

**NASA Advisory Council (NAC)
Joint Meeting of the
Space Operations and Exploration
Committees**

Ames Research Center, Moffett Field, California

August 2-3, 2011

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Joint Meeting of the NAC Space Operations and Exploration Committees

August 2-3, 2011
Ames Research Center
Moffett Field, CA

Space Operations Committee Members

Present

Chair: Col. Eileen Collins

Dr. Pat Condon

Dr. Leroy Chiao

Dr. John Grunsfeld

Ms. JoAnn Morgan

Mr. Bob Sieck

Executive Secretary: Mr. Jacob Keaton

Absent

Mr. Tommy Holloway

Other Attendees

Mr. Robert Zimmerman

Ms. Lynn Cline

Exploration Committee Members

Present

Chair: Mr. Richard Kohrs

Mr. Bohdan Bejmuk

Ms. Nancy Ann Budden

Ms. Carolyn Griner

Dr. David Longnecker

Executive Secretary: Dr. Bette Siegel

Administrative Officer: Ms. Shawanda Robinson

Absent

Gen. Lester Lyles

Mr. Joseph Cuzzupoli*

Dr. John Logsdon*

Mr. Richard Malow

**participated via teleconference August 3*

August 2

Dr. Bette Siegel, Executive Secretary of the Exploration Committee, called the joint meeting to order and explained that this is an open NASA Federal Advisory Committee Act (FACA) Committee. Committee members are responsible for recusing themselves if they have a conflict of interest. The public was to have an opportunity for comment on the second day of the meeting.

Task Group on Analysis Groups (TagAG) Final Report

The NASA Science Committee joined the meeting for this presentation by Dr. T. Jens Feeley, Executive Secretary of both the Science Committee and the TagAG.

TagAG, chaired by Dr. Waleed Abdalati, was charged with examining how NASA's Analysis Groups (AGs) might be reorganized to better advise the Science Mission Directorate (SMD) and the Exploration Systems Mission Directorate (ESMD) regarding integration of science into exploration mission objectives, particularly with respect to the Planetary Science Subcommittee (PSS).

TagAG conducted two FACA-compliant teleconferences in May, focusing on three AGs:

- LEAG-Lunar Exploration Analysis Group (Moon)
- MEPAG-Mars Exploration Analysis Group (Mars)
- SBAG-Small Bodies Assessment Group (Asteroids)

TagAG then examined the draft Terms of Reference (TOR) to determine the changes necessary to ensure that the AGs meet the needs of both SMD and ESMD. After obtaining feedback from the Chairs of the affected AGs, TagAG reached consensus on a final set of recommendations and revised the TOR for the three AGs. The recommendations include the following:

- Add explicit tasking authority for ESMD and relevant Committees;
- Provide a procedure to include both SMD and ESMD Associate Administrators (AAs) in appointment of AG chairs;

- Update language to capture revisions in the topic areas covered by the respective AGs;
- Obtain PSS input into possible AG realignment;
- Acknowledge the uniqueness of LEAG; and,
- Refine the wording concerning the role of the Designated Federal Official (DFO)/Executive Secretary in coordination with the Chair.

TagAG has already consulted with PSS about the possibility of realigning the AGs to match the recent Planetary Science Division (PSD) Decadal Survey (DS). PSS decided to keep the AGs in the existing topic areas. The proposal for LEAG includes having two co-chairs, one for science and one for exploration. The LEAG Executive Secretary will be appointed by the AA for Science after consultation with the AA for Exploration Systems.

Discussion

- *Dr. Feeley* added that TagAG had just concluded its recommendations in the previous week, and that it had not yet consulted with the AAs. TagAG determined a procedure to present the recommendations first to the Committees, then to NAC. After receiving their input, the recommendations will go to NASA for implementation.
- *Dr. Hubbard* asked if TagAG members felt that these changes will help advance the causes of human and scientific exploration. It was explained that the group felt that this will better integrate science and offer a common ground for implementation.
- *Dr. John Grunsfeld* noted that in 2004, another group struggling with the best way to address these issues looked back to the 1960s for a joint program model. It was explained that TagAG hopes this arrangement is equivalent to that joint program office, which worked very well.
- *Dr. David Longnecker* inquired about whether the changes will address the sometimes awkward separation between the biomedical sciences and SMD. *Dr. Feeley* replied that TagAG did not directly address biomedicine. However, these are the broad, community-based groups that the Directorates could task with that analysis. There might be a separate discussion of biomedicine at some point. *Ms. Griner* added that TagAG had a limited charter on how to organize these AGs. There are still questions as to how these are to be integrated at the AA level. Another consideration is the new Directorate that is to be formed, and its likely charge. There will be a need for a careful examination to ensure that these areas are internally consistent. There is, at this time, no integration that takes these AGs into the main stream. That has to happen at the Agency level.

Mr. Richard Kohrs, Chair of the Exploration Committee, thanked Dr. Feeley for his presentation and the Science Committee for their participation.

SOMD/ESMD Merger Update

In preparation for the next presentation, Mr. Kohrs explained that the new NASA Directorate will be known as the Human Exploration and Operations Mission Directorate (HEOMD). To reflect NASA's needs with this reorganization, the Exploration Committee and the Space Operations Committee will be combined into one committee that will advise HEOMD.

Ms. Lynn Cline of SOMD and Dr. Laurie Leshin of ESMD provided details of the proposed HEOMD organization. NASA is calling this organizational change a "unification" in order to stress that this is two organizations coming together equally, rather than one taking over another.

The unification team anticipates that HEOMD will be an effective and efficient way to accomplish the following:

- Ensure safe operation and effective use of the International Space Station (ISS);
- Provide sustainability for a range of operations such as the Multi-Purpose Crew Vehicle (MPCV);
- Maintain strong momentum on commercial activities;
- Support the remaining launches in the Launch Services Program (LSP);
- Continue the Space Communications and Navigation (SCaN) Program's success, including the Tracking and Data Relay Satellite System (TDRSS) development, advance research and beyond-Low-Earth-Orbit (LEO) capabilities; and,
- Enable Directorate support organizations to continue their excellent and critical work.

NASA formally notified Congress of its intent to unify the Directorates when the Agency submitted the Fiscal Year (FY) 2011 Initial Operating Plan to Congress. Now that an agreement with the union is in place, the Agency is asking the affected employees where they would like to work. For many, there will be no changes. Once employees have told NASA where they would like to be placed, a detailed plan of each employee's placement will be developed and go to the Agency personnel office for final approval, probably in the Fall of 2011.

