

**National Aeronautics and Space Administration
Washington, DC**

NASA ADVISORY COUNCIL

Human Exploration and Operations Committee

December 9-10, 2013

**NASA Kennedy Space Center
Cape Canaveral, Florida**

MEETING MINUTES

Ken Bowersox, Chair

Bette Siegel, Executive Secretary

**Human Exploration and Operations Committee
NASA Kennedy Space Center
Cape Canaveral, Florida
December 9-10, 2013**

**MEETING MINUTES
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***Meeting Minutes Prepared By
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**NASA ADVISORY COUNCIL
HUMAN EXPLORATION AND OPERATIONS COMMITTEE
NASA Kennedy Space Center
Cape Canaveral, Florida**

**PUBLIC MEETING
December 9-10, 2013**

Monday, December 9, 2013

Call to Order and Announcements

Dr. Bette Siegel, Executive Secretary for the Human Exploration and Operations (HEO) Committee, called the public session of the Committee meeting to order at 9:30 a.m. The HEO Committee is a Federal advisory committee established under the Federal Advisory Committee Act (FACA) and was open to the public. Meeting minutes were taken by Mr. David Frankel and will be posted after the meeting to the HEO Committee web site, <http://www.nasa.gov/directorates/heo/nac-heoc/#.Usbfnbad5OE> Each Committee member has been appointed by the NASA Administrator, Mr. Charles F. Bolden, Jr., based on the member's individual subject matter expertise. Each member is a Special Government Employee, subject to ethics regulations, and must recuse himself or herself from discussions on any topic in which there could be an ethical conflict. The second day has time set aside for public comments.

Opening Remarks

Dr. Siegel introduced Mr. Ken Bowersox, NAC HEO Committee Chair. He welcomed everyone to the meeting and noted that the Committee had three new members, all former astronauts, including him. The other two new members are Mr. James Voss and Mr. Michael Lopez-Alegria. At Mr. Bowersox's request, each Committee member introduced themselves.

Status of Human Exploration and Operations

Mr. Bowersox introduced Mr. William Gerstenmaier, Associate Administrator, Human Exploration and Operations Mission Directorate (HEOMD), NASA Headquarters.

Mr. Gerstenmaier described HEOMD's major accomplishments in 2013. These accomplishments included the following:

- Safe and successful International Space Station (ISS) operation
- Commercial Cargo Program (CCP) success, resulting in two ISS cargo transportation services providers

- The initial Certification Products Contract's (CPC's) Phase I products received and evaluated
- Space Launch Systems (SLS) Preliminary Design Review
- Orion Multi-Purpose Crew Vehicle (MPCV or Orion) heat shield delivery
- Orion power on
- Successfully launched Tracking and Data Relay Satellite System (TDRS)-L, Landsat 8, and Mars Atmosphere and Volatile Evolution (MAVEN)
- Successful Lunar Laser Communication Demonstration (LLCD) from lunar orbit.
- Initially defined the Asteroid Redirect Mission (ARM)

Mr. Gerstenmaier discussed the biggest challenges for HEOMD in 2014. A decision will be reached on whether to extend ISS beyond 2020. Commercial Crew Transportation Capability (CCtCAP) providers will be selected. The Orion test article will be delivered and Exploration Flight Test-1 (EFT-1) will be flown. The overall design for SLS will mature to Critical Design Review. The pathway for SLS upper stage development will be established, including international partner roles. The ARM Mission will be taken into formulation. The next TDRS will be launched.

Mr. Gerstenmaier discussed the ARM. He described how NASA's capabilities and activities in the Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD), and HEOMD will be leveraged for the asteroid mission. These activities include asteroid identification and characterization efforts, high-power solar electric propulsion (SEP), autonomous guidance and control, Orion and SLS vehicles, and technologies for astronaut Extra-Vehicular Activities (EVAs). The goal is to identify and redirect a small asteroid to a stable orbit in the lunar vicinity and to have astronauts investigate and return samples. A slide was presented showing ARM's three segments. First, an appropriate asteroid will be identified for the mission. Second, the asteroid will be redirected to a lunar-distant retrograde orbit (DRO) using high power SEP. Third, astronauts, using Orion and SLS, will rendezvous with the asteroid and return to Earth with samples from the asteroid. A chart showing an alignment strategy for the ARM and the timeline through 2023 was presented. The concepts for the asteroid capture mechanism were discussed.

