NASA AEROSPACE SAFETY ADVISORY PANEL
National Aeronautics and Space Administration
Washington, DC 20546
VADM Joseph W. Dyer USN (Ret.), Chair

*July 29, 2013*

Mr. Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Bolden:

The Aerospace Safety Advisory Panel (ASAP) held its 2013 Third Quarterly Meeting at Marshall Space Flight Center, Huntsville, Alabama, on July 10-12, 2013. We greatly appreciate the participation and support that was received from the subject matter experts and support staff.

The Panel submits the enclosed Minutes and Recommendations resulting from this meeting for your consideration.

Sincerely,

VADM Joseph W. Dyer, USN (Ret.)
Chair

Enclosure

**AEROSPACE SAFETY ADVISORY PANEL**
**Public Meeting**
**July 12, 2013**
**Marshall Space Flight Center (MSFC)**
**Huntsville, AL**

**2013 Third Quarterly Meeting**
**Report**

**Aerospace Safety Advisory Panel (ASAP) Attendees**
VADM (Ret.) Joseph Dyer (Chair)
Dr. James Bagian
The Hon. Mr. Claude Bolton
CAPT Robert Conway
Mr. John Frost
Mr. Bryan O'Connor
Dr. George Nield

**ASAP Staff and Support Personnel Attendees**
Ms. Harmony Myers, ASAP Executive Director
Ms. Tina Alexander, HQ Support
Ms. Paula Burnett Frankel, Technical Writer/Editor

**NASA Attendees**
Scott Chandler
Letisha Antone
Sherri Stroud
Kelsey Doering
Jennifer Stanfield
Dena Yell
Baraka Truss

***OPENING REMARKS***
VADM Joseph Dyer called the ASAP's Third Quarterly Public Meeting of 2013 to order at 9:05 am. He noted that over the past two days, the Panel had an opportunity to see the great work being done at the Marshall Space Flight Center (MSFC). They spent the first day touring the facilities, including advanced manufacturing, payload operations, and hardware that will find its way into space as part of the Space Launch System (SLS) Program. They looked at facilities both new and refurbished and transitioned that afternoon to meetings with NASA stakeholders from both MSFC as well as NASA Headquarters. The first topic was continuing education regarding NASA's cost policy, with specific emphasis on confidence level.

***JOINT CONFIDENCE LEVEL/NASA COST POLICY [reported by Panel member Dr. George Nield]***
Mr. Doug Comstock, Director of the Cost Analysis Division in the Office of Evaluation at NASA Headquarters, provided the Panel with an overview of the Joint Confidence Level (JCL) process. His office views itself as the steward of the tools, processes, historical data, and lessons-learned that NASA has accumulated over the years. This office can serve as consultants and advisers to programs that are responsible for developing the estimates that NASA uses. One of the interesting things that the ASAP learned about was the history of cost estimation at NASA. Starting in the 1960s, costs were estimated by the use of analogies, intuition, and guesses. In the 1970s, historical data started to be collected, and models were used for the first time to make parametric estimates. In the 1980s, there were some very complex NASA projects, including work on the International Space Station (ISS) and Space Shuttle operations. Those programs incurred significant cost overruns, despite the use of improved cost-estimating models. In the 1990s, there was government-wide pressure to reduce staffing in areas such as procurement, human resources, and budget. Not surprisingly, this resulted in significant cost and schedule growth throughout the decade, averaging 30 to 40 percent across the government. In the 2000's, in response to criticisms from stakeholders on cost and schedule growth, a number of new initiatives were put in place, including the use of probabilistic approaches to estimating cost and schedule as well as very rigorous cost data collection.

Today, NASA uses what is referred to as a "portfolio approach." In general, NASA tries to fund projects at the 50 percent confidence level—in other words, a 50 percent probability that the project will cost more than that amount and a 50 percent probability that it will cost less than that amount; however, in its planning, NASA budgets to the 70 percent confidence level. The difference between 50 and 70 percent is held above the project level and provided only if justified on a case-by-case basis. The idea is to incentivize better cost management behavior and still achieve a relatively high probability of completing the project within cost and schedule. The results seem to show steady improvement over time with the use of the new policy, but the jury is still out as to how well NASA and the government will do using these approaches over the longer term.

