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

September 12, 2007

The Honorable Michael D. Griffin
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

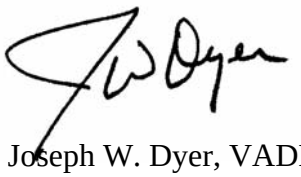
Dear Dr. Griffin:

This report includes the minutes and recommendations resulting from our 2007 Third Quarterly Meeting, held at the Johnson Space Center (JSC), on July 12, 2007. We greatly appreciated the time the folks at JSC spent with the ASAP and their willingness to discuss our concerns candidly. The ASAP also regrets that you were unable to attend the meeting and wishes you a speedy recovery.

After our meeting at JSC, we were encouraged by NASA's efforts towards implementing an agency-wide technical authority and with the significant progress in NASA's Human Capital planning process. We were particular impressed with the United Space Alliance's safety and mission assurance overview and their role in maintaining safe Space Shuttle operations, as we were with the efforts of the Commercial Orbital Transportation System program. Areas that left the ASAP concerned included the lack of integrated agency-wide standards, training, and standardization of risk management. Constellation's preliminary plan to have large quantities of hypergolic fuels in the Vertical Assembly Building at KSC and the human versus robotics risk trade process are also of continuing concern.

We submit our Third Quarterly Report for 2007 and associated recommendations to NASA for your consideration.

Sincerely,



Joseph W. Dyer, VADM, USN (Ret)
Chairman
Aerospace Safety Advisory Panel

Aerospace Safety Advisory Panel
2007 Third Quarterly Report
Minutes and Recommendations

ASAP Public Meeting
July 12, 2007
NASA, Johnson Space Center
Houston, TX

Aerospace Safety Advisory Panel Members Present
Vice Admiral Joseph Dyer, USN (Retired), Chairman
Ms. Joyce McDevitt
Dr. Donald McErlean
Mr. John Frost
Mr. Randy Stone
Ms. Deborah Grubbe
Dr. James Bagian
Mr. Mark Kowaleski, ASAP Executive Director

Attendees, Public Session
Mr. Don Nelson, retired NASA aerospace engineer

Introductory Remarks
Vice Admiral Joseph Dyer, Aerospace Safety Advisory Panel (ASAP) Chair, opened ASAP's public session, conducted at the conclusion of the ASAP's two-day non-Federal Advisory Committee Fact-Finding visit to the Johnson Space Center (JSC). Topics discussed during this meeting included JSC's Safety and Mission Assurance (SMA) program, JSC's perspective and communications on technical governance, the Constellation program, the United Space Alliance's (USA) Space Operations Services contract, the Commercial Crew and Cargo program, and NASA safety policy and Human Capital updates.

JSC Safety and Mission Assurance
The ASAP addressed the topic of JSC's safety organization and management, and reported having had an excellent meeting with Ms. Yolanda Marshall, JSC's SMA Director, who addressed the vision and goals of her organization, SMA risk process, workforce, communications, and technical governance, among other subjects. Ms. Marshall presented a statement of the vision and goals framed in a 5-year implementation plan, stressing that the plan was a living document, which would be updated periodically. The ASAP credited Ms. Marshall in her efforts to lay out a pathway towards becoming a "world-renowned" safety organization. The ASAP has seen evidence of activities in progress toward achieving that goal, which will be accomplished through the application of a forward-thinking, futuristic approach established by the Director. The recent establishment of astronaut-performed lunar lander quality assurance tasks is an example of this approach. Simply stated, SMA is working to ensure a successful human space flight program and to provide support for a healthy and safe working environment. That implementation plan is in place, and they are operating to it.