In many respects, SOMD and ESMD are already operating as if they are a single Directorate. They are backing each other up and did joint budget planning for FY13. For the FY12 budget, which has been submitted to Congress, NASA will use the existing appropriations accounts.

Among the key benefits of the unification is having all human spaceflight activity in one group, which alleviates some of the fractured activities of the past. The unification will also allow NASA to fully focus on full utilization of ISS, smoothly transition to future human exploration systems, establish integrated commercial transportation activities, and streamline program planning, decision making, and international and interagency cooperation and interfaces. Collaborating external organizations, such as the U.S. Air Force (USAF) and the European Space Agency (ESA), will now be able to rely on a single organizational point of contact within NASA.

The Decada Survey for Space Life and Physical Sciences was recently released. The unification team is working to achieve its recommendations by creating a critical mass research capability that will leverage ISS, include opportunities for ground-based research, and support other capabilities as identified by the DS.

Ms. Cline presented an organizational chart for HEOMD and identified the capabilities within the various Divisions. These include Space Shuttle, which is winding down; Exploration Systems Development; Human Spaceflight Capabilities; ISS; Commercial Space Flight Development; Advanced Exploration Systems, a new group; and Space Life and Physical Sciences Research and Applications.

The new Advanced Exploration Systems Division will be the organizational home for system-level prototyping for enabling capabilities, like an in-house skunk works capability, and will include much civil service talent. This is also where robotic precursor activities will occur. In answer to a question by Mr. Kohrs regarding the role of the Chief Technologist organization, Ms. Cline explained that the unification team discussed whether the technology program should move or split. Management decided to split it, keeping within this unit the prototyping activities integral to exploration systems themselves. Regarding engineering talent within the Agency, that generally falls under the Office of the Chief Engineer, which has been setting a baseline of the key capabilities identified as strategic, unique, and inherently governmental. Within HEOMD, NASA hopes to harness in-house talent and set specific engineering requirements for the unique needs of human space flight. The Chief Engineer looks more broadly across the Agency.

At this time, the unification strategy affects only the Headquarters staff and organization. There will be changes at the Centers, and the team has worked with the Centers on setting up the governance structure for the future. There will be more on that at a later date.

The program management relationship for ISS has not changed; it remains a straight line to Mr. Gerstenmaier. At this time, many of the heads of the various organizational units are acting and yet to be confirmed. There was much discussion about the name of HEOMD, including whether to include the word "research." Ultimately, it was decided that a simpler name would be preferable. There have been no changes to the independent technical authorities, such as the Chief Scientist, Chief Engineer, and others who will report directly to the HEOMD AA.

Discussion

- *Col. Eileen Collins*, Chair of the Space Operations Committee, expressed concern about how the Centers will interact. She was also concerned about some of the people involved, noting that some at the Centers have lost jobs as a result of the Space Shuttle program termination. She wondered if any of them would be able to find jobs within HEOMD. *Ms. Cline* explained that the current unification effort is focused on Headquarters. However, Space Shuttle experience is being infused into the new programs there, and the intent is for similar activities to occur at the Centers. At a lessons-learned meeting at Kennedy Space Center (KSC), a primary suggestion was to infuse the Shuttle personnel throughout the new programs in order to share their expertise. There will be more of

that now that the last mission is complete. At this time, there are five affected staff at Headquarters; the number involved at the Centers was unavailable.

- *Ms. Griner* said that it was not clear where exploration that does not involve humans fits in this scenario. *Ms. Cline* said that this activity occurs at multiple levels and in Agency strategic planning. Senior management has a dialogue between the Chief Technologist and the Chief Scientist. The exploration systems portfolio has been incorporated into the reorganization, but it has not changed. *Dr. Leshin* added that the portfolios are integrated in a holistic sense. There are two significant elements. The first is the tactical near term, which is being worked through the joint robotic precursor and through other activities. The second element, a higher strategic aspect, is happening through the Architecture Team, which is embedded and integrated at the working level. She added that the unification is meant to be more strategic at the Agency level. NASA Administrator Charles Bolden brought in the Chief Technologist and Chief Scientist positions to ensure collaboration and less overly narrow focus on individual areas.

Col. Collins thanked the presenters.

ISS Mars Analog Status Update

Col. Collins noted that the Space Operations Committee put forth a formal resolution on use of ISS concepts as a basis for future exploration. She introduced Mr. Charlie Stegemoeller of Johnson Space Center (JSC), who provided an update on the topic.

The NASA Authorization Act of 2010 established a long-term goal of expanding the permanent human presence beyond LEO, working with international partners wherever possible. Objectives include finding ways to sustain the capacity for long-duration human activity in LEO, and determining if humans can live in an extended manner in space with decreasing reliance on Earth, using LEO infrastructure to the extent possible. To meet these objectives, NASA established the Human Exploration Framework Team (HEFT). The results of the Team's efforts are used in identifying technology investments and mission planning throughout the Agency.

Science representatives out of SMD are part of HEFT, which seeks outcomes that are capability driven and that will pull in human exploration where appropriate. Mr. Stegemoeller explained how capability-driven exploration will progress from LEO. The plan includes a lunar landing and possible asteroid landing as elements of the progression to planetary exploration, and assumes incremental progress in technology, systems, flight elements, and operational experience.

The common capabilities needed for human space exploration include capability-driven architecture elements such as ground operations and MPCV, cross-cutting systems, and elements of technologies, science, and research. The Mars Design Reference Architecture (DRA) for exploration assumes a minimum of 6 months to reach the planet, up to 18 months on the surface, and another 6 months to return. The long surface days will likely involve missions arriving on and departing from Mars while the astronauts are there. The Mars DRA spans the spectrum of possible Human Space Flight (HSF) exploration missions and identifies the core risks for exploration. Some of the exploration mission risks can be managed today. HEFT is evaluating proposed candidates regarding risk reduction, need, priority, feasibility, and whether the right analog is being used to lower the risks. Possible analog platforms include terrestrial, partial gravity, and micro-gravity platforms.

ISS is a possible Mars analog for several reasons. The crews are in the Space Station environment for 4-6 months, which mimics the Mars transit phase, for example. Crews can also serve as both operators and subjects. The ISS micro-gravity environment will allow development of system performance requirements and testing of payloads. National and international ground and on-orbit support have been tested, as have some of the flight durations. Use of the ISS as a test bed will facilitate evaluation of new exploration technologies, advance preparations for crew autonomous operations for Mars or Near-Earth Asteroids (NEAs), and help direct ground elements training and technology development.

