

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

June 6, 2011

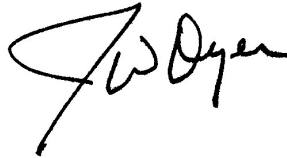
Mr. Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Bolden:

The Aerospace Safety Advisory Panel held its Second 2011 Quarterly Meeting at NASA Headquarters on May 23-24, 2011. We greatly appreciate the participation and support received from the subject matter experts and support staff.

The Panel submits the enclosed Recommendations with Minutes resulting from this 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" followed by "Dyer".

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

Enclosure

ASAP RECOMMENDATIONS, SECOND QUARTER 2011

2011-02-01 Commercial Crew Program

Finding: After the final Space Shuttle flight in July 2011, the Nation will not have the ability to unilaterally launch a U.S. astronaut into space for the first time since 1981. The Panel considers this to be a problem of major importance to the Nation. Therefore, recovering this capability should be accomplished as quickly as possible. The current plan to fill this gap is the Commercial Crew Program (CCP).

ASAP notes that:

- There has been good progress in developing a coherent method to manage this effort.
- The maturity level is still behind what the schedule requires.
- The budget is well below what is required to support at least two partners.
- Without competition there is even greater budget pressure.
- Budget and schedule pressure can impact program success and safety.

Recommendation: NASA needs to apply appropriate resources to the CCP to ensure that it meets or beats the 2016 goal while maintaining NASA's high standards for quality and safety. To this end, NASA should seek additional resources either within the existing budget or through additional appropriations.

Rationale: Apparent impending budget and schedule pressure can deleteriously impact cost and ultimate program feasibility, success, and most importantly, safety.

2011-02-02 Space Shuttle Launch and Re-entry Risk Study

Finding: As the Nation's longest running human spaceflight program with over 100 launches, the Shuttle Program represents the largest database available for analysis. It is inevitable that it will become the baseline against which all future human-carrying space systems will be compared.

Recommendation: Following the Space Shuttle Program completion, NASA should perform an analytical study on the Space Shuttle launch and re-entry risk to both crew and public safety. It is likely this will be a function of both time and change with major alterations in the system. This study should be done using a consistent set of assumptions over the total launch history.

Rationale: An accurate and consistent calculation of what the risk actually was at launch and re-entry for both crew and public safety over the total time history is essential. This will provide a reference baseline for future programs.

2011-02-03 Space Operations Mission Directorate (SOMD)/Exploration Systems Mission Directorate (ESMD) Organizational Merger

Finding: SOMD and ESMD are being merged into one organization. The primary purpose (directed by the Administrator) is to provide a single organization that is responsible for working all human spaceflight activities with outside entities.

Recommendation: The Office of Safety and Mission Assurance (OSMA) should review the current reorganizational plans to ensure that no current critical safety and mission assurance (SMA) aspects, particularly programmatic, are inadvertently eliminated or disrupted due to the merger.

Rationale: OSMA must ensure that no current SMA functions or skill sets are overlooked during the reorganization's implementation.

2011-02-04 SMA Software Assurance

Finding: The Agency currently has no requirement that mission critical or safety critical software undergo 100 percent independent validation and verification (IV&V); it is done to the extent that budget permits.

Recommendation: OSMA should do an analysis on what the impact is to NASA's critical programs by not doing 100 percent IV&V testing for software assurance.

Rationale: One hundred percent IV&V is fundamental to the safe operation of systems.

Updates to Prior Recommendations

2010-01-03 (update) Changing Work Skills

The ASAP recommends that this recommendation be left open due to the evolving nature of the work and the growing understanding within the NASA SMA community.

Anytime an organization needs to add substantial Level 2 work to its existing workload, coupled simultaneously with a significant reorganization, there is higher than normal potential for additional educational needs.

The Panel noted that the SMA Technical Experts also brought forth concerns around the decrease in their disciplines' abilities to address the work for CCDev2 and beyond.

In order to close this recommendation, the Panel would like to see a written plan, with details around skills and dates. It is critical that OSMA actively participate in the transition to Commercial Crew and integrate SMA into the CCDev process.

