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

March 11, 2016

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 2016 First Quarterly Meeting at Kennedy Space Center, Florida, on February 22-24, 2016. We greatly appreciate the participation and support that was received from the subject matter experts and support staff.

At this meeting, we closed Recommendation 2012-03-05, "Five-Year Roadmap for Continuous Improvement of the Agency's Mishap Investigation Process." The Panel submits the enclosed Minutes resulting from the public meeting for your consideration.

Sincerely,

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

Enclosure

ASAP AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
February 24, 2016
Kennedy Space Center
Kennedy Space Center, Florida

201 First Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP) Attendees
VADM (Ret.) Joseph Dyer (Chair)
Dr. Patricia Sanders
Dr. James Bagian
Dr. Donald McErlean
CAPT (Ret.) Robert Conway
Mr. John Frost
Dr. George Nield
CAPT (Ret.) Brent Jett

Telecon Attendees:

Kim Carolson	Attorney
Jeff Foust	Spacenews
Rebecca Regan	Boeing
Nigel Simmons	[not affiliated]
Dale Ketcham	Space Florida
James Dean	*Florida Today*
Kathryn Hambleton	NASA
Trent Perrotto	NASA
Diane Rausch	NASA
James Richards	NASA
Tom Whitmeyer	NASA

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

NASA Attendees:

John Marinaro	Bo Henry
Bill Jordan	Linda Euell
April Jordan	Bridgett Mack
Melanie Dickson	Eric Lench
Phillip Swinhart	Mark Gordon
Tracey Drake	Billy Stover
Russ DeLoach	Ryan Richards
Nancy Potts	Tracy Young
Dawn Martin	Martin Hayes
Brittney Mostert	Ashley Vigo
Debra Caldwell	Isolda Galiana-Liang
Jessica Williams	

Opening Remarks
Ms. Carol Hamilton, the Aerospace Safety Advisory Panel (ASAP) Interim Executive Director, called the public meeting to order at 1:00 p.m. and welcomed attendees. She noted that no public comments were received prior to the meeting. VADM Joseph Dyer, ASAP Chair, began the meeting by relaying some things learned from Mr. Robert Cabana, Kennedy Space Center (KSC) Center Director. There has been metamorphosis at KSC – 44 percent reduction in the workforce since the peak of Space Shuttle and 2 percent reduction in facilities— resulting in efficiencies and reduced cost of doing business. The Center has become a joint government and commercial spaceport. During the previous two days of fact-finding, the ASAP spent time considerable amount of time focusing on the Commercial Crew Program (CCP). VADM Dyer noted that that the Program is well led, and the ASAP greatly appreciates the transparency and frankness with the Program and its manager, Ms. Kathy Lueders. Other topics included exploration, risk acceptance, and the International Space Station (ISS). Focusing o commercial space, the ASAP had joint fact-finding meeting with some members of the NASA Advisory Council (NAC), led by Dr. Steven Squyres, and the International Space Station Advisory Committee (ISSAC), led by Gen. Thomas Stafford, one of the Apollo astronauts. There are challenges in commercial space, but those challenges are being met, and the Panel finds that the Program and the providers have made substantial

progress over the last several years. The ASAP noted that there is increased pressure on both schedule and finance as Boeing and SpaceX work under fixed-price contracts to achieve first flights, but the competition is serving NASA very well.

In the exploration programs, and more specifically the Orion Program, the Panel is observing cost, schedule, and performance—the "tools" in program manager's "toolbox." Cost is fixed, and schedule is a prime focus, perhaps too much in the Panel's view. With only performance (and risk associated with performance) the only tool left, the ASAP has been watching very closely to see how the Program progresses. VADM Dyer noted that "committees are braver than individuals." The ASAP believes strongly in accountability at the individual manager or leadership level. When one makes a change to a program and accepts more risk, a formal risk acceptance process lets one keep the history and the alternatives that have been considered. It provides a senior level review o the way to risk acceptance. VADM Dyer observed that in his career, he has noted that when senior accountable leader is presented with accepting the risk for a decision, sometimes he or she is able to find resources that might otherwise not be available. He reiterated that the Panel has strong feelings with respect to risk acceptance.

