Statement of

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Chairman

National Aeronautics and Space Administration's

Aerospace Safety Advisory Panel

before the

Committee on Science, Space, and Technology

Subcommittee on Space and Aeronautics

U.S. House of Representatives

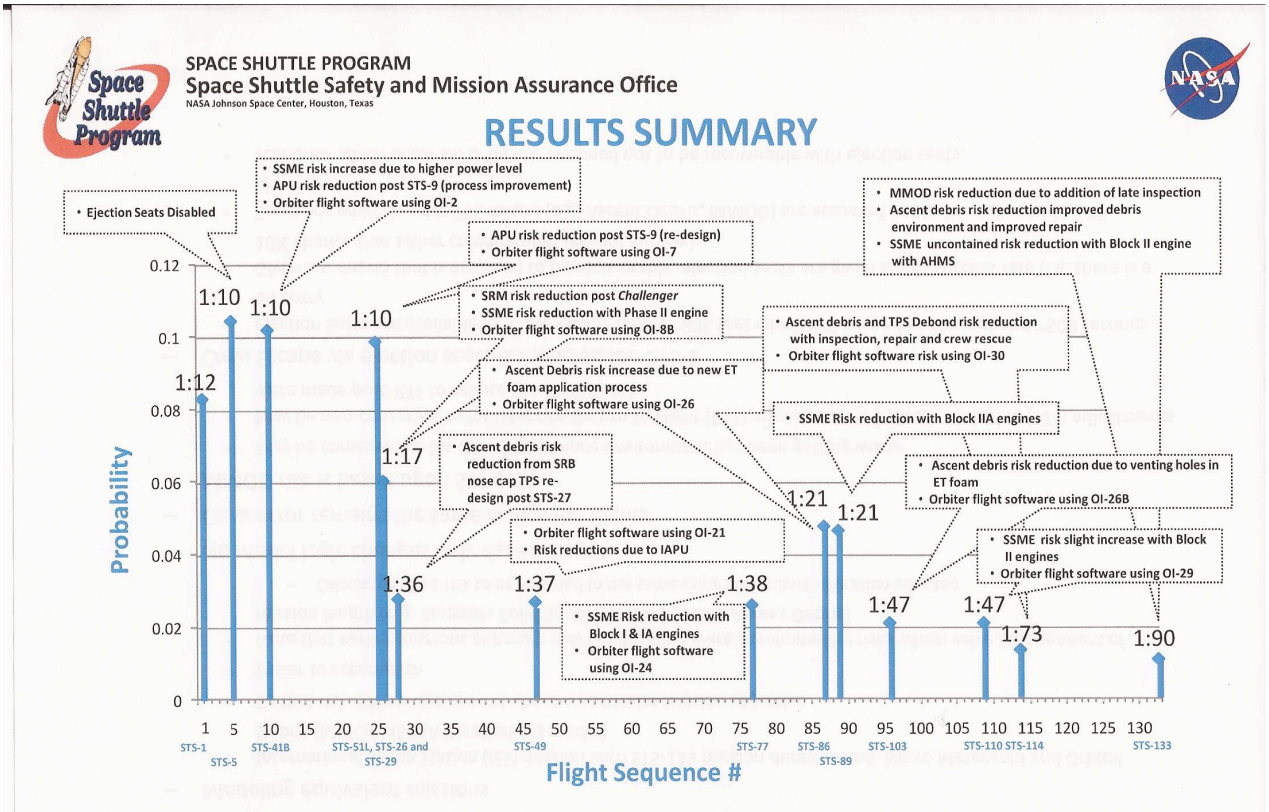
Chairman Hall, Ranking Member Johnson and distinguished Members, thank you for the opportunity to appear before you today. As requested, I would like to present the NASA Aerospace Safety Advisory Panel's (ASAP's) perspective regarding NASA's current acquisition approach for the Commercial Transportation System (CTS).

As noted in our 2011 Annual Report, the Commercial Crew Program (CCP) remains an important topic for the ASAP. We have been closely following the Program's progress and the acquisition strategy for the CTS.

The Panel is especially focused on requirements, design, and certification, given the historical reassessment of risk that was performed on the Space Shuttle. In that regard, I would like to quote from the ASAP's 2011 Annual Report:

> "How safe is safe enough?" The pursuit of great reward often comes hand in hand with great risk—so it has always been with explorers. The answer to the question must come from a balance between risk and reward and should reflect a consensus among the American people, the White House, the Congress, and NASA.
>
> It is not our intent or purpose to answer the question; however, we point to areas where we believe the stated requirement may not produce the requisite safety. We especially invite your attention to the section "Reassessment of Space Shuttle Risks" and the historical gap between anticipated and deployed systems risk.