Operations and exploration capability testing on ISS will likely occur through the life of the Mars project, from building the foundation through actual sustainable exploration of the solar system. A notional traffic model, with the technologies that need to be evaluated, has been developed as a roadmap. Instead of starting systems and technologies from the beginning, HEFT is looking at existing elements to determine where they might fit.

The International Space Station Test Bed for Analog Research (ISTAR) is a joint collaboration between NASA exploration and ISS programs. An ISTAR Integrated Product Team (IPT) has been established as a multi-center team that includes Exploration Systems, Exploration Analogs, Flight Crew, Human Research Program, Mission Operations, ISS Utilization, and Engineering. This group defines and ranks Exploration Development Test Objectives (xDTOs). Categories have been established to mitigate key exploration risks and answer architectural questions. As just one example, once human space flight moves beyond the Moon, there will be a need for interrupted and delayed communications, an area where NASA must learn and relearn what is needed. NASA must also identify what has been learned from Earth-based analogs, including Desert Research and Technology Studies (Desert RATS), NASA Extreme Environment Mission Operations (NEEMO), the Pavillion Lake Research Project (PLRP), the Space Station Training Facility (SSTF), Neutral Buoyancy Lab (NBL), and others. In response to a request, Mr. Stegemoeller said he will pull together more information about the PLRP platform.

Four phases for have been identified for the Mars analog program:

1. Evaluate ISS capabilities;
2. Short-period simulations and experiment packages;
3. Longer-period simulations and experiment packages; and,
4. Six-month mission and crew.

The current projects include the Communications Delay Countermeasures, which involves validating of communications delays; Active Shielding Proof of Concept, in which active radiation shielding of the crew is being studied; Synchronized Position Hold Engage Reorient Experimental Satellites (SPHERES); Free Flyer Simulated Extravehicular Activity (EVA) Inspection, which takes advantage of EVA tools; and, Robonaut 2 Simulated EVA Routine and Emergency Operations. No new hardware is required for these projects.

Mr. Stegemoeller confirmed that neither the crews nor the robot will go outside ISS. NASA is working with existing packages, and budget and other issues currently preclude running up new capabilities, though that is likely to change in the next 12 months. The focus is on learning from ISS and determining how to apply that information. The first evaluations are in process, but there has been no decision on using anything specific yet. HEFT is looking at what buys the most at the least cost. This is an emerging strategy.

ISTAR will do no tests to risk crew. ISS has a 2-year planning template, and the Mars analog program will build on that, using as many crew as possible while keeping to the current crew rotation scheme. The Communications Delay investigation is being packaged as an experiment and research set to evaluate operational countermeasures for the crew and ground to use when voice communication is not available. The investigation will get crew notations on ground communication delays, possibly using video instead of a dialogue, as delays cause frustration with a dialogue. This is happening as quickly as possible, for 2012 and 2013. Hardware systems will be more difficult.

For Increments 33 and 34, the Miniature Exercise Device (MED) on the current Advanced Resistive Exercise Device (ARED) has shown promise as a real benefit to crew. The Mars system will have to be simpler, with less mass. Comparative data from crews will help validate the larger device before testing the smaller one. This is being conducted and budgeted under SOMD. The plan is to offer all space station crew the opportunity to participate, not just the U.S. contingent.

Going forward, HEFT will continue the near-term ISTAR efforts to mature exploration capabilities via DTOs on ISS. More complex system level candidate proposals are being developed by the Exploration and ISS teams. Within the next 6 months, Mr. Stegemoeller expects to have a more concrete, less notional roadmap. The goal is to determine what can be accomplished at the current level of investment.

Discussion

- *Mr. Bohdan Bejmuk* said that he thought this was the right direction, but a bigger challenge is likely to be finding the funds to pay for a voyage like this. ISS probably provides another analog, a business analog, in how to enlist all the space-faring participants on this planet to combine resources and funds to contribute to a Mars mission. He wondered if HEFT was looking at ISS as a business model or had thought about how to bring in international collaborators. *Mr. Stegemoeller* replied that NASA is looking at what can be done today. It is important to take advantage of existing opportunities to inform the exploration plans, which involves the international partners. *Mr. Mike Suffredini* said that there are no formal plans with the international partners, but they continue to work

together and look at how to begin the collaboration. NASA is looking at options where there are operations with partners and where they owe NASA in kind.

- *Col. Collins* said she had previously viewed a chart on the Mars analog program that listed very specific areas for technological investigation such as clothing, food, microbial protection, and water recycling. She would like the Committee to look at that, as they might be able to provide help and input. For example, they might discuss how the recycling of air and water are done on the Space Station. For the Space Shuttle, there had been talk of in-space refueling. These are exciting ideas on which the Committees might be able to provide feedback.
- *Dr. Grunsfeld* noted that the Space Operations Committee had discussed the Mars analog in April, and he sensed a lack of a sense of urgency at that time. With HEOMD, there might be more support. He is not sure how long NASA will have ISS. The communications delay is a minor story in the scheme of things. He wants to get the public engaged and interested in ISS, and it is not clear that communication interests anyone outside of Mission Control. There is a need to find engaging ideas.
- *Dr. Grunsfeld* asked if the xDTO solicitation will be internal to NASA or go outside as be a test piece for the new organization that will prioritize national lab activities. *Mr. Stegemoeller* said that NASA is working with the existing framework and will determine with ISS how to engage the National lab team.
- *Dr. Leroy Chiao* said that he is intrigued by the MED and asked where it was in the process. *Mr. Stegemoeller* said that it is a candidate device that is still in development. He used it as an example to show the variety of devices the team is having to consider. It is a high priority for crew health. *Ms. JoAnn Morgan* would like to hear more about nutrition and other technologies and systems relating to the health of astronauts.
- *Mr. Bob Sieck* said that NASA should present this activity as something the public can understand. The public understands food, gravity, and the like. He wants the public to understand this and not have it be so detailed that only scientists understand it. Others agreed that the taxpayers need to understand what the project is doing.
- *Ms. Griner* suggested engaging the international partners regarding their robotic capabilities. She thinks the Agency is still extremely risk averse. For example, the discussion about something as simple as communication amounts to tiny steps that are behind the current sociological environment of children who are texting and using a range of instant and non-instant communications. She would like to see NASA develop a “just do it” attitude toward this and other things like the exercise devices, taking leaps and catching up with the rest of the world.
- *Ms. Nancy Ann Budden* said that through the 1990s, JSC looked at a lot of analogs. It is encouraging to learn about the Mars analog work, but she did not see a lot of physiological parallelism being considered regarding human performance and the ability to get outside and work on Mars. She recommended teaming up with another team like Desert RATS, where people are tested as soon as they are off a mission.