Another prime topic was ISS. The ASAP is always impressed and amazed with the Station's continuous presence in space with years of exposure, and the ISS works amazingly well. The Program has string of issues that it is dealing with, but it does so very competently.

Federal Aviation Administration (FAA) Licensed Commercial Launches and Landing from KSC

Dr. George Nield reported on the ASAP review of the material presented by Ms. Nancy Bray, Director of Spaceport Integration and Services at KSC. The reason that this was an appropriate and very important topic relates to Mr. Cabana's vision to transform KSC into a multi-user spaceport now that the Space Shuttle has been retired. Transition planning began in 2004, following the Space Shuttle retirement announcement. In 2005, a Request for Information (RFI) was released to gauge interest within the commercial community for potential use of KSC facilities. In 2008, the KSC Master Plan identified number of area development plans for potential commercial operations o KSC property. Efforts intensified approaching the last flight of Shuttle. There were industry workshops, RFIs, and an additional notice of availability in 2011 that identified some underutilized facilities at KSC.

After the Shuttle's retirement, KSC developed KSC Future Development Concept that was precursor to the KSC Master Plan. Some of the key principles included in that document were: support for NASA missions and programs, the desire to evolve to be a multi-user spaceport, goal to be leaner and greener, and to divest some facilities that were no longer needed without diminishing KSC capabilities. In 2011, some of the first facility-level partnering agreements came about. In 2014, the KSC Master Plan was completed. It implements and follows the direction from the NASA Authorization Act of 2010 to transform KSC into a multi-user spaceport to support commercial space launch and landing and associated activities. It also aligns with the National Space Policy and the National Space Transportation Policy that were intended to facilitate the growth of the commercial sector. It maximizes the opportunity for industry to develop launch-site capabilities at KSC. One of the key milestones in this transformation progress was the recognition that the Webb-McNamara agreement, which originated with the first NASA Administrator and formed partnership between NASA and the Air Force o how launch safety would be handled at KSC, did not envision the kinds of commercial activity that we are seeing today. After discussion and review by the NASA legal community, the NASA Executive Council, in March 2013, concluded that the range services for commercial launches from KSC property could be provided by the government through the Air Force Eastern Range or via another FAA-approved or licensed entity. This acknowledged an alternate way to perform operations at KSC that involves having an FAA license. That potentially will allow industry to function

in a more cost effective but equally safe way. This was very enabling conclusion, and we are seeing people work towards that approach today.

One of the partnership agreements includes that with SpaceX in 2014, a 20-year property agreement for Launch Complex (LC) 39A. SpaceX has done considerable work over the past year to upgrade the LC. The ASAP visited the pad and the SpaceX horizontal processing facility earlier this week. Another important agreement was the one with Space Florida for use of the Shuttle Landing Facility for vehicles launching or landing horizontally. There is a wide range of potential users ranging from X-37 to XCOR to Stratolaunch to Sierra Nevada, and even some unmanned aircraft operations. Another agreement mentioned was the small vehicle launch pad at LC 39C that NASA has constructed within the perimeter of LC 39B. The intent is for launches under FAA licenses, and KSC is in the process of developing the concept of operations (conops) for use of that pad.

In terms of what needs to be done, there is a pyramid of requirements, starting with basic safety requirements for an FAA launch license, then additional KSC requirements (non-duplicative and non-conflicting) on top of those, and finally, specific program requirements. In terms of future actions, NASA expects to finalize the joint operations agreement with SpaceX for launches from LC 39A. They are also developing Commercial Space Launch Act Annex template for use of Pad 39C, working with Air Force Space Command and 45th Space Wing to finalize the agreement on how commercial launches will be coordinated and managed. KSC will continue to work with FAA o the process to ensure coordination and that work is done in an efficient manner. Considerable progress has been made o this very important area. It was exciting to see the possibilities of multi-user spaceport come to life in the near future.