[The results of the NASA analysis are depicted in the following graphic]



One key finding was that the risk on a new system that has not been flown before and thus has not been through the rigors of real-life flight is probably much higher than what the initial risk assessments show. The reason for this difference is that at the beginning of operations, all the failure mechanisms are not fully known. In the language of risk analysis, such unknown failure mechanisms are often called “unknown-unknowns.” In the Shuttle’s case, the first flight risk as now retrospectively calculated was in actuality 1 in 12 for LOC [loss of crew], yet at least one analysis that existed at the time of the initial launch estimated the risk to be 1 in 1,000 or better. In other words, the system was almost 100 times more dangerous than the early analysis indicated. This type of disparity must be remembered when future targets for reliability and LOC numbers are chosen for new programs. One thing that has always been said in the design business is that engineering design standards take care of the “knowns”; factors of safety take care of the “known-unknowns”; and margin is what takes care of the “unknown-unknowns.” A significant margin for error should be allowed for the unknown-unknowns as well as to create a robust design.

NASA has determined that CTS certification contracts are needed for the International Space Station (ISS) mission. Quoting from a NASA white paper on **NASA Commercial Crew Program (CCP) Updated Acquisition Strategy, August 2012**:

> "NASA has decided to begin initial certification efforts immediately to enable the earliest possible crew transportation. If NASA were to delay certification activities, the development of industry's capabilities could eventually reach the point where any changes necessary to meet NASA requirements would likely not be technically feasible or affordable, potentially extending our reliance on foreign systems.
>
> To mitigate these risks, NASA is moving forward immediately with CTS Certification activities, as depicted in Figure 1. By instituting critical, yet limited, early certification activities as soon as possible, NASA has the opportunity to minimize technical risks, and cost or schedule impacts that would result by waiting to begin CTS Certification activities after industry's designs have been completed."

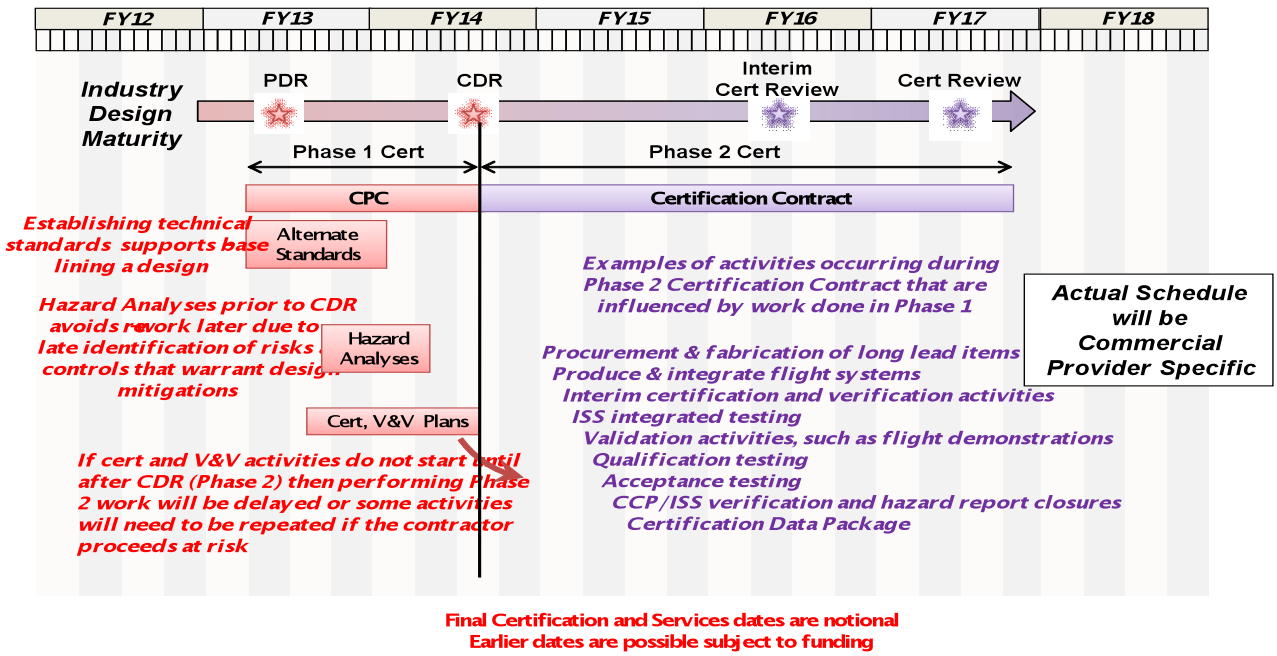


Figure 1: NASA's CTS Certification Activities

Continuing to quote from the NASA white paper:

