NASA AEROSPACE SAFETY ADVISORY PANEL
National Aeronautics and Space Administration
Washington, DC 20546
Dr. Patricia Sanders, Chair

October 13, 2017

Mr. Robert M. Lightfoot, Jr.
Acting Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Lightfoot:

The Aerospace Safety Advisory Panel (ASAP) held its 2017 Fourth Quarterly Meeting at the Johnson Space Center, Houston, Texas, on October 5, 2017. We greatly appreciate the participation and support that was received from the subject matter experts and support staff.

The Panel submits the enclosed Minutes resulting from the public meeting for your consideration.

Sincerely,

Patricia Sanders
Chair

Enclosure

ASAP AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
October 5, 2017
Johnson Space Center, Houston, TX

2017 Fourth Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP) Attendees
Dr. Patricia Sanders, Chair
CAPT (Ret.) Christopher Saindon
Mr. John Frost
Lt Gen (Ret.) Susan Helms
Dr. Donald McErlean
Dr. Sandra Magnus
CAPT (Ret.) Brent Jett (telecon)

Other Attendees:
Ken Bowersox, Human Exploration and Operations Committee, NASA Advisory Council
Eric Berger, Ars Technica

Telecon Attendees – see attached list

ASAP Staff and Support Personnel Attendees
Ms. Carol Hamilton, NASA ASAP Executive Director
Ms. Paula Burnett Frankel, Writer/Editor
Ms. Evette Whatley, Administrative Officer

NASA Attendees:
Rex Walheim
Annette Moore
Kelly Humphries
Bernadette Hajek
Melanie Saunders
Kevin Window
Eileen Stansbery
Cathy Koerner
John Sims

Opening Remarks
Ms. Carol Hamilton, ASAP Executive Director, called meeting to order at 10:15 a.m. CST and welcomed everyone to the ASAP's fourth quarterly meeting of 2017. She indicated that the public had an opportunity to request to make verbal statements or to file written statements on the subject of NASA safety. There were no public requests submitted prior to the meeting. She turned the meeting over to the ASAP Chair, Dr. Patricia Sanders.

Dr. Sanders thanked Center Director Dr. Ellen Ochoa and the Johnson Space Center (JSC) personnel for hosting the ASAP's fourth quarterly meeting of 2017. The Panel was particularly impressed during its tour of the recently completed and opened Human Health and Performance Laboratory. This facility houses a number of key research and support activities in one place, which were previously scattered around the Center. This should enable synergy among the researchers as well as efficiencies and cost effectiveness. Some amazing and critical science activities are being conducted there. Dr. Sanders also commended the Center and the workforce on their resilience and dedication in the face of Hurricane Harvey. It is a credit to the workforce, to excellent planning, and to some well-placed facility investments that the crucial missions of JSC were uninterrupted as a result of the severe storm.

Dr. Sanders continued with her opening remarks. It is clear to the Panel that NASA is at "crunch time" in the development of human space flight programs. Both the Commercial Crew Program (CCP) and the Exploration Systems Development (ESD) are beyond paper design and are at the stage where hardware is being produced, testing is underway, and first flights—uncrewed flights followed by crewed flights—are on the horizon. This is a time when it is important to retain focus on the details of the programs; to maintain a sense of urgency while not giving in to schedule pressure; and to continue with program plans without neglecting, shortchanging, or

deleting planned content. There will also be important decisions facing NASA leadership with respect to certifying these platforms for human space flight. While space flight will always remain inherently risky, these decisions will necessitate careful weighing of all the technical and operational aspects of the risk-benefit trades. It is important the leadership has a strong foundation on which to base those decisions.

Looking beyond those nearer term challenges, the ASAP had some discussions on the Deep Space Gateway (DSG) concept during its time at JSC. The Panel believes that the DSG provides an important next step and critical enabler for the expansion of human exploration beyond low-Earth orbit (LEO). A flexible infrastructure in cislunar space provides a near-Earth testbed for both technologies and human operations needed to understand and buy down the risk of further space exploration—to Mars or elsewhere. In addition, the way the DSG has been formulated creates excellent opportunities for cooperation with commercial and international partners with different goals and objectives, including potential lunar exploration. Expanding human operations in cislunar space and maturing technology and operations in that environment lies directly on the path to longer-range goals. The ASAP strongly encourages NASA to pursue the DSG concept and step toward the Deep Space Transport (DST) as a logical follow on.