VADM Dyer noted that Dr. Nield's presence on the ASAP is link between the FAA and NASA. He is currently a senior executive at FAA and leads commercial space flight there. With regard to the people at KSC, morale is good and getting better. Tremendous progress is being made at KSC.

KSC Safety Culture Survey Results

CAPT (Ret.) Robert Conway reported o the KSC culture survey results from 2015. They were briefed by Ms. Darcy Miller, the KSC representative for the NASA Safety Culture Working Group, formed in 2009 by the Office of Safety and Mission Assurance (OSMA). The Group's purpose is to establish and maintain a strong safety culture throughout NASA. It comprises representatives from each Center, both civil servants and contractors. In assessing the culture, they use five pillars—a reporting culture, just culture, flexible culture, learning culture, and an engaged culture—matching Dr. James Reasons's safety culture model. CAPT Conway opined that safety culture and organizational culture are really one, and it is difficult to separate them. The survey has been given every three years—2009, 2012, and 2015. KSC is compared to the Agency results. In 2009, KSC was a little lower than the Agency rating and in 2012, it was a little higher. The comparison rating for 2015 has not yet been released. In the recent survey, KSC scored relatively high on the five basic pillars. The survey represented about 2 percent of NASA employees. CAPT Conway questioned whether 23 percent is enough. Typical feedback is between 25 percent and 75 percent. He suggested that perhaps NASA should consider taking a different approach to the survey or survey results. Two basic questions should be: Where are our problems? Where can we do better? One can look at it from a comparative assessment or an improvement assessment. In other words, competing against others (comparing) or competing against self (improving). The better of the two is competing against self, because the organization should always want to improve and move forward to focus on things that would lead to improvement.

One of the topics that caught the ASAP's attention was aspects of the "just culture." Just culture is one of the harder pillars to address. Just culture, as described in Ms. Miller's brief is "we treat each other fairly," or, to quote from Dr. Reason, "an atmosphere of trust in which people are encouraged, even rewarded, for providing

essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior." In other words, encourage people to come forward with safety information and, outside of gross negligence or criminal behavior, not "shoot the messenger." The ASAP asked the questions: Why not more respondents? Is there something to be interpreted from that? One of the things that Mr. Cabana had mentioned favorably was his "Ask Me Anything" page o his website. However, the majority of the inputs are anonymous. Questions that could be explored are: Why are so many responses anonymous? Are people too afraid to identify themselves? Is it a lack of just culture? Or do people feel that it isn't worth the exposure if there are no responses or results? In a just culture, we want to encourage information to come forward. It is about creating an atmosphere where information flows both ways without retribution unless otherwise warranted. The focus of the survey results should be o "how can we improve." There is no doubt that the safety culture at KSC is good, but they could go little deeper on the analysis of the findings and questions. CAPT Conway indicated that he would probably have some conversations with Ms. Tracy Dillinger at NASA Headquarters o this topic.

Dr. James Bagian agreed with CAPT Conway. He highlighted the importance of comparing one against oneself and not being content with how one compares to others. The ASAP had n indication that the culture is not good, but there may be missed opportunities. There did not seem to be a lot of KSC concern with the 23 percent response. It was noted that the general employee survey gets about 60 percent response. The question is: Why? There could be little more introspection o how the organization could d better. KSC is high-performing organization and should take advantage of that motivation.

CAPT Conway clarified that the safety culture at NASA is good and the Safety Culture Working Group is a worthwhile entity, but they could improve on how they are doing business.

Knowledge Management

VADM Dyer noted that at ASAP's joint meeting with the NAC and ISSAC members, there was one person who was an astronaut o Apollo and one who was an engineer/scientist on Apollo. They possess an amazing body of knowledge, and it is important to capture it. If we don't, it will be painful to learn the hard way. VADM Dyer introduced Mr. John Frost, ASAP member who reported o the knowledge management topic. He is former head of safety for Army aviation at Redstone Arsenal in Huntsville, Alabama, and is now a prestigious safety consultant.