Col. Collins thanked Mr. Stegemoeller for his presentation. Mr. Stegemoeller noted that he is working out of the Human Element Support Office at JSC. He is not part of ISS, though he works with them. He said that HEFT is trying to work with what they have in hand and will become more assertive in coming years. He thanked the Committee members for their feedback on conveying information to the public.

Commercial Orbital Transportation Systems (COTS)/Commercial Resupply Services (CRS) & Commercial Crew

The NASA Commercial Space Committee joined the meeting for this presentation, which was given jointly by Mr. Phil McAlister of ESMD, Mr. Alan Lindenmoyer of JSC, and Mr. Michael Suffredini, also from JSC. Mr. Bretton Alexander, Chair of the Commercial Space Committee, observed that it was important to have the Committees meet together, as they have issues that have overlapped. His group has made some recommendations regarding commercial crew.

Mr. Lindenmoyer presented first, with a status update on COTS, including the latest information from Orbital Sciences Corporation (Orbital) and Space Exploration Technologies Corp. (SpaceX). Both are progressing well, though there have been some delays due to the typical development challenges. SpaceX successfully completed its first COTS demonstration mission in December, 2010, and has demonstration flights C2 and C3 scheduled for November 2011 and

March 2012. The company asked NASA to consider combining the integration of cargo on the two missions, accelerating the C3 mission objectives (ISS berthing) on C2 flight. NASA has been studying the safety, reliability, and technical aspects of this proposal and is close to a formal approval. However, questions remain due to the SpaceX desire to do secondary payloads. Therefore, NASA is looking at the proposal more closely, and SpaceX is looking at changes that might mitigate risks. SpaceX will conduct the third flight regardless, so this is an opportunity to do berthing early. A successful C2 flight means that the C3 flight would have a “bonus” objective. NASA will assess how well the mission meets the total objective. The milestones are based on objective criteria; NASA has paid not for a certain number of rockets, but for the demonstration missions. The last payments are small.

SpaceX and Orbital must meet all of the NASA criteria, and NASA makes the decisions where there is a difference of opinion. Orbital is conducting integration of the Cygnus Service Module and the Taurus II launch vehicle. The latter has had problems with a fuel line during tests. The question is how to inspect these engines for flight. Therefore, Orbital is developing inspection and repair criteria in anticipation of a February 2012 ISS demonstration flight. The company will test to 100 percent and believes that at least one-third of the engines will pass the inspections and can be used as-is.

For FY11, NASA received \$288 million in additional funding to reduce risks associated with the remaining development and timely demonstration of cargo space transportation capabilities. COTS determined that the best use of these funds is additional spacecraft-level testing for SpaceX. The company already does extensive component testing, which it prefers as a way of testing the entire system, and agreed to the spacecraft testing of systems that NASA prefers. Orbital spent most of its additional funds on another flight.

To date, SpaceX has completed 27 of 40 milestones, accounting for a total of \$313 million out of a total \$396 million in NASA payments. The second SpaceX flight will be much more complex than prior efforts, as the Dragon 2 spacecraft will have a cargo rack, Passive Common Berthing Mechanism (PCBM), claw, and solar array. SpaceX has tested the first stage and is fitting the second stage. The project is progressing through the milestones.

At Orbital, 23 of 29 milestones have been completed, for \$261.5 million in NASA payments out of the allocated \$288 million. The pressurized cargo module is ready to ship, Cygnus has been through avionics testing, the launch pad is under construction, and two launch vehicles are in the integration facility.

Discussion

- *Mr. Alexander* asked if the December date for the first Taurus 2 maiden flight was date selected before the engine testing mishap. *Mr. Lindenmoyer* said that the original plan was for an October flight, but the change was driven primarily by turnover of the plan. The schedule does include slack for additional engine inspection, so that was not a factor.
- *Dr. Bernard Harris* of the Commercial Space Committee asked how serious the engine failure was and whether it might be a system problem. *Mr. Lindenmoyer* said it was serious. There was a detailed discussion of a mitigation plan, and NASA is confident that Orbital will conduct a full critical flaw site analysis on each engine. It will be at least the end of August before NASA knows if the mitigation techniques are acceptable. *Mr. Seffredini* explained that an experienced person from Marshall Space Flight Center (MSFC) is working on the project. This individual says that the repair technique has been used on Apollo and other programs, and he believes it will work in this situation as well. It is likely to have a minor schedule impact. Aerojet will do the repairs.
- *Mr. Wilbur Trafton* of the Commercial Space Committee asked if NASA was satisfied with SpaceX’s Dragon splashdown and recovery. This was watched at the launch control center, and NASA was pleased with the results.

Mr. Suffredini, Manager of NASA’s ISS Program, gave a CRS status update. His team is responsible for ensuring that commercial visiting vehicles to the ISS meet the required level of safety. While mission success is left to the individual visiting vehicle developers, there is a 4km by 2km by 2km approach sphere. No vehicle entering that sphere has differing criteria. This is key to ensuring crew safety. A document called the SSP 50808 “ISS to Commercial Orbital Transportation (COTS) Interface Requirements Document (IRD)” spells out the interface requirements.

A plan was provided addressing requirements and the schedule. The integration status schedule for the Orbital demonstration flight, for example, shows 32 completed safety hazard reports. The Mission Planning and Integration process is proceeding well, with completion of Expedition 30 crew training for the commander, Dan Burbank, and the

remaining crew about to be trained. The Horizontal Integration Facility (HIF) construction is complete. The Flight Operations Review (FOR) was scheduled for mid-September, launch pad turnover testing will occur at the end of October, to be followed by robotics crew trials.