Commercial Crew Program

Lt Gen Susan Helms reported on the Panel's discussions with CCP management. She noted that the ASAP continues to be impressed by the Program Manager, Ms. Kathy Lueders. Lt Gen Helms commended the Program, noting that it is "doing a fabulous job" raising the bar of excellence on what is a challenging paradigm—two providers with a commercial-type contract, where "human-rating" is one of the most difficult design challenges. The closer they move toward implementation of this Program, the more impressive the team appears to be. The ASAP reviewed the CCP's launch dates. The official dates, as reported at this meeting were: for SpaceX, April 2018 for an uncrewed, flight-demo mission to the ISS, and August 2018 for a crewed flight to the ISS; for Boeing, August 2018 for the uncrewed flight test, and November 2018 for a crewed flight test.

Lt Gen Helms addressed the safety discussions pertaining to both providers. The ASAP believes that NASA is judiciously continuing to address the risk drivers with the providers for the most serious scenarios through continued analysis, modeling, testing, and design development. It remains challenging. Nevertheless, the focus on worst case scenarios has driven positive design decisions for both providers, as well as other aspects such as increases in systems testing for some of the systems that carry notable risks. As reported at the last quarterly, micrometeoroid and orbital debris (MMOD) continues to be the prime risk driver for both providers by a significant margin. Lt Gen Helms emphasized that one should not put a disproportionate emphasis on exact numbers at this point in time. The modeling of MMOD is a very challenging analysis, and there are notable uncertainties in the calculation. NASA is continuing to work on the modeling problem through proposed MMOD sampling experiments on the International Space Station (ISS), which is an outstanding use of the vehicle for this type of analysis. The team is also working on some unique defect testing with the Dragon cargo mission to recover and study the Dragon after it returns to help reduce modeling uncertainties on MMOD damage. In other words, defects are being deliberately placed on Dragon to try to simulate some of the MMOD scenarios. The operational mitigations, such as on-orbit inspection, are obviously prudent to consider, and NASA is doing so. The focus is on better understanding the risks of the space environment in advance and the design of the provider vehicles in the face of those risks.

Lt Gen Helms discussed some other major risk drivers common to both vehicles that were highlighted in the CCP's report. Both providers continue comprehensive parachute test plans to help refine the nature of parachute risks. Related to other prominent risk drivers for both vehicles, NASA will begin to adjudicate launch commit criteria for launch day weather and sea states in support of normal flight sequencing, especially abort modes. Given that the staging events of the vehicles have been evaluated to have a notable contribution to risk,

launch day weather will be a fairly critical element of risk management. NASA is about to embark on developing criteria that will provide both mitigation to abort staging risks while still providing some reasonable time for launch opportunity.

The Panel also had a discussion with NASA about authorities. The Panel has been very focused on the level at which risk is accepted and by whom. The ASAP was informed that the NASA Associate Administrator level or higher will make the decision on certification for both designs.

Lt Gen Helms continued with the status on the individual providers, beginning with SpaceX. She reported that there has been good progress on composite overwrapped pressure vessels (COPV) analysis, resulting from the accident late last summer. There is a very cooperative SpaceX/NASA team pursuing additional analysis, testing, and investigating cause. The COPV 2.0 development continues. A subgroup of Panel members visited SpaceX last month and heard more about how the development is proceeding. NASA appears to be taking a prudent risk reduction step and a possible alternative parallel path—a different design—that would be a form of insurance. Lt Gen Helms noted that NASA is good at working additional options. Throughout the COPV work, the team has been pushing state-of-the-art of this COPV technology for everyone. This has been one of the positive outcomes of the accident, and everyone will benefit from this cooperative relationship between NASA and SpaceX. With regard to the parachutes, there has been great progress on the test program. Several more tests are coming up, focused on reducing the uncertainty in the parachute reliability analysis and also to help facilitate lessons learned in the design. Another special topic that was a "good news story" was the blade disk and engine improvements for the Merlin. The turbine wheel crack mitigation operational changes have been implemented and robust testing continues to support the validity of the improvements. Again, this will not only benefit the CCP, but all potential customers—both government and commercial—who intend to use the Falcon 9.