2010-01-08 (update) Leading Indicators for Industrial Safety

The ASAP appreciates the work done by the Marshal Space Flight Center (MSFC) SMA organization on leading indicators and considers it a good start.

Since even NASA states that this recommendation will not be closed until July 2011, the ASAP offers some thoughts for the MSFC team to consider:

- 1) When leading indicators show up green and 99 percent all the time, start measuring something else.
- 2) Introduce more measures in all the key areas--people, work process, and facilities.
- 3) Broaden the "management of change" definition to include personnel, work process, and facilities.
- 4) Consider including electrical power and distribution systems under the category of facilities that would benefit from a leading indicator approach.
- 5) Consider safety training for personnel beyond civil servants in the leading metrics.
- 6) Review and adopt Operational Risk Management (ORM) principles to reduce risk and inform decision-making.

AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
May 24, 2011
NASA Headquarters
Washington, DC

2011 Second Quarterly Report
Minutes

Aerospace Safety Advisory Panel (ASAP) Members Present

Ms. Joyce McDevitt, P.E. (Acting Chair)
Dr. James Bagian
Ms. Deborah Grubbe, P.E.
Mr. John Marshall
Dr. George Nield
Dr. Donald McErlean

ASAP Staff and Support Personnel Present

Ms. Katherine Dakon, ASAP Executive Director
Ms. Paula Burnett Frankel, Reports Editor

Attendees, Public Session

James Bryce Taylor, ISE
Kelly Kabiri, NASA HQ
Randall Corell, Ball Aerospace

WELCOME/OPENING REMARKS

Ms. Joyce McDevitt, acting for the Chair, VADM (Ret.) Joseph Dyer, in his absence, called the ASAP's 2011 Second Quarterly Public Meeting to order at 11:05 am. After members', staff's, and attendees' self introductions, Ms. McDevitt reviewed the agenda from the previous day's fact-finding session and made a few introductory comments.

This is a very difficult time for NASA and the Nation. In two more months, the last Shuttle flight will occur, and the U.S. will no longer have its own capability to take astronauts into space; however, the ASAP remains fully committed to the human spaceflight program as the most important mission for NASA and has been very proactive in assessing the Commercial Crew Program (CCP). The Panel has reviewed the CCP on a quarterly basis and, at this meeting, spent about three hours on a comprehensive review on all program facets: the organization, the major milestones, and the budget.

COMMERCIAL CREW UPDATE

Dr. James Bagian commented further on the Commercial Crew update that was provided by Mr. Ed Mango and Mr. Phil McAlister on the previous day. The ASAP had asked NASA to explain more about the acquisition strategy and human rating requirements (HRR). Overall, the goal is a commercial U.S. capability to take humans to the International Space Station (ISS) by late FY 2016. The mission model is about two missions per year from 2016 through 2020, depending on budget availability. The CCP Office and Program Manager are located at Kennedy Space Center (KSC); the Deputy Program Manager is located at Johnson Space Center (JSC).

The top program risk is inadequate budget—it is not clear that the budget that is currently available will support commercial crew transport to the ISS by 2016. During Commercial Crew Development 2 (CCDev2), the details will be defined; then the effort will move to the next phase in 2015-2016, which will be development, test, evaluation, and certification (DTEC). The Program is concerned about requirements creep. There is still some uncertainty around what all the detailed requirements are and how certification will be accomplished. This could change the requirements as well as have a schedule impact. Although

there are top level requirements, the HRR have still not been completely defined; this has been an ASAP concern for the past two years.

There are about 50 people in the CCP office, which is very lean for a program this size with this broad span of responsibility. Currently, four companies are under Space Act Agreements for CCDev 2, which will continue for the next two years. An 1100 series requirements document has been issued that will include several portions—design reference missions, technical management processes, certification, and services requirements, standards and design evaluation criteria, and operations standards, as well as the ISS document on interface requirements. The 1130 document will state how “intent of requirement” is judged; however, how that will be accomplished remains to be seen. The ASAP was heartened to see that the Program now has a coherent, defined process. This week, there is a Partner workshop at KSC. One of the current issues is whether there should be a requirement for manual control through all phases of flight, which is desired by the crew. This type of issue (crew requirement) relates to a previous ASAP concern regarding how crew requests are handled.