Mr. Gerstenmaier described the FY13 progress in the crew operations portion of the asteroid recovery mission. He discussed EVA technique development for the ARM and EVA testing in the Neutral Buoyancy Lab (NBL) using the Advanced Crew Escape Suit (ACES) suit to represent a typical suit that could be used for the sample return EVAs. A chart was presented showing how lunar gravity would be used to leverage trajectory for the asteroid rendezvous and redirection to a stable lunar orbit. The crew's outbound flight time will be eight days and nine hours. The return flight time will be eleven days

and six hours. The rendezvous time will be one day. The lunar DRO stay time will be five days.

The planned docking system for the ARM was discussed. It will leverage the docking system standard used at the ISS. A chart and slide were presented showing the steps and missions necessary for making a long stay on the Mars surface possible. A chart showing the LLCDC mission architecture was discussed and recent project accomplishments in space communications were described. A slide showing CY13 highlights from the Launch Services Program (LSP) was presented.

Mr. Gerstenmaier discussed a chart showing the Global Exploration Roadmap (GER). The Roadmap is a collaboration among international space agencies, through membership in the International Space Exploration Coordination Group (ISECG), to define space exploration missions that advance global space exploration activities as well as individual agencies' own goals and objectives. The roadmap reflects space exploration moving forward in three areas: the ISS; robotic missions, including the Mars sample return and precursor opportunities; and human missions beyond low-Earth orbit (LEO), including sustainable human missions to the Mars surface. In response to a question from Mr. Pat Condon about radiation exposure, Mr. Gerstenmaier explained that radiation sensors would be included in the Orion to determine the radiation reduction that is provided by the capsule. Not much work has been done on background galactic radiation, and they are looking at putting a shield around the capsule. In addition, NASA is working with the National Institute of Medicine on changing, with full regard for ethical standards, the allowable limits on radiation exposure. Currently, the threshold is a three percent increase in the likelihood for developing cancer over the lifetime of the astronaut. In response to a question from Mr. Bob Sieck, Mr. Gerstenmaier explained that the roadmap originally had multiple paths and is becoming more precise. The roadmap allows other countries to see what is needed and affords them an opportunity to determine what they would like to work on. There is also a need to identify the next critical piece that should be developed on the U.S. side. In response to a question from Mr. Bohdan (Bo) Bejmuk, Mr. Gerstenmaier answered that the next international meeting on the roadmap would be hosted by Japan in two years.

Mr. Bowersox thanked Mr. Gerstenmaier for his presentation.

Status of Commercial Spaceflight

Mr. Bowersox introduced Mr. Phil McAlister, Director, Commercial Spaceflight Development Division, HEOMD, NASA Headquarters.

Mr. McAlister described the accomplishments to date in the CCP. The program has produced two new low-cost U.S. launch vehicles, two new autonomous cargo spacecraft able to carry cargo to and from the ISS, and two new privately developed launch facilities at Cape Canaveral, Florida. This is providing the future robustness that is needed for ISS cargo transportation. Two medium class launch vehicle options are now available for NASA science missions. The program is helping to recapture U.S. market share for commercial launches. A brief video on the cargo missions was presented. SpaceX and Orbital Sciences have each had two successful launches and one successful berthing, with no failures. NASA's cost towards this development was approximately \$800 million. In response to a question from Mr. Bowersox about the cost, Mr. McAlister explained that \$700 million went to the commercial partners and \$100 million was used by NASA for its support.

A chart showing the roadmap for the CCP was presented. There are several elements in the program: Commercial Crew Development (CCDev); Commercial Crew Development Round 2 (CCDev2); Commercial Crew Integrated Capability (CCiCAP); and NASA Crew Certification. The certification has two phases: phase 1 - CPC, and phase 2 - CCtCAP. Under CCiCAP, there are funded Space Act Agreements (SAAs) with the Boeing Company, Sierra Nevada, and SpaceX, and an unfunded SAA with Blue Origin. Milestones achieved under these agreements were reviewed. A brief video on Commercial Crew was presented. Mr. McAlister noted that the commercial partners are competing vigorously on cost, safety, and reliability, which is the reason competition is believed to be an important part in the program going forward. In response to a question from Mr. Lopez-Alegria, Mr. McAlister explained that Sierra Nevada's program would be less mature than Boeing or SpaceX because it had only received \$212 million and was not fully funded through Critical Design Review (CDR). Blue Origin, while not receiving any NASA funding, was receiving NASA technical assistance. That technical assistance is enabling Blue Origin to continue to participate in the competition without NASA funding.