Mr. Frost stated that the "Knowledge Management" subject has been of great interest to the Panel for several years. In high-performing organizations around the world, the members have seen that the ability to share and find crisp knowledge sets the good organization apart. Mr. Frost opined that NASA's only mission is the generation of knowledge, whether that be scientific knowledge or the technical and engineering knowledge about human space flight. The Panel has been amazed at the expertise at NASA's Centers and the databases that can provide answers to many questions. However, NASA has not found a good method of sharing that. The ASAP has been encouraging the Agency to improve knowledge management. At the briefing this week, there was some good news and some not-so-good news. The ASAP fact-finding started with the local Knowledge Management Program under Dr. Michael Bell, KSC Chief Knowledge Officer (CKO), and there are a number of initiatives at KSC. They have developed lessons learned, knowledge-sharing committee that meets regularly and discusses ways of improving the Program. They have a KSC Engineering Academy that meets once or twice a month where topics are discussed and people can share what they know. They make videos of those events, and KSC employees who were not able to attend can watch those. Unfortunately, the videos are only at KSC and are not embedded into an infrastructure throughout NASA. Something that appears to be working well is "Ask the Librarian," where questions or issues can be taken to a trained specialist who knows how to research the various databases. However, the fact that one needs a trained researcher to find the data is telling—the system is not

easily useable for the average worker. Another favorable aspect is the number of case studies where issues are examined and participants talk about what was done right and what was done wrong. These are shared with some Centers but not all. The KSC case studies are stored on Goddard Space Flight Center system, but that system is not readily available and well-known to everybody else in the Agency. There is lessons learned repository, but that is limited to KSC. Dr. Bell noted that he briefs every new employee and explains the tools that are available. Mr. Frost agreed that is a good thing, but the fact that there needs to be a special briefing may be an indication that it is not easy to access or use.

Mr. Frost discussed knowledge management at the NASA Headquarters level, which is where more of his concern lies. Several years ago, the ASAP recommended and NASA implemented position for an Agency CKO. That is good news, and things are happening. The Panel heard from Dr. Ed Hoffman, the NASA CKO, who described several efforts that have been underway. His team is beginning to develop a taxonomy and have established six main categories of knowledge—NASA language for "Knowledge Services." These are good starts, but Panel did not find a functioning, easy-to-use, crisp-and-clear method of sharing data. It is very difficult for a NASA employee to quickly and crisply search and find the data that is available. When an example of a technical question was posed to Dr. Hoffman, he indicated that one of the methods was to find an "expert." This is a 1950's approach, and NASA needs to do better than that.

In 2014, the Panel presented a specific recommendation that is still open. It reads in part:

> *The ASAP strongly recommends continuous an formal effort in knowledge capture an lessons learned that will make them highly visible and easily accessible. Modern tools exist to facilitate this and NASA should avail itself of them.*

NASA has many things started and underway; there are people and programs, databases and committees. However, when couple of the ASAP members tested the system for a specific engineering topic, nothing showed up.

Dr. James Bagian added that he looked for several things and could not find them. The interfaces were not designed in ways that were easy to use. It appears that there needs to be more effort put into making the system user friendly. Expertise for normal user interfaces and displays and controls exists, both at NASA and outside the Agency. Although not a part of knowledge management per se, NASA does need to examine the system from the user's frame of reference—how users want to locate information. People should be able to use the system fairly intuitively. If they must acquire extensive training to use it, that could be considered a failure.

Mr. Frost noted that the ASAP carried the recommendation as "yellow" (defined as concern, but currently being addressed by NASA) in the 2015 Annual Report. Based on the sampling done recently, he suggested increasing it to "red" level (defined as long-standing concern that is not being adequately addressed). The infrastructure is in place and NASA appears ready to move on it, but Mr. Frost felt that the ASAP should increase the emphasis.

VADM Dyer added that this will be a recruiting and personnel issue as well. Younger generations of people coming aboard NASA are accustomed to having the world body of knowledge at their fingertips. They will become frustrated with a system that is not what is needs to be or should be.