Mr. Claude Bolton commended the presentation. He remarked that this is a good initiative to combine cost and schedule, and there may be an opportunity to connect those elements to the budget. Mr. Bolton offered to look at the Department of Defense (DoD) Probability of Success (Ps or POPs) model that combines all three (cost, schedule, and performance) and also considers external influences to determine probability of success in a program. He indicated he would be sharing some results and lessons learned. There could be benefit for both NASA and the DoD.

***MSFC UPDATE [reported by Panel member Capt. Robert Conway]***

Ms. Teresa Vanhooser, MSFC Deputy Center Director, provided an overview on the status of activities at MSFC. The brief focused on three appropriate themes: Lifting To and Through Space, Living and Working in Space, and Understanding Our World and Beyond. Most importantly, the entire briefing was underscored by the report of excellent morale of the MSFC workforce because of the tangible and meaningful work that provides a sense of accomplishment. There has been much progress on the SLS Program, including engine testing, vehicle structure and core stage panel testing, the adaptor ring (which the Panel had an opportunity to see on its tour at the 7-axis milling facility), advanced development on the F-1 engine, and many other examples. Ms. Vanhooser also provided encouraging updates on some enhancements at the Michoud Assembly Facility (MAF), which is critical to the SLS and Orion Programs. She reported the installation of the vertical weld center, which is in place and operating, and the entire facility is on track for the core stage assembly. The MAF is a multi-tenant facility, which can lead to some prioritization issues, but MSFC is confident that SLS will remain the top priority. Ms. Vanhooser also discussed the work being done by MSFC for the ISS enabling science and mission support. Testing on some James Webb Space Telescope elements is also ongoing, and commercial space interests are leveraging the Center facilities. The Panel received a good briefing on institutional affordability and sustainability, which is a common theme among the Centers. MSFC's efforts appear to be in line with other Centers in regard to eliminating unnecessary structures and revitalizing infrastructure. MSFC's 20-year plan is in line with what the ASAP has seen at other Centers to date.

One of the ASAP's questions was about obstacles to success. Ms. Vanhooser indicated that the foremost obstacle is the political and budget climate. Budget stability is still a large concern, but leadership is doing well in tempering the news and the "rumor mill" to maintain proper focus. This coupled with the meaningful work being accomplished, enables the leadership to keep the workforce focused on their goals. This is good news to the Panel and appears to be a large key to the Center's success. It should also be noted that the Panel was shown a few You Tube videos of the ongoing work at Marshall, which demonstrated that good news and information is getting out to public via popular media.

***TECHNICAL AUTHORITY IMPLEMENTATION AT MSFC [reported by Panel member Mr. John Frost]***

Technical Authority has been a primary topic for ASAP since 2006. It was one of the primary recommendations from the Columbia Accident Investigation Board (CAIB) as one of the ways to improvement the governance model and to ensure that the right decisions are made by the right people. Mr. Nelson Parker led the discussion with the Panel. He framed what MSFC is doing on Technical Authority under the broader umbrella of "Technical Excellence." Technical excellence is an Agency-wide effort to ensure that well considered and sufficient technical thoroughness and rigor are applied to NASA programs and projects under an uncompromising commitment to safety and mission success. Mr. Parker described the strong efforts they are making to ensure Technical Excellence and much progress seems to be made. Recent efforts include establishing Technical Authority for software and health and medical. Those are small and unique specialties, and those efforts are working.

The Panel moved to a discussion on Agency Technical Authority, which was the primary subject. The governance model is based on a robust Technical Authority independent of the program chain, which was one of the CAIB recommendations. One key to that implementation was the direct link of the Center Technical Authorities back to their counterparts at NASA Headquarters. This was to ensure that local pressures to be a "team player" and support the project that naturally occur in any organization were counterbalanced with the "horsepower" and the larger picture that Headquarters brings to the table. In the past, the Panel had often seen that implemented in center organization charts—either as dotted or solid lines from the Center Technical Authorities to their Headquarters counterparts. Recently, the ASAP has begun to see organization charts with Technical Authority lines connected only to the Center Director, and the Panel has been looking more closely into how the communication chain works. Specifically, the Panel has seen some confusion over the simple question: "If there is a non-concurrence by a Technical Authority on a decision by the program or project, and that goes to the Center Director for resolution, does the Center Director have the authority to override that non-concurrence or does it automatically go up to Headquarters for resolution? Mr. Frost noted that he has heard different answers from different people, and some clarity would be worthwhile. Clearly, everybody agrees that if the Technical Authority (or anyone) sees something that is wrong, that person has the ability to take it to the next level. Everyone understands that, and the culture exists that would allow that to happen. However, some Panel members have been concerned that this requires a "level of courage" that is above and beyond a simple non-concurrence, and that makes the situation more difficult.