Mr. McAlister explained that the primary objective for the CPC procurement is the delivery, technical interchange, and NASA disposition of early lifecycle certification. Mr. Bejmuk asked how requests granted by NASA for deviations from standards or for variances would reduce risk. Mr. McAlister explained that delaying deviations until designs were more complete would severely impact cost and schedule. He described the CCtCAP procurement. It is an acquisition process using competitive down-selection procedures and allows for a full and open competition. It will result in firm-fixed-price, performance-based contracts with a fixed-price Indefinite Delivery/Indefinite Quantity (IDIQ) element. The base period for the contracts awarded will be August 2014 through September 30, 2017. The Request for Proposal (RFP) is centered on how well the

contractor shows compliance to core CCP and ISS requirements. He noted that crew safety is the foundation of the program mission. A slide showing the CCtCAP schedule was reviewed. A company able to demonstrate sufficient maturity can participate in the bidding, even if it has not previously participated in the program. The winning bidder will be awarded at least two missions, which gives them an assurance that they will recover some of their investment. In addition, the winning bidder will be able to sell services to non-NASA customers. An award is expected to be made in August or September 2014. Mr. Bowersox asked whether there would be a Soyuz backup plan. Mr. McAlister responded that a Soyuz backup plan is under active debate within the Agency and overlap options are being discussed. Mr. Bowersox commented that Soyuz could become very expensive if NASA's commercial partners come under schedule pressure.

The budget situation was discussed. The President's Budget Request for FY14 is \$821 million for commercial spaceflight. That is the same amount that was requested for FY13, where only approximately \$525 million was appropriated. Since then, NASA's ability to accommodate a lower budget than requested without further schedule slippage has decreased.

Mr. Richard Malow asked about NASA's involvement in Dennis Tito's "Inspiration Mars" mission to send a man and a woman on a flight around Mars with a planned launch sometime in 2017 to 2018. Mr. McAlister observed that the effort has not been dismissed by NASA. Mr. Gerstenmaier explained that while some elements made sense, it had initially been understood that there would be private funding for the effort and that has not happened. A demonstration module would need to be tested at the ISS and NASA is open to that. Mr. Malow advised that another opportunity for the Inspiration Mars mission would be in 2021 and would make more sense from an overall NASA perspective.

Mr. Bowersox thanked Mr. McAlister for his presentation.

Status of Exploration Systems Development

Mr. Bowersox introduced Mr. Daniel Dumbacher, Deputy Associate Administrator for Exploration Systems Development Division (ESD), HEOMD, NASA Headquarters.

Mr. Dumbacher briefed the Committee on recent developments in ESD. He explained that ESD is responsible for bringing together SLS, Orion, and the Ground Systems Development and Operations (GSDO) Programs for the Exploration Mission (EM). A brief video was presented showing progress in hardware development. A chart showing the ESD Summary Schedule for SLS, Orion, and the GSDO was reviewed. Recent accomplishments were described. The Orion EFT-1 flight test is on track for a launch on

September 18, 2014. A power-on test for Orion was conducted successfully. The Orion heat shield, which had been a major risk item, has been delivered and is onsite at Kennedy Space Center (KSC). In response to a question from Mr. Bejmuk, Mr. Dumbacher explained that the European Service Module is part of the Orion spacecraft. The tiles for the Thermal Protection System (TPS) have all been cut to dimension, fit-checked, and are waiting to be fully installed. A slide showing the painting process was presented. Mr. Bejmuk asked whether the painting was solely for aesthetics. Mr. Dumbacher responded that the painting was mostly for aesthetics, but also served as a sealant against moisture absorption by the ablator. Mr. Bejmuk commented that much weight could be saved by eliminating the painting.

Recent accomplishments in the SLS program were described. Painting on the Vehicle Spacecraft Adapter (VSA) has been completed. Core Stage flight computers are installed and soon will be ready for testing. A new foundation has been poured for the Vehicle Assembly Center (VAC). In response to a question from Mr. Joseph Cuzzupoli, Mr. Dumbacher informed the Committee that flight computer integration is ESD's responsibility. He noted that drawings for 70 percent of the Core Stage have been released, and 200 drawings, on average, have been released per month. No drawings have yet been released for the main engines. Mr. Bejmuk noted that Preliminary Design Review (PDR) occurs when drawing release is at 10 percent and that CDR occurs when drawing release is at 90 percent. The new vertical weld center at NASA's Michoud Assembly Facility (MAF) in New Orleans was described. In response to a question from Mr. Bowersox, Mr. Dumbacher advised that ultrasonic and x-ray testing is being used for weld inspections.