Exploration Systems Development (ESD) and Risk Acceptance

VADM Dyer introduced ASAP members CAPT (Ret.) Brent Jett, who is a former astronaut and current entrepreneur, and Dr. Donald McErlean, who is an Engineering Fellow at L-3 Communications and retired

senior executive from the Naval Air Systems Command. CAPT Jett's comments were primarily on the Orion Program and related test and evaluation (T&E) issues, and Dr. McErlean's comments were directed to the European Service Module (ESM) and the cross-program systems integration activity.

CAPT Jett noted that a significant section of the ASAP's 2015 Annual Report focused o the Orion Program and the certification for first human flight, currently planned for Exploration Mission (EM)-2. He noted that there have been changes made to the Orion test and qualification plan, that in the Panel's opinion appeared to be schedule driven and would require NASA to ultimately accept more risk for EM-2. Late last year, the ASAP made recommendation that NASA reassess some of these decisions to include the alternatives to schedule relief or mission content adjustment. The Panel also noted that since these issues are often evaluated and debated individually as they arise, and the risk associated with a specific individual change may be acceptable, it is important periodically take a step back, add them all up, and assess the total risk.

After the Annual Report was released, the Panel was invited by NASA to a more detailed fact-finding session at the Johnson Space Center (JSC) to take a "deep dive" into the Orion test and qualification program. subset of the Panel completed that fact-finding session on February 12, 2016.

CAPT Jett noted couple of widely-held Panel opinions: (1) there has been some very good work by the Orion team to close gaps in the Orion test and qualification plan, and NASA has moved some of the testing originally planned for the EM-2 hardware to other test articles, which reduces risk for the EM-2 mission (the first planned crewed mission); and (2) the Panel reaffirmed the findings in the Annual Report that schedule pressure, in combination sometimes with cost pressure, is causing some compromises in the test and qualification program, and these compromises carry with them some additional risk.

Three specific areas noted by the Panel were: the thermal vacuum qualification, the pyrotechnic shock qualification, and the reduced fidelity of the Ascent Abort (AA)-2 test.

CAPT Jett observed that the NASA team has done an excellent job to put together the best technical plan that they could that holds schedule. However, the Panel did not see an adequate evaluation of the alternatives involving schedule relief or mission content change. This is where some improvement could be made by NASA. Further, when looking back six or seven years, the cumulative effects of many changes to the test and qualification plan remains a concern.

Mr. Frost noted that in the past, the ASAP has spoken about accretion of risk. At one meeting, he kept track of some of the additional risks that NASA has "bought into." In addition to the three areas mentioned by CAPT Jett, they are: in 2010, the initial crew flight test was restructured from a low Earth orbit (LEO), where things can be recovery quickly if something goes wrong, to a deep space mission of some type; in 2010, NASA went from a typical integrated qualification test to qualification of subcomponents and pieces; because of schedule and cost, the current plan is fly the crew for the first time at the same time that the complete Environment Control and Life Support System (ECLSS) flies for the first time; and Congress recently directed that the upper stage not be the one that was planned, and NASA is going moving to the Exploration Upper State (EUS), which will be first flown on the first crewed flight.

Each one of these changes was done to help meet schedule or cost, and very careful attention was given to what could be done to minimize the risks, but the additional risk is there. It appears to the Panel that NASA is taking risk after risk to meet schedule and keep the mission as originally planned.

CAPT Jett ended the discussion o a positive note—he stated that the Panel is confident that NASA understands the concerns, and the Panel is looking forward to NASA's actions and responses.

Dr. McErlean noted that the ASAP's Annual Report also mentioned growing concern about the ESM due to the number of Zero Fault Tolerant (0FT) items. The Panel received its first detailed briefing o the subject from Mr. Chuck Dingell and Mr. Robert Hudson. They appear to have a strong handle o what is going o and how to ameliorate the risks, but there is n question there are 0F items within the ESM that violate the evaluation criteria as contained in the MultiPurpose Crew Vehicle (MPCV) 7038 document. At the moment, they are tracking 16 independent items, 12 of which are contained in the propulsion system, 3 mechanisms, and one item in the ECLSS.