The loss of crew (LOC)/loss of mission (LOM) requirements were reviewed. The lowest threshold is 1/270—a composite of the launch requirement (1/1000), the entry requirement (1/1000), and the requirement at ISS (1/55). The 1/55 at ISS has been around for awhile and is driven primarily by the micrometeorite and orbital debris (MMOD) hazard. This means that over the ISS lifespan (through 2020), there would be a greater than 30 percent chance of losing a mission from MMOD. The ASAP does not believe that this number has been clearly and publically communicated, and it should be.

Program Integration Teams (PITs) will be used to gain insight into the Commercial Partners’ designs, requirements flow-down, trades, risks, and processes. Although it is possible that the Program has enough in the budget to support the 2016 goal, it is highly unlikely. The Program has already planned for a one-year overlap with Soyuz, which is a good thing, but the timeline and budget still raise concerns.

The briefing and discussions led the ASAP to several conclusions and a recommendation. After the final Space Shuttle flight in July 2011, the Nation will not have the ability to unilaterally launch a U.S. astronaut into space for the first time since 1981. The Panel considers this to be a problem of major importance to the Nation; therefore, recovering this capability should be accomplished as quickly as possible. The current plan to fill this gap is the CCP.

In summary, the ASAP notes that there has been good progress in putting together a coherent method to manage this effort; however, the maturity level is still behind what the schedule requires, and the budget is well below what is required to support at least two partners. Without competition, there will be even greater budget pressure. The apparent impending budget and schedule pressures can deleteriously impact cost and ultimately program feasibility, success, and, most importantly, safety.

NASA needs to apply appropriate resources to the CCP to ensure that it meets or beats the 2016 goal while maintaining NASA’s high standards for quality and safety. To this end, NASA should seek additional resources either within the existing budget or through additional appropriations.

Mr. John Marshall added that this was the first time the ASAP has seen a systematic approach to managing the process, and the team deserves high marks for “getting their arms around” the approach. They are managing towards success, but clearly have challenges ahead. Nevertheless, two issues require further effort: (1) ensuring that Safety and Mission Assurance (SMA) and Technical Authority processes are integrated into the structure—Mr. Marshall expressed concern that while both are recognized as important, the integration process needs to be more transparent, better articulated, and thought through a little more; and (2) the importance of budget control and budget shortfalls, both of which are discussed above. The threats to safety and reliability are direct and NASA must address this.

Ms. Deborah Grubbe noted that over a year ago, the ASAP recognized that a transition must occur in the SMA organization to successfully support crew. This was highlighted in ASAP recommendation 2010-01-03, “Changing Work Skills.” While the ASAP received an update at this meeting, it recommends that 2010-01-03 be left open. The work continues to evolve and there is growing understanding within the

NASA SMA community that this work is changing; however, the ASAP has not yet seen any cohesive plan around that new work.

Anytime an organization needs to change its work by adding substantial Level 2 activity to its existing workload, coupled simultaneously with a significant reorganization, there is higher than normal need for a coherent plan and the potential for additional educational needs. The Panel noted that the SMA Technical Experts also brought forth concerns around the decrease in their disciplines' abilities to address the work for CCDev2 and beyond. Due to the budget cuts and turnover, there are other issues as well.

In order to close this recommendation, the Panel would like to see a written plan that integrates safety and mission assurance changes into the Commercial Crew development process, with details around skills and dates.

Ms. McDevitt added that this is a challenge for the SMA community, particularly when considering that they are issuing the 1100 series document that expresses requirements as "intent to comply" and allows the provider to substitute its own way of doing business. Depending upon the number of commercial providers and the associated tailored documents that will be the basis for agreements between NASA and the commercial providers, there can be numerous ways to comply with what was in the past a proscribed set of requirements. Now, there could be as many tailored documents as there are partners. This requires the Office of Safety and Mission Assurance (OSMA) organization to articulate the skills required to have the necessary understanding and knowledge to do this job. It will require the most mature, qualified SMA people within NASA. What was heard the previous day needs to be worked further, and the ASAP needs to see a written plan.

