

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

August 5, 2015

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 2015 Third Quarterly Meeting at Langley Research Center, Hampton, Virginia, on July 21-23, 2015. 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,

A handwritten signature in black ink, appearing to read "J. W. Dyer". The signature is fluid and cursive, with a large initial "J" and "W" that are connected to the "Dyer".

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

Enclosure

**AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
July 23, 2015
Langley Research Center
Hampton, Virginia**

2015 Third Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP) Attendees

VADM (Ret.) Joseph Dyer (Chair)
Dr. Patricia Sanders
Dr. James Bagian
The Honorable Claude Bolton
CAPT (Ret.) Robert Conway (via telecon)
Mr. John Frost
CAPT (Ret.) Brent Jett
Dr. George Nield
Dr. Donald McErlean

NASA Attendees:

Gaudy Bezos O'Connor, LaRC
Bryan Haas, LaRC, COD
John Inge, LaRC, COD
Chuck Niles, LaRC, COD
Jim Osborn, LaRC, COD
Joseph Patterson, LaRC, SMAO
Krista Jenson, LaRC, OP
Ryan Bradley, LaRC, OP
John Gieko, LaRC, OSMA
Pete Polen, LaRC, OCC
Melody Liples
Karen Fallon, LaRC, OP
John Koelling, LaRC, EIA
Sherilyn Brown, LaRC, EIA
Sandra Holmes, LaRC, SMAO
Jose Caraballo, LaRC
Don Parker, LaRC

Opening Remarks

The Aerospace Safety Advisory Panel (ASAP) Chair, VADM Joseph Dyer, called the public meeting to order at 10:00 a.m. and welcomed attendees. He thanked Mr. David Bowles, Langley Research Center (LaRC) Director, and everyone at LaRC for their hospitality. He noted the Panel's pleasure to see the new facilities and a refreshed energy here. LaRC is a very important part of NASA. VADM Dyer highlighted one of the most important outcomes of this quarterly meeting: in the detailed discussion of a full spectrum of ongoing activities at NASA, there was consensus among the Panel as well as with the NASA Chief Engineer, Mr. Ralph Roe, and NASA's Head of the Office of Safety and Mission Assurance (OSMA), Mr. Terry Wilcutt, with regard to the top

ASAP Staff and Support Personnel Attendees

Ms. Harmony Myers, ASAP Executive Director
Ms. Tina Alexander, Assistant Administrative Officer
Ms. Paula Burnett Frankel, Writer/Editor

Telecon Attendees:

Marian Norris, NASA HQ
David Balajthy, NASA OIG
Josh Berk, SpaceX
Nick Cummins, U.S. Senate
Doug Cooke, self-employed
Alexander Fischer, no affiliation
Jeff Foust, Space News
Rick Irving, NASA
Kelly Kabiri, NASA OSMA
Josh Manning, Senate Commerce
Jennifer Read, NASA JSC
Ralph Roe, NASA HQ
Tommy Sanford, Space Flight
Jared Stout, U.S. House of Representatives

Other Attendees:

Angela Bounds, ManTech
Carter Ficklen, ManTech
Laura Northern, ManTech

technical risks and issues now and over the near horizon. These top technical risks will set the tone for the Panel's work over the next year and the 2016 Annual Report to the Administrator and the Congress.

(1) Technical insight into commercial crew partners' designs and processes. There has been significant improvement in the Panel's insight and the transparency into the Commercial Crew Program (CCP), and continued technical insight into that Program as it enters into final design is critically important.

(2) Integration of the Exploration Systems Development (ESD) programs.

(3) Closing the technical baseline for the Orion Multi-Purpose Crew Vehicle (MPCV), the Space Launch System (SLS), and the Ground Systems Development and Operations (GSDO). ESD embodies what NASA and the Panel have called "capabilities-based management," which is a slower and more flexible approach to building needed capability for the future. In other words, it is a "let's build the parts and we will integrate them into things such as an aggressive mission to Mars downstream." This approach is different from the focus that was seen in Apollo, which had a date and a destination, with a program built and integrated to directly support that. There are challenges in the "parts" approach, both in program management and in integration.

(4) Maintaining and supporting the International Space Station (ISS).

(5) The James Webb Space Telescope (JWST)—an important program and a system that represents a great investment. It is sometimes expressed in the popular media as "being able to see to the beginnings of time."

The ASAP's fact-finding on July 21 began with an overview and update on LaRC by Mr. Bowles, followed by several topics related directly to LaRC. The Panel then continued with topics that are reviewed at every meeting: ESD, ISS, and CCP.

Overview of Langley Research Center

VADM Dyer reported that the Panel was pleased to see Mr. Bowles in place as Center Director. He has a long and successful history at LaRC and has played an important part in building the institution that NASA has today. The Center's annual budget is around \$850 million (M). About \$30M of that comes from external sources (the Department of Defense and others). The current workforce is about 3,500 total—1,900 civil servants and 1,300 contractors. VADM Dyer noted that the civil servant/contractor ratio is more balanced at LaRC than at most other NASA Centers. The budget is invested primarily in two program streams: aeronautics (\$217M) and science (\$214M). Science reflects primarily entry/descent/landing (EDL) activities, structures, and radiation. The ASAP noted the facilities improvements and LaRC's approach to people management, which they refer to as "forward-fill" rather than "back-fill"—looking at what is needed for future work and not just back-filling the status quo.

Infrastructure and ViTAL (LaRC Revitalization)

Dr. Patricia Sanders reported on the ASAP's fact-finding on this topic. She noted that Mr. Bryan Haas gave the Panel a fairly comprehensive overview of the state of LaRC's infrastructure and its revitalization plan. The Center has 159 buildings and other assets with a current replacement value of \$3.5 billion (B) located on 764 acres. Like all the NASA Centers, this one is challenged with many aging facilities and nearly \$200M of deferred maintenance. Its goal is to strategically use its resources to ensure critical assets are available to meet Agency mission needs. Among the major challenges are maintaining the electrical distribution systems and utility tunnels, avoiding or mitigating major component failures of the research facilities, and addressing the deterioration of building exteriors.

