

National Aeronautics and  
Space Administration  
**Office of the Administrator**  
Washington, DC 20546-0001



May 22, 2017

Dr. Patricia Sanders  
Chair  
NASA Aerospace Safety Advisory Panel  
Washington, DC 20546

Dear Dr. Sanders:

Enclosed is NASA's response to the Aerospace Safety Advisory Panel (ASAP) recommendation resulting from the First Quarterly Meeting held on February 23, 2017, at NASA Kennedy Space Center. The ASAP Recommendation is entitled, 2017-01-01, Practice of System Engineering and Integration Principles by Commercial Crew Providers for Transportation Services to the International Space Station (ISS). Please do not hesitate to contact me if you or the Panel would like further background on the response.

I look forward to receiving continued advice from the ASAP that results from your important Quarterly and Insight fact-finding meetings.

Sincerely,

A handwritten signature in blue ink, appearing to read "Robert M. Lightfoot, Jr.".

Robert M. Lightfoot, Jr.  
Administrator (Acting)

Enclosure:  
2017-01-01 Practice of System Engineering and Integration Principles by  
Commercial Crew Providers for Transportation Services to the ISS

## **NASA Aerospace Safety Advisory Panel Recommendation**

### **Practice of System Engineering and Integration Principles by Commercial Crew Providers for Transportation Services to the International Space Station Systems 2017-01-01**

#### **Finding:**

The investigations into two recent mishaps on commercial launch vehicles have concluded that the mishaps were unrelated because the immediate (or proximate) causes of the mishaps were different. However, in the opinion of the Panel, the underlying root causes of both mishaps can be traced to escapes in the System Engineering and Integration (SE&I) process and controls involving one or more of the following areas: design, analysis, manufacturing, quality control, qualification, and operations (including operational tests).

#### **Recommendation:**

The Panel recommends that NASA require the Commercial Crew providers to produce verifiable evidence of the practice of rigorous, disciplined, and sustained SE&I principles in support of the NASA certification and operation of commercial crew transportation services to the International Space Station (ISS).

#### **Rationale:**

Rigorous and disciplined SE&I processes and controls are essential elements of any engineering effort. When dealing with complex systems for human space travel, where inherent risks must be managed to an acceptable level, the emphasis on SE&I and cross-discipline engineering is even more critical. No amount of NASA oversight or insight into the performance of the commercial providers can compensate for a lack of rigor in the providers' SE&I processes and controls. On a regular basis, the commercial providers make numerous important decisions that do not rise to the level of NASA oversight. Their detailed knowledge of the system design, qualification, and performance generally exceeds that of the NASA engineers who provide insight and oversight. Thus, the responsibility for producing a system that provides an acceptable level of risk for NASA missions to ISS rests heavily on the commercial providers and their SE&I processes and controls. Finally, it is important for the provider to not only furnish evidence that rigorous, disciplined, and sustainable SE&I processes and controls are in place, but they should also be shown to be effective over time. This is a foundation for all other certification activities.

#### **NASA Response:**

NASA concurs with the ASAP Recommendation that "NASA require the Commercial Crew providers to produce verifiable evidence of the practice of rigorous, disciplined, and sustained SE&I principles in support of the NASA certification and operation of commercial crew transportation services to the ISS."

The Commercial Crew Transportation Capability Contract (CCtCap) fixed-price contracts were written to facilitate, empower, and stimulate commercial industry in the pursuit of a safe, reliable, and cost-effective space transportation capability. As such, the contracts allowed the

companies to respond with the most efficient practices that were already aligned with their corporate policies and practices. CCP utilized a tailored approach to the NASA SE&I practices versus the prescriptive traditional deliverables in a NASA development program. While not all traditional NASA SE&I deliverables were levied on the contracts, the CCP included the SE&I requirements that were necessary to ensuring that rigorous, disciplined, and sustainable SE&I principles would be performed in order to meet NASA's certification requirements. Evidence of adherence to SE&I principles is, therefore, gained through a variety of methods such as requirement verification, contract deliverables, and insight into the provider's management systems and processes.

In summary, CCP commercial providers are responsible for ensuring cost-effective system design, realization, operation, and technical management of the systems they are developing to meet CCP certification requirements in a fixed-price contract. Through contract requirements, deliverables, and insight, CCP is able to verify and/or validate that SE&I principles are followed to assure the proper management of risks, requirements, interfaces, configuration, and technical data throughout the system life cycle.

The CCP will provide the ASAP with a formal briefing in response to this recommendation at the next ASAP Quarterly Meeting in May 2017.