The primary items in the propulsion system are "plumbing"—valves, pipe routing, etc. Several of the items involve the selection of hardware that is currently in the ESM. A number of valves have valve latch seal, and any seal is single point failure in valve, which represent a 0FT condition. If the valve fails to hold pressure, it can lead to leaking of all the propulsion material in the ESM, leaving the ESM without maneuvering capability. The other item is problem faced in Shuttle—propulsion latch valve bellows that allow for the system to expand and contract without leakage. However, bellows are historically weak link in a system and are single point failure. Typically, there is secondary backup/containment system. However, these particular bellows d not comply with that. Other problems include the way the system is plumbed; for example, currently, all of the helium ullage pressure sensors are plumbed on one line. NASA has directed movement of at least half of those sensor to second line for EM-1. The helium pressurization system burst disk relief valve, which is necessary if there is overpressure, was not properly sized. The valve is not large enough for full flow rate, and it represents a single point failure. They have now moved that part from the ESM to the crew module adaptor, and KSC will take over the engineering using the proper standards. At the moment, the two ESM fuel tanks are in series; they are planning to move to two parallel tanks such that a leaky tank could be isolated. All of these issues are recognized by the Program and the European partners. Plans and projects are in work to ultimately redesign and fix these weaknesses. They may not be included in EM-1, but the plan is to include them in EM-2 or by the time the first crew flies. The ASAP supports this plan and is most pleased that there has been deep look into the plumbing and systems o ESM and the work with the European partners to get these 0FT pieces and designs out of the system.

CAPT Jett added that this is good news, and NASA's intentions are very clear. NASA's bottom line is: all of the 0F items will be fixed before EM-2; the parallel tank system will be moved in somewhere down the road, probably EM-3 or EM-4. However, they don't have concrete schedules from ESA to make that happen. Potentially, there can be some schedule pressure, and technical and schedule risk could come into play. The Panel will continue to follow this closely.

Dr. McErlean discussed the ESD plans for cross-program systems integration. In producing the total ESD system, Orion, the Space Launch System (SLS) and the Ground System Development and Operations (GSDO) must be integrated. This is currently being handled by the Cross-Program Integration Team (CPIT). It is responsible for tracking interdependencies among the programs and settling or adjudicating any interdependencies where there is disagreement. From an engineering perspective, they are resolving the Inter-Connectivity Document (ICD). They are doing a fairly good job—the number of identified serious interdependencies has been reduced. According to the briefing, over last several quarters, the number that is being elevated has been reduced to zero. Currently, the largest interdependencies that are being treated are the hydrogen burn-off igniter o the core stage and implementing the integrated test lab for ground and flight software testing. ASAP has a concern with the Orion Flight Software Emulator Update (or SOCCRATES). It needs to be updated to handle Class C safety-critical format items. For safety-critical software, the simulator used to validate the software must be of a

higher fidelity than that for other types of software. This activity is in work. They are beginning to put into operations the GSDO ground operations software. Another key interface—the umbilical plate release—is still being worked.

Mr. Frost discussed risk acceptance. In this program, the ASAP continues to see the same approach—a governance model that NASA has used where safety hazards are discussed by various panels and boards and accepted by those entities. The ASAP has examined some of the minutes of the boards and has found that the right people are thinking about the right things, but the result is a board decision rather than an individual decision. The Panel has gone o record with a recommendation that serious safety risks should be assigned to an individual to accept, and that the acceptance should include what the alternatives are and document what the benefit and the risk is. NASA is working on changing the policy to respond to the recommendation, but the policy has not yet been released by NASA Headquarters. Because the Panel believes there is great benefit to be gained in changing the approach of documenting and accepting risk, it encourages NASA to continue to press forward o the action.

International Space Station

VADM Dyer introduced Dr. James Bagian, former astronaut and professor in both the University of Michigan's School of Medicine and School of Engineering, who reported on the ISS. Dr. Bagian noted that the ASAP is continually impressed with this complex endeavor. The Panel has high confidence in the way the program is being managed. Mr. Kirk Shireman, ISS Program Manager, briefed the Panel members on the status of the manifest. The ASAP looks forward to an upcoming launch of the Bigelow Expandable Activity Module (BEAM), which is an expandable module that will be berthed o ISS and will be evaluated for several years on orbit. This will add to the knowledge already being gleaned from the two subscale free flyers that are already on orbit.