CAPT Christopher Saindon reported on the Boeing status. The Panel had a good discussion with Mr. Chris Gerace from CCP regarding Boeing's path forward toward Flight Test Readiness Review for both the orbital flight test and eventual crewed flight test. Boeing and the CCP team have been conducting detailed probabilistic safety analysis (PSA) modeling with an eye toward reducing overall risk. This has been a primary focus area for Boeing, and the results of these ongoing risk analyses have influenced design, development, test, and evaluation (DDTE) activities significantly. As with Space-X, the greatest risk driver remains on-orbit MMOD vulnerability and recovery parachute systems performance and certification. The CCP did note that both partners had effectively used the PSA analysis results to identify primary risk drivers. SpaceX and Boeing have used that data to develop focused mitigations including vehicle design and operational protocol changes. Nevertheless, at this point in the Program, there are only a few design changes that will likely result in substantial risk reductions.

In terms of operational changes, the CCP has identified additional opportunity to reduce risk. Specifically, this includes operational approaches to mitigate unacceptable abort weather criteria—primarily unacceptable recovery sea-states—through tailored launch commit criteria (launch rules) as well as strategies for on-orbit MMOD inspection. While more work still remains in both of these operational mitigation strategy areas, they represent solid, safety-focused, risk decisions being made collaboratively between CCP and the providers to improve the overall risk profile of the Program.

Mr. Gerace also discussed the CST-100 abort capability certification strategy. The CCP shared with the Panel how they have developed a stringent abort system performance requirement intended to ensure a continuous ascent abort capability. The requirement did not obligate the CCP providers to demonstrate a live, in-flight or pad abort test. However, Boeing has elected to conduct an actual pad abort test, and they will rely on extensive subscale wind tunnel testing for the in-flight regime testing. For the in-flight abort wind tunnel testing, Boeing has been working to validate abort performance working with the aero-skirt design to alleviate non-linear aerodynamic

properties associated with the "hammerhead design" of the crew module/service module/launch vehicle interface.

Mr. Gerace led a discussion about the specifics of the CCP's development of the Abort Certification Roadmap, which has been developed to identify key gaps that drive risk in abort system capability and certification. This effort identified some issues with integrated testing and eventually led to identification of potential gaps. To date, only two gaps remain, which Boeing is working diligently to resolve with additional testing, including high-Mach parachute testing. Mr. Gerace also reviewed the ongoing structural test article (STA) shock testing related specifically to the recovery parachute deployment system. Again, there have been some unknowns discovered in that testing, and CCP and the provider are working to achieve an acceptable solution.

Mr. Justin Kerr discussed the details of the Boeing parachute testing plan being conducted at White Sands with a boilerplate model vehicle. Boeing added six parachute tests to ensure that there is sufficient hard data to define in-flight abort envelope. The test plan consists of three boilerplate static balloon drops, followed by three "lawn dart" tests (a more dynamic test of the parachute system).

Finally, Ms. Dayna Ise led a discussion with the Panel on the ongoing certification efforts for the RD-180 engine. In the Panel's view, this was a good news story, since there has been a great deal of uncertainty regarding the path forward toward certification of that engine. While the CCP is still carrying certification of the RD-180 as a top-level programmatic risk, Ms. Ise highlighted some significant and promising forward progress in light of the challenges related to obtaining granular design and component level data from the engine designer.

Boeing is tracking numerous DDTE milestones as they work toward certification for flight. Quite a bit of work remains on verification and closure notices (VCNs), and the Panel reviewed the burn down chart and the plan to achieve critical milestones. Undoubtedly, it will be a challenge to work through all the VCNs and address any unknown unknowns that result from the ongoing test and evaluation program. It was clear to the Panel that Boeing, the CCP, and safety and mission assurance (SMA) were fairly well aligned on their assessment of top program and safety risks.

CAPT Saindon concluded his report with a brief mention of the Panel's open recommendation regarding SpaceX and Boeing providing verifiable evidence of rigorous systems engineering and integration (SE&I) principles in support of the NASA certification and operation of Commercial Crew Transport (CCT) services to ISS. The Panel believes the NASA CCP Office and the providers are making good progress toward meeting the intent of the Panel's recommendation, and the discussions regarding testing and resultant design changes are indicative of that progress.

Lt Gen Helms made a final comment regarding the schedule. The Panel appreciates the sheer volume of work by NASA's Program team and the providers—under fairly unique circumstances—in getting two vehicles off the ground in the same timeframe. It is clear that NASA will be receiving a great quantity of provider products. The Panel has reviewed the schedules for the providers, and they are very ambitious to meet the official launch dates. Behind the provider schedules are the NASA schedules to assimilate, process, adjudicate, and approve the products and activities for the NASA readiness review. It is a lot of work. This process has begun and it will get more difficult as the team moves closer to the launch readiness dates. The Panel encouraged support of the CCP to ensure they have all the resources to accomplish the work judiciously and safely. Lt Gen Helms noted that this is an important ASAP "watch item."