**Mr. Frost stated that he would like to see the role of the Center Director clarified. Specifically, does he or she have the authority to override a non-concurrence by a Technical Authority? He requested that this be included as a formal recommendation. It appears that a possible mechanism to clarify this question may be the guidance document—NPD 1000.0A*, NASA Governance and Strategic Management Handbook*, which was written in 2008 and reflected the governance model at that time. This document is supposed to be revised in next three weeks, based on the 5-year schedule. Mr. Frost recommended that NPD 1000.0 be revised to reflect the Administrator's current governance model, and specifically address the question on how non-concurrences are handled.**

***AGENCY POLICY ON PROBABILISTIC SAFETY CRITERIA [reported by Panel member Mr. Bryan O'Connor]***

Dr. Frank Groen, the Acting Director of the Safety and Assurance Requirements Division in NASA's Office of Safety and Mission Assurance (OSMA), briefed the ASAP on the answer to the basic question: What is the policy of the Agency on whether or not and how to do probabilistic safety assessments (PSA) for programs that involve human spaceflight? He directed the Panel to several policy documents. At the highest level, there are a couple of policy documents. One of them requires that for human rated systems, a probabilistic risk assessment (PRA) or PSA be performed and that requirements be formulated for future human spaceflight programs. The first program that was under this authority was Constellation; now there is the Commercial Crew Program (CCP) and Exploration Systems Development (ESD). The requirement must be stated in terms of probability of loss of crew (LOC). The verification to meet that requirement would be with a peer-reviewed, acceptable protocol of a PRA.

There are many ways to do PRAs. One of the other documents is a guideline for programs on what constitutes accepted protocols for doing PRAs. Mr. Groen outlined this process. The purpose of PRA is two-fold: (1) these programs are required to use PRA as one of their tools in their toolbox of safety, reliability, and quality tools and engineering assessments; and (2) to deal with the requirement from the top—that a design or operation have a limit or "threshold" of safety assigned to it, and that it can be verified with one of these tools. With regard to the roles of various people, the project is required to produce the PRA for its design. The project can do it in-house or can ask its contractor to execute it. If the contractor does it, the project must have good oversight and audit capability, using experts in the Agency to ensure that it is a satisfactory process. The Technical Authority is assigned to the project by the program and must concur with the assessments that are done. OSMA at NASA Headquarters will perform requirements traces and do audits; they also provide guidelines and a handbook on

how to do PRA. In addition, they will provide technical assistance to a project or program that is looking for expertise in reliability or risk-analysis work.

Later, the Panel heard briefings on how this actually flows into the programs.

***EXPLORATION SYSTEMS DEVELOPMENT (ESD) UPDATE AND ESD RISK ACCEPTANCE [reported by Panel member Dr. Jim Bagian]***

Mr. Bill Hill provided an update on ESD activities. He covered the status of progress in the three program areas—SLS, Orion, and the Ground System Development and Operations (GSDO). They have gone ahead with various parachute testing and static load testing of the Launch Abort System. All are moving forward as planned, and the SLS is making progress. Mr. Hill discussed the full-duration testing of the J-2X upper stage engine. They hope to get EFT-1 launched by the end of FY14. Mr. George Deckhert talked about the PRA process and some of the goals; most specifically, they still lack a firm requirement for overall mission LOC. This has been outstanding for some time. They have some targets that have been established by ESD. However, the firm "goals" and "thresholds" for the program have not been set yet. These numbers have been open for some time. The Program expects to have this resolved by the last quarter of this calendar year. The Panel looks forward to hearing what those numbers are because that will affect the decisions and the trades that must be made along the way. The Program thinks that the Orion/SLS ascent phase risk will be twice as safe as Shuttle was. Much of this safety factor comes from having the Orion abort capability. On orbit, the mission will be riskier, partly due to longer duration in orbit and destinations that do not afford a rapid return to Earth in the event of an emergency. Entry, Descent, and Landing (EDL) risk will be similar to Shuttle. This is because there is a "trade" of one set of risks for another. However, they are still working on this aspect. The Panel encouraged establishment of a firm set of Agency-level LOC threshold requirements as soon as possible.