Mr. Dumbacher described recent GSDO accomplishments. Roller bearings have been installed on the crawler transporter. These bearings provide an extraordinary 1/1000-inch clearance. A new flame deflector that will be able to serve multiple launch vehicles, including SLS, is being constructed. It will allow pad 39B to be used by multiple users. A slide showing the steps for EFT-1 was presented. Mr. Dumbacher explained that a primary purpose for the flight is to test Orion's heat shield. The test will be launched on the Delta IV-Heavy rocket. Orion will orbit the Earth twice and reach a 3,671 mile apogee. Speed on its return to Earth will reach 85 percent lunar re-entry velocity--20,000 miles per hour. KSC will be responsible for handling the landing and recovery operations in the Pacific; this includes coordination with the Navy.

A chart on EM-1 (Exploration Mission-1) was presented. Mr. Malow asked whether it was able to carry crew. Mr. Dumbacher responded that from a performance perspective, it could, but due to funding shortfalls, it would not have the necessary life-support systems, shielding, or flight software. The ARM was briefly discussed. Forty-five

states have some involvement in the mission. In response to a question from Mr. Bejmuk, Mr. Dumbacher explained that the asteroid capture and towing will be performed by a robotic spacecraft.

Mr. Bowersox commented that launching a vehicle without a crew in order to save funds that would otherwise need to be spent on an Environmental Control and Life Support System (ECLSS) will not excite people. Mr. William Gerstenmaier reported that ECLSS is the pacing item for a flight in 2021, and the delay attributable to it is evidence that budgetary constraints are adversely affecting the program. Mr. Bowersox commented that the ECLSS delay is difficult to justify when there is a need to maintain support and interest from supporters. Mr. Cuzzupoli commended NASA for the work it is doing on integration, despite the limited number of people available to work on it. Mr. Dumbacher noted that a Standing Review Board (SRB) grades integration activities. Mr. Bejmuk expressed concern over the fact that it will be years before people can fly aboard Orion. Mr. Sieck agreed with Mr. Bejmuk and commented that nothing is learned from sitting on the ground. Mr. Gerstenmaier cautioned that it is important to think about parts obsolescence and that it is important to have a program that is affordable and sustainable for future flights. Mr. Bejmuk stated that it appeared that NASA would be flying only once every two or three years. Mr. Gerstenmaier responded that NASA would fly once a year because a repetitive cadence is necessary.

Mr. Bowersox thanked Mr. Dumbacher for his presentation.

Adjournment

Mr. Bowersox adjourned the public session of the Committee meeting for the day at 2:45 p.m.

Tuesday, December 10, 2013

Call to Order and Announcements

Dr. Siegel called the public session of the Committee meeting to order at 9:00 a.m. She reminded everyone that the meeting is a FACA meeting and is open to the public.

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Opening Remarks

Dr. Siegel re-introduced Mr. Bowersox, HEO Committee Chair. He welcomed everyone back to the second day for the HEO Committee meeting.

Update on the Capability Driven Framework and Status of Advanced Exploration System

Mr. Bowersox introduced Mr. Jason Crusan, Director, Advanced Exploration Systems Division (AES), HEOMD, NASA Headquarters.