The LaRC strategic approach to meeting infrastructure challenges consists of tiered maintenance to invest in higher priority facilities to reduce risk to mission, proactive maintenance to minimize unexpected failures, investment in new mission capabilities and reduction in the cost of maintenance, and demolition and divestment of excess and antiquated capability. Under LaRC's revitalization plan, the Center has invested in new and renovated state-of-the-art, sustainable, and energy-efficient facilities and upgrades to electrical, sewer,

water, and high pressure air. The plan is periodically revisited to ensure it meets current and future needs. The Center has eliminated assets, reduced deferred maintenance, saved maintenance and utility costs, and reduced the facility footprint. It has exceeded the Agency goal for reduction in water and energy usage.

Dr. Sanders made two observations: First, the Panel was impressed by the thoughtful consideration being given to not only replacing infrastructure in kind with newer, more efficient facilities, but to rebuilding for the future, supporting emerging needs and new technologies. Second, the Panel observed that the revitalization clearly enhances safety at the Center and applauds that outcome.

CAPT Robert Conway added that he was equally impressed with LaRC's VITAL program, much as the Panel was impressed with the Marshal Space Flight Center (MSFC) approach to infrastructure management. LaRC's deliberate approach is noted and commended.

VADM Dyer agreed and noted that one of the interesting and exciting parts of participating on the Panel is the opportunity to visit all of the NASA Centers. Great examples of good work could be made even better if best practices are shared across the Centers. The "cross-pollination" between the excellent work that the Panel saw at MSFC and the work being done here would set the standard for the Agency at large.

Research Directorate Infrastructure and Contributions to Human Space Flight

Dr. James Bagian reported on the Panel's fact-finding on the material presented by Dr. Jeremy Pinier from LaRC's Research Directorate (RD). He covered the infrastructure involved in supporting research and development done at LaRC as well as some of the projects. Primarily, he talked about the RD's contributions to the ground test infrastructure in aerosciences and how there is close work among the RD, the Engineering Directorate, the Systems Analysis and Concepts Directorate, the NASA Engineering and Safety Center (NESC), and other NASA Centers. Various areas in which the RD is involved include configuration aerodynamics, computational aerosciences, aeroelasticity and unsteady aerodynamics, aerothermodynamics (EDL), and flight dynamics stability and controls. Dr. Pinier discussed the various facilities that exist at LaRC. He noted that the LaRC Unitary Plan Wind Tunnel (UPWT), while still being used, is slated to be closed. It is an historic wind tunnel, in use for decades. Among the projects, often there is interaction both on a professional basis and use of facilities at other Centers as well as the private sector. He talked about two recent highlights: one in the UPWT for the SLS booster separation testing, and another one in the Transonic Dynamics Tunnel (TDT) with the SLS transonic buffet environments. It was noted that despite the great capabilities here, there is an issue that runs throughout the Agency—there is no longer any substantial redundancy of capabilities, either professionally or from a facilities standpoint. This is cause for some concern. Currently, they are working at capacity, both professionally as well as regarding what the infrastructure can support. If any facilities go down, a capability would be totally lost, at least temporarily. This is due to the fiscal environment, and it represents a vulnerability. There is a lack of robustness to accommodate surges in work demand.

VADM Dyer commented on his experience when he was program manager on the Navy's variant of the F/A-18. There was a serious problem with some aerodynamic stability, and the program came to LaRC aeronautics and the wind tunnels for help. The Navy got it, and the problem was fixed. The facilities at LaRC are critical and the people even more so.

City Environment for Range Testing of Autonomous Integrated Navigation (CERTAIN)

Mr. John Frost reported on the fact-finding on CERTAIN. Mr. John Foggia from the Crew Systems and Aviation Operations Branch walked the ASAP through the LaRC plans in this area. The goal of CERTAIN is to develop trust and confidence in Unmanned Aerial Vehicle (UAV) navigation. He noted that we are in an interesting transition period—from how to get UAVs to work to how to get people to trust them. The Program consists of three

phases: (1) an indoor phase (the facilities are here at LaRC to work with UAVs); (2) an outdoor phase where there is GPS in a constrained area; and (3) a phase where LaRC is turned into a testbed for UAVs, representing a realistic city with urban issues. The first part of that will be in an outdoor area adjacent to LaRC. Mr. Frost noted his experience with testing ground vehicles (unmanned cars). The manufacturers are working with the University of Michigan to have a similar “city environment” to test ground vehicles. The ASAP noted that the issues are similar, and there may be something that the two groups can learn from each other. Currently, LaRC has a Certificate of Authorization (COA) allowing operations below Class D aircraft (108 acres). It will soon be expanded to include the entire LaRC complex. That will give great flexibility to work with operational aircraft and fields. LaRC recently conducted a unique operation near Wise, Virginia where LaRC fixed-wing aircraft (remotely controlled, but with a safety pilot onboard) delivered medicine that was remotely helicoptered to a remote site. These are one-step-at-a-time progressive improvements. The long-range goal for this Program is to expand LaRC to become the East coast center of excellence for Unmanned Aircraft Systems (UAS). They are also working with Virginia Tech and the Mid-Atlantic partnership. This offers great promise toward meeting the center of excellence capability. Mr. Frost noted that LaRC has an excited program manager with great vision and energy. He expects on a future visit that LaRC may look a lot like “George Jetson’s” neighborhood, with vehicles flying about.

Mr. Claude Bolton commented that the ASAP asked Mr. Jeff Hill from the UAS Office about his qualifications and how they certify pilots. Mr. Bolton indicated that he was impressed with the procedures, not unlike procedures for manned aircraft. Everyone has to be certified, and Mr. Hill or someone from his office personally supervises the pilots when they are flying. LaRC is on the leading edge of a revolution in UAS. Currently, the technology is ahead of regulations. Anything NASA can do to make system work better will be of great benefit.

UAV Range Safety

Dr. Donald McErlean reported on the fact-finding with Mr. Hill, who provided a good overview of LaRC’s UAV range safety. It was very satisfying to see that LaRC has moved out on both range safety and safety for operations to create a “Range Safety Officer” (RSO), Mr. Hill, for UAS operations. Mr. Hill’s responsibilities cover all UAS operations for LaRC—any UAS that operates on the LaRC site and any LaRC UAS that operates anywhere. Dr. McErlean stated that this is the right approach. It provides a single set of policies and oversight to help ensure safety. As noted by Mr. Bolton, the person selected for the first RSO position has exceedingly extensive experience, both as a UAS and a radio-controlled pilot. He is a systems safety engineer and a voting member on LaRC’s Airworthiness and Safety Review Board (ASRB). He provides oversight of UAS operations with the objective to prevent injury to persons and damage to property. He works to ensure that UAS stay within their approved ranges, or “fence lines.” Mr. Hill readily admitted that is one of his primary concerns. He wants to ensure flight contingency plans. Also, he has a set of responsibilities for an accident. The ASAP was pleased to see that the responsibilities are laid out in advance.