Organizationally, there were no surprises. The Shuttle and Exploration SMA programs have been placed in the same division in order to take advantage of a knowledge base common to both programs, a move that the ASAP finds sensible. The Commercial Orbital Transportation System (COTS) and the International Space Station (ISS) SMA personnel are also in one division because COTS will dock with ISS, and ISS requirements must be addressed in that context. JSC has a new Flight Safety office that was noted as not being seen at some other centers; the programs' chief SMA officers have been placed in that organization for the purpose of overall supervision and the opportunity to share knowledge and experience. In the budget area, Ms. Marshall addressed the full-time employee (FTE) profile and the allocation of SMA civil servants based on present tasking and the current baseline. Work is underway to identify future needs, which are expected to increase staffing requirements, however the overriding NASA policy is that new programs will not increase a center's personnel ceiling. The JSC SMA FTE ceiling of 176 people is supported within the 5-year plan, but any additional needs of the program must be satisfied by reshuffling projects within the program, or by assigning the task to another center. This approach has been mandated by Dr. Griffin to be the preferred approach so as to maintain ten healthy centers. An option also exists to have an SMA support contractor, but when one looks at the profile, it's difficult to see the basis for the ramping down on the Shuttle side and ramping up on the Constellation side because of the constrained budget. The ASAP was told that documentation is being maintained for additional funding needs, but they do not show up in this current plan. The ASAP commented on the fact that Ms. Marshall has had to do extra work to ensure good communication. Communications must be sustained in some way, perhaps through documentation and recording so that good practices can be transported to other centers. The ASAP commented that OSMA also might want to formalize programs for cross-pollination of knowledge and best practice.

The ASAP looked favorably on the well-developed JSC training plan to establish basic, mid-level, and advanced training, which seemed a little more specific than what the ASAP has seen across the Agency. JSC training seemed more specific with correlation to journeyman and advanced levels, for instance. This training plan could be shared among centers and possibly Agency-wide, so that training need not be center-specific. Hence, JSC's high-quality training program might be a good basis for standardization. The ASAP commented that the ASAP had been concerned in the past about a lack of standardization among centers and the possible existence of a cultural barrier to the sharing of best practices. The strongest impetus for overcoming this barrier is to say that career progression is influenced by the ability to view NASA from several different perspectives and even different geographical locations, i.e., make career pull more powerful than central control and administrative push. However, ASAP feels that NASA is moving in the right direction in this regard given that the new NASA Safety Center will undertake several SMA technical discipline training initiatives. The ASAP added that one good feature of the JSC plan is formal succession planning as expertise moves on or retires, identifying potential SMA candidates from within and outside the SMA organization.

Direction, Alignment and Communication

The ASAP addressed this subject and reported on JSC's perspective and overview communications on Technical Authority (TA) and how TA is being implemented at JSC by the Center Director and program/project Level 2 and Level 3 interfaces. The approach presented is that even though the "independent" wording had been dropped from an earlier draft policy of

Independent Technical Authority (iTA), the TA is best described as independent yet resident within the center organization to provide a "checks and balances" decision-making system separate from that for Program Authority reporting. A positive finding was that both Level 2 and Level 3 TAs have been named at JSC. Senior staff has been briefed on how the TA works, and the flow down of communications to the employees is continuing. A briefing is also part of the new employee orientation, a positive sign that communication of concerns will go forward, and the ASAP encouraged videotaping of these orientations. An all-hands meeting in August was also to include contractors, further expanding the understanding of TA. The ASAP recommends that training be done repeatedly and not just once. The ASAP would also like to see an ongoing plan for communication, as well as scenario planning and real situation analysis coupled with theoretical problem-solving. Currently JSC is in the process of baselining Technical Authority Implementation Plans for executing all three TAs; SMA, Engineering, and Crew Health and Safety - the latter position being provided at JSC by the Director, Space Life Sciences.

Safety Technical Governance

The ASAP addressed how the Safety TA (STA) is to be flowed down from the Chief of the Office of Safety and Mission Assurance at NASA Headquarters through the JSC Center Director and program and project TAs to JSC program/project managers, independently from the Program Authority. For JSC, the STA authority has been delegated to the JSC S&MA Director by the Chief of the Office of Safety and Mission Assurance at NASA Headquarters for Level II. The JSC Center Director has delegated the STA authority for Level III projects to the JSC S&MA Director as well. The primary focus of the STA is to assure the proper tailoring/baseline of SMA requirements and to formally approve waivers, deviation, exceptions to those SMA requirements throughout the program or project life cycle. In addition, the STA has a major involvement in the risk acceptance process. It is important to emphasize that risk acceptance remains the responsibility of the program or project manager. The STA responsibility is to formally approve that the risk is of a magnitude or nature that it is acceptable for the program or project manager to accept. Understanding the subtle distinction between "accepting the risk" (Program/Project Manager) and "approving that the risk is acceptable" (STA) is critical to understanding the responsibility of the STA and its relationship to the programs and projects. A key piece is that STA is at its heart, an appeal path for dissenting opinions.

