

**NASA ADVISORY COUNCIL (NAC)  
Exploration Committee**

**CORRECTED MINUTES**

Meeting Date: August 3-4, 2010

AGENDA:

- Exploration Program Status
- Constellation Program Status
- Heavy Lift and Propulsion Technology
- Human Research Program Status
- Joint Session with Technology & Innovation Committee
  - Review of Human Exploration Framework Team (HEFT)
  - ESMD / Office of Chief Technologist (OCT) Technology Coordination
  - Overview of ESMD New Technology Initiatives
- International Space Cooperation

ATTENDING:

Exploration Committee: Richard Kohrs (Chair), Nancy Ann Budden, Bo Bejmuk, Joe Cuzzupoli, John Logsdon (part-time by phone), David Longnecker, Bette Siegel (acting Executive Secretary), Jane Parham (Administrative Officer)

Members Absent: Les Lyles

Others: Doug Cooke, Paul Bremner, Garry Burdick, Mino Dastoor, Dennis Grounds, Wes Huntress, Jitendra Joshi, John Olson, Mike Sander, Frank Slazer, Dale Thomas, Brenda Ward (See detailed list, p. 7)

**OUTCOMES**

Exploration Committee Observation #1: “We note that there is currently no budget or roadmap for space exploration agreed to by the White House, Congress, and NASA leadership. This complicates ESMD operations.”

Exploration Committee Observation #2: “If NASA selects LOX-Kerosene combination of propellants for Heavy Lift Launch Vehicle first stage, the following two considerations should be kept in mind: (1) Russia currently leads LOX-Kerosene propulsion technology. (2) LOX-Kerosene will provide NASA with an opportunity to create a huge operability improvement by using high pressure kerosene as the working fluid in the Thrust Vector Control actuation system, thus eliminating the need for hydraulic power generating system.

This approach has been successfully used in Russian RD-170 1500K lbs thrust Lox-Kerosene engine resulting in simpler and lower weight engine/TVC system, much easier to operate. In order to benefit from this approach the engine and its TVC should be designed as an integrated system. Outcome of this design decision will not only be a lighter, less expensive to operate propulsion/TVC system, but a “green” stage with complete absence of toxic reactants and conventional hydraulic fluid.”

Joint Exploration Committee and Technology & Innovation Committee Finding:

“Uncertainties and lack of budget consensus complicate efforts to define, fund, and promote requirements for space technology. The Office of Chief Technologist is charged in part to address future technology development within NASA. ESMD has funding for Technology development and demonstrations.

“We observe that the recently established Office of Chief Technologist has made significant and positive advances in identifying advanced technologies required for future human and robotic exploration of space. They have moved forward quickly and aggressively with plans and an organization to rapidly facilitate technologies that will be required for a variety of future missions to the Moon, Mars, or a Near Earth Object (NEO).

“We support and applaud the direction of Office of Chief Technologist for maintaining close communications and interactions with the ESMD, coordinating critical-path technologies and technology development required to execute a roadmap to future human exploration beyond low earth orbit (LEO). Because future technologies represent an area of overlap between OCT and ESMD, these interactions are critical to avoid duplication, cross purposes, and gaps, and may result in schedule and cost savings, and position NASA to more effectively execute a future space exploration effort.

“We encourage continued collaboration and request a future update on coordination within the NASA Office of Chief Technologist and ESMD.”

**ACTIONS**

**NAC\_100803\_001:** Bette Siegel. Provide EC with link to video of Orion Pad Abort Test.

**DISCUSSION**

**NASA Exploration Systems Mission Directorate (ESMD) Status**

Doug Cooke, NASA Associate Administrator – ESMD, presented status on ESMD activities and budget issues, including a comparison of the President, House, and Senate budget proposals, new ESMD program planning, major workshops: Exploration Enterprise Workshop (Galveston in May) and Exploration of NEOs Objectives Workshop - Explore NOW (Washington, DC, to be held August 10-11), and the major ESMD challenges: Acquisition planning, dealing with the continuing resolution budget, and the Constellation transition.