Mr. Hill is also involved in getting UAS airspace for public use UAS—new COAs and Memoranda of Agreement (MOAs)—all of which will expand the area of operation for UAS development. He is responsible for implementing policy and procedures in accordance with NPR 8715.5 Range Safety Program, upholding those and ensuring that they are followed during range operations. The range safety criteria are based on a set of performance questions and risk analyses—risk of losing the airframe, risk of range boundary violation, risk of injury to people or damage to property, and risk to NASA’s reputation. UAS for public-use airspace is very important. This is where the research and development community, the FAA, and the general aviation community have come together to protect public safety and allocate appropriate research resources to continue development of these devices in a rational way. The current operations at LaRC are excellent, and they have well-qualified people. Dr. McErlean indicated that he would like to see the policies, procedures, and operations documented in standard operating procedures or policy documents. Currently, the system is working well, but is

depending heavily on the embedded experience of the people in the system. Documentation is needed for two reasons: (1) eventually, people will be replaced and new people will come onboard; and (2) as clearly the leader in UAS operations, the ASAP would like to see LaRC's ideas, processes, and procedures promulgated at other Centers as a basis for NASA-wide policies on UAS operations.

Mr. Bolton added that the last bullet on Mr. Hill's summary chart said it all: "This is just the beginning!"

Health & Safety Update

Mr. Bolton reported on the fact-finding with Mr. Grant Watson, LaRC's Director of Safety and Mission Assurance (SMA). He discussed the changes to LaRC since the ASAP's last visit. He also discussed the health, safety, and mission assurance highlights, injury metrics, and areas of concern. With regard to his office, he introduced the new Deputy Director with 25 years' experience in the Army, at the Kennedy Space Center (KSC), and at LaRC—Mr. Jose Caraballo. The ASAP also looked at the technical assistance that has been added to manage support contracts. Responsibility for the health and wellness programs has been transferred into the SMA Office. This is not unique. Ames Research Center (ARC) and Glenn Research Center (GRC) have the same structure. Mr. Watson's office is also responsible for the aging clinic and fitness center equipment. Focusing on employee health and safety is a two sided coin, but it is also reflective of very old philosophies that view a person's health as both the body and the mind. Studies have shown that if people are kept on the health, fitness, and wellness track, they are more productive. This is totally in line with NASA's philosophy. Feedback from employees has been extremely positive.

With respect to the changes in the Safety and Facilities Assurance Branch (SFAB), there is a vacancy for the Acting Branch Head. The SFAB is divided into two teams—facilities assurance and occupational safety. Two early hires are already in place. Employees have been transferred to the office to help rebuild the facilities management capability. In terms of safety highlights, the SFAB workforce is well positioned for the future. There is good age distribution and leadership development underway. The focus is on the "people side" of health and safety.

The ASAP looked at the safety metrics, which are all favorable. The Total Case Incident Rate (TCIR) is around 1.0 and shows a decreasing trend. Days-Away/Restricted-Duty (DART) metrics are also in the right direction. There is a concern over aging facilities. Mr. Watson noted the gantry as an example. It is old and corroding but is being used on recent projects because of its unique capability. Over the years, various decisions have been made. While they were the right decisions at the time, NASA was not looking at the cumulative effect of those decisions. Highlighted examples are the gantry and the wind tunnel. Mr. Bolton suggested looking at the cumulative decisions and then making a decision on what to do with the facility. LaRC is not unique when it comes to aging facilities. NASA needs to look across the board and see if there is better way to make the final decision on whether to sustain the facility or eliminate it.

The challenges for the Mission Assurance Branch (MAB) are not unique. Over the next 10 years, there are a number of potential engineering retirees. This is not unique to NASA. ASAP is pleased to see fill-forward and other initiatives to get younger people onboard and to reduce the "brain drain." Along those lines, the MAB has hired mid-career, quality assurance specialists to ensure viability of the quality assurance workforce over the next 5 to 10 years. NASA need to keep a close watch on this area. Highlights for the MAB include successfully supporting three Earth-observation instrument designs/builds: The Stratospheric Aerosol and Gas Experiment (SAGE) III on ISS, Tropospheric Emissions: Monitoring of Pollution (TEMPO), and the Radiation Budget Instrument (RB). Mr. Bolton expressed the ASAP's compliments to all who made those instruments possible.

Exploration Systems Development

Dr. McErlean reported on the briefing that was provided by Mr. Bill Hill, Associate Administrator for ESD, and noted that it was an extremely comprehensive presentation. Mr. Hill began by reviewing the overall ESD program for the SLS, including the space launch core vehicle, the Orion crew capsule, and the GSDO. He described some of the most recent accomplishments, including the beginning of the hardware to support Exploration Mission (EM)-1, the EM-1 pathfinder first weld at the Michoud Assembly Facility, crew module structural test at GRC, and some flight tunnel and integrated test lab mock-ups. He mentioned that they have now had a successful solid rocket booster (SRB) qualification motor (QM) firing at Orbital ATK. This was a SRB that was found to have had voids. It was recast using a new process, and when re-fired, it was successful. The RS-25 engine is beginning its testing phase at MSFC and so far, has been successful as well. With respect to GSDO, the ASAP saw the Mobile Launcher at KSC. It is moving ahead for its final testing and refurbishment.

Dr. McErlean noted that the ESD is really three programs: GSDO, SLS, and Orion. The question from the ASAP is: How does one manage the interfaces among these three “semi-autonomous” programs such that the integrated product performs in accordance with the desired capability and provides a level of performance and safety for NASA’s astronauts? These large, complex, multi-variable systems must work together to create an integrated performance. This is often a difficult task. For ESD, it is being handled by a Cross-program System Integration (CSI) team. NASA reviewed the CSI accomplishments with the ASAP. They range from relatively simple interface control document (ICD) agreements to more complex items in terms of risk assessments and opportunities to improve performance. Products are on schedule and the cross-program interdependences (those elevated to “watch” level) have dropped dramatically. This means that the programs are getting better at talking with each other and working out the interactions at a lower level to preclude elevation for resolution at the leadership level. Dr. McErlean noted that all of that is good news. Out of 160 interfaces, 134 had no required changes from the previous report. The interfaces are becoming stable and well-defined, which is also very good news.