Mr. Shireman talked about Extravehicular Activity (EVA) 35 where there was a water leak in the suit. This was the same Extravehicular Mobility Unit (EMU)—suit 3011—that was used in EVA 23, where there was a leak some months ago. The amount of water in the recent incident was approximately 200cc to 250cc, which was much less than that o EVA 23, where it was estimated that 1000cc to 1500cc was observed. They are in the process of gathering information to understand the cause and are bringing back samples of the water collected and the suit to better understand the situation. The Program does not believe it is the same fan separator problem that was the issue on 23, but at this point it is uncertain. Until they get suit 3011 back and examine it, they will not know for sure. Utilization of ISS continues to be at an average of approximately 37 hours per week and is on target for what was planned. Mr. Shireman also talked about the ongoing work associated with the CCP flights that will be coming up in the future. CRS-2 contract award winners were announced in January 2016: Sierra Nevada, Orbital, and SpaceX. Those flights will commence in 2019.

Dr. Bagian discussed ISS End-Of-Life (EOL) status. The ASAP talked about this subject several years ago and brought it to NASA. At the time, the Agency approach was to study it and try to understand it. At some point, Station will be deorbited, hopefully under planned situation. However, it is possible it may be under emergency or contingency conditions, and the thinking was that it would be better to have a plan ready and not needed than not have a plan ready and need it. Although some planning has occurred, actions have been progressing more slowly than desired. The good news is that in January 2016, the Russians received direction to restart EOL product development. This is step in the right direction. In March 2016 there will be a Technical Interchange Meeting in Houston to move the EOL activities forward. A number of issues still need to be addressed, ranging from the equipment's ability to operate in vacuum to implementation of propellant freeze-mitigation steps. The ASAP was heartened to see more substantial movement forward and was glad to see a reinvigoration of EOL-related activities, since the Panel feels that it is important to have an executable plan in

place. The ASAP hopes that these new activities will rectify the issue and Panel members will continue to follow its evolution.

Tri-Federal Advisory Committee Act (FACA) Meeting on Commercial Crew Program

Dr. Patricia Sanders, aerospace consultant and former Executive Director of the Missile Defense Agency, with extensive missile test and evaluation experience, reported on the Panel's fact-finding with the CCP. As noted by VADM Dyer, the Panel's time with the CCP was shared with representatives of two other advisory groups. This made for a greater number of questions and a longer session. While not intended to become the norm, there was value to do it this one time by bringing different perspectives to the discussion.

As VADM Dyer has stated, the Panel believes that the very challenging CCP is in good hands. Ms. Lueders is an excellent program manager and has assembled a quality team. She is managing a program with a very different approach from the traditional NASA program. Requirements are levied on providers at a higher level and skill is needed in balancing insight and oversight. Ms. Lueders has a superb grasp of the Program's challenges, an awareness of the risks, and a team that is actively and effectively working the issues.

The balance in applying insight and oversight is exemplified by the ongoing certification process. Requirements for certification were defined by NASA and laid on the industry partners. Industry responsibility is to design, develop, test and evaluate, to support their assertion of compliance. NASA's role is to ensure compliance and to evaluate and approve the evidence. It is a shared assurance model, with providers working together as partners. It is also being addressed by NASA with a risk-based approach. The Program Office is allocating insight and oversight with the most intense resources going to the items with the most risk—whether technical or with respect to certification difficulty. The Program Office is making good progress in driving out the risks in each partner's approach with a consistent process for addressing proposed variances. Where necessary, risk is accepted by the Program Control Board. While the Panel feels that they have a disciplined and thorough risk acceptance process, we continue to advocate strongly for a single signatory and accountable individual for accepting risk and documentation of the rationale. The ASAP noted positively that the Program Manager paid focused attention to avoiding cumulative and compounding risks and specifically looked at these at system levels. This is more difficult and time consuming, probably prolongs the progress, but is critically important. Similar to the certification process, the Safety Review Panel has been addressing Hazard Reports. Eighty-five percent of the Hazard Reports have been delivered and forty-three percent have been adjudicated. The process is still lagging the ideal timeline, but appears to be catching up.