SPACE OPERATIONS MISSION DIRECTORATE (SOMD)/EXPLORATION SYSTEMS MISSION DIRECTORATE (ESMD) ORGANIZATION MERGE UPDATE

Dr. George Nield reported on the ASAP discussions with Ms. Lynn Cline and Dr. Laurie Leshin, Deputy Associate Administrators of SOMD and ESMD, respectively, who briefed the Panel on the planned merger. The primary purpose (directed by the Administrator) is to provide a single organization that is responsible for working all human spaceflight activities with outside entities. To date, NASA has had an "all hands" meeting with all affected employees and has conducted pre-decisional meetings with the labor unions. The Administrator has made it clear that the mission comes first—focusing on the Shuttle fly-out, continuing ISS operations, and completing the scheduled expendable launch vehicle (ELV) launches that support the scientific community. An agreement on the organization chart was reached last week and will be rolled out to the employees tomorrow. The next step will be to work with the individual employees on their placements. Once the plan has been finalized, NASA will provide formal notification to the Office of Management and Budget (OMB) and Congress. The process is expected to be completed this summer.

Mr. Marshall proposed a recommendation that OSMA review the current reorganizational plans to ensure that the current SMA functions and skill sets are retained and maintained in the merger implementation.

NASA UPDATE

The Administrator, Mr. Charles Bolden, talked with the ASAP about some activities in which he is involved, the Agency's challenges, and where the ASAP's help would be appreciated.

LEADING INDICATORS FOR INDUSTRIAL SAFETY

Ms. Grubbe first reviewed the history on this subject. Because of its work diversity, Marshall Space Flight Center (MSFC) has always had a more robust set of metrics than other Centers. In early 2010, the MSFC SMA organization was charged to do more work on leading indicators for industrial safety. At yesterday's meeting, Mr. Ed Kiessling gave an interim report. The ASAP appreciates the work that MSFC has done in this area and considers it a good start.

Since even MSFC recognizes that this recommendation will not be closed until July 2011, Ms. Grubbe offered some thoughts for the MSFC team to consider. When leading indicators show up "green" and "99 percent" consistently, it is time to start measuring something else. More measures should be introduced in the three key areas--people, work process, and facilities. The "management of change" definition should

be broadened to include personnel, work process, and facilities. MSFC should consider including electrical power and distribution systems in its category of facilities that would benefit from a leading indicator approach. In the leading metrics, MSFC should consider measuring safety training for personnel beyond civil servants. To reduce risk and inform decision-making, MSFC should review and adopt Operational Risk Management (ORM) principles.

Dr. McErlean noted that safety occurs incident by incident. In looking at those singular operations that pose the most risk, one analyzes the operation's safety on an event by event basis, looking at risk drivers and mitigators. This is a process by which the DoD moved its safety metrics ahead and drove incident numbers down even further. This approach might have some application to MSFC's operations.

SAFETY METRICS UPDATE

Ms. McDevitt noted that this update resulted from a recommendation made a year ago to have the Agency-level metrics presented in a way that could enable Center performance comparisons, aimed toward improving performance. This task was given to the NASA Safety Center (NSC), and Mr. Alan Philips presented the results. The NSC presentations have been given to the Panel quarterly, and the ASAP has made suggestions for fine-tuning and data presentation so that important aspects could be enhanced. The NSC has now compiled data on 750 mishaps involving both injury and damage, types A through D, for CY 2010, and has presented the data in a variety of ways. The data was very enlightening. "Facility operations" had two times the number of mishaps than the next highest category, which was "office injuries." From a damage standpoint, the category with the highest number of mishaps was the transportation area. From a cumulative cost standpoint, program mishaps resulted in 69 percent of the costs, although they were only 27 percent of the number. The NSC also looked at injury and damage mishaps by SMA program area, as defined by the federal- and agency-mandated safety and health program providing applicable mishap-preventive control options. Requirements are spelled out on how to mitigate risks in these areas, and yet a large number of mishaps still occur. For the injury area, ergonomics is the most common area.

