(Mar. 9, 2012) NASA's plans for a new generation of commercially owned and operated spacecraft and launches involve meeting a number of goals, none higher than keeping to the agency's high standards for crew safety.

The agency's Commercial Crew Program (CCP) outlined hundreds of human safety and performance requirements for the companies it is working with to carry astronauts to low Earth orbit. NASA's engineers won't directly tell the companies how to meet the requirements, though. Instead, they'll rely on their partners' innovations to meet their safety objectives.

"The success of this program is really dependent on all of us working together to design, develop and verify that we have a sound crew transportation system," said Ed Mango, CCP program manager. "Safety is our No. 1 priority. That's why, in our list of goals as a program, it's safe first, then reliable, then cost-effective access to low Earth orbit."

In 2011, CCP developed and released a set of requirements and standards, called the 1100 series, which outlines about 300 requirements for NASA missions to the International Space Station.

"We wrote the 1100 series to be independent of our acquisition strategy. So, it's a set of documents that can stand alone whether we're in a Space Act Agreement (SAA) or contract with our commercial providers," said Chris Gerace, deputy chief of CCP's Systems Engineering and Requirements Office.

Gerace said that throughout CCP's second round of development, known as CCDev2, NASA's industry partners are either meeting those requirements specifically or attempting to meet their intent. The program anticipates the same level of enthusiasm in meeting requirements during the next round of development, called Commercial Crew Integrated Capability (CCiCap).

"It really behooves our industry partners to meet our requirements now so that it doesn't become costly to the partnership to fix later on down the road," Mango said.

The standards cover every aspect of safety, from ground processing and providing a crew with optimal breathing air and life support systems to ensuring the reliability of a spacecraft's windows and computer circuit boards.

"When you look at everything that goes into designing both a launch vehicle and a spacecraft that has to dock with the space station, stay in orbit for months, and re-enter the Earth's atmosphere, every safety requirement is important," Gerace said. "Our partners can be as creative as they want when it comes to their designs, but they've got to meet the intent of these standards before they can fly a NASA crew."

Gerace noted that his team relied heavily on the successes and hard lessons learned from NASA's Space Shuttle Program to develop CCP's requirements.

"Our goal has always been to be safer than the programs that came before us," said Mango, who spent the majority of his NASA career supporting the shuttle program. "As engineers, as designers, as test conductors, as assistant launch directors or as project management for the shuttle program, we have the scars in order to make this program even better."

When NASA launched its first space shuttle, Columbia, from Kennedy Space Center on April 12, 1981, its mission was to prove a number of cutting-edge technologies, from the innovative main engines that provided enough thrust to accelerate the shuttle to 17,000 mph in eight-and-a-half minutes to the ceramic tiles that protected the shuttle from the searing heat of re-entry. Never before had the agency put astronauts on board a spacecraft that hadn't been tested without a crew first.

"The first four shuttle flights were considered test flights," Mango said. "It wasn't until the fifth flight that shuttle missions were considered operational."

Mango said he envisions CCP verifying systems and subsystems in a somewhat similar fashion, whether it's with demonstrations, such as test flights without a crew, or through analyses, inspections or testing, and then, finally, test flights with a crew.

"What we want is innovation," Mango said. "So, if we're meeting the intent of our requirements, we are more than willing to talk about different verification methods with our partner. As long as the intent has not changed and the risk that that requirement is trying to negate is being accounted for."

There are several reasons CCP is handling safety and mission requirements a little differently than its shuttle predecessor. One is that shuttles had a lot more mission capabilities than what CCP is requesting, which is to transport up to four crew members and a few lockers full of supplies and experiments to the International Space Station. Shuttles had the unique capability to house satellites in their payload bays or act as a research laboratories all on their own in space. And, second, because each design is so different, CCP couldn't develop a set of requirements that detailed every nut and bolt like the thousands of requirements levied for the shuttle.

"Our goal from the beginning has been to have a NASA-certified system before NASA crews use the capability," Mango said. "I have 100 percent confidence that our partners will succeed with our knowledge base and our help."

Mango said that CCP's acquisition approach is sound because overall verification and certification of a crew transportation system will take place once NASA enters into a contract with a commercial provider. The first crew members of a test flight would likely be employed by the commercial providers themselves, but that doesn't change the importance of NASA's safety goals.

"The value of a human life is priceless," Mango said. "It's the same whether it's a NASA employee or a company employee. The people who will sit in these rockets and spacecraft are our partners, our friends, our neighbors, our spouses, so we will only fly when we are ready."

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