Dr. Donald McErlean, who has had extensive experience with propulsion items, commented on SpaceX's remanufacture of a new "blisk," which is a combination of a blade and disk in one single forging. The recent

insight visit to SpaceX provided an opportunity to examine that new device. This is an example of a "spin-off" that comes from NASA programs. This complex forging is unquestionably a state-of-the-art in manufacturing technology, and that technology is now contained within American industry. It was very gratifying to see the technology, which is encouraged by NASA's programs, leading to a great step forward for SpaceX and its future customers, both government and commercial.

Mr. John Frost added emphasis to Dr. McErlean's point on spin-offs. The NASA mission is to improve our knowledge of the universe. Many people think of that in terms of discoveries about other planets, and while that is certainly true, the technology that is developed in obtaining that goal is worth its weight in gold. For example, the research being done on COPV to fully understand the physics of failure of that important technology is state-of-the-art. Mr. Frost observed that when applying the brightest minds to the most complex issues, the solutions and advances in technology can be remarkable. During the tour at JSC, the Panel also looked at the human performance work regarding eyesight degradation in low gravity, which is advancing the medical world. The public needs to understand that NASA spin-offs are more than Tang or Velco—there are important breakthroughs, and they are one of the major benefits from what NASA does.

International Space Station

Dr. Sandra Magnus summarized the report and discussions on the ISS Program. ISS continues to operate nominally and to increase its value with every crew and science experiment. Because the Russians have decreased their crew complement to two crew members for another year, there are four U.S Orbiting Segment (USOS) crew members on board, which creates more crew hours for utilization. Vehicle traffic continues to be robust, with Progress, SpaceX and Cignus vehicles coming and going fairly regularly. A series of extravehicular activities (EVAs) are being planned in October to mainly service the Canadian Space Station Remote Manipulator System (SSRMS). In fact, an EVA was underway during the public meeting. Dr. Magnus noted that the Panel was encouraged to see the continued use of ISS as a test bed for the development and demonstration of technology needed to send humans beyond LEO. ISS is an important asset for that technology, and this is a vital exercise to buy down risk as humans extend further away from Earth.

One of the most promising developments the Panel learned about concerned the ISS Deorbit Plan, which is an action the ASAP has been tracking for some time. One of the critical pieces required to establish a comprehensive deorbit procedure involves input from and dialog with the Russians. Until now, the Russians have not been at liberty to engage on this topic, but the Panel was informed during the ISS presentation that some conversations have begun. They involve some of the open items related to software changes and data required from the Russian segment in order to implement an effective and safe deorbit concept. The ASAP understood that there is still a lot of work ahead, but it was encouraging to hear that the conversations with the ISS partners have begun, and the Program is moving forward with detailed discussions on the steps needed to continue maturing the ISS Deorbit Plan.

Exploration Systems Development

Dr. Donald McErlean reported on what the Panel learned from this week's engagement with ESD managers. There was a great deal of discussion on the ESD elements—primarily the Space Launch System (SLS). The Panel received the usual status update from Mr. Bill Hill, Deputy Associate Administrator for ESD at NASA Headquarters, and heard from Mr. Wayne Germstead, the Deputy Chief Engineer for ESD at JSC. In summary, the SLS Program continues to make progress. There is no question that it faces upcoming challenges, but progress is continuous. The Program is now moving into one of the more intense phases of the testing program—structural testing of the major flight components. Dr. McErlean explained that structural testing for these huge components is almost a technology in itself. The rocket pieces are 20 to 30 feet in diameter, some of them several stories tall, and the associated structures that must be built to test loads on these pieces of hardware are themselves huge operations, roughly equivalent to the skeleton of a skyscraper. Moving these test

articles around the Nation to perform tests at various Centers is a huge job. There are points in the schedule where simply transporting the items from one place to another is similar to a technical project. The intensity of moving the structural test articles (STAs)—from scheduling the test facilities, to conducting the test, to analyzing the data, to determining whether they can move to the next test phase—will occupy the Program over the next year plus.