A chart showing the integrated flow included the Orbital hot fire test in late November 2011 and the test flight scheduled for late February 2012. Preparations are being made for the mission readiness review and flight readiness review. Orbital is conducting Phase 3 in two segments. The company has a lot of testing yet to do. NASA has conducted its analysis to ensure the PCBM interfaces work, and there has been some integrated testing with the entire software suite. Avionics and PCBM testing are continuing. Mr. Suffredini provided status information for the Orbital Demo Cargo, Orb-1, and Orb-2 flights. On the Demo, the pressurized cargo manifest is 704 kg, though reserves might allow that to reach 800 kg if necessary. The Orb-1 launch date of May 11, 2012 may slip. The major milestones have been completed, however. On Orb-2, there will be a new radio vendor, as well as a new vendor for the lidar system.

All but one hazard has been approved for SpaceX, and that remaining hazard is collision, which is the most difficult test. The SpaceX demonstration flight is an integrated flight that is scheduled to launch on November 30 and dock on December 9. Some SpaceX dates are likely to move due to space traffic. The communications frequency had conflicts and was changed. This, the thermal vacuum (TVac) testing, and the integrated testing of the flight software have presented challenges for the company. SpaceX will deliver the software in parts, which could involve more testing, which usually results in changes. Any changes will jeopardize the November launch date.

Both the demonstration cargo and SpX-1 flights are fully loaded with the maximum amount of cargo, 800 kgs in both cases. SpX-2 will have the small deployable **Secondary payloads** that the Department of Defense (DoD) plans to use. Mr. Suffredini showed a flight schedule overview chart with increments, crew rotations, vehicle traffic, berthing dates, and launch schedules. This manifest is extremely tight, but it is also optimistic, in that it is unlikely there will be that much actual traffic.

In looking at ISS consumables through 2013 with no commercial cargo flights, it is clear that the Space Station can manage well through 2012 with no commercial providers. STS-135 brought consumables sufficient to provide a considerable margin. Crew supplies fall off sharply after January 2013, however, and there are also significant drops in utilization and preventive maintenance supplies at that point. Therefore, the ISS integration for demonstration and CRS missions continues. The requirements and preparations for commercial crew have been defined, and provisions have been made for medical emergencies. NASA has modified the IRD to include docking capabilities and is working with the commercial partners to communicate systems requirements and provide the information necessary to eventually dock on the ISS.

Discussion

- *Mr. Kohrs* asked about the terminology of “dock” and “berth.” *Mr. Suffredini* said that the former is being used by the commercial crew personnel. Therefore, NASA developed an international docking standard. The Agency may have to provide the mating half until the commercial providers can do it, but the intent is for the companies to build their own.
- *Mr. Bejmuk* wanted to know if NASA had sufficient information *about the interiors* of the commercial vehicles and if the companies know enough about the ISS that they can evaluate the integrated hazards. *Mr. Suffredini* said that there is sufficient knowledge in both directions, but NASA does not know as much about the commercial systems as it did about its own. However, NASA defined and verified the design requirements.
- *Mr. Kohrs* asked if NASA has access to contractor failure and verification analysis. It does.
- *Mr. Sieck* inquired whether NASA involvement in the certification of demo flights is similar to activities related to the Automated Transfer Vehicle (ATV). *Mr. Suffredini* confirmed that the same approach was taken.
- *Mr. Bejmuk* advised caution in having Aerojet conduct repairs, due to the techniques employed. *Mr. Suffredini* explained that this is not NASA’s responsibility, and that Orbital must meet Federal Aviation Administration (FAA) criteria. FAA will make the determination and NASA will have to accept it. However, NASA and Orbital have a good relationship when it comes to solving problems. The situation will be different with commercial crew, where NASA will be deeply involved. *Mr. Suffredini* said that he would convey *Mr. Bejmuk’s* advice.

Mr. McAlister, Acting Director of Commercial Spaceflight Development at NASA, presented the Commercial Crew Program status. With enactment of the President's budget requests, funds will be sufficient through the middle of the decade. The objective of the commercial crew initiative is to facilitate development of a U.S. commercial crew space transportation capability, with the goal of achieving safe, reliable, and cost-effective access to and from LEO and the ISS. The Commercial Crew Program (CCP) will use a non-traditional acquisition and partnering approach that will provide performance incentives, support cost-effectiveness, and eliminate NASA's dependence on a single provider. The 2010 NASA Authorization Act established commercial crew as the primary means for ISS crew transportation. The real partnering aspects come through in how NASA implements the partnership, including oversight.

CCP has made awards to four different companies: Boeing, Blue Origin, Sierra Nevada Corporation, and SpaceX. Each has a different strategy. There is also an unfunded agreement with United Launch Alliance to certify the launch vehicle for the commercial providers. This could apply to SpaceX and Sierra. Sierra and Blue Origin are looking at the integration safety analysis, which NASA will certify as safe for crew.

CCP had hoped to be able to use Space Act Agreements (SAAs), which were used by CCDEV1 and CCDEV2. However, when mitigations through SAAs broke down, CCP looked at other Federal Acquisition Regulation (FAR)-based instruments. However, industry prefers more integrated solutions. The big issues were requirements and certification. NASA felt that waiting would be unwise, and therefore sought a means of having interactions that could not be done under an SAA. Ms. Patricia Grace Smith of the Commercial Space Committee noted that she understood this was a policy issue. Mr. McAlister explained that it was both a policy and legal issue. CCP told NASA's Office of the General Council (OGC) of its interest in doing verification under SAAs, but the OGC said that this was not an option. The human space flight world is very interactive and requires a steep level of verification that cannot be done under an SAA, in part because of difficulties in giving feedback under an SAA. CCP did not consider changing the objectives, which had been given to the Program by the Administration and which the Office of Management and Budget (OMB) had accepted as a baseline.

The proposed strategy is a firm fixed price contract instrument based on milestones. This will maximize industry retention of intellectual property rights. The strategy will not dictate design solutions but will provide approval, tailoring, and the necessary exceptions or waivers. Payments will be based on milestones, with a fixed government investment, and NASA will have control at the "Certification Requirements" level only.

Industry has some issues with this. First, it is a new, hybrid structure, and the commercial providers already have experience with SAAs and FARs, though they dislike the latter. NASA has begun this dialogue. The next phase, a draft Request for Proposals (RFP), will show the waived FAR elements. CCP has begun communicating this to industry and is answering questions that came in online. Dr. Condon cautioned that DOD has demonstrated that such a strategy does not work well for development, and wondered how certain CCP was that industry will take the risk on a firm fixed-price contract. Mr. McAlister said that some of this will be learned through the draft RFP. CCP is trying to model the COTS Program. In addition, DOD's development of External Expendable Launch Vehicles (EELVs) was done under a fixed price contract. Dr. Condon said that the question is whether industry will see a return from operational use, which could determine whether companies make the investment.