The TA structure is laid out very clearly in regulations and requirements by NASA. The Level 2 and Level 3 authorities are independently funded by the center, and concerns ultimately go to the Center Director (CD) for resolution; the Administrator feels that CDs today are being selected not just for their management skills but also their technical acumen. To support the JSC Center Director in the TA process, a JSC Institution Risk Management Model has been instituted to provide a "bottoms up" tiered process in which risks are identified and escalated through the JSC management hierarchy. Direction and resources from the JSC Center Director are communicated through the "top down" tiered process through the Directors and Division chiefs to the manager level. While there is still work to be done in this area, the TA process is itself sound and well documented. The ASAP gave full credit for the requirements for the dual-reporting path, while noting that progress on independent funding for the STAs is not complete but moving in the right direction. The TA process is well led, well supported and on the face of it, well understood. It is a construct that meets the requirement laid out by the Columbia Accident Investigation Board (CAIB), but it's not simple. The ASAP emphasized that efforts

thus far clearly meet the requirements and put the independent reporting path into place. As more of the technical community works with the process, the more institutionalized and routine it will become.

The ASAP commented that the challenge had been bringing TA to the working level, and was pleased to see the in-house newsletter articles, the new-hire briefings, and the draft TA Implementation Plan almost ready for signature noting that these developments are late but good. Headquarters (HQ) is working on an agency version of the TA Implementation Plan; ideally, the ASAP would like to see this come out before the center plans. The more places the Technical Authority can be codified, the better. The ASAP also commented that while the concept of the dual reporting path is critical, it is more important that the TA has stepped up to the responsibility for the promulgation of standards to be applied as part of the requirement. The fact that concrete standards are levying requirements, and that any decision not to comply with one of these requirements will require submission of a waiver for approval by the organization that owns the requirement, is a very fundamental piece of TA. This will be the real touchstone of the process.

As an aside, the ASAP member who had attended the STS-117 readiness reviews reported that there had been a dissenting opinion that was presented at both the STS-117 Safety and Mission Assurance Review (SMSR) and Flight Readiness Review (FRR). It was felt that the presenter was treated respectfully and that the ensuing discussion was sufficient to satisfy the presenter that his opinion was heard and considered - a healthy sign that the NASA safety culture is improving. The SMSR and FRR also acknowledged that three NASA Safety Reporting System (NSRS) reports had been received and closed. The NSRS allows for anonymously reporting by both NASA employees and contractors of problems, issues and concerns that may affect safety. To protect the confidentiality of the individual making the report, even the title or nature of the input is not disclosed; therefore the Program Authority and Safety Technical Authority do not have insight into the actual assessment conducted to address the report. The NSRS has been in effect for a number of years, and the ASAP felt it to be appropriate that they provide some level of oversight into the integrity of the evaluation process and results. They requested that OSMA provide an overall summary and analysis of the NASA Safety Reporting System (NSRS) reports, actions taken, evaluation results, and resultant changes made as well as any other supporting documentation that substantiates the integrity of the NSRS evaluation process.

Safety Policy

The ASAP reported on safety policy, and on meetings with the Mr. Bryan O'Connor, Chief of the Office of Safety and Mission Assurance (OSMA). In discussing the presentation by Mr. Wilson Harkins of OSMA's Safety Assurance Requirements Division, Mr. O'Connor pointed out that for clarity's sake, rationales are permitted in some of the requirements to make the contextual understanding of the requirement more lucid; the ASAP agreed with the briefers that inclusion of more rationales would be valuable. The ASAP also lauded the use of the Web as a facilitator of communication of safety policy and ready availability of requirements. Another positive point was that an effort was underway to scrub safety documents to make the distinction between requirements and guidance. The ASAP approved of this effort and recommended scrubbing safety requirements documents across centers to increase consistency, and to reduce ambiguity and contradiction.