Mr. Crusan presented a chart captioned "Capability Driven Framework." It depicted several mission classes flowing in a sequence. He explained that as each class is reached, different missions become possible. The mission classes depicted in the chart are: Initial Exploration Missions; Extending Reach Beyond LEO; Into the Solar System; Exploring Other Worlds; and Planetary Exploration. The first mission class includes the ISS, SLS, and Orion. Mr. Bejmuk questioned the rationale for identifying the ISS, SLS or Orion as missions. Mr. Crusan clarified that these are not missions; rather, they are building blocks or capabilities. Ms. Shannon Bartell observed that the missions in the distant classes are being worked on today with robotics. Mr. Crusan concurred and noted that the missions shown on the chart are actually all human-class missions and robotic missions are contributing to answering reflect key strategic knowledge gaps before human missions. Mr. Bowersox asked whether a list of the strategic knowledge gaps could be provided. Mr. Crusan agreed to do so and noted that they are publicly available documents. Mr. Condon observed that the chart reflects a change in philosophy; formerly, a mission was defined and NASA then determined what capabilities were needed to achieve it. Now, capabilities are being identified first and NASA is then trying to figure out what to do with them. Mr. Crusan agreed with Mr. Condon's analysis and explained that from a technologist's point of view the destination does not really matter. The intent is to look at technologies that are crosscutting and to "let the politics play out." This permits an approach that is politically "agnostic." Ms. Nancy Budden noted that a previous Associate Administrator also used a technology milestone chart showing milestones that were mission agnostic. Mr. Crusan reported that HEOMD/AES uses system maturation teams to determining what capabilities needs to be developed. Ms. Budden encouraged that approach because it enables NASA to demonstrate that it continues to advance each year and achieve milestones without regard to politics. She recommended that the chart clearly indicate that it pertains to human missions.

Mr. Malow asserted that the asteroid mission was not well received on Capitol Hill. Mr. Crusan responded that the mission is to go to Mars and beyond and to send humans farther and farther out into space. Mr. Condon advised that a clearly stated objective is

needed as well as the steps for accomplishing the objective. Without this, he maintained, it is hard to make the case for the program. Mr. Voss added that even Mars is a step, and what is missing is a goal statement. Mr. Cuzzupoli advised that SLS is not necessary because the program could be accomplished with NASA's existing capabilities. That, he argued, makes it hard to sell the program. He explained that it is cheaper to use two or three flights than it is to develop and build a new vehicle. Mr. Bowersox asked whether anyone had conducted a financial analysis on this issue. Mr. Crusan responded that there have been numerous studies via the design reference missions and he agreed to provide those to the Committee. Mr. Bowersox noted that the private "Inspiration Mars" project had concluded that a new vehicle was needed. Dr. David Longnecker counseled that the Committee should spend significant time dealing with questions like the issues with the chart; he cautioned, however, that there is a need to avoid any conflict of interest. Mr. Bejmuk opined that if the Council spent two days working to improve the chart so that it makes sense, it would be a good contribution.

Mr. Crusan discussed a chart describing six key strategic principles for incrementally building capabilities to provide a sustainable program. He described the linkage between how NASA's Technology Roadmaps are linked to HEOMD's capability driven framework through to NASA Technology roadmaps and investment priorities. A chart showing evolutionary capabilities for Mars was presented. Mr. Bejmuk noted that ECLSS has already been developed for the ISS, and he inquired as to the reason for its absence from Orion. Mr. Crusan explained that it is not due to a technical challenge; rather, it is due to a budgetary challenge and the timing not being required until the first crewed mission.

Mr. Crusan described how AES fits into the HEOMD organization chart. AES is responsible for system-level integration work and prototype and design development for future exploration architecture elements. He explained how AES' objectives are differentiated from STMD's Exploration Technology Development (ETD) Division's objectives, and he described how AES collaborates with STMD. AES FY13 accomplishments were described for crew mobility systems, deep space habitation systems, vehicle systems, operations, and robotic precursor activities. A chart showing the status of AES FY13 milestones was presented. AES FY14 program changes were described. One new emphasis within AES's space suit efforts is the support for the development of a modified Advance Crew Escape Suit (M-ACES). Another new project will demonstrate oxygen production from the Martian atmosphere on the Mars 2020 mission. A chart showing AES milestones for FY14 was presented. Mr. Crusan concluded his presentation with a slide on AES' Industry Robotic Lander Partnership. He explained that NASA is seeking external partnerships to jointly develop a robotic

lunar landing capability as early as 2018 and had released a RFI to seek inputs from industry earlier this year.

Mr. Bowersox thanked Mr. Crusan for his presentation.

Status of International Space Station

Mr. Bowersox introduced Mr. Sam Scimemi, Director, ISS, HEOMD, who briefed the Committee on the ISS and its status. He presented a video entitled “Benefits for Humanity: In Their Own Words.” The video described benefits to humans on earth attributable to activities on the ISS. One example was a robot that has been constructed to operate inside a MRI machine with the precision, accuracy, and dexterity of a neurosurgeon. Other examples were water purification technology, remote-sensing imagery for crops, and using ultrasound for medical care where x-ray equipment is not available. Mr. Scimemi asserted that it is difficult to communicate how the ISS benefits people. It takes from two to five years to complete research on the ISS and three to twenty years before the benefits from that research reach the public. He noted that only about one and a half years of productive on-orbit microgravity research has been conducted to date.