NSC is now normalizing the data so that comparisons can be made. The NSC has continued to improve and build on data that represents the industry at large, taking certain targeted areas that have been shown by industry to be hazardous. By analyzing the information, some of the NASA-unique metrics have been added. Until now, the NSC has been focused on data collection; however, a level of data maturity in metrics analysis has been reached, and the ASAP looks forward to seeing how this information can be used to enhance the SMA program. For example, two recent campaigns on ladder safety and slips, trips, and falls have been initiated. NASA SMA is starting to appreciate how the trending activity can be used in concert with auditing, supporting leads for industrial safety, and developing corrective action plans.

Ms. Grubbe added that breaking out metrics Center-by-Center now provides a granularity that to date had not been present. This should help the Center Directors make better decisions for their own SMA programs.

R&D OF SMA TOOLS UPDATE/TECHNICAL FELLOWS UPDATE

Mr. Marshall noted that this presentation was in response to ASAP recommendation 2010-01-01, which asked NASA to develop a process to ensure that technical safety tools development is identified as a priority when technology development opportunities are being funded. This is intended to capitalize on some of the opportunities that have been embraced by the engineering side, which has a technical fellows program. The Chief, OSMA, Mr. Bryan O'Connor, wanted to have a similar program for a number of reasons: to maintain and advance the disciplines; to develop a mentoring program for the future development of safety skills; to provide advice and collaboration; to identify, assess, and mitigate risks; to advance knowledge and expertise in those particular disciplines; to develop advanced tools and technologies; and to assess the health and risk readiness as appropriate. OSMA has embraced a reporting process that is very similar to the engineering technical fellows.

The ASAP received reports from four SMA technical fellows: one on quality engineering; one on systems safety; one on reliability and maintainability; and one on software assurance. Each area is an enhancement and important step forward in providing the transitional capabilities that will be necessary.

Mr. Marshall noted several accomplishments that the fellows have achieved. On the quality engineering side, they have implemented a supply-chain handbook, developed audit programs, adopted various standards for soldering, developed an uncertainty data management system, and worked closely with DoD on lead-free testing. On the systems safety side, they have made progress in developing a systems safety steering group, formalized and codified a systems safety handbook, developed curriculum for the Safety Technical Excellence Program (STEP), and worked on other safety-related handbooks. On the software assurance side, the Agency software assurance standards and guidance have been created and embraced, extensive software assurance classes have been developed, and they are looking for independent validation and verification (IV&V) expertise to develop standards in that area. In the reliability and maintenance area, progress also has been made. They have provided extensive in-line engineering and mission assurance support to NASA's various mission programs and projects. The R&M community has put in place an extensive library of industry standards and is supporting and participating in STEP training. They have collaborated with the NASA Engineering and Safety Center (NESC) to both lead and support various assessments.

ASAP is beginning to see a trend and embracement in these four disciplines and commends them for the progress. Each technical fellow that spoke noted that funding deficiencies are having an impact on program sustainment and codification throughout the Agency. However, this is a good start and they are to be commended.

As a former engineering fellow in the Department of the Navy and a current engineering fellow with industry, Dr. McErlean agreed with Mr. Marshall that this is a good start and that there are talented and accomplished people. However, he suggested that the technical fellows take a more active role to help create Agency policies and processes that support the OSMA objectives and goals. This is an area that needs to be emphasized. A fellow can have a long-lasting, systemic affect if he or she can create the necessary policy and process that codifies the advantages that continue beyond his or her service.

Mr. Marshall noted that the ASAP was surprised to learn that the Agency currently has no requirement that mission-critical or safety-critical software undergo 100 percent independent validation and verification (IV&V)—it is done to the extent that budget permits. One hundred percent IV&V is fundamental to the safe operation of systems. The ASAP was equally surprised that this situation was accepted. This is a shortfall. When people in the organization see a policy shortfall, they should highlight it. As the fellows process matures, the ASAP would like to see the fellows take this on as one of their responsibilities.

Mr. Marshall proposed a recommendation: OSMA should do an analysis on what the impact is to NASA's critical programs from not doing 100 percent IV&V testing for software assurance.