Dr. McErlean briefly reviewed the Panel's interaction with Mr. George Deckert and the ESD Safety and Mission Assurance (SMA) team, which was quite enlightening. He noted a prepared chart that listed all the significant safety incidents in human space flight—going back to the SR-71 and X-15, and including Gemini, Mercury, Apollo, the Shuttle Program, etc.—and what all of the incidents were. Mr. Deckert and his SMA team reviewed all those incidents and "binned" them into: (1) items not relevant to SLS, (2) those incidents that could happen on SLS, and (3) those incidents that represent an up-to-date threat assessment to SLS. The team has put mitigation actions into the Program to prevent those relevant incidents from happening again, at least in the same way. The Panel felt that this was an excellent initiative by the SMA team, and is the best use of "lessons learned" that the Panel has observed in the Program. Dr. McErlean complemented SMA team on this initiative.

With regard to the ESD programs themselves, progress continues in key areas where they have challenges. One of the more significant ones is the integrated avionics and software. The Orion and SLS flight software has moved from the build status to the initial integrated testing status for their flight releases. The Integrated Test Facility capacity still remains a programmatic issue, but the Program is managing this with careful scheduling and it has not become a bottleneck, although it is a watch item. In terms of validation and verification (V&V) for structure, the STA testing is now underway at multiple locations across the country. Various STAs are being tested individually at NASA Centers, then they are mated and tested as an assembly, then they are stacked with another piece and tested as a stack. All of that requires transportation and movement of STAs and ensuring that the test facilities have the proper crews and are adequately resourced. All of this is a continuing programmatic and logistical challenge. Dr. McErlean cited a couple of examples. The SLS engine section STA at MSFC started testing this month; the liquid hydrogen tank STA is still being instrumented at MAF, after which it will ship to move into its initial testing phase.

Another part of program—the Ground System Development and Operations (GSDO)—has three principal parts: the Mobile Launcher (ML), the Vehicle Assembly Building (VAB), and the pad itself. All required modification to move from the Shuttle era to the SLS. The Program is making progress with all of these elements, and some are very near completion. There are some typical "first-time-assembly" problems that are being worked by the onsite engineering and construction crews; however, none of those are "show-stoppers." Dr. McErlean noted that there is a continuing issue that the Panel hopes might be resolved. The ML is currently configured for the Interim Cryogenic Propulsion Stage (ICPS). Ultimately, Exploration Mission (EM)-2 and beyond will use the Exploration Upper Stage (EUS). There is a 20- to 30-foot height difference between the two configurations. This will require modification or change to the ML, which transports the rocket from the VAB to the pad. That "iron bar"—the length of time for that modification to be made—is somewhere around 30 months. This represents a pause in the Program that the Panel thinks could involve safety difficulties. It would be much more efficient for the continuation of the Program if it were possible to construct a second ML—starting that construction now—so the appropriate ML would be ready for the transition from EM-1 to EM-2. Obviously, this requires additional resources and must be taken to the appropriate funding sponsors. Dr. McErlean noted that the ASAP agrees with that strategy and encourages Congressional leadership to consider funding that opportunity. Progress is going very well in the VAB and the modifications to the platforms are now complete. The software and ground systems control facility is in testing, and the computers that handle the software are being upgraded. The original design was "Shuttle times two," or about 100 changes per second. With the increased complexity of the

SLS rocket, the Program has estimated that the capacity should have been around 350 changes per second. The upgrade to 500 changes per second (to provide additional margin) is in progress.

With respect to Orion for EM-1, the crew module and crew module adaptor production continues. The crew module is complete, has gone through initial power-on testing, and is moving on to final integration assembly and test. All welding in the Vertical Assembly Center for the SLS core stage for EM-1 is complete. As noted at the ASAP's last meeting, there had been an issue with the friction stir welding process at the Michoud Assembly Facility (MAF). What had been causing the weld anomalies has been corrected, and the new welds passed all necessary inspections. That entire process will now continue without interruption. The liquid hydrogen tank qualification is complete and will move on to structural testing. NASA has increased staffing on the floor and is continuing to increase manufacturing efficiencies at MAF, which will help gain schedule. Major planning is underway for advancing to EM-2 (first crewed flight) and some hardware is being manufactured. This is where there is an issue with the ML delay (the "iron bar" in the schedule).

With respect to the schedule for launch, three items remain on the critical path: the European Service Module (ESM), the SLS core stage, and ground system software. They are being monitored by the Program on almost a daily basis.