The ASAP commented that while the goal is clear on safety standards, establishing safety standards is a big job, manpower-intensive, and there is a long way to go. The ASAP suggested writing these standards as NASA-wide safety standards, putting them under configuration and control of the Agency and not individual centers. A huge effort will be required to reach state of the art, which will be especially necessary for the Constellation program. The ASAP was impressed that the SMA enterprise had a genuine expert who could pull back and look at the tiering of processes in a holistic manner. If that was organization rather than instruction, then this needs flattening and simplification but getting it established is a good first step. The ASAP observed that various centers are military SysCom-like in operation. HQ is administrative and perhaps technically suspect. Part of this best practice sharing comes from technical expertise being deep and resident in the centers. The current NASA structure makes best-practice sharing a challenge. The ASAP further commented that as NASA moved toward the concept of SMA Technical Discipline Fellows including a System Safety Fellow, these Fellows will be in a position to provide technical expertise for HQ since they will be funded by and report to the Chief, OSMA.

Major Contractor SMA Overview

The ASAP reported that a great deal of time was spent with the United Space Alliance (USA), which has been the nucleus of the Shuttle support program, and employs a quality safety culture. It has been long known that NASA's integrated workforce is dominated by a contractorworkforce, almost 75%, and USA is the largest single piece on the Shuttle program, particularly. Mr. Crain Lovell, USA Vice President for SQ&MA reported that USA's CEO, Mr. Mike McCully, who was also present at the ASAP meeting, provides clear leadership and vision to the company, and was open to criticism. USA's performance has been excellent and is continuing to improve, and the ASAP was impressed with the leadership and product.

The ASAP felt USA had done an exceptional job in focusing their safety program, thanks to the strong leadership. They will have a difficult job over the next several years, as Shuttle moves toward retirement, to keep that focus on safety. The systems in place will serve them well during the transition. The ASAP commented that USA has a number of innovative programs; one is the Risk Associated Trouble Spots (RATS) program, which identifies hazards with an automatic requirement that managers respond to the hazards. The ASAP also liked the fact that employees are rewarded with small items of appreciation up to larger monetary awards, depending on the significance and number of hazards uncovered. The ASAP commented that it had seen a very high level of operational discipline in the organization, noting that the leadership was actively and frequently involved with the workforce, much more so than any other contractor the ASAP had exposure to. This open communication style should serve them well in the future. The ASAP commented that like NASA organizations, USA will have to deal with workforce issues during the gap between Shuttle retirement and Constellation operations, and USA is pursuing some very innovative measures for dealing with this.

Human Capital Update

Human capital management has been an ongoing concert for the ASAP. The ASAP reported being pleasantly surprised with recent improvements in the area of human capital management. NASA has a plan, resourced to some degree, but not perfectly. The nature of the work in terms

of multiple centers, cultures and human resources systems, is difficult to untangle. NASA is looking at a large process and a shift in the workforce. The ASAP was encouraged to hear about the three phases of planning (short-term, mid-term and long-term). NASA is still working on identifying workforce needs, one of the key pieces of which is running scenarios for potential outcomes. NASA is trying to be very creative, with a team led by Ms. Toni Dawsey, Assistant Administrator for Human Capital Management, in not placing constraints on thinking. The Agency is willing to go to Congress to see if they can get special dispensation relating to personnel regulations, and is having ongoing conversations with contractors and other industries, while bringing on new staff. The ASAP should keep human capital on its radar screen at frequent intervals, and will need updates at major milestones. The ASAP was gratified to be hearing that a list of products has been developed, and that actual output is emanating from this effort. Mapping of the Shuttle workforce by person to Constellation needs is expected to becompleted by mid-Oct 2007. The good news is that some bad news has been delivered early, e.g., a recent NASA workforce analysis identified 2000 unfunded FTEs, which translates to a lot more people. The ASAP commented favorably on the two-week training period for all new hires, which is however dependent upon the supervisors making the training available. There should be more emphasis on enforcing the training and making sure the supervisor spares the new hires for training. The ASAP sought details relating to the major milestones for Phase 1, such as percentages of employees in various disciplines and attrition rates.

Constellation

The ASAP noted, with respect to Constellation, that one of the best ways to move a program is to put it on the coattails of another major program. There are great people on the Constellation program, and NASA is instituting the efforts the ASAP would like to see. The program is fully implementing the TA concept, and is off to a good start. Constellation is making good progress on requirements, and is working on implementation approaches to satisfying the human rating requirement.