Discussion Points

- Constellation contractors have been provided a set of priority guidelines. Top two priorities are the Crew Rescue Vehicle (CRV) and the J2 Engine.
- NASA is under Congressional direction to neither cancel nor begin new programs. We are not terminating prime contracts, though subcontractors are affected.
- The Constellation Program schedule is in a high state of flux. The Program is trying to manage tasks for the rest of this year and into next year. ESMD has directed a spending rate to get to the right level for most likely funding levels under a Continuing Resolution budget.
- It is a tribute to Constellation management that the Program is still executing and making progress, though affected by the uncertainties.
- ESMD was in the process of looking for offsets from existing budget lines in order find money for the newly inserted CRV. Charlie Lindquist led a study to scrub what a CRV

- would cost based on a version of Orion and laid out a budget accordingly. With the budget conflicts among President, House, and Senate, we put this activity on hold.
- It is critical we get a resolved budget in order to proceed.
  - The House and Senate have created their own budget allocations and dates for NASA. In response, NASA has briefed the appropriate House and Senate committees on ESMD programs, advising them that the proposed dates are not realistic.
  - Termination Liability is accounted for in the contracts. However, during FY10 contractors were putting most of their money on performance, operating at risk. NASA cannot increase their funding.
  - ESMD has done a major capabilities exercise throughout the NASA Centers. NASA will continue to carry 10 centers but will have to decide what facilities will need to be kept ready, mothballed, or otherwise. This is a big part of budget discussion.
  - Specific schedule for Heavy Lift vehicle will depend on final funding level. Also, both House and Senate have pointed in the direction to build on shuttle and other existing technologies.
  - The Human Exploration Framework Team (HEFT) is an ongoing activity. Completion of first phase is expected end of August. We will then bring HEFT leadership to Headquarters.
  - An integration team is managing various studies going on at NASA Centers.
  - Final decisions on vehicles will come from the NASA Administrator.
  - The new U.S. Space Policy calls for ISS support through 2020 and closeout of Shuttle, beyond that it is a flexible path with possible multiple destinations reflected in the President's budget. Policy needs to be stated more clearly when we get budget resolution.

### **Constellation Program Status**

Mr. Dale Thomas, Constellation Program Manager (JSC), presented the Constellation Program (Cx) current status. Completion of Program Initial Capability PDR in March confirmed that the Cx Initial Capability Design is technically sound and able to perform the ISS Mission with acceptable risk and margins. Mr. Thomas provided a summary of the program elements' status, the FY10 Re-Plan cost rate, planned events for FY10, and upcoming milestones through February 2011.

#### **Discussion Points**

- There are elements in Cx that align with the new suite of ESMD programs. This is currently under discussion at HQ.
- Pad Abort Test 2 is planned for 2013; however, it is questionable whether PATest 2 is necessary since PATest 1 went so well this year.
- The Constellation team continues to make progress and is playing different options.
- Dr. Longnecker pointed out that results of a study of Skylab astronauts showed that the astronauts were unanimous against a space vehicle water landing on return to earth. Mr. Thomas responded that the CRV will be primarily water landing, otherwise it would have to be redesigned. The planned touch down is near Catalina Island, California, which is within safety requirements for getting injured astronauts to a hospital. There are plans for testing of getting ill crew out of the landed vehicle.
- CRV design will be a simplified version of Orion.

### **Heavy Lift and Propulsion Technology**

Cristina Guidi, Deputy Director of the Constellation Systems Division at NASA HQ, summarized the background, NASA Point of Departure plans, and near-term activities for a Heavy Lift and Propulsion Technology (HLPT) program, expanding on previous work of

multiple programs, including recent internal Heavy Lift Launch Vehicle (HLLV) study. The program goal would be to provide new National capabilities, reduce costs, and shorten development time for future heavy-lift propulsion systems. Projects may include commercial, academic and international partnerships. Requirements would be synergistic among Commercial Launch, NASA Heavy Lift, and Department of Defense.

#### Discussion Points

- Suggestion was made that the program look at Russian Lox kerosene system as propulsion model.
- FY11 environment creates mind shift to operability and affordability rather than performance.
- PDR by 2015 is possible, but this is under discussion with OMB and OSTP.
- Marshall Space Flight Center is managing effort to procure system analysis effort to engage industry in architecture studies and launch vehicle concepts.
- ESMD is working closely with Department of Defense in this endeavor.

#### **Human Research Program Status**

Dr. Dennis Grounds, Manager of the ESMD Human Research Program, presented an overview of the Program, covering the areas of Program Changes from Recent Agency Budget Events, Management Approach, Human System Risks in Exploration Missions, Human Research Program Research And Technology Highlights, Effects of a potential Budget Augmentation, and the Emerging Risk [to astronauts] of Intracranial Hypertension with Associated Visual Changes.