The market for human transportation will be modest at first. NASA will set requirements for eight crew rotations per year on four flights. CCP delivered a commercial market assessment to Congress. Mr. Alexander said that NASA has to restrain itself in determining design solutions, and the track record is not good. Industry needs to know whether the relationship is that of a contractor or a partner. Mr. McAlister explained that the requirements document states what NASA wants, not how the Agency wants it, and this has been discussed with industry, which is still providing input. The goal is to have baseline requirements at the end of the year, then obtain more industry feedback.

Design and development will be split, and industry will see the difference in the approach to development. All of the key program attributes are maintained in the new strategy. The ultimate goal is to rejoin Russia and China in getting humans to LEO, and the best way to do this is through the Commercial Crew Program.

Discussion

- In answer to a question about the budget, *Mr. McAlister* explained that there is not enough money. For this strategy, CCP believes the \$850 million budget request will put NASA on the right path. If funds are significantly less than that, the United States will not be able to launch a commercial crew in 2016, at which point there are real

problems. The United States is committed to the ISS through 2020. If the program slips too much, industry will balk and the risk for the entire program goes up. If there are cuts, even in the early years, the program will need to extend and the risk increases. The overall funding has to be balanced or there will be a gap.

Col. Collins thanked the presenters and the Commercial Space Committee.

Multipurpose Crew Vehicle/Space Launch System (MPCV/SLS) Update

Mr. Dan Dumbacher from ESMD provided a status update on the MPCV/SLS.

When Congress approved and the President signed the NASA Authorization Act of 2010, it was with bipartisan support for human exploration beyond LEO. The Act authorized extension of the ISS until at least 2020; strong support for a commercial space transportation industry; development of an MPCV and heavy lift launch capabilities; a flexible approach to space exploration, including near-Earth asteroids and Mars; and new space technology investments to increase the capabilities beyond LEO.

The ultimate destination is Mars, though it is not yet clear how to get there. The fundamental needs are for a crew vehicle, a large launch vehicle to go beyond low orbit, and appropriate ground operations. Those capabilities are now being examined. How NASA will go from lower orbit to Mars is up to debate and not on a schedule, in addition to being subject to the budget. The Systems Analysis and Integration Division is working on the requirements. Mr. Kohrs observed that another factor is collaboration, as the United States cannot afford to do this alone. Dr. Grunsfeld added that Mars exploration will be a huge benefit to the planet, and there is already an amazing international alliance for the ISS. Ms. Cline noted that the ISS coordinating group is looking at what to do before going to Mars, which will likely be trips to the Moon and an asteroid. NASA is talking to its partners about what could be done on ISS to further Mars goals.

Mr. Dumbacher said that when looking at the roadmap to Mars and the other destination candidates en route, it becomes clear how far NASA and its partners have to go. The current focus is on launch and crew vehicles. NASA is developing plans for exploration systems that are affordable, sustainable, and realistic. The Agency has selected a Reference Vehicle Design for both the SLS and MPCV. It is important to prepare an integrated plan before plans for critical exploration capabilities can be finalized. NASA is working to develop and understand cost estimates and potential affordability measures. The reference vehicle is Orion at this point. NASA has been performing due diligence to ensure that the final vehicle choices will be the best value for the taxpayer with respect to cost, risk, schedule, performance, and impacts to critical NASA and industrial skills and capabilities. The overall strategy for an integrated SLS/MPCV plan involves careful planning and due diligence. NASA has been validating MPCV requirements and working through the acquisition strategy and procurement options. The focus is on an integrated acquisition strategy that will be documented in an update to Congress.

The current strategy for SLS/MPCV is based on architecture analysis and Authorization Act direction. The Act states that “[t]he Administrator shall, to the extent practicable, extend or modify existing vehicle development and associated contracts.” ESMD is focusing on the word “practicable.” The law also specifies an initial capability of the core elements, without an upper stage, to lift payloads weighing between 70 tons and 100 tons into (LEO), as well as the capability to lift the multipurpose crew vehicle. The requirement to “serve as a backup system for supplying and supporting ISS cargo requirements or crew delivery requirements not otherwise met by available commercial or partner-supplied vehicles” does not mean that this program is to compete with COTS and CRS. Instead, it is being interpreted as NASA being ready to go to ISS in an emergency.

Dr. Grunsfeld asked whether the SLS vehicle will be designed as the optimum vehicle for travel to the Moon and an asteroid, or if it will be overdesigned for those destinations. Mr. Dumbacher said that for a mission that goes beyond Earth orbit, the launch vehicle is designed to the same requirements. The next issue is the number of launch vehicles needed. The current design requirements for MPCV for Orion are the same as what existed at the start. However, at some point there will be a need for crew habitation capacity, and the MPCV will go along for the return. Dr. Grunsfeld said that the intent was to separate the crew from a large vehicle with a lot of stored energy and send the cargo up on another, more powered vehicle. The idea is to put crew on the less dangerous vehicle. Mr. Dumbacher said that this creates a complicated launch architecture. The tradeoffs keep leading back to the current solution.

Booz Allen Hamilton is doing the Independent Integrated Cost Assessment (ICA) in order to inform the program budget process. This is an interactive approach with the program, involving much give and take. The early planning especially

emphasizes the launch vehicle. It is too early to do a joint confidence level. The ICA report will give NASA weaknesses and action items. ESMD does not yet want a quantified estimate. The information being sought at this early stage is qualitative, not quantitative.

The Authorization Act and NASA requirements dictate that the MPCV will serve as the primary crew vehicle for missions beyond LEO, safely perform regular in-space operations, provide an alternative means of delivery of crew and cargo to the ISS as back-up to commercial crew, and pursue an approach that includes potential new technologies, competition of sub-elements, and commercial operations. It is important to ensure that NASA's design can add on new technologies instead of locking the Agency into a single approach.

Dr. Grunsfeld was concerned that the Authorization's requirement about the primary crew vehicle will create problems with weight and cost, if taken at face value. Mr. Dumbacher explained that the MPCV will get the crew to low orbit, at which point they will do all the deep space activities, transfer to the MPCV, then come home. It is designed for 21 days of crew habitation. The 21 days for habitation accounts for the various uncertainties for transition, weather, and other issues. He will make the justification for that available to the Committee members. Regarding cost and weight, the Orion is heavy. But ESMD examined everything and found it made sense from an architecture perspective and programmatically.