EM-1, the uncrewed mission, is scheduled to fly in December 2017, and it is moving along. EM-2 will be the first crewed flight, currently scheduled for 2021. This is the mission that the ASAP had questions about—specifically, a first crewed flight with the first time the ECLSS and other systems would be onboard and concerns about how to mitigate risk. Mr. Hill illustrated how the Program is addressing the risks, describing several models on how they would do that. There is one approach that includes a 30-hour high elliptical orbit (HEO) for checkout before committing to a trans-lunar return. The Program is still exploring this approach. They are also considering combining the first crewed-flight mission with an asteroid mission. This would complicate the mission considerably, and a number of things would need to be resolved. The Program team is in the process of figuring out what will work. The ASAP was satisfied that there are activities directed at characterizing and mitigating the risks associated with the first crewed flight, EM-2, and that the first-flight risk would be potentially reduced through the 30-hour checkout proposal. This appears to be a more prudent way to go. The mission planning team will start meeting on July 30 to assess what the mission would look like and options going forward.

Mr. Paul McConnaughey provided a status update on the Orion pressure vessel crack repair. The Program has made a successful repair for EFT-1, and the EFT-1 Crew Module structural loads test has been competed. They have learned several things that can be applied to other locations on the vehicle. The aft bulkhead for EM-1 and subsequent builds have been redesigned based on what has been learned through the pressure vessel crack investigation activities.

**Mr. Frost emphasized the need for firm LOC number. The reason why this is so important is that LOC is the safety performance standard to which vehicle is designed. If the Program waits until the vehicle is designed to establish that, it does very little good—it doesn't guide design; it serves only to assess design. He noted that the Panel discussed this in May 2012, when it was at MSFC. At that time, the Panel thought that the LOC would be coming soon; it needs to happen as soon as possible. This is not a local issue; the LOC number is established at NASA Headquarters. Mr. Frost suggested that this be escalated to a formal recommendation: NASA should establish the LOC as soon as possible.**

Dr. Nield added that the ASAP has the impression that NASA is selecting the LOC numbers based what is achievable rather than what is appropriate philosophically and where we want to be driving the design. Once the design is

done and the hardware is built, it is hard to impose a number. Still, the process itself is beneficial and the sooner the numbers can be established, the better. In particular, it was pointed out that even at the ESD level, the LOC numbers released to date are only for ascent and EDL; the in-space LOC number is still "TBD." The Program has stated that that requirement would be established as soon as the EM-2 mission is finalized. There would be merit in getting some preliminary numbers for some reference missions, e.g., going to the Moon, going to Mars, etc. The LOC numbers could then be part of the decision-making process in terms of what the appropriate mission should be, given the risk level that we think it is possible to achieve.

Mr. Frost noted that the Program has Design Reference Missions (DRMs) that are being used to help guide the design. Risk based on those DRMs sounds like one answer.

***INTERNATIONAL SPACE STATION (ISS) UPDATE [reported by Panel member Mr. Bryan O'Connor]***

VADM Dyer encouraged the Panel and the meeting attendees to signup for the "SPOT to Station" text message. It provides a great reminder to look at the ISS when it is visible overhead and remember that the U.S., along with our International Partners, still has people working in space.

Mr. Michael Suffredini provided a considerable amount of information on what has been happening since the last ASAP meeting in April. The biggest safety event was the contingency extravehicular activity (EVA) that they needed to do to look for the leak in the Pump Flow Control System. There was also a discussion about the Automated Transfer Vehicle (ATV). One of the ATVs had a propulsion drive electronics (PDE) failure in June while it was en route to dock with the Station. Because of its redundancy and other workarounds, it was clear that this was not an abort situation. The PDE was reincorporated after docking. Mr. O'Connor noted that whenever there is a visiting vehicle that sustains some kind of event on ascent, the public has no idea of the work that goes into deciding whether a flight rule is violated and, if so, how to work around it. All the public hears is "successful docking." However, significant work goes on to ensure that safety requirements are being met. For example, a visiting vehicle is not allowed to get near the Station unless it is "two failure tolerant"—this means triple redundancy, or three systems.