#### Discussion Points

- Astronaut risk for cancer is half the general population's risk, because the general population includes smokers, drinkers, and low standard of living. But compared to peers at JSC, astronauts have higher instance of cancer, apparently related to altitude and flight duration.
- Two treadmills on Space Station help with bone and muscle risks.
- Without Shuttle there will be much more limited sample return for experiment investigation. Program is looking at on-orbit analysis.
- Dr. Longnecker raised the issue of lifetime medical care for astronauts, as in the military. A condition previously unknown is now showing up – interocular pressure. The astronauts put their life at unknown risks and should have this care.

#### **International Space Cooperation**

Dr. John Olson, Director of ESMD Directorate Integration Office, provided an overview of the current status of international and other governmental partnerships in space exploration efforts, level of involvement, recent activities and a brief look at rationale and strategy.

#### Discussion Points

- These are pivotal times in the dynamics of the European Space Agency and the European Union, with political jockeying for leadership.
- Travel to Mars would require international participation
- International partners may want to keep their ISS modules running beyond 2020, rather than disassembling them as the U.S. plan sets forth.
- Currently ESA, JAXA, Canada and the U.S. are the biggest players in international space arena.

## **Joint Session with Technology & Innovation Committee**

### **Review of Human Exploration Framework Team (HEFT)**

Dr. John Olson, Director of ESMD Directorate Integration Office, provided a look at HEFT, reviewing FY10 accomplishments and explaining the HEFT process, strategy, and goals. The HEFT primary goal is to “Generate a process that evolves into a long term, permanent NASA activity to support human space flight strategic planning.”

#### Discussion Points

- Goal in next month is to narrow trade space into scope recommended by NASA Administrator.
- Goal in next five months is to increase level of identification of architecture, to continue to add fidelity to program evolution, and to maintain the senior leadership team in an advisory role, dialoging with international partners.
- HEFT activity is aimed at influencing FY12 budget.
- HEFT is analyzing a large number of questions, some technical, some “religious,” and some political, evaluating the full trade-space spectrum. Key is balance of capabilities from a reliability and operational risk standpoint. Decision on type of vehicle will be made as an Agency.
- As a reservist working with the Pentagon National Security Space Office, Dr. Olson is sensitive to NASA information being so available on the web. We balance openness for the national good with the fact that there are some strategic elements that must be kept closed.
- Before NASA can get commitments from international partners, we have to be sure what our forward path is and whether they can meet the commitment we need.

### **Crosscutting Capability Demonstration Division**

Dr. Prasun Desai, Acting Director of the Crosscutting Capability Demonstration Division of NASA’s Office of Chief Technologist (OCT), summarized current approach to space technology, covering strategic guidance and road mapping, a full spectrum of technology programs that provide an infusion path to advance innovative ideas from concept to flight, competitive peer-review and selection, a projectized approach to technology development, with the overarching goal to reposition NASA on the cutting edge. The Crosscutting Capability Demonstrations Division includes three programs: Technology Demonstration Missions (Marshall Space Flight Center), Edison Small Satellite Missions (Ames Research Center), and Flight Opportunities (Dryden Flight Research Center).

#### Discussion Points

- It is not a competition between OCT and ESMD. These two organizations can arrive at mutually necessary collaborative need statements to drive which technologies are selected.

### **ESMD / Office of Chief Technologist (OCT) Technology Coordination**

James Reuther, OCT Director for Strategic Integration, presented a briefing on the goals, responsibilities, governance structure and strategies of the OCT, established in February 2010, for development of NASA technology and integration across the Agency Mission Directorates and throughout the NASA Centers, with a Center Chief Technologist appointed at each Center.

#### Discussion Points

- There is no target for how much should be spent inside or outside NASA; the quest is for the best ideas wherever they come from.

- Draft roadmaps due in October 2010 do not take into account available budgets; the effort is to catalog needed technologies, paths NASA should look at, and where they fit in a phased mission program. A group will be brought in to look at costs.
- The first step was looking at all previous roadmaps to take lessons learned.
- Request for Proposals is structured so that if a particular firm brings a proposal to the table, they bring innovations with it. Technology development is part of the program, and the path is within Mission Directorates.