NASA examined the architecture pertaining to MPCV requirements and considered whether new acquisition for MPCV would allow for a more optimized integrated SLS/MPCV plan. After also considering the potential for use of advanced technologies and changing approach to MPCV development in context of advances already integrated into Orion plan, NASA determined that development of the MPCV using the current Orion plan and contract was practicable and appropriate in the context of the Authorization Act requirements. This approach considers the investment and work NASA has done, plus the flat budget.

There are challenges in using the same vehicle for LEO missions and for exploration, as the two purposes have some significantly different requirements. The propellant requirements, thermal protection, system reliabilities, and radiation shielding needs for beyond-LEO missions are all greater. Orion was already working from this set of requirements. Dr. Grunsfeld said that except for the 21 days and large amount of propellant, the rest is qualitative. He wondered about the design reference distinction. He was concerned that despite the problems with Orion, there is now a law telling NASA to use Orion, and that NASA is now finding a way to justify the requirements to make Orion fit. If it does not work out, NASA could be out considerable funds and no closer to having a mission. Mr. Dumbacher volunteered to bring the Committee the analysis that led to the decision to use Orion, and took it on as an action item for himself.

For the SLS analysis, three government Requirement Analysis Cycle (RAC) Teams were created and studied different design concepts that leverage industry capabilities. ESMD obtained industry input and analysis from HEFT and is now evaluating inputs from all 13 heavy lift study contractors. There have been numerous innovative ideas. Three contractors provided detailed cost and configuration data, which are being compared to the RAC study results. The cost estimates were similar to NASA's.

The resulting configurations from the RAC teams include:

- LOX/H₂ – Reference Vehicle Design, which is a hydrogen core configuration with solid strap-on boosters and multiple evolution paths, and a lift capability of 70-150 metric tons;
- LOX/RP, a large RP configuration (large diameter tanks) with multiple engine options, including a NASA/USAF common engine, and a lift capability of 100-172 metric tons; and,
- A modular configuration (smaller diameter tanks) with multiple engine options, including a NASA/USAF common engine, and a lift capability of 70-130 metric tons.

The LOX/H₂ is the vehicle of choice at this point; the other two configurations are not being considered. Affordability will be treated as a requirement, not an attribute. The budget drives the planning, and for that reason NASA must examine and stay on top of a range of funding scenarios. NASA is still looking at a first uncrewed flight in 2017, and a flight with crew in the early 2020s. That is what ESMD is working to right now as they evaluate procurement strategies and assess all trades.

In summary, the integrated analysis process continues to develop a schedule and initial cost estimates. The results will guide NASA's approach to providing beyond LEO transportation capability and will form input to an updated SLS/MPCV report to Congress. ESMD is providing interim results to Agency leadership, OMB, the Office of Science and

Technology Policy (OSTP), and Congress in order to let them know where the project is and what will be needed. The schedule is challenging because of the complex analyses needed and the importance of using funds judiciously.

Adjourn

The meeting adjourned for the day at 2:35 p.m.

August 3

Convene Meeting

Dr. Siegel called the meeting to order at 9:51 a.m. The Committees were to spend the session developing findings and recommendations based on the previous day's presentations.

Deliberations & Recommendation Preparation

Mr. Kohrs reviewed the agenda from the previous day. Dr. Siegel explained that the Science Committee had sent a letter that they hoped the Space Operations and Exploration Committees would endorse. After the individual members read the letter, they agreed to concur.

TagAG Final Report

Mr. Kohrs reminded the Committees that the recommended changes have not been implemented yet. There were no recommendations from this presentation.

SOMD/ESMD Merger

Ms. Griner sought additional information about how HEOMD will operate and how it will be integrated into the overall organization of NASA. She wanted to know lines of authority and other relationships. Dr. Longnecker observed that despite many reminders that biomedical research is an integral part of numerous activities, it has always been treated as an add-on. He hopes the link to Exploration will make it more integrated. Mr. Kohrs said that the Exploration Committee had recommended the appointment of an AA for Space Life and Physical Sciences. This did not happen, but the area does now have a separate organization.

It was agreed to state that this meets the intent of the recommendation.

ISS Mars Analog Status

For the report to NAC, Col. Collins proposed depicting the rationale for using ISS as a Mars analog, ISTAR assumptions, the number of ISS visiting vehicles, and information on the Space Shuttle and workforce. Some of this information came from Mr. Stegemoeller's presentation, and the rest from a presentation at another meeting. Mr. Sieck suggested also showing the major blocks of activity across the calendar for the next decade, in order to lay out a schedule and indicate the percentage of activity related to the Mars program.

Mr. Kohrs said that the finding here is that the program is doing a good job. The recommendation is to provide the metrics to go forward and show how well the program is doing.

Col. Collins advised adding that the Committee seeks a briefing or information on how the decision-making tools are used in setting priorities for Mars exploration. Mr. Sieck asked that NASA should create and publish the metrics that relate to activity on the ISS that relate to the issues and challenges of reaching Mars. These specific tests, operations, or DTOs should be identified and the activities associated with them should be tracked and published on a routine basis. Ms. Griner cautioned about unintended consequences here, noting that metrics drive behavior, and that the Mars analog is an adjunct to the existing work.

Col. Collins said that the reason for recommendation is to help both NASA and the public understand why there is a Space Station and how it contributes to future deep space exploration. The consequences of no action are a potential lack of awareness of the ISS mission and the loss of support of the space station among the general public. A working recommendation was developed, subject to further editing after the meeting.

Recommendation Title: Tracking Mars Analog Metrics

Recommendation: NASA should create and publish the metrics of the activities on the ISS that relate to the exploration of Mars. For example, specific activities and DTOs should be identified and the opportunities on the ISS associated with these tests should be tracked and published. This type of information could be included in a Space Station activity update available to the general public.

Major Reasons for the Recommendation: To help NASA and the general public understand why we have a Space Station and how the Space Station contributes to future deep space exploration.

Consequences of No Action: Potential lack of awareness of the mission of the ISS and the potential loss of opportunity to generate enthusiasm among the general public for the ISS and future exploration.

Finding Title: ISS as a Mars Analog Update.

Finding: The Committee is pleased with the initiative that the ISS program has taken in the Mars analog project. Due to the length of time before an actual Mars mission is flown, we feel that some of the operational tests, i.e., communication delays, will require a long-term effort. We also feel that the project requires a greater sense of urgency.