Dr. Longnecker asked what the Committee could do to help. In response, Mr. Scimemi described how a relationship with the National Institutes of Health (NIH) had been developed for conducting experiments. The Committee’s assistance may be needed to help maintain that relationship because budgetary costs have compelled the NIH to reduce its work with NASA. In response to a question from Mr. Bejmuk, Mr. Scimemi reported that NASA’s budget for the ISS is approximately \$3 billion; half is used for operations, maintenance, and research, and the rest is used for crew and cargo transportation. Mr. Condon asked about the ISS National Laboratory. Mr. Scimemi reported that the Center for the Advancement of Science in Space (CASIS), a nonprofit organization promoting research aboard the ISS National Laboratory, is now bearing fruit. It has agreements with Merck, a major pharmaceutical company, and Proctor and Gamble to conduct research on the Station. In response to a question from Mr. Malow, Mr. Scimemi discussed the crew time available for conducting research. With a six-person crew onboard Station, the U.S. crew members have a requirement to spend 35 hours per week on research. Recently, they have been providing 40 hours on science research every week. Mr. Bejmuk recalled a commitment made by Mr. Gerstenmaier to provide free crew time, transportation, and power to ISS experimenters. Mr. Scimemi explained that CASIS is disseminating that information; however, it may not be well known to the general public. Mr. Bejmuk counseled that CASIS, unlike NASA, is not prohibited from advertising. A chart was presented showing how SMD uses the ISS for

science. Its missions are conducted on platforms outside the ISS. In response to a question from Dr. Longnecker, Mr. Scimemi described how NASA engages with emerging countries on using the ISS. A chart showing the ISS flight plan was presented.

Mr. Scimemi discussed expanding the ISS beyond 2020 for research. Crew time available for conducting experiments would double, the number of international experiment opportunities would double, and observatory time would be 166 percent greater. If the Station was ended in 2020, there would only be one or two commercial crew flights. The Global Exploration Roadmap was discussed. The Station is on the Roadmap's critical path and is needed to mitigate 21 of the 32 human health risks on the Roadmap. A chart was presented showing the Roadmap's critical paths. Mr. Scimemi noted that there is a need to reduce the size and complexity of exercise equipment if humans are to travel beyond LEO. Mr. Malow observed that NASA has contracted with Russia for providing Soyuz flights through the return mission in 2017. Mr. Bowersox asked whether there has been any backup planning. Mr. Scimemi replied that NASA needs to wait until proposals with hard numbers are received in response to the RFP for providing crewed flights to the ISS. A chart was presented showing the ISS top program risk matrix. One risk shown on the matrix is ISS Pension Harmonization, and Mr. Voss asked for that to be explained. Mr. Scimemi responded that it relates to a contractual labor obligation under dispute with a Space Station contractor.

Mr. Bowersox thanked Mr. Scimemi for his presentation

Public Comments and Input

Mr. Bowersox invited comments from the public. There were none.*

Committee Discussion and Deliberation

Mr. Bowersox invited suggestions and comments from the Committee members for providing advice to Mr. Bolden and Mr. Gerstenmaier. Mr. Malow asserted that it is critical to advance EM-2 a year because the current four-year gap is too long and a threat to the program. Ms. Budden endorsed the capability-based approach and recommended that the Committee "red-team" the presentation on that subject to ensure that it is communicated effectively to a broader audience. Mr. Cuzzupoli expressed concern that unless the budget is addressed, the SLS, which is NASA's most expensive activity, could be canceled; if that happens, NASA would cease to exist. Mr. Voss noted that a common theme is communication difficulties and the need to clarify NASA's Exploration Mission, its goal, and the path to get there. Mr. Condon counseled that discussions are needed for what should be done after 2028, and that the Committee should encourage NASA to have a solid plan for that. Ms. Bartell recommended looking

at NASA's 7120 document, which is the "bible" on how NASA runs and measures the success of its programs. Mr. Bowersox concurred and explained that programs are always evaluated "red" because the document was not written for an era where funding is always uncertain. Mr. Bejmuk suggested that financial risk be addressed by reducing program content rather than slipping the schedule. Dr. Longnecker suggested that the HEO Committee's Research Subcommittee be tasked with addressing the research gaps discussed by Mr. Scimemi. Mr. Cuzzupoli counseled that the urgency for work on avionics integration is under-recognized. Ms. Bartell concurred and requested an additional briefing on the integration schedules for avionics and software. Additional information is also needed on ISS system reliability, she advised, before the Committee should advise on extending the ISS.