The top technical issues that were closed in the last quarter included: a concern about Orion Service Module (SM) hazardous servicing (a face-to-face meeting that resulted in developing SM servicing plans at KSC), disconnect of Core Stage umbilical loads between GSDO and SLS/Stages (resolved by further refining analysis, stiffness testing, and minor design changes to some small cable supports), lack of the interim Cryogenic Propulsion System (ICPS) emulator for ground software development (ULA agreed to provide an emulator), and potential interference of ICPS telemetry with Orion (a new frequency was selected). Some new issues have developed since March. There is a concern with gaseous hydrogen buildup just prior to RS-25 start and how that will be handled. If there is a problem, there is the potential of using a burn-off. That research is ongoing. Finally, there is the question regarding the goal of crew recovery within two hours of splashdown. Under certain sea states, that is a difficult task. It may mean getting the crew out within two hours and allowing recovery of the capsule to take longer under certain sea states. This seems to be a reasonable safety mitigation. Mr. Hill went through the Technical Program Metrics (TPM) summary report. The “red” risks appear to be going down, although they have not yet been eliminated. Probably the largest risk area is in risk to the currently configured EM-1 launch date. Schedule is a continuing issue as budgets drive schedule and technical problems arise. That is a programmatic risk and is a concern, and it is being closely monitored by the Program. Currently, it is not a direct safety risk unless someone starts to make safety tradeoffs in order to gain schedule. That is something that the ASAP looks for continuously. The probability of Loss of Crew (LOC) on ascent and descent (one of the TPMs) has been holding steady. There have been some positive results, one of which came from LaRC: wind tunnel verification of booster separation analysis. There had been a number of computational fluid dynamics analyses that showed that there was a reasonably high probability of booster re-contact with the core stage. Results from two different analyses did not agree with each other. A decision was made to use the wind tunnel to confirm the correct analysis. As a result, the threat of booster re-contact is down, which is certainly good news. Dr. McErlean commended the people who participated in the study.

CAPT. Brent Jett noted that one of the most difficult things to do is identify the integrated hazards. This is something that the Panel will continue to watch closely. Even when there is an overarching program that is responsible for all of the elements, identifying integrated hazards and developing mitigation plans or eliminating them is tough to do.

Mr. Frost added that NASA owns the world's textbook example of failure to find an integrated hazard—in the Columbia accident, the foam that came off the tank was not a threat to the tank, but was a threat to another component. That is the classic type of failure that no one wants to repeat.

Dr. James Bagian reported on the fact-finding on the separate ESD program pieces where the ASAP learned about recent Orion challenges and issues. One was the supplier base. The Program team is finding that in the machining of the cone panels, they have a "spring-back" phenomenon. As the parts are machined, the actual form of the cone is changed. Machinists are learning how to better form these panels. Mr. Hill indicated that the Program is still working to get more consistent results. He went over the issues that are still open. Another was the heatshield status. In the past, there have been issues on the Orion heatshield from a host of areas. One was the underlying structure and another was the thermal protection system itself. The decision was made to go from a monolithic heatshield to a block heatshield (both use Avcoat). That decision is not yet final, but the Program is moving toward using a mosaic block system, bonded to the structure itself. Each has its challenges. Cracks were an issue with the monolithic heatshield. With the Avcoat block, the issue is the adherence (bonding) of the block. There is risk associated with both approaches. Neither is a mature system that has been demonstrated. Due to fiscal reasons, the selection of one has become necessary. CAPT Jett clarified that the Orion Control Board made the decision to change the heatshield design to Avcoat block, but there was a dissenting opinion that has not been resolved. The issue is being carried forward to the Agency level. Both heatshield designs have challenges that needs to be closely watched. Another issue concerned "pendulum risk." If one of the three Orion parachutes fails, there can be a pendulum effect where there is oscillation of the suspended Orion spacecraft under the parachutes. Under certain situations, the landing loads could present a hazard in terms of crew health. The Program has done extensive analysis and has found that the way to mitigate this risk is reduce the deploy altitude for the main chutes from 8,000 feet to 6,800 feet. The Panel has requested further information to understand how that was decided, what the margins were, and why 8,000 feet was the deploy altitude for the parachutes to begin with if 6000 feet is thought to be acceptable now. Mr. Hill agreed to get back to the Panel with the rationale and the margins. He also talked about the Altitude Abort (AA)-2 flight test and the things that would be handled during this testing. The Program completed a study to develop a more affordable AA-2 option that meets a minimum set of flight test objectives. Dr. Bagian noted that the ASAP is becoming somewhat concerned about the interplay among schedule, performance, and budget and how that can affect safety.

Mr. Hill reviewed some of the SLS issues. One of the main activities has been looking at the RS-25 engines. He indicated that they should not be much of a problem. As mentioned earlier, the QM-1 test went well.

With regard to the budget, Mr. Hill concluded his presentation by looking at the interplay among schedule, cost, and technical content. One of the concerns is that with the schedule inviolable for a 2017 launch, technical content mandated, and costs constrained, there is no "wiggle" room. The Panel's concern is that everything is not locked down yet; there are uncertainties. As these uncertainties become known, it will almost necessitate something else giving way. If faced with the situation where there are mandates on schedule and cost, the level of performance and/or safety could be encroached upon. There is always the need to be vigilant to ensure that the right tradeoffs are made.

Mr. Frost fully agreed with Dr. Bagian regarding the constrained environment in which ESD finds itself. The ASAP is continuing to see where slight risks are being taken to meet cost and schedule constraints, e.g., the abort test. There will be an altitude abort test, but in order to reduce schedule and cost, a decision has been made to leave off a few of the features, e.g., the parachute and the ejection. These features will be demonstrated other ways—analytically and at the component level. NASA has made the decision that the entire end-to-end abort system does not need to be demonstrated. It appears that the Agency has done a good job of “fleshing out” the pluses and minuses. The decision has gone through the Agency to the highest management levels. If there is any “wiggle” room, NASA should try to get the parachute and the ejection back into the test. This may be fairly minor, but as seen in the past, higher than intended risk can be introduced subtly, one step at a time.