RESEARCH & TECHNOLOGY (R&T) STRATEGY UPDATE

Dr. McErlean highlighted one specific recommendation within 2010-01-01—the involvement of the OSMA in R&T programs. The ASAP identified this as a problem and recommended that OSMA review its strategy for involvement in the R&T programs. In response, the chief of OSMA chartered a study on their involvement in Agency research. They have done a good job—they have formed the OSMA R&T Strategy Team (ORTS) to evaluate NASA's current capacity, perform certain trade studies and gap analyses, and to ensure that NASA maintains the safety of its facilities, assets, personnel, and the public while supporting advances in technology. ORTS will evaluate and provide recommendations for needed additions or modifications to procedural, facility, test, and product requirements. Specific tasks assigned to the group were to: review Center safety, reliability and quality assurance (SR&QA) processes and involvement in R&T development; evaluate ways to provide quicker and more accurate risk assessment; investigate ways to ensure safety in testing and test facilities; and benchmark NASA's processes against other organizations'. The group had a wide membership with R&T experience.

ORTS conducted a widespread process review and an impressive list of benchmarks was taken, including all the NASA Centers, key industries, national laboratories, and the Defense Advanced Research Projects Agency (DARPA). They found that SMA did not at the present time have a consistent approach on how it supported the R&T organizations. There are a number of best practices that could be applied, but they were not being used universally. Clearly, they could demonstrate that early SMA involvement, even at the proposal stage for R&T investment, yielded benefits and kept programs more relevant. Risk in these programs must be consciously evaluated. Technology readiness levels (TRLs) are not sufficient to capture the risk assessment for the conduct of the R&T activities. In order to perform this function, SMA needs more insight into R&T activity. While current Agency requirements do a reasonably good job covering early TRL activities (levels 1-3), and they do a fairly good job of moving out into TRLs levels 7-9, they miss the key transition points at TRLs 4-6, i.e., from basic research to applied research to early demonstration, or what is known as “game-changing” levels. Unfortunately, a lack of understanding of SMA’s roles and the R&T organization’s roles contributes to misunderstandings and miscommunications between the two groups.

The ORTS made several good recommendations: increase education and awareness all around; ensure that cognizant SMA are involved early; establish within SMA designated R&T points of contact with experience in the R&T area; develop a consistent but flexible approach to R&T; try to make SMA a part of the R&T process; and for small R&T programs, fund SMA involvement from corporate funds since small projects are usually heavily taxed already. The ASAP supported all of these recommendations. The findings and recommendations went to the OSMA Chief in March, and the organization’s action team is developing a corrective action plan, which is due to be presented in May. The actions are clearly in support of the ASAP recommendation, and they are moving in the right direction.

PUBLIC COMMENTS

Ms. McDevitt stated that this concluded the agenda topics. She invited public comments or questions.

Dr. James Bryce Taylor, Chief Engineer for a small consulting firm, ISE, which provides comprehensive radiation protection services intended for the commercial space industry, made a few comments about space radiation protection. His concern is that space radiation protection does not seem to be emphasized as strongly as it should be in the current safety culture within the commercial market. For about six months, ISE has been trying to sell its services to commercial firms, but has been told that they don’t need those services, radiation protection is a solved problem, and it is a low priority issue. Radiation protection has been put on the “back burner” to be worked on later. ISE believes that protection from space radiation for both crew and electronics is a critical safety issue that should be central to the safety culture in any regulatory environment that covers commercial space. The feedback from both commercial partners and also within NASA is that radiation is regarded as almost a solved problem and not worth the attention or cost. Dr. Taylor expressed his personal as well as business concern over what the present attitude implies for the safety culture in commercial space. He stated that greater emphasis should be put on radiation protection for everyone.

In response to a question from Dr. Bagian, Dr. Taylor indicated that his concern is for all space—from suborbital to low Earth orbit (LEO) and beyond. Scientific rigor is necessary to show that spacecraft are shielded and crews are protected. Based upon the information that is publically accessible, it appears that radiation protection is not being pursued by commercial firms and is not being emphasized strongly by NASA. He clarified that his concern is not about NASA’s safety standards, which cover NASA missions. In fact he was very complimentary in his evaluation of current JSC programs in this area. The concern is for future commercial space missions and whether or not NASA will require an equivalent level of protection for those missions.

There were no further comments or questions, and Ms. McDevitt adjourned the meeting.