Mr. Suffredini discussed the ISS flight schedule. With all of the flight activity, it is amazing that the crew gets any other work done on ISS. However, they spend considerable time working on utilization efficiencies. For example, over the next six months, nine visiting vehicle visits are scheduled, although the team knows that not all of those will happen—for example, the Proton flight will slip due to the recent failure investigation—but the schedule includes two Progress, two Soyuz, one SpaceX, two Orbital (first Orbital vehicles visit to ISS), and a Proton launch. All of these are scheduled to happen when there are events such as EVAs and science work.

Mr. Sufredini discussed the objectives of the next expedition (Expedition 36). During expedition handover, there is sometimes a short period where there are only three crewmembers. This is another thing that affects utilization. EVAs take up a lot of time as well. When there are only three crewmembers, utilization basically stops because the priority is maintaining the Station. This led to a discussion on what kind of utilization they are achieving. Mr. Suffredini reported that they peaked at 58 hours per week and bottomed out around 12 to 15 hours per week. On average, however, they are meeting the 35 hours per week utilization target. In terms of research statistics, they are up to 1549 investigations since beginning Station utilization. Currently, there are over 200 investigations on-going. This includes Earth and space science, human research, and physical science. The Program has looked at consumables and how that would be affected by a gap in visiting vehicles, e.g., a delay in the next Progress flight. Even if there were no more flights at all, the Station could go through early 2014 with its on-board consumables.

Mr. Suffredini discussed some recent challenges. As noted earlier, there was the contingency EVA. The media implied that this was "no big deal." However, in talking with the crew, mission operations, etc., one learns that a contingency (or unplanned) EVA requires a tremendous amount of work and there is always a high risk that something might go wrong. These are risky operations, and the press makes them look too easy. On this particular EVA, the crew changed out the leaking pump system and replaced it. The new system is working fine and the EVA was successful.

Another event since the last meeting was the docking issue with Progress 51P. One of the Kurs antennas did not deploy (they are redundant). There was a major discussion with the Russians and the Europeans on this issue. The implication was that with the antenna undeployed, docking could happen but there could be interference with or damage to the retroreflector, which is used to bring the ATV into its docking position. According to the drawings, the undeployed antenna could hit the ATV equipment. However, the team did a lot of analysis and cleared it. When Progress departed, the antenna then deployed. There was no damage, but there were a lot of lessons-learned in this close call. Another case concerned a failure on the Beta Gimbal Assembly latch. The team developed a procedural workaround to go to the redundant side, which was successful. Another potential safety implication involved the H-II Transfer Vehicle (HTV). The Russians suspected that there was microbial contamination in some of the bags in the HTV-4. They went through a number of procedures to take air samples, clear the air, run fans, and scrub the bag. Everything went well.

At the last meeting, Mr. Suffredini talked about the Dragon check valve failure, which was handled very well real-time. Dragon did not violate the criteria for continuing proximity operations and met all of the failure tolerance requirements, but the team was puzzled on how it failed. The ASAP heard about the discussion on root cause at its fact-finding meeting yesterday. SpaceX and its vendor found some faults with the quality test procedure that was done at the factory as well as with the prime contractor's acceptance test procedure. It was not a "test as you fly" case. They fixed the process failures and learned from that. NASA was pleased with the lessons-learned from this incident, and SpaceX now has a better approach with the vendor. New values with the new procedures have been installed for the next Dragon flight.

There was discussion about the first Orbital demo mission that will be going to the Station this year. It is currently scheduled for August 29, but there is a chance that it might slip into September. The SpaceX-3 mission will have a significant upgrade on the Falcon rocket. There will be a test flight and two or three commercial flights prior to use by NASA. The performance improvements are quite high; for example, a 50 percent increase in the engine thrust.