Mr. Frost raised another issue: on EFT-1 they found more hits by micrometeoroid and orbital debris (MMOD) than anticipated, which tells NASA that they need to address this issue. For the long term, they plan to do some hardening on the upper stage. For the short term (EM-1), one option is to reduce exposure time to the hazard. The ASAP’s concern is that the hardening for future designs may not be ready for EM-2, and there is some worry about reducing orbits on that mission. EM-2 will be the first time the Environmental Control and Life Support System (ECLSS) is demonstrated on a crewed mission. There is risk in taking that approach. The mitigation of that risk would be to spend some significant time orbiting. If that orbit time is reduced, confidence in ECLSS would be reduced. Mr. Frost suggested keeping a close eye on this situation.

CAPT Jett added that this couples into the question raised at the last quarterly: Is NASA going to fly the Exploration Upper Stage (EUS) on EM-2, or is it going to go with the ICPS? Obviously, if NASA goes with EUS (a good decision), there will be an opportunity to build in MMOD shielding. Adding that feature to the ICPS could be more challenging. Those two issues go hand-in-hand and will be watched closely. He noted that because of the constraints the Program is under, at the ASAP’s next quarterly fact-finding session, the Panel will be reviewing in detail the overall test and verification program for the SLS, Orion, and GSDO, as well as how those have been modified from the original baseline. Individual decisions can be very good and the right ones at the time, but the ASAP wants to take a step back and look at the overall impact of the decisions and become comfortable that the test and verification program remains robust.

VADM Dyer observed that the Panel is sometimes criticized for delving into budget and cost issues. The ASAP doesn’t accept that criticism because when looking across NASA’s safety history, one will see that cost pressures and schedule pressures are most often the causal factors in a path of shortcuts that doesn’t lead to a good place. With regard to the SLS, there is special interest and concern about the trade space, the ability to find an optimum path forward, and the importance of having sufficient funding.

NASA Engineering and Safety Center

Mr. Bolton reported on the fact-finding with Mr. Tim Wilson, NESC Director. He noted that this particular presentation on the NESC was well-placed, given the previous comments. As NASA goes forward with these challenging programs, it is good to have an organization that is independent and has the right expertise to examine the technical and safety issues. Independent technical assessment is a critical component of the safety and mission success of NASA’s programs. The question sometimes asked is: What is independent about the NESC? It has a reporting chain to NASA Headquarters, not the Center or program, and its funding comes from the Headquarters budget line and is independent. People in that office are also independent—they are not part of a program. According to Mr. Wilson, the NESC workload remains high and is distributed across all of NASA’s missions. It continues to receive outstanding support and participation from the Centers, and it receives very positive support from the Administrator and NASA Headquarters. The NESC is engaged in mitigating the Chief Engineer’s top technical risks and laying the groundwork for technical capability management. With three human spaceflight programs in development, one in operations, and multiple Earth and planetary science

programs in every lifecycle phase, continued support from the Agency and others will be critical. Another common question is: How did the NESC get started? It is an outgrowth of NASA's last major accident (Columbia). Although it was not a direct recommendation from the Columbia Accident Investigation Board (CAIB) report, the NASA Administrator and the then current Chief Engineer came together and looked at the challenges and the best way to address them.

Requests come into NESC from across NASA. Engineering and scientific organizations put in about 46 percent of the requests; program managers put in about 18 percent. Trends over the last 10-plus years are leveling out to the exploratory-type programs. From what Mr. Wilson discussed regarding workload, the NESC is probably at the maximum on what they are about to handle now (about fifty activities). Beyond that, they would have to prioritize. Mr. Bolton highlighted what the NESC has been doing with regard to the top five agency risks.

- (1) Technical Insight into CCP designs and processes. The CCP Chief Engineer asked the NESC to assess the risk of frangible joints in CCP spacecraft designs. The NESC has extensive frangible joint modeling and testing underway to characterize design sensitivities. This work will advance the understanding of the hardware and help ensure its safe handling, installation, and operation in flight hardware. This an example that highlights how safety and engineering merge together, and it is a good example of how it is working well. This would also present an opportunity to understand the various rules, regulations, and specifications on frangible joints and whether any of that should be changed.
- (2) Technical Integration of ESD programs. NESC is developing independent models and performing independent simulations to mitigate integration risks in the program elements. It is applying model-based systems engineering tools to assess and manage the complex interfaces between the SLS, the MPCV, and the GSDO projects. It is probing specific integration processes such as hazard development and avionics and software verification and validation (V&V).
- (3) Sustaining and maintaining the ISS. NESC participated in the ISS extravehicular activity (EVA) water anomaly and the EVA recovery team failure analysis investigation. On another subject, also related to ISS, the NESC is assessing the potential for lithium-ion battery thermal runaway and developing severity reduction measures.
- (4) JWST mechanical systems. NESC has conducted independent testing of the JWST micro-shutter mechanism to isolate the cause of unexpected wear. They determined that there was debris from roller misalignment and insufficient lubrication.
- (5) Closing baselines for the MPCV, the SLS, and the GSDO. NESC has conducted tests and analyses to isolate the cause of low material properties and cracking observed in the Avcoat used on the EFT-1 heatshield. They are assisting in development of bond verification techniques for the Avcoat block.

The NESC is also looking at other areas outside of the top technical concerns. NASA Technical Fellows are leading discipline-level technical capability baseline assessments (4 complete and 11 in work). They are also looking at developing improved, analysis-based "shell buckling knockdown factors" for modern launch vehicles. That work alone will probably save the SLS about 2,500 lbs. in mass. Another discipline-advancing project is involved with developing a composite-overwrapped pressure vessel (COPV) liner inspection capability.

NASA is leading the way in knowledge management. The NESC has instituted management processes to capture and share knowledge gained from NESC activities. Key NESC knowledge products include assessment reports, lessons learned, technical bulletins, technical videos and webcasts, annual summary reports, and the NESC website. These products are outside the NASA "firewall" and are available to the public.

In summarizing, Mr. Wilson stated that the NESC has established itself as the "value added" independent test and analysis organization for the Agency with over 600 assessments in 11 years. The workload remains high and

is distributed across all of the missions. The fact that so many organizations' programs have been requesting support from NESC speaks volumes for how well they are doing and the expertise they provide.

