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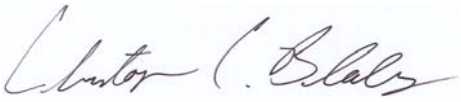
NASA ADVISORY COUNCIL

April 19, 2007

Hilton Cocoa Beach Oceanfront
Cocoa Beach, Florida

MEETING MINUTES



Christopher C. Blackerby
Executive Director

Harrison H. Schmitt
Chair

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Meeting Report

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Opening Remarks

Senator Harrison H. Schmitt, Chair of the NASA Advisory Council (the Council) called the meeting to order at 8:00 a.m. and welcomed Council members and meeting attendees to the Council's seventh meeting. He reminded everyone that the full Council meeting is open to the public and held in accordance with the Federal Advisory Committee Act (FACA). He requested that the public attendees refrain from questions and comments unless requested by the Chair. He thanked Mr. Bill Parsons, Director of the Kennedy Space Center (KSC), and the KSC staff for assistance with logistics as well as an excellent tour of the Center facilities on April 17, 2007. He introduced the Council's new member, Dr. Donald Fraser, formerly Director of the Photonics Center at Boston University and currently member of three corporate Boards, the largest of which is DRS Technologies.

Sen. Schmitt commented that the Council now has NASA's response to all of its recommendations to date. Recommendations and responses can be found on the Council website: www.hq.nasa.gov/office/oer/nac/.

Science Committee Report and Discussion

Sen. Schmitt thanked Dr. Bradley Jolliff for his work as General Chairman of the Council's Workshop on Science Associated with the Lunar Exploration Architecture that was held February 27 – March 2 in Tempe, Arizona. Dr. Jolliff then reported on the results of the Workshop. With the help of a Workshop Synthesis Group, recommendations were drawn from the input from the five Science Subcommittees (Astrophysics, Earth Science, Heliophysics, Planetary Protection, and Planetary Science).

Dr. Jolliff briefly reviewed the background of the activity: the goals; the role of the Workshop as a Council activity; the location and format; participants; timing and schedule; related activities; and the Workshop report and results. Most of this information can be found on the post-Workshop Website: www.lpi.usra.edu/meetings