Mr. Suffredini talked about the End-Of-Life (EOL) action item from the ASAP. Mr. O'Connor noted that the Program has been working for two years on this, and the Panel is impressed with what has been accomplished. NASA now has a plan so that in the event the Station must be evacuated, there will be a 14-day period in which to make a decision on whether or not to bring the ISS down. The Program is setting the contingency plan in place, although there is still a lot of work to be done. They will have 180 days to get down to deorbit altitude. This would give them time to get 2 Progress vehicles launched to autonomously dock, autonomously transfer propellant to the Service Module, and to provide propulsion to deorbit. This would provide a good, safe, controlled deorbit. The ASAP is very pleased with the progress to date.

Mr. Frost added that the ASAP raised this issue two or three years ago as the kind of thing to think about ahead of time. At that time, the general thinking was that the response would be to boost the orbit to get the Station higher; however, after all the analysis was done, it was determined that what will actually be needed is the opposite. The ASAP is pleased that all of this work has been done in advance.

Mr. O'Connor noted that the ASAP received its periodic update on the ISS risk matrix, which displays the top Program risks. It is more or less the same as the Panel saw the last time. The visual impairment/intracranial pressure issue is one of the higher risks, and a lot of work needs to be done in this area. Micrometeoroid and Orbital Debris (MMOD) is still high up in the risk matrix and will continue to be. The Program also has a risk that is termed a "safety risk," although it is not a LOC risk—the lack of overlap in launch services, which represents a threat to the ISS mission. If the CCP does not progress properly and/or NASA does not have the Soyuz as a back-up, there could be a potential gap in transportation services to and from the Station. The implication is that the Station could reduce to a crew of three.

The Standing Review Board gave the Program high marks during its Program Implementation Review. There were some good recommendations, including extending the life of the ISS and continuing to increase crew time and achieve full utilization.

***MARS PROGRAM TECHNOLOGIES AND ASTEROID MISSION OVERVIEW [reported by Panel member Mr. Claude Bolton]***
Dr. James Reuther, the Deputy Associate Administrator for the Space Technology Mission Directorate (STMD), presented an overview and status briefing on the newly formed Directorate. The STMD was established in January 2013, to better focus efforts in the space technology area. Dr. Reuther briefed the reasons for investing in space technology, which includes researching and developing technologies that will be required to enable and perform future NASA missions, such as missions to asteroids and Mars, as well as providing technology alternatives to selected mid-term missions such as SLS. STMD has developed its technology portfolio in three areas: (1) Transformative and Crosscutting Technology Breakthroughs; (2) Pioneering Concepts/Developing Innovation Community; and (3) Creating Markets and Growing Innovation Economy.

STMD has developed technology roadmaps that identify technology timelines, Technology Readiness Levels (TRLs), and budget allocations. They are developing a new paradigm that intends to effectively balance the desire to focus on far-term technology needs with the near-term operational needs. STMD is working with a number of outside institutions and organizations in the government (such as the Department of Defense), business (particularly small business), and academia.

The current budget for the STMD, while not formally presented, appears to be adequate based upon the information provided by Dr. Reuther. The budget should allow NASA to achieve what needs to be done in that particular area.

In balancing all the various desires, the Directorate has looked at outside models and companies, including 3M. Mr. Bolton suggested that STMD might want to take another look at that particular model and others as they go through this change.

Dr. Reuther's informative presentation provided the Panel with a very good insight into the new STMD. The ASAP appreciated the presentation, commends NASA for establishing this organization, and encourages NASA's continued support. As mentioned earlier by Mr. O'Connor, NASA tends to make things look easy. The future missions (such as going to an asteroid and Mars) are difficult. Part of making that look easy starts now with this type of technology activity.

In the Science, Technology, Engineering, and Mathematics (STEM) education area, Mr. Bolton noted that he had the opportunity to meet with about 30 to 40 STEM students. These 18- and 19-year-olds from around the country were at MSFC to participate in its STEM program. They were very excited about being at MSFC and what was happening at the Center. Mr. Bolton commended NASA for doing this—it is not only good for NASA, it is good for future programs and the Nation.