COTS/CRS & Commercial Crew

In discussing this presentation, Mr. Bejmuk said that it would be disastrous to reach 2014 with no CRS. The Japanese H-II Transfer Vehicle (HTV) does not show up on the manifest at 2014. Col. Collins selected three charts for this topic: Mr. Suffredini's slide 13, and timeline charts for Orbital and SpaceX. A draft recommendation was developed, although it was decided not to send it further without presenting it to the Commercial Space Committee in order to ensure that there was no excessive overlap or contradiction in recommendations between the Committees.

The original version of the recommendation was entitled: Spaceflight Participant Policy for ISS. The original version of the recommendation itself was: NASA should establish a policy for spaceflight participants to fly to ISS on U.S. commercial vehicles. The first draft of the Major Reasons for the Recommendation read: This policy will incentivize CCDev participants to invest in the development of commercial transportation to LEO, expecting additional return on their investment by flying tourists to the ISS. The Draft Consequences of No Action was: Absent such a policy, all spaceflight participant activity will be to the Russian side of the ISS, hence depriving U.S. commercial companies of ISS spaceflight participant revenue and decreasing commercial investment in the development of the transportation to ISS for NASA crews.

Because commercial cargo is already going to ISS, that part was to be deleted. It was also agreed that the word "tourists" should be changed to "space flight participants" throughout, in which case the consequence of no action would be the missed opportunity for revenue and commercial work. With Committee members in agreement about the general concept, this recommendation was to be developed more fully outside of the meeting.

MPCV/SLS Update

There were no recommendations based on this presentation. Mr. Dumbacher will present more information at the next meeting. Until then, there are no actions to be taken.

Further Recommendations

Based on the Committees' closed session discussion, it was agreed that Mr. Kohrs would talk to NASA Administrator Bolden about their concerns. Col. Collins, who was retiring from NAC after this meeting, said that she would send Mr. Bolden an email upon her departure.

Ms. Budden and Dr. Condon presented a recommendation they developed during the break between the closed and open sessions that day. It was entitled: Updated/Revised NASA Vision Statement. The recommendation was to revise the mission statement and update it. Committee members debated whether they really wanted a "vision statement," which means something very specific in the Federal government.

Ms. Griner explained that it is crucial to establish a foundation and rationale to communicate to NASA's stakeholders and the general public about the integrated direction of NASA in terms of exploration. The message should say what NASA is doing and why, emphasizing that these activities will move the country forward and secure its place in the global community. NASA should explain how its various pieces contribute in order to gain more public support and engagement. It is also critical that this message go to Congress. It should be like a business plan.

Others noted that while NASA has a vision plan, a mission plan, and a strategic plan, all which have been sent to Agency employees, they do not inspire, nor do they provide the kind of explanation of purpose that the Committee members consider essential. Col. Collins advised saying something about the current mission statement and the Space Shuttle. She suggested taking it to NAC as written, in order to see if there are additional ideas. They may wordsmith it.

After subsequent discussions, no recommendations were taken forward to the NAC. The decision was made that more information was needed on all of the subject areas before a fully realized recommendation could be made. These issues will be addressed at subsequent meetings.

Public Comment Session

Mr. Robert Zimmerman thanked the Committee and noted that they talked about metrics. He said that there should be more national support for science. Life sciences is a key to public support. Scientists do innovative work in that field, which will be a key to more support. Areas of innovation include stem cell activity, which is exercise dependent and is, in turn, hugely important to astronauts. We have a very complex biological colonization of our bodies, but we do not understand the impact of radiation on that. We know that we have very substantial rates of calcium washout in space. There are related issues to crew selection. We need to link DNA, epigenetics, and calcium washout. These are opportunities to do things in space that have an impact on broad human populations. NASA should do this work and communicate it. We need to innovate and do it as a faster pace. Doing things that are pedestrian will not gain support. We need to close the loop, get feedback, and learn how to apply this to individuals. There is a lot that can contribute to the long-term viability of all mankind. There are a lot of cool things we can do. There are resource constraints, but we need to be doing this for NASA's growth and long-term stability.

Adjourn

The meeting was adjourned at 11:48 a.m.

NASA Advisory Council

August 2-3, 2011

Ames Research Center • Building 152, Room 171 • Moffett Field, CA 94035

Space Operations Committee	Exploration Committee
<ul style="list-style-type: none">• Chair: Col. Eileen Collins• Dr. Pat Condon• Dr. Leroy Chiao• Dr. John Grunsfeld• Mr. Tommy Holloway• Ms. JoAnn Morgan• Mr. Bob Sieck• <i>Mr. Jacob Keaton, Executive Secretary</i>	<ul style="list-style-type: none">• Chair: Mr. Richard Kohrs• Gen. Lester Lyles• Mr. Bohdan Bejmuk• Ms. Nancy Ann Budden• Mr. Joseph Cuzzupoli• Ms. Carolyn Griner• Dr. John Logsdon• Dr. David Longnecker• Mr. Richard Malow• <i>Ms. Shawanda Robinson, Administrative Officer</i>• <i>Dr. Bette Siegel, Executive Secretary</i>

Tuesday, August 2, 2011

- 8:00 – 8:15** Arrive/Convene Meeting
- 8:15 – 9:00** Task Group on Analysis Groups (TagAG) Final Report – with Science Committee
- Dr. T. Jens Feeley/ NAC Science Committee
- 9:00 – 9:30** Space Operations Mission Directorate (SOMD)/Exploration Systems Mission Directorate (ESMD) Merger Update
- Ms. Lynn Cline/SOMD & Dr. Laurie Leshin/ESMD
- 9:30– 10:30** ISS Mars Analog Status Update
- Mr. Charlie Stegemoeller/Johnson Space Center (JSC)
- 10:30 – 10:45** Break
- 10:45 – 12:30** COTS/CRS & Commercial Crew – with Commercial Space Committee
- Mr. Phil McAlister/ESMD, Mr. Alan Lindenmoyer/JSC, Mr. Michael T. Suffredini/JSC
- 12:30 – 1:30** Lunch
- 1:30 – 2:30** Multipurpose Crew Vehicle/Space Launch System (MPCV/SLS) Update
- Mr. Dan Dumbacher/ESMD
- 2:30** Adjourn

Wednesday, August 3, 2011

- 9:20 – 9:30** Arrive/Convene Meeting
- 9:30 – 11:30** Deliberations & Recommendation Preparation
- 11:30** Adjourn