Dr. McErlean enumerated some recent key events. There were four successful launch abort tests for the EM-1 Launch Abort System (LAS) in 2017. In the first quarter of 2018, the LAS is due for delivery to the Kennedy Space Center (KSC). With regard to Orion structural qualification, the crew module began in April 2017, the ESM STA started in August 2017, and the LAS structural test was completed in August 2017. Upcoming events include completion of the heat shield and the combination of the crew module and the ESM as a stack before the end of this year. The entire stack—crew module, ESM, and LAS—is scheduled to go into structural testing in April 2018. They are still looking at getting certain improvements to the ESM into the follow-on missions, e.g., fault tolerance corrections and additional safety improvements.

In summary, the SLS continues to advance; challenges exist, but work to overcome those challenges is in progress. Dr. McErlean commented that the ASAP has not seen anything that cannot be overcome. EM-1 is moving forward to its launch date, the structural testing has begun, and the main and abort system engines have achieved major milestones. The ASAP has often talked about "constancy of purpose," and that has both a near-term and a far-term definition. In the near term, the Panel advocates continuing to emphasize the movement forward on the Program. It is at a critical point, with a considerable amount of activity over the next year or so. If constancy of purpose can be maintained, the ASAP sees nothing to indicate that the Program will not be successful.

Safety and Mission Assurance Recommendation

Mr. John Frost provided an update on an ASAP recommendation that was made a couple of meetings ago. He reminded everyone that in addition to looking at specific programs (ISS, SLS, CCP, etc.), the Panel also looks at the NASA infrastructure that ensures all the programs work together effectively. The Panel has spent considerable effort ensuring that the policies and procedures are in place to guide the various elements of the safety program. In general, the ASAP has been pleased the framework was in place—NASA has NASA Procedural Requirements (NPRs), regulations, and procedures that are descriptive and specific, but leave flexibility where needed. The next question is: Are those procedures and policies being followed? As the ASAP has visited the Centers, asked questions, and made subtle probes, it has found almost invariably that they are doing great things, but sometimes those things are not in accordance with the published guidance. The question then becomes: Is that important? Is that good enough?

The ASAP looked at the Safety Audit Program to see if it was effective in ensuring the policies were being implemented. The Panel found that some areas could be improved and one of those was system safety. There was a general lack of auditing of this area. System safety is the element of design that focuses on identifying potential hazards—principally in space systems—and making sure there are controls in place to limit risk to acceptable levels. The Panel was told that for several years, NASA has not been auditing the system safety element of the safety program, because the Office of Mission Safety and Assurance (OSMA) had found that the auditing they had been doing was not value-added. Mr. Frost explained that the reason was they were using a "binary-type" audit, which was limited to checking whether basic program elements existed or not, as opposed to determining how well they were working. This was not a very useful way to look at system safety policy implementation. NASA has examined the problem and has developed a two-phase plan to address the issue.

Dr. Homayoon Dezzfuli, a Technical Fellow with OSMA, described the two phases of the plan to the Panel. The ASAP recommendation was that they develop a rigorous and formal auditing program. OSMA has gone a step further—before they can audit what the programs do, they are looking carefully at whether NASA is asking the programs to do the right things. Phase 1 will be a "deep dive" into how the people in the field are using the existing policies, whether the policies meet their needs, and how the policies could be better. That phase will be completed this quarter. The audit community will include the system safety engineering practitioners, the customers (project or program managers), and all of the stakeholders involved. Next year, the auditors will begin doing "deep dives" at Centers, looking carefully at compliance with NPRs, and make adjustments where needed. This will not be a quick process. It will probably involve bringing experts from the field Centers to participate. NASA already has an excellent model: the NASA Aviation Program. That Program uses experts at each Center to look at other Centers, share what works well, and take lessons home. The ASAP will keep this recommendation open and continue to follow this activity, which will take some time to implement. The Panel did discuss the audits that OSMA is performing in other areas—such as institutional safety, fire safety, and explosive safety—and whether those are effective. The ASAP believes that they are being conducted as required; whether they are effective or not is a different question. The Panel will continue to watch these activities and try to determine how well they are working. Mr. Frost noted that Dr. McErlean had observed that their tracking indicators—accident rates, etc.—look good, but the Panel will keep an eye on both topics.

Dr. Sanders reiterated that it is important to continue to maintain focus on the safety aspects of the programs; NASA has important work ahead, and the ASAP will continue to try to provide the best advice.

Dr. Sanders adjourned the public meeting at 11:08 a.m.

TELECON PARTICIPANTS

Michael	Beims	NASA
Alfredo	Colon	NASA
James	Dean	Florida Today
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