***COMMERCIAL CREW UPDATE [reported by Panel member Dr. George Nield]***
Mr. Phil McAlister, Director of Commercial Space Flight Development, and Mr. Ed Mango, Program Manager of the Commercial Crew Program provided updates on the status of commercial cargo and crew. With respect to commercial cargo, SpaceX has completed all of its COTS milestones and has gone on to regular resupply flights to ISS. Orbital Sciences has accomplished its initial test flight of the Antares rocket from the Mid-Atlantic Regional Spaceport (MARS) at Wallops and is looking forward to its final COTS demonstration mission later this summer or early fall. With regard to Commercial Crew Integrated Capabilities (CCiCAP), Boeing has completed 8 of its 19 milestones, including wind tunnel work and some tests on the dual engine Centaur stage; Sierra Nevada has completed 5 of its 9 milestones, including an integrated system safely analysis review and a milestone for investment financing; SpaceX has completed 6 of its 14 milestones, including a review of the pad abort test that it will be doing late this year or early in 2014 and accomplishment of the company's Human Certification Plan review with NASA.

With regard to the Certification Products Contract (CPC), NASA has a contract in place for each of the partners to look at the actual certification products and provide feedback on what is acceptable and what it not, as well as comments on the approaches being taken. This involves a number of documents and paperwork. All three partners

have met their due dates. The deliverables include alternate standards and rationale, hazard reports, verification and validation plans and variances, and their certification plans. NASA now has a significant amount of work to do to review all of this documentation and provide feedback to help the contractors understand what is expected.

Mr. McAlister discussed the independent cost assessment performed by Booz, Allen & Hamilton (BAH). This report was performed to critique how NASA was estimating the costs associated with the CCP. The report gave NASA good marks on methodology and following best practices on how the cost estimation was done; however, the report pointed out that the cost estimates were optimistic and BAH predicted cost growth going forward. In response, NASA generally concurred with the report. The Program made some changes to how the estimates were being provided and increased the management reserves. This remains an important issue for the ASAP, and the Panel will continue to watch this area going forward.

Mr. McAlister also responded to ASAP's previous observation: NASA should develop a policy on when NASA certification is required. The response was: NASA certification is required for all crewed space systems with NASA personnel. This response brings up a new question: What does "NASA personnel" mean? This is a very important issue, and the Panel had discussions with the Commercial Crew managers and NASA senior management on this question.

**Dr. Nield recommended an action Item for NASA: come back in 6 months with a response on what constitutes "NASA personnel." This is not only important for commercial crew, but also for some of the suborbital science missions that will be conducted under the Flight Opportunities Program. We need to understand how those missions will be certified.**

Mr. Scott Johnson, Chief Safety Officer for CCP, talked about the Probabilistic Safety Assessment (PSA) approach. NASA is depending on the partners to be responsible for the development of an integrated PRA; however, NASA is doing its own modeling as an assurance tool. The team is having weekly status meetings on PSA and special technical exchange meetings to ensure that the partners and NASA can learn from each other and understand what is being done. Mr. Mango followed up on a couple of other items of ASAP interest. NASA has decided that there will be test flights for CCP; the question is: Will they be certified? There will be a certification for each test flight; most likely it will be an interim certification, which will include a thorough flight test readiness review process. The companies are talking about using existing hardware subsystems, systems, and even entire rockets, such as the Atlas, and there was a brief discussion about heritage design acceptance. If heritage hardware is proposed, there will be a thorough review of the particular use of the particular piece of hardware and why it is or is not acceptable for the new application. Looking ahead, Mr. Mango indicated that they intend to release the draft RFP for the phase 2 certification contract later this summer with the final RFP release sometime this fall. NASA expects to have companies on contract by Summer 2014.

VADM Dyer noted that this public meeting was off site primarily because of sequestration effects—a workforce reduction at the front gate of Redstone Arsenal is generating impressive traffic delays. This is a harbinger of budget issues that will be more challenging. It speaks to the necessity of balancing expectations with budgets in looking toward future missions. NASA's history with major program undertakings that have "failed to birth" exceeds two dozen. It will take some hard work going forward to achieve harmony between the resources available and NASA's undertakings. The Agency has some difficult challenges, and there will be some difficult decisions. However, one cannot be at MSFC without feeling good about the people, the mission, the innovation, and the expertise of America in space.

After thanking MSFC for hosting the meeting and providing support to the ASAP, VADM Dyer adjourned the meeting at 11:15 am.