Constellation is based totally on Agency requirements without yet incorporating system-unique features. In this regard, the ASAP would like to see an early hazard analysis that guidesprogram and project requirements. The program will be doing a functional hazard analysis soon, which is a good thing, and can be retrofitted into specifying other requirements. The Ares V is basically a heavy-lift vehicle concept for lifting cargo, and does not need all the requirements for human rating; however NASA is leaving open requirements for an upgrade to human rating. The ASAP cautioned that there is a penalty to be paid for the human rating option, despite some common elements. It is hoped that NASA gets the issue of human-rated *vs.* non-human-rated version finalized soon. There have been some suggestions for using the Vehicle Assembly Building (VAB) for Constellation for loading hypergolics. Options are to load hypergolics on the launch pad, on the way to the pad, or in the VAB. In any event, the amount of time spent on the pad must be minimal due to weather constraints. Issues remain about loading hypergolics in an area that includes office buildings, and areas not designed for hypergolic use. Quantity-distance issues are being considered. The real issue is getting into orbit quickly. Prepackaged fuels and other solutions are being considered, and progress is being made. A big challenge is Crew Exploration Vehicle (CEV) weight - the program is well aware and working on it. Implementation of requirements on contracts also remains an issue, but is getting better.

The ASAP commented that another concern is that the Constellation SMA leader has an organization of 89 people scattered at 8 centers, while having to create teamwork and trust, and somehow acquiring face time with staff. The program needs to follow up on this too. Training on hazard analysis, and putting work out to the unmanned centers, is also a concern. Research centers do business differently from the manned space flight centers - these differences need to be recognized and accounted for.

Risk communication and risk management within the Agency is another issue; i.e., how to identify, quantify and communicate risk. A risk matrix is one tool for doing this. Constellation has a significantly improved risk matrix in that it categorizes risk by levels of management, increasing the level of management required for accepting increased levels of risk. The ASAP recommended that NASA incorporate the improved risk matrix approach Agency-wide. The ASAP also suggested improved definitions associated with quantification; NASA must allocate resources to the most significant hazards. Quantification will help determine where resources must be directed. The ASAP is also concerned about the size of risk space at HQ, which reserves fewer decisions for HQ than most organizations do and the ASAP encouraged NASA to expand the space. The ASAP clarified the concept of the risk matrix in terms of what they had witnessed, noting that the roles and responsibilities of the STA was concerned with assuring that the analyses be thorough and proper, and that the level accepting the risk be the right organizational level. This marked the first time the ASAP had seen an attempt to clarify the difference in roles and responsibilities as differentiated by programs and projects, versus STA. Given that, the ASAP also noted that the STA does not document their objective assessment of the risk. Overall, the ASAP recommended that STA consider performing an independent assessment of the risk to verify that the risk is properly characterized and to also provide advice on the acceptability of the risk.

Constellation Integration

The ASAP addressed Constellation's complexity and overall integration challenges. Integrated systems engineering as modules is being designed at independent sites. NASA must establish a clear line of authority for decisions on trade space, design, etc. The structure is not yet in place. If engineering is done in-house, it becomes a question of capacity; the workforce may not be large enough. Most projects are 25% civil servant, with contractors providing the arms and legs of the work. It can be done, but integration must be a critical part of this, and an integration systems engineering organization must be put in place and clearly set up. The ASAP agreed that NASA can do this integration, but if done internally, the groundwork needs to be laid now, or it will be difficult to accomplish. There are beginnings of a plan, but NASA needs to pay attention to how the plan will be executed. The ASAP added that there have been some telltale signs of stress in e.g., funding limitations and cost threats between real needs and negotiated levels, design being conducted in concurrence with requirements setting, hiring freeze in view of the competency and skill set gap between Shuttle and Constellation, which seem to be arising earlier than one might expect. All of these areas speak to safety concerns that will need to be watched closely.