> "As depicted in Figure 2, NASA plans to award 2-4 FAR [Federal Acquisition Regulation]-based fixed-price contracts in CTS Certification Phase 1 to begin early certification activities. These contracts are referred to as Certification Products

Contract(s) (CPCs). The scope of the CPCs will be limited to submittal and technical disposition of the following specific, early lifecycle certification products: Alternate Standards, Hazard Analyses, a Certification Plan, and a Verification & Validation Plan. The CPC activities will not include any design, development, test or evaluation activities. The CPC period of performance will be approximately 15 months, with an expected award date in February 2013. CPC awards will not exceed $10 million per award, and the total value of all CPC awards is expected to be $30-40 million."

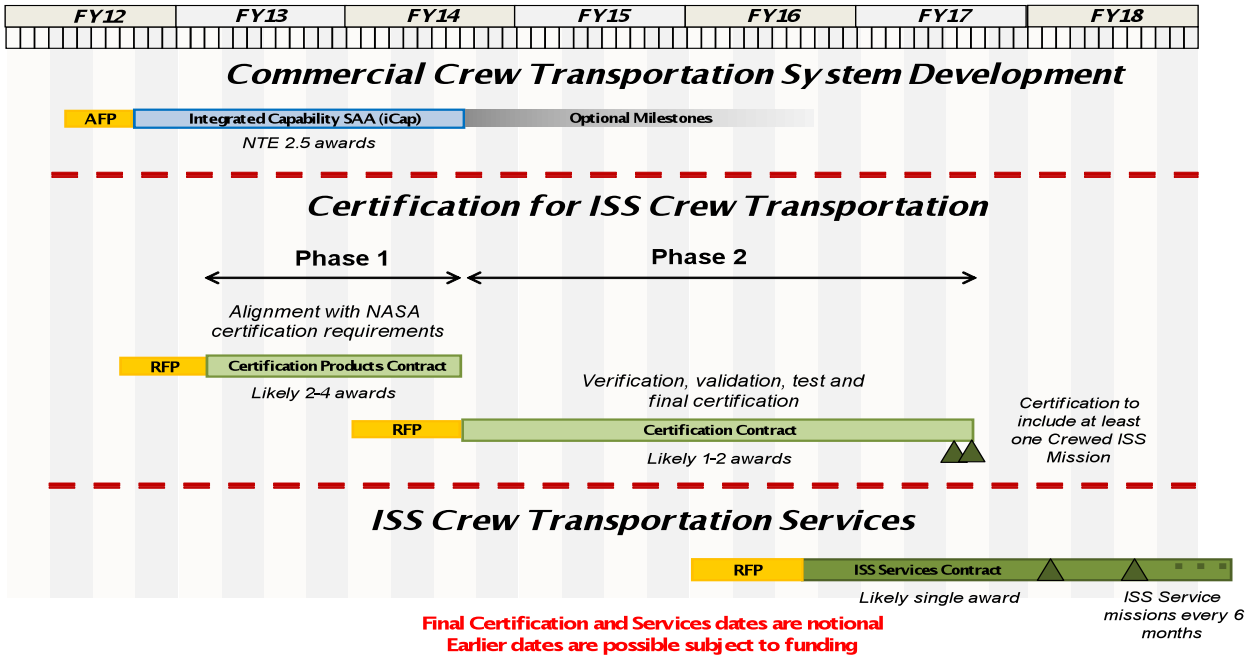


Figure 2: Overall CCP Roadmap

At the conclusion of the CPCs, NASA anticipates that more than one commercial provider will have an integrated design with sufficient technical maturity to enable a Phase 2 competition for the CTS Certification Contract. The ASAP agrees.

NASA believes that having up to two contractors through Phase 2 would provide significant advantages for ensuring safe and affordable CTS through competition. The ultimate number of awards will be driven by technical maturity, funding availability, and mission needs. We agree that having two contractors through Phase 2 is advantageous. Lacking an independent cost estimate, we are uncertain as to affordability.