Mr. Bolton noted the remaining 7 of the Agency's top 12 technical risks:

- (6) cross-cutting supply chain issues and a shrinking industrial base;
- (7) lack of "hands on" opportunities to train the next generation of engineers and leaders;
- (8) an inflexible accounting system driving inefficient use of Agency-wide engineering skill, facilities, and other resources;
- (9) constrained budgets driving insular behavior counter to the successful model of strong checks and balances and collaboration;
- (10) constrained budgets driving reduced testing and a heavy reliance on models and analysis with limited anchoring to ground or flight tests;
- (11) loss of skills for ground and dynamic flight operations for human spaceflight; and
- (12) gaining acceptance of 21st century technology, tools, and methods to successfully integrate into NASA's programs and projects.

Mr. Bolton noted that the ASAP liked the NESC organization. It can work independently on programs and projects across the Agency with people who have the right expertise, ensuring that all of the missions are as successful as they can be.

VADM Dyer added that he leaves this quarterly meeting feeling good about the balance between the competency side of NASA and the programmatic side of NASA. It is possible to "overshoot" in both directions. The competency side without a spirit of compromise and appreciation of scarce resources can make things unaffordable or even impossible; on the programmatic side, a lack of respect for solid systems engineering can lead to systems that do not deliver the safety that is necessary. The balance at NASA is thanks in part to the NESC, the NASA Safety Center, Mr. Ralph Roe (NASA Chief Engineer), and Mr. Terry Wilcutt (Head of OSMA). VADM Dyer stated that in his experience with NASA, there exists the best balance and harmony that he has seen within the institution.

International Space Station

CAPT Brent Jett reported on the fact-finding on the status of the ISS. The Panel reviewed the ISS status with Mr. Joel Montalbano, ISS Deputy Manager for Utilization. First, Mr. Montalbano covered the flight plan for the rest of the year. Two direct crew handovers (launch of new crew members before returning crew members come home) are upcoming this year, one at the end of August when Soyuz 44S arrives and Soyuz 42S departs, and the second in December, when Soyuz 45S arrives and Soyuz 43S departs. In order to make that happen, some port "juggling" is necessary. A Soyuz port relocation will occur prior to each direct handover. It has been a little while since the ISS team has executed a port relocation, but the task is well understood and the Panel is confident that the team will take the appropriate steps to review any changes made to the ISS that might impact procedures since the last port relocation. There will be a Russian EVA on August 10. The tasks and the recent agreements to reduce the U.S. Orbital Segment (USOS) crew member isolation during Russian segment EVAs were reviewed.

The Panel spent some time and attention on the impacts of the recent cargo mission failure. Mr. Montalbano provided a detailed list of the research and cargo lost on SpaceX-7. From there, he talked about the ISS consumables status. The cumulative effect of the three cargo mission losses are, in the Panel's opinion, significant, but the ISS Program was well positioned to mitigate the impacts. Consumables are in fairly good shape. Research was stockpiled onboard (waiting to be executed), and the research is now underway with plenty of utilization time. However, there are a couple of key replacement parts for the ISS systems that were

lost in the mishaps. The combined effect of that loss with a low or zero inventory here on Earth represents a particular challenge to the Program. Two examples of that are the multi-filtration beds for the water processing assembly and the flow control pump assembly for the urine processing assembly. To the credit of the Program, they were able to procure and manifest those items on the upcoming H-II Transfer Vehicle (HTV)-5 mission. The tangible evidence of the excellent forward planning by the ISS Program is the fact that after losing three cargo resupply flights in about eight months, the ISS is able to support six crew members and continue a full research utilization program. The Panel covered the status for the upcoming cargo missions –HTV-5 in August and Orbital (Orb)-4, currently scheduled for December. Mr. Montalbano also discussed the SpaceX-8 mission status. However, that mission is to be determined pending the mishap investigation.

The Panel reviewed the findings of the Progress 59P investigation. A Russian commission was formed to investigate the failure, determine the cause, and provide recommendations. It was chaired by Alexander Ivanov, First Deputy Head of Roscosmos. The commission examined ten versions (failure scenarios) and reduced them to one most probable cause. NASA formed an independent team to review the data and the anomaly, and the partners participated. NASA performed a detailed fault tree analysis and arrived at a conclusion that aligned with the Russian findings. The oscillations produced by engine shutdown from the third stage coupled into a structural dynamic Huygen mode on the upper stage of Soyuz, which led to structural failure. NASA believes that the structural failure caused mechanical separation of the Progress with the third stage pyro bolt system. Mr. Montalbano talked about how they regained confidence to fly crew on the Soyuz U third stage, which is different from the Soyuz 2.1A third stage involved in the failure. The Russians fully understand what happened and have a good forward plan.

Finally, the ISS Program provided a summary of new vehicle issues they are dealing with (or have dealt with) since the Panel's last meeting. Two of note were the inadvertent Soyuz thruster firing during a test of the KURS and the shelter in place for a debris conjunction. There was not enough advance warning to maneuver the Station out of the conjunction, so the only recourse was to put the crew in the Soyuz to shelter in place. Fortunately, the Station was not struck by any debris. Mr. Jett noted that Mr. Frost probed into the thruster firing issue and felt comfortable with the answers he received on how they plan to prevent that in the future.

Overall, the Panel continues to be impressed with the openness and candor of the ISS program management in their dealings with the Panel and in their response to some recent unfortunate events that were, for the most part, out of their direct control.

Mr. Frost reminded everyone that the number one threat to the station is MMOD. He said "we need to stay on our toes" because this threat can happen at any time. There is every indication that the Program is doing that. They have reacted appropriately in both cases. The event of the thrusters firing is somewhat alarming, but they took immediate action and had a plan in place for recovery. There is a lesson there, and it is clear that it was learned—the importance of simulating and exercising the software fully on the ground before taking it to space. The Russians have developed the capability to do that, and they have taken action to ensure that that is what will happen in the future.

VADM Dyer called out the logisticians on ISS as unsung heroes. It is an incredible balancing act of transportation planning and inventory. The comfort that the Panel expresses in continuing to go forward after the loss of three support missions is a tribute to those people.

Commercial Crew Program Status

Dr. George Nield reported on the status overview and the provider status that was presented by Ms. Kathy Lueders, CCP Program Manager. She and her staff spent about four hours with the Panel on the CCP progress

and their many challenges. It started off with a top-level look at the schedule. The Program is still officially targeting a 2017 date for the first flight test involving the crew's visit to ISS. However, this schedule was based on the assumption that NASA and the companies will have the needed funding to implement the work that is captured in the signed contracts. NASA has been very clear that should Congress not appropriate the requested amounts for the Program, the date is likely to slip. The ASAP will watch this closely.