Commercial Orbital Transportation System (COTS)

The ASAP took a first look at the commercial crew and cargo program, and remarked on the innovative approach of infusing government money into the commercial sector to obtain low-

cost access to space, noting that this is a good time to test the commercial waters. The COTS program has down-selected to two companies under the Space Act agreement. These companies will have to provide additional monies for development. The two companies, SpaceX and Rocketplane Kistler, received a total of $500M, and possess different philosophies on how to achieve program goals. SpaceX is almost all in-house while Rocketplane Kistler uses multiple industrial partners to help the program. The COTS program is very hands-off from a bureaucratic standpoint. The experiment is to allow free reign over ideas. The two companies have elected to comply with NASA safety requirements even though the approval for launch falls under the FAA licensing provisions. The ASAP will be observant of the fact that both vehicles will have to comply with safety requirements for vehicles that visit ISS; these requirements will be stringent, and perhaps might need more oversight. The program has established a chief safety officer for these vehicles and is holding safety reviews. The groundwork is in place. The ASAP will take another look at the program as the design process goes forward. It is a good start and a great opportunity for American business. The ASAP remarked on the combination of technical and business elements and that the human-rating requirements pose an interesting challenge - some of these are "how-to" versus performance. Out-of-the box solutions will be challenging, and may either produce safety breakthroughs or increased risk. The level of experience of space crews also poses different presumptions on the requirements for these vehicles. NASA is on a good path with human rating criteria. If space tourism evolves, these criteria may mimic aviation criteria.

Public Comment

The ASAP invited public comment. Mr. Don Nelson, a retired NASA aerospace engineer with experience in Gemini, Apollo, and lunar outpost programs, responded, stating that he felt strongly that the Administrator would lose the path to the moon. Mr. Nelson commented that NASA can't go back to the moon with expendable launch vehicles- the technology is not there to do it. It is too expensive and NASA needs reusable systems. The schedule for the Ares V is completely unacceptable. The reality of what is happening to Ares I and Orion is that it is not simple, soon, or safe. NASA is now looking at tens of billions of dollars to redesign and test components, and the Agency does not have the money. Instead NASA is robbing science programs by going forward with a system that should be cancelled. This vehicle has created a five-year gap, with Russians supplying vehicles during that time being a highly doubtful scenario. Limited funding for testing is a formula for disaster, as is starting from scratch in a too-compressed schedule.

Mr. Nelson further commented that safety issues include the structural loads on the 5-stage booster that are unacceptable. The first stage exposes seals to a high torquing force, and they will fail because they were not designed for structural wind shear loads. There is already a major weight problem with the vehicle. The Shuttle's main engine, from the only reusable launch vehicle in the world, is about to be warehoused, representing a loss of years of testing and technology. Orion also has significant problems; stability problems at 20-40,000 feet are major. Since the first of the year, reports indicate the problems have worsened. The thrusters NASA has today do not satisfy requirements. The service module will also have a debris pattern in populated areas. There has been no competitive evaluation of the Ares/Orion design; Congress is being pressured by the aerospace lobby to build an inferior and dangerous launch vehicle. A safer alternative is the privatization of Shuttle. A trusted environment for reporting

mismanagement is lacking. Not listening leads to avoidable accidents. This concluded Mr. Nelson's remarks.

In response, the ASAP thanked Mr. Nelson for his comments, noting that the ASAP has been sensitized to the areas of concern posed by him and will include his comments in their report.

2007 Third Quarterly Meeting Recommendations

2007-03-01 – JSC SMA training program and instruction should be shared with other centers, the NASA Safety Center, and OSMA in pursuing a goal of providing Agency-wide safety training. JSC's high-quality training program may provide a good basis for standardization.

2007-03-02 – OSMA should provide an overall summary and analysis of the NASA Safety Reporting System (NSRS) reports, actions taken, evaluation results, and resultant changes made as well as any other supporting documentation that substantiates the integrity of the NSRS evaluation process.

2007-03-03 – The Constellation program should initiate the development of an early hazard analysis in order to define program and project system-specific safety requirements.

2007-03-04 – NASA should adopt the improved risk matrix approach developed for the Constellation program Agency-wide. The ASAP also suggested improved definitions associated with quantification thus providing a basis for NASA to allocate resources to the most significant hazards.

2007-03-05 – Roles and responsibilities for the Safety Technical Authority (STA) at the program and project level should be expanded to include an independent assessment to verify that the risk is properly characterized and also giving advice on the acceptability of the risk.