**ASAP RECOMMENDATIONS, THIRD QUARTER 2013**

**2013-03-01 Technical Authority and Role of Center Director** [ASAP point of contact: John Frost]
Finding: Technical Authority has been a primary topic for ASAP since 2006. It was one of the primary recommendations from the Columbia Accident Investigation Board (CAIB) as one of the ways to improvement the governance model and to ensure that the right decisions are made by the right people. The governance model is based on a robust Technical Authority independent of the program chain. One key to that implementation was the direct link of the Center Technical Authorities back to their counterparts at NASA Headquarters. Recently, the ASAP has begun to see program organization charts with Technical Authority lines connected only to the Center Director, and the Panel has been looking more closely into how the communication chain works. Specifically, the Panel has seen some confusion over the simple question: "If there is a non-concurrence by a Technical Authority on a decision by the program or project, and that goes to the Center Director for resolution, does the Center Director have the authority to override that non-concurrence or does it automatically go up to Headquarters for resolution?

Recommendation (a): Revise NPD 1000.0A, *NASA Governance and Strategic Management Handbook,* to reflect the Administrator's current governance model and specifically address the question about how non-concurrences are handled.

Rationale: The Panel has heard different answers from different people, and some clarity would be worthwhile. Clearly, everybody agrees that if the Technical Authority (or anyone) sees something that is wrong, that person has the ability to take it to the next level. Everyone understands that, and the culture exists that would allow that to happen. However, some Panel members have been concerned that this requires a "level of courage" that is above and beyond a simple non-concurrence, and that makes the situation more difficult.

Recommendation (b): Make a clear distinction in the Technical Authority policy between the formal appeal process related to Technical Authority decisions and the dissent process related to non-authoritative differences of opinion on matters outside the TA's authority.

Rationale: The current directives confuse these two distinct activities, and the effect is to water down true Technical Authority to something more like technical advice.

**2013-03-02 Firm Loss of Crew (LOC) Number for the Exploration System Development (ESD) Program** [ASAP point of contact: John Frost]
Finding: The Panel discussed the need for a firm loss of crew (LOC) risk requirement number in May 2012, when it was at MSFC. At that time, the Panel thought it would be coming soon; however, the Program still lacks a firm LOC number. This has been outstanding for some time. Some targets have been established by Exploration System Development (ESD); however, the firm "goals" and "thresholds" for the program have not been set yet.

Recommendation: Establish a firm, Agency-level safety threshold and goal for LOC for ESD's first crewed mission as soon as possible.

Rationale: The Design Reference Mission (DRM) LOC is the safety performance standard to which vehicle is designed. The LOC requirement will affect the decisions and the trades that must be made along the way. If the Program waits until the vehicle is designed to establish the LOC number, it does very little good—it doesn't guide design, it only assesses it and can result in the decision to accept what is available rather than actively specifying what would have been desired.

**Action Item for ASAP Recommendation 2013-01-01 Philosophy on the Certification Process**
NASA should come back to the ASAP in 6 months with its response on what constitutes "NASA personnel." This is not only important for commercial crew, but also for some of the suborbital science missions that will be conducted under the Flight Opportunities Program. We need to understand how those missions will be certified.

*2013-01-01 Philosophy on the Certification Process [ASAP point of contact John Frost]*
*Finding: NASA and the nation are blazing new trails and attempting new ways of getting to space. It is a trail that is not well marked. One of the areas that has created many questions is: What does it take to approve a human to go to orbit? NASA has its long-proven method for its astronauts. How can it bridge that gap between that program at one end and less rigorous programs, e.g., commercial crew, on the other? This debate has been difficult because NASA does not have a formal policy with rationale that clearly states what types of designs and/or operations must be certified by NASA.*

*Recommendation: NASA should develop a philosophical approach to the certification process; specifically, when NASA certification is required and when it is not.*

*Rationale: There are some subtle nuances about NASA missions—when are they NASA missions, what kind of crew, etc. There has been good dialog; now is the time to capture that into a single philosophical approach to certification. The CCP is working on a white paper on how it will do certification; however, an overarching statement on NASA‟s philosophical approach to certification would provide needed clarity to all parties.*