Ms. Lueders reviewed some of the program risks, such as the budget uncertainty issue, followed by a detailed review of the CCP provider status for both Boeing and SpaceX. That included detailed schedules, specific accomplishments, risks and issues, and a series of special topics. Because of the proprietary nature of a lot of that material, Dr. Nield indicated that the ASAP would not be discussing those topics at the public meeting.

Dr. Nield commented that there are two top-level, CCP-related topics that are important to note.

(1) In the past, the ASAP has perceived a lack of openness on the part of the CCP. In its most recent Annual Report, the ASAP expressed significant concern that the CCP did not have a culture of open communication, and the Panel was not seeing transparency and candor from its leadership. Having met several times with Ms. Lueders, the Panel feels very good with the progress being made under her leadership and with support from Mr. Bolden, Mr. Gerstenmaier and Mr. Lightfoot at NASA Headquarters. It is clear that NASA has heard the Panel's concerns and has appropriately dealt with that area.

(2) The second topic that Dr. Nield emphasized was budget uncertainty. In the last Annual Report, the Panel expressed the opinion that NASA's budget was insufficient to deliver all of the current undertakings with acceptable programmatic risk. The CCP has never received from Congress the amount that has been requested in the President's Budget. In the past, there has been some question about the basis for the request and the cost estimates from the Program, because there was a lack of independent cost analysis that is commonly used in other programs. Today, there are two fixed-price contracts in place and there is appropriate understanding of what the Program will cost if it proceeds according to plan. If Congress does not appropriate the amounts needed to implement the current contracts, there is a problem. At best, the companies will be under pressure to cut corners, eliminate testing, or otherwise try to cut back on cost. In a very real way, that can have a safety impact. At worst, NASA will be forced to renegotiate those contracts in order to slip the schedule, decrease the content, or increase the cost. As everyone is aware, if the schedule slips out, that will extend the period of time that NASA will need to rely on the Russians and buy seats on Soyuz to get U.S. crew to the Space Station. Some people have suggested that it would be appropriate for NASA to downselect to one provider to theoretically save money. The ASAP strongly opposes such a move. Going back to the Annual Report, the Panel stressed the importance of the decision to select two companies for the Program. When both companies are certified for crew missions, NASA has the potential to benefit from competition, not only for price but for safety features as well. Also, the inherent dissimilarity of the redundancy means that if there are technical issues with one provider, it will not preclude the U.S. from having access to the ISS. The recent experiences with the cargo mission mishaps reinforce the importance of maintaining competition in the CCP.

Mr. Frost agreed with the openness and clarity from the management. It is at least an order of magnitude improvement from a year ago. One item he drew attention to was the probability of loss of crew that the Panel had focused upon in the past. At the last ASAP meeting, the Panel had a "deep dive" into the changes to the LOC number that was allocated to the contractors. At the end of that review, the Panel understood what had been done. The contractors had been allocated a different amount of the risk, and the Program would make up the gap by procedures, orientation, orbit, or other changes. NASA further addressed the topic at this fact-finding meeting. It has become clear that it may be harder to do than they thought it would be. Currently, they are looking at all options. They are also pursuing "buying" some of that risk back through vehicle design. The Panel

needs to keep close attention on that issue. The Panel's concern last quarter was that it might be hard to buy risk back, and NASA might end up with a lower LOC than what was initially desired.

Dr. McErlean agreed with Dr. Nield and Mr. Frost that the Panel's access to information is considerably better than before. However, Dr. McErlean observed that he continually sees the challenge of the certification process in front of NASA and the contractors. He is still wary that all of the bases for certification are covered and that NASA is in line with the contractors on what they believe they need to produce for certification. Late this summer, Boeing has a major milestone for that information, and the Panel is looking forward to that milestone and its products. That is the leading edge of seeing that the certification basis is, in fact, agreed to. A similar thing will need to be done with SpaceX. In Dr. McErlean's opinion, they are not there yet, and the ASAP looks forward to that in the future.

Commercial Crew Program Certification of Flight Readiness/Human Rating Certification Plan

Mr. Frost reported on the topic presented by Mr. Ed Burns, Manager of the Systems Engineering and Integration (SE&I) Office for CCP. Mr. Frost noted that the certification process topic has been an ASAP top priority for years. It is a process of the government and the contractors agreeing to what must be done to prove that the hardware meets the safety requirements. It is a critical document to avoid conflict and the untoward results that can come from that. If the contractor knows what NASA requires and NASA knows what the contractor is going to provide, it is a fairly smooth process. If those are not married early, the result is stress at the end, and stress often means not meeting requirements.

Two basic documents come out of the certification process. The first is "certification," which is the authorization by NASA to transport NASA crew. It is a review of the design—an assessment of the basic design of the vehicle to ensure that it is solid for future operations. There is a separate document, the Certificate of Flight Readiness (CoFR), which is NASA's authorization for a specific mission. That looks at what is different about a particular mission and what is different about the vehicle for that mission. The CoFR comes later in the schedule; most of the focus now is on certification. During the fact-finding meeting, the Panel looked primarily at NASA plans on what is required and NASA's assessment process. NASA has two basic documents: the CCT-PLN-2000 and the CCT-PLN-2100. These describe how NASA does the certification and the CoFR. The Panel reviewed how those work and the flow charts associated with them. There is a clear process where all stakeholders make an input into the acceptability decision, and the decision flows up to the NASA Administrator for final decision. Each Technical Authority (Engineering, Safety, and Crew Health and Safety) have inputs as well as the ISS program managers. The goal is to have these PLNs revised and detailed tasks baselined by October 30, 2015. That is how the government will handle the assessment of the plans. The ASAP has not seen the actual plans by the contractors; those are being worked now. The Panel continues to emphasize that those need to be done early and they need to be clearly understood by all parties. Mr. Frost indicated those are critical documents, and he would like the Panel to have a look at them. The contractors are working on "fleshing out" their plans now. What was presented by NASA is how the Program will review those plans. The remaining question is exactly what those plans are and whether everyone is happy with them. The Panel's understanding is that the NASA technical personnel are involved and are working with the contractors on what will be contained in those plans. Hopefully, there will be no major surprises. As mentioned earlier by Dr. Nield, there are some potential hazards coming out of the process; however, they are proprietary and could not be discussed at the public meeting. Mr. Frost noted that there are a couple that are of concern to the Panel, and the ASAP will talk off-line about how to handle those. There will be a lot happening over the next six months.