The Program is now in an especially stressful period dealing with a fixed-price contract as they address the variances and waivers. The Program Manager and her team are paying key attention to focusing on and allocating resources to the "big rocks." They also have the challenge of still dealing with several issues as hardware is being produced and it becomes more difficult and costly to make changes to designs. Also, changes to address one risk may introduce new risks. While the partners are optimistic with respect to the schedule for first flights, the Program Office is being realistic about waiting to see how the work progresses. They maintain placeholders in the ISS manifest, but will decide later when and which provider will fly first. This seems to be a prudent approach.

The Program Office presented a discussion of their top programmatic risks. These included the potential for engineering changes and impact on the program, additional costs for Independent Verification and Validation (IV&V), and the ability to close the Loss of Crew (LOC) gap. The previous top risk of "budget uncertainty" has been mitigated for now by the recent Appropriation, and the ASAP is pleased to see that. The group also spent time on in-depth and candid review of some of the main risk areas in the partner programs. The Panel was gratified to see the thoroughness of how they are being addressed.

There were a couple of special interest topics discussed at the end of the session. One of these was integration with the ISS. The Program is already working the issues involved with this integration and leveraging existing ISS forums. This includes working with the International Partners, which will always be challenging. Another area that has been of particular interest to the ASAP is planning for potential mishaps. Late last year, the Panel made a recommendation with respect to the appointment of a Presidential Commission for some mishap investigations. In response to the recommendation, NASA has developed some language to be proposed to replace the current Congressional mandate for such a Commission. The ASAP believes that NASA is on a good path for that.

Finally, the Panel continues to see the value of two providers with very different approaches and commends NASA for staying the course on competition.

CAPT Jett added that since the last quarterly, both Dr. Sanders and Dr. McErlean did "deep dive" into commercial crew certification in early December 2015. Dr. McErlean reported that they reviewed the certification process and the program that is currently being worked to bring both partners u to meeting requirements. They were very pleased to see the process that was being used, similar to that being used in military and commercial aircraft. The Agency has provided a set of requirements, has stated what needs to be shown to validate that the design is in compliance with those requirements, and has gotten agreement that the providers will produce the compliance artifact (test, report, analysis, etc.). All that work has been done, and the Program Office is in the process of gathering the compliance artifacts and reviewing them. Dr. McErlean stated that Dr. Sanders and he were very satisfied with process. This was addressed in the Annual Report. Dr. McErlean also noted that the media and others have carried stories about usable rockets; currently, there are at least two commercial contractors that have demonstrated reusability. There is a great hope that reusability will drive down cost. During the Panel's visit to KSC, it was allowed to visit significant piece of hardware that had been recovered from space and was impressed with its condition. This is good news for the future.

Mishap Response

CAPT Conway reported o the ASAP review of the status of the open recommendation o the five-year roadmap for continuous improvement of the Agency's mishap investigation process. The Panel had wanted to hold this recommendation open a little longer to get a good feeling for the Mishap Investigation Board (MIB) chair and member courses to see how they were shaping up. NASA appears to have a solid roadmap. Mr. Gerry Schumann provided an update to the ASAP. The briefing was short but full of good information. The NPR 8621.1C is in the signature loop and should be released soon. It was reorganized to follow the flow of the investigation process, making it a more user-friendly document. Excerpts from document showed what training an individual should receive, and the training assignments are there. Several courses were listed. Mr. Schumann showed the Panel the 2015 metrics and the new courses to be introduced for 2016. The continuation and finalization of the MIB chair course combined the best of the DoD and NASA courses. The rest of it is on track. CAPT Conway recommended that the ASAP close Recommendation 2012-03-05, "Five-Year Roadmap for Continuous Improvement of the Agency's Mishap Investigation Process," and the Panel agreed.

There were no comments or questions, and the meeting was adjourned at 2:15 pm.