Mr. Bejmuk suggested requesting a detailed schedule for integration activities. Mr. Bowersox concurred. Dr. Longnecker advised that NASA needs to engage more with emerging countries; he noted that there is a lot going on in Africa, where greater NASA involvement would be important for the Nation's well-being. Mr. Cuzzupoli expressed concern over the fact that there is only one experienced commander remaining on the astronaut office roster. Mr. Bejmuk suggested that the Committee recommend extending ISS beyond 2020, without specifying a more specific date. He explained that 2028 had only been used in briefings because that is the date through which the engineers have certified the structure. Mr. Malow counseled that a recommendation on the ISS extension is needed before the National Academy issues its report on the subject in July.

Mr. Bowersox summarized three potential areas for recommendations to be presented to the NAC: revisiting NASA's 7120 document; extending the ISS beyond 2020; and the need for NASA to develop a specific plan for after the ISS. He noted that the specific language for the recommendations would be developed after the meeting.

Adjournment

Mr. Bowersox expressed his appreciation to KSC for hosting the meeting. He thanked the Committee members for their participation and Dr. Siegel for her assistance. He adjourned the Committee meeting at 2:10 p.m.

* After the opportunity for public comments, it was discovered that the telephone used for persons attending the meeting remotely had not been unmuted for comments, and one person attending remotely had an interest in making comments. That person subsequently submitted two questions via email as follows:

1. I understand that the whole purpose of the station is to conduct experiments in microgravity as well as develop the technology and logistics of sustained human space flight. The knowledge of how human physiology behaves in a weightless environment is interesting and so are the techniques developed to mitigate its undesired effects. Would it not be in the astronauts best interest that a centrifuge based living habitat be developed/deployed? This would at least allow the astronauts to sleep, eat and do other hygiene activities with some normalcy? While it would not eliminate the need to exercise it would reduce the enormous amount required at this time. I see the challenge as purely mechanical. Even fractions of a "G" should prove useful for this purpose.

2. Many cargo ships come to the station and depart only to burn up in reentry along with the stations garbage. With launch costs still in the thousands of dollars per pound would it not be more economical to deorbit the trash, in say, a Bigelow Aerospace inflatable and use the expensive and painstakingly engineered hardware for habitat expansion? I understand these pressurized vehicles are not designed for the kind of multiple and reconfigurable experiments as other modules on station but they may be useful to hold large experiments such as crop growth, algae based co2 processing or perhaps even guest quarters to entice commercial involvement.

Thank you very much,
Juergen Nittner II



NASA ADVISORY COUNCIL
Human Exploration and Operations Committee
MEETING

Kennedy Space Center
Headquarters Building, Room 2229
Kennedy Space Center, FL 32899

Monday, December 9, 2013

AGENDA

Committee Public Meeting

10:30-10:35 am	Opening Remarks	Mr. Ken Bowersox, NAC HEO Chair & Dr. Bette Siegel, Executive Secretary, NAC HEO Committee
10:35– 11:35 am	Status of Human Exploration and Operations	Mr. William Gerstenmaier Associate Administrator HEOMD, NASA HQ
11:35-12:35 pm	Status of Commercial Spaceflight	Mr. Phil McAlister Director, Commercial Spaceflight Development Division, HEOMD NASA HQ
12:35-1:35 pm	<u>LUNCH</u>	
1:35 -2:35 pm	Status of Exploration Systems Development	Mr. Daniel Dumbacher Deputy Associate Administrator for Exploration Systems Development, HEOMD, NASA HQ
2:35 pm	<u>ADJOURN</u>	