### **Overview of ESMD New Technology Initiatives**

Benjamin Neumann, Director of ESMD Advanced Capabilities Division, presented a briefing on the Exploration Technology Development Program, with an overview of Policy Goals, Budget Strategy, Program Overview, Near-Term Activities, Heavy Lift and Propulsion Technology, Exploration Precursor Robotic Program, Exploration Scouts, International Partnerships, and FY 2011 Considerations. The Exploration Research and Development Theme includes three robust Technology Development and Research Programs: (1) Human Research Program, (2) Enabling Technology Development and Demonstration, and (3) Flagship Technology Demonstrations.

#### **Discussion Points**

- Russia and China participated in last month's international meeting, though NASA's interactions with China are limited by U.S. policy. India signed on just after that meeting.
- The change created by the new budget direction is a function of how the budget is resolved. The planning in process during the last several months includes precision landing, hazard avoidance, inflatable habitats, conversion technologies for nuclear power. We have had some level of funding for years, but the new program under the President's FY11 budget would accelerate these technologies.

### **Discussion and Recommendations**

- It is difficult for the NAC Committees to create recommendations with no settled NASA budget.
- One observation might be that until the program plan is clarified, the budget cannot be resolved. Although ESMD has a plan based on the President's budget, the confusion is how to convince Congress that it is now impossible for a NASA launch vehicle to meet the 2015 deadline. A heavy lift vehicle might reach PDR by 2015.
- ESMD should have a crisper definition of mission than a portfolio of enabling technologies. Perhaps that would facilitate Congressional budget resolution.
- Mr. Cooke pointed out that ESMD does have an architecture that defines possible mission in this flexible path. When the President's budget came out February 1, 2010, ESMD reviewed all the reports on Exploration roadmaps, including the 1990 Augustine Report, the Synthesis Group, the Sally Ride Report – all dealing with enabling missions to Mars. The technologies reported today, are the technologies discussed in these reports. ESMD has defined these over the years and is now refining the technologies that are enabling. I think it is clear what technologies are critical and which will be accelerated by the President's budget.
- HEFT will define what NASA considers as Exploration mission and is working on integration to define a solid set of technologies to move forward.
- It seems that another big gap is developing between expectations and funding level in Congress, leading to schedule slips, possibly leading to further budget cuts.

- Mr. Cooke again emphasized that the FY10 appropriations language prohibits NASA from either canceling any activities or beginning any new activities. NASA has moved out with solicitations for proposals on the potential programs. The intent has been to get as much done on planning these programs so that we can quickly respond to the green light when it comes.
- NASA is completely constrained without getting appropriated money. We have lawyers guiding us through the entire process.
- Currently, the programs are already losing people, which creates a morale issue among civil servants as well as contractors.
- Congress could write a Continuing Resolution (CR) anomaly, adding words that would allow the program to proceed with Requests for Proposals. A number of CR anomalies get introduced every year. NASA is ready to release several RFPs. Possibly NASA could be allowed to release draft RFPs.
- One Committee observation might be that, in the absence of a specifically defined mission, the technology and exploration communities seem to be working toward mutually beneficial long-term technologies that support future exploration.
- Another observation might be recognition of an impressive structure NASA has created for managing technology pull and push and vertical integration across the agency. The mechanism for proceeding is in place.

Attendees other than Exploration Committee Members:

|          |          |   |                              |
|----------|----------|---|------------------------------|
| Paul     | Bremner  | ATA Engineering - Sr.Bus.Dev.Consultant | paul.bremner@atae.com        |
| Garry    | Burdick  | NASA/JPL - Dep. Prog. Mgr               | garry.m.burdick@jpl.nasa.gov |
| Doug     | Cooke    | NASA/HQ/ESMD Assoc. Administrator       |                              |
| Minoo    | Dastoor  | NASA/OCT                                |                              |
| Dennis   | Grounds  | NASA/JSC/Human Research Prog Mgr        |                              |
| Wes      | Huntress | Carnegie/NAC Science                    |                              |
| Jitendra | Joshi    | NASA/HQ/ESMD                            |                              |
| John     | Olson    | NASA/HQ/ESMD - Dir., DIO                | john.olson@nasa.gov          |
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| Frank    | Slazer   | Northrop Grumman- Mgr. Bus. Dev.        | frank.slazer@ngc.gov         |
| Dale     | Thomas   | NASA/MSFC - Prog Mgr Constellation      |                              |
| Brenda   | Ward     | NASA/JSC - ExAstMgr Integration         | brenda.L.ward@nasa.gov       |

*Presentation charts and materials will be posted on the NAC Exploration Committee web site:*  
<http://www.nasa.gov/exploration/about/explorationcommittee.html>