Falcon 9 rocket on Sept. 1. The blast destroyed the rocket along with a commercial satellite stacked on top of it. *PHOTO: KRIS N./HANDOUT/REUTERS*

By **ANDY PASZTOR**

Updated Oct. 21, 2016 6:54 a.m. ET

Investigators believe operational issues linked to fueling procedures, rather than a manufacturing flaw, likely caused a Space Exploration Technologies Corp. rocket to explode during ground tests last month, according to people familiar with the details.

Seven weeks after the high-profile accident, which occurred during a routine fueling exercise, company experts are conducting tests to try to determine the precise sequence of events. They hope to re-create the complex interplay of variables—including pressure, temperature and fill rate—suspected of rupturing a helium tank inside the Falcon 9 booster's upper stage, the people said.

The result was a violent, nearly instantaneous chemical explosion that destroyed the rocket along with a commercial satellite stacked on top of it, and temporarily grounded the entire Falcon 9 fleet pending the outcome of the current probe.

The conclusions are preliminary, still could change and SpaceX, as billionaire entrepreneur Elon Musk's company is called, hasn't yet presented any formal interim reports to federal authorities, these people said. Tests are expected to be finished in coming weeks.

Company officials have said it is too early to arrive at definitive answers, though one person familiar with the investigation said initial concerns about potentially substandard welds have been relegated to a low priority.

If testing bears out early findings focusing on problematic fueling practices instead of hardware flaws, SpaceX likely will avoid a major redesign effort or extensive quality-control checks that could drag on for months.

More than two weeks after the Sept. 1 explosion, SpaceX disclosed there was "a large breach" in a second-stage helium tank, which is used to maintain pressure in the propellant system as the engines burn, but didn't elaborate on the reasons. Mr. Musk later told reporters that investigators had eliminated all the "obvious possibilities" and were delving into "the less-probable" causes.

Earlier this month, Gwynne Shotwell, the company's president and chief operating officer, said investigators believed the cause likely was an operational issue, versus a design or manufacturing problem. One of the biggest questions, according to industry officials, is how the helium tank interacts with the surrounding supercooled liquid oxygen. The process is unfamiliar to most of the industry because such a supercooled oxidizer isn't typically used on big rockets.

Company officials are hoping to resume Falcon 9 flights by the end of the year, but many industry experts consider that overly optimistic. The National Aeronautics and Space Administration already has delayed its next unmanned cargo flight to the international space station with SpaceX to January at the earliest, according to people briefed on the timeline.

A company spokesman said "we are continuing to make progress with the investigation, and are focused on safely and reliably returning to flight at the earliest opportunity."

In an email, a NASA spokeswoman said "we will work with SpaceX and our other station partners to identify a launch date that fits NASA's traffic and cargo needs." She added that "supplies and research investigations are at good levels" at the station.

Last month's accident followed a June 2015 unmanned rocket explosion shortly after launch, which destroyed more than $100 million worth of cargo destined for the space station and grounded the Falcon 9 for roughly six months. In that accident, SpaceX determined the probable cause was a faulty structural support, or strut, that failed

during ascent, allowing a helium tank to smash into other internal parts of the second stage. The company has indicated that last month's accident likely had a different cause.

Battered by two catastrophic rocket failures in roughly 15 months, SpaceX is facing dozens of delayed commercial and U.S. government missions. Overall, the company values its backlog of launches at roughly $10 billion, including cargo and prospective manned missions for NASA, launches for the Air Force and a passel of foreign contracts.

The latest accident also has delayed the inaugural flight of the more-powerful Falcon Heavy, which has 27 main engines versus the nine on the current version. The heavy-lift rocket, years behind schedule, is now slated to blast off for the first time in 2017.

The Falcon 9's helium system has been a previous source of technical headaches for SpaceX engineers. In the spring of 2015, the company delayed launch of a communications satellite built for Turkmenistan because of concerns about internal pressures and quality controls affecting helium bottles.

The latest investigation is headed by SpaceX, with participation of NASA, the Federal Aviation Administration, the Air Force and industry experts. But the makeup of that team has prompted sharp debates on Capitol Hill.

Republican lawmakers representing areas where a SpaceX rival has facilities have pushed for an independent probe. Some two dozen of SpaceX's bipartisan Capitol Hill supporters have objected to such a change.

Write to Andy Pasztor at andy.pasztor@wsj.com