**NASA ADVISORY COUNCIL
Human Exploration and Operations Committee
MEETING**

**Kennedy Space Center
Headquarters Building, Room 2229
Kennedy Space Center, FL 32899**

Tuesday, December 10, 2013

AGENDA

Committee Public Meeting

9:00-9:05 am	Opening Remarks	Mr. Ken Bowersox, NAC HEO Chair & Dr. Bette Siegel, Executive Secretary, NAC HEO Committee
9:05– 10:05 am	Update on the Capability Driven Framework & Status of Advanced Exploration Systems	Mr. Jason Crusan Director, Advanced Exploration Systems Division, HEOMD, NASA HQ
10:05-10:15 am	<u>BREAK</u>	
10:15-11:30 am	Status of International Space Station	Mr. Sam Scimemi Director, International Space Station, HEOMD, NASA HQ
11:30-11:35 am	Public comment and input	
11:35-11:40 am	<u>BREAK</u>	
11:40- Noon	Committee Discussion and Deliberation	
12:00-1:00 pm	<u>LUNCH</u>	
1:00-2:00 pm	Conclude Committee Discussion and Deliberation	
2:00 pm	<u>ADJOURN</u>	

**Human Exploration and Operations Committee Membership
December 2013**

Mr. Ken Bowersox <i>Chair</i>	Former NASA astronaut and retired U.S. Navy Captain
Mr. Bohdan I. Bejmuk <i>Co-Chair</i>	Aerospace Consultant, former Space Shuttle Orbiter Program Director, Boeing
Dr. Bette Siegel <i>Executive Secretary</i>	NASA Headquarters
Ms. Shannon Bartell	Former Director of Safety & Mission Assurance, KSC
Ms. Nancy Ann Budden	Director for Special Operations Technology, Office of the Secretary of Defense
Dr. Leroy Chiao	Former NASA Astronaut and ISS Commander
Dr. Stephen "Pat" Condon	Aerospace Consultant, former Commander of the Ogden Air Logistics Center, the Arnold Engineering Development Center, and the Air Force Armament Laboratory
Mr. Joseph Cuzzupoli	Former Assistant Apollo Program Manager, Rockwell, and manager of the Space Shuttle Orbiter Project
Mr. Tommy Holloway	Former Space Shuttle and ISS Program Manager
Dr. David E. Longnecker	Director, Health Care Affairs, Association of American Medical Colleges (AAMC), member of the National Academy of Sciences Institute of Medicine (IOM)
Mr. Michael Lopez-Alegria	Former NASA astronaut and retired U.S. Navy Captain, President of the Commercial Spaceflight Federation
Mr. Richard Malow	Distinguished Advisor at the Association of University for Research in Astronomy (AURA)
Mr. James Odom	Former NASA Associate Administrator for Space Station Freedom
Mr. Bob Sieck	Former Space Shuttle Launch Director
Mr. James Voss	Former NASA astronaut and retired U.S. Army Colonel, Scholar in Residence, Department of Aerospace Engineering Sciences, University of Colorado, Boulder

**Human Exploration and Operations Committee
NASA Kennedy Space Center
Cape Canaveral, Florida**

December 9-10, 2013

MEETING ATTENDEES

Committee Members:

Bowersox, Ken, <i>Chair</i>	U.S. Navy (<i>Ret.</i>)
Bejmuk, Bohdan, <i>Co-Chair</i>	Aerospace Consultant
Siegel, Bette, <i>Executive Secretary</i>	NASA Headquarters
Bartell, Shannon	Aerospace Consultant
Budden, Nancy Ann	Office of the Secretary of Defense
Condon, Stephen "Pat"	Aerospace Consultant
Cuzzupoli, Joseph	Aerospace Consultant
Longnecker, David	Association of American Medical Colleges
Lopez-Alegria, Michael	Commercial Spaceflight Federation
Malow, Richard (telecom)	AURA
Sieck, Bob	Aerospace Consultant
Voss, James	University of Colorado, Boulder

NASA Attendees:

Adams, Pam	NASA/KSC
Clarke, Steve	NASA Headquarters
Crusan, Jason	NASA Headquarters
Dumbacher, Dan	NASA Headquarters
Gerstenmaier, William	NASA Headquarters
Hill, Bill	NASA Headquarters
Kennedy, Eracenia	NASA Headquarters
Lockley, Barbara	NASAKSC
McAlister, Phil	NASA Headquarters
Perez, Glenn	NASA/KSC
Scimemi, Sam	NASA Headquarters

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LIST OF PRESENTATION MATERIAL

- 1) Human Exploration and Operations Mission Directorate [Gerstenmaier]
- 2) NASA Commercial Space Update [Williams]
- 3) Status of Exploration Systems Development [Dumbacher]
- 4) Advanced Exploration Systems [Crusan]
- 5) International Space Station Program Status [Scimemi]