The ASAP offers a check list and provides our color-coded status assessment below. [A note on colors: ❑Red highlights what the ASAP considers to be a long-standing concern or an issue that has not yet been adequately addressed by NASA. ♦Yellow highlights an important ASAP concern or issue, but one that is currently being addressed by NASA. ❑Green indicates a

positive aspect or a concern that is being adequately addressed by NASA but continues to be followed by the Panel.]

a. • Clearly communicate to the contractors that NASA certification is a fundamental requirement prior to transporting NASA and NASA sponsored astronauts into space.

b. ♦ Establish solid requirements – (Improving with the advent of the Certification Product Contract and Certification Contract)

c. ♦ Promulgate how the Agency will verify that requirements are being met – (Improving as in b., above)

d. ♦ Possess a validation plan that confirms the required capability – (The plan is late, but will be produced in the upcoming CPC contract)

e. ☐ Clearly lay out a process that the contractors shall follow on the path to certification – (It is not yet clear how waivers and deviations will be approved, who is accountable, and how the process shall be administered)

f. ☐ Stabilize NASA's budget at a level sufficient to execute the plan – (Made more difficult by the lack of a good cost estimate and a stable acquisition plan)

Mr. Chairman, in your invitation letter of September 7, 2012, you asked that I relay the ASAP's assessment on NASA's current acquisition approach. We believe that the Phase 1 and Phase 2 approach to clear the certification "fog" is a significant step forward. We believe, and NASA concurs, that both Phase 1 and Phase 2 must be FAR-based contracts. The Panel believes a fixed price contracting approach is satisfactory for Phase 1, where establishing technical standards is the objective. NASA has not yet decided upon contract type for Phase 2, which encompasses interim certification, verification, and validation.

The ASAP strongly believes that only a cost type contract is appropriate for Phase 2. We believe that fixed price type contracts are appropriate for low risk undertakings where the requirements are clearly understood by both the government and the contractor(s). Phase 2 is neither, and we believe both schedule and safety would be enhanced in a cost-plus environment. Why? While Space Act Agreements (SAAs) may have stimulated new companies to enter the business, much remains unsettled. Design has preceded requirements, and with the recent phased approach, NASA is just now undertaking to determine how systems will be certified to transport NASA astronauts to and from the ISS. This timing increases programmatic risk and has serious potential to impact safety.

Additionally, any number of Department of Defense (DOD) programs provides evidence that the presumed cost advantages of fixed price development may be illusory. The following picture perhaps best illustrates the result of trying to manage fixed price development.

Mr. Chairman, informally, the committee staff has asked, "Is a Space Act Agreement appropriate to support the development of commercial crew transportation capabilities?" To date, many maintain that the freedom and flexibility of an SAA have enabled creativity and innovative design solutions and may have delivered greater value for money. That may be true. However, we arrive at this point in time with designs that are maturing before requirements, and where government and industry have not yet agreed on how winning designs will be accepted and certified. We worry that the cart is ahead of the horse.

The current acquisition approach—CTS Development that is funded under an SAA concurrent with Certification that is funded under a FAR-based contract—is complex and unique. In our opinion, this approach is a workaround for the requirements and communications challenges implicit to the SAA. It is not yet clear to the Panel how the safety requirements necessary for certification will flow from the FAR contract to the SAA "partners."

Let me speak specifically to the communications challenges under SAAs. In our travels to Boeing, SpaceX, Orbital Sciences, Sierra Nevada, and Blue Origin, we heard pros and cons about SAAs. Flexibility is universally the prime advantage; however, as design matures and begins taking shape, the partners seek reassurance that they are on a track that will lead to successful certification. They pose specific questions about what NASA will eventually require of the designs, but NASA cannot provide those answers under the SAA construct. We asked, "In

that case, what do you do?" One contractor answered by saying, "We look for nonverbal communication…you know, body language and 'winks and nods'." If you are the Congressionally-chartered Panel tasked to watch over safety, this is not a comfortable communication approach for requirements. The FAR-based certification contract has the potential to overcome this challenge, but it is a workaround for the SAA's downside.

In summary, in the Panel's view, NASA is being very creative and doing all it can to develop a commercial crew transportation capability on a very limited and potentially unstable budget. However, they unquestionably face a number of challenges in reaching the point where these systems can be confidently certified as being "safe enough" for the astronauts that rely on this process to ensure their safety.