CAPT Jett observed that the ASAP did state in its 2014 Annual Report that it was unable to assess the certification approaches from the two companies. The information that has been mentioned—the contractor

certification plan and their basis of certification—is the key document that the Panel needs to make its assessment and provide its report to the stakeholders.

CCP Forward Work

Dr. Sanders reported on the “forward work” that was presented by Ms. Lueders in the Panel’s fact-finding session. Ms. Lueders wrapped up the CCP discussions with a few topics relevant to the work ahead for the Program. She talked with the Panel about ongoing assessments of qualitative and schedule risk as the Program Office prepares for what is deemed a “Key Decision Point” in September. She acknowledged that the assessments are based on designs at this time and that having actual hardware will be an important component of realistic risk assessments. She particularly emphasized the impact that any budget shortfall would have on these risks and the allocation of responsibilities between NASA and the commercial partners. Looking at the issues the Program is working, the ASAP believes that the schedule of record may be significantly at risk. This will inevitably result in cost, performance, and safety risk as well. The Panel will continue to follow this with Ms. Lueders.

Ms. Lueders consistently emphasized that the thought process needs to be “we are getting ready to fly.” She discussed steps that must be taken to prepare for post-certification missions; in particular, granting authority to proceed for some of the long-lead items for the first mission following certification. To manage risk, she noted that these upfront costs need to be kept low.

Ms. Lueders shared with the Panel the evolving mishap plan, which has two key elements: (1) guidance for who is the primary lead for mishap investigation by mission and phase, and (2) a generic master action checklist. This is an area that clearly needs serious thought as they address the respective roles and responsibilities of the government and the commercial providers in a new business model. The government is nominally buying a “transportation service” but still retains accountability for life and taxpayer resources. A great deal of work is still needed on this planning, and the Panel will be following up on this topic at its next quarterly meeting. The other aspect of mishap planning that deserves serious consideration is the potential role of a Presidential Commission for investigating a mishap that involves the loss of a vehicle and/or the loss of crew. Currently, a Presidential Commission investigation is required by law as an artifact of the Shuttle era, and the ASAP believes its applicability in this new environment should be given serious reconsideration.

As noted earlier, the ASAP was pleased with the remarkable improvement in transparency and candor on the part of the CCP. This Program has all the challenges inherent in any space program; it is technically hard. In addition, it has the challenge of working under a new and untried business model—engaging with two commercial partners with widely varying corporate and development cultures, each bringing unique advantages and opportunities and each presenting differing aspects to be wrestled with. This challenge is compounded by budget and schedule pressures, appropriation uncertainties, the desire to remove crew transportation to the ISS from dependency on Russian transportation as soon as possible, and the fixed-price contract environment. Given all of these challenges, the Panel sees considerable risk ahead for the CCP. Fortunately, competent and clear-headed professionals (in whom the Panel has great confidence) are dealing with these risks. However, the risks will only increase over time and test the skills at all management levels.

VADM Dyer noted that the Panel has observed before in other quarterly meetings and reports that it believes the challenges for Boeing, a company with a one-hundred year history in aircraft and space, is to find new ways of doing business that are faster and less expensive. On the SpaceX side, the challenge is configuration management and the management of its supply chain of sub-tier contractors. This is still true today.

Mr. Frost further emphasized Dr. Sanders' comments on regulatory direction for a Presidential Commission investigation. That was clearly based on the circumstances where NASA owned the Shuttle, which was reusable. It was a national asset. In this case, NASA does not own the commercial vehicles. If one takes the regulatory guidance to the extreme, it includes situations like post-mission loss of a vehicle. VADM Dyer agreed that everyone needs to better understand the accident plan matrix and if all these intersections require, by law, a Presidential Commission investigation. That needs to be revisited with the Hill. Dr. Bagian noted that at the last quarterly meeting, the ASAP was first advised of the potential for a Presidential Commission investigation. There was a greater level of granularity in the briefing that the Panel received at this fact-finding meeting. However, the level of attention still needs to be turned up. There seems to be lesser sense of urgency to resolve this issue than the ASAP feels is appropriate. There may be many things that need to be done to address the Presidential Commission investigation issue, and sooner rather than later is advised. The meeting yesterday still showed a level of naivety and lack of attention to detail that should not be there given the right level of attention. Dr. Bagian encouraged NASA to put a "fine point" on what needs to be done.

Dr. McErlean observed that there is a tendency to use the term "certification" as if that were the end all of the conformance. It is not. Everyone needs to keep in mind that there is a process—a certification of the design—in which there is a decision made between the designing entity and the airworthiness agent that the design is capable of safely performing flight. The design is then built. There is a conformance inspection to ensure that the hardware was built in accordance with what the prints say, so the design is "conformed." All during that process there is quality assurance that the processes used in building the hardware used standard quality practices, inspections, etc. There then is an assembly and maintenance process that ensure that the properly designed, conformed, and inspected pieces are assembled in the proper way, such that the entire system is functional. There is the CoFR process that says that this assembled system is actually capable of doing the mission. There is an operational process that says that the assembled system is properly prepared such that the mission will be successful. Certification is the entry into a process, each part of which needs to have oversight, surveillance, and supervision to ensure that safety is protected—from the design to the astronaut sitting in the capsule ready to launch.

Before adjourning the meeting, VADM Dyer recognized the Executive Director, Ms. Harmony Myers, who is leaving the ASAP for another position within NASA. On behalf of the Panel, he wished her farewell and noted that she has served the Panel extremely well. She is a true professional, and one who has tremendous leadership growth ahead of her.

The meeting adjourned at 12:00 pm.

UPDATE TO EXISTING ASAP RECOMMENDATIONS

2012-03-01 – Software Assurance and CMMI Requirements

Closed

Rationale: The ASAP received closure request from NASA stating that KSC completed their Capability Maturity Model Integration (CMMI) assessment, and they were awarded a Level 3 rating on Friday, June 26, 2015. This action closes this recommendation.

The Panel would like to monitor NASA and Contractor’s CMMI status as the certification is perishable—good for three years—and the Panel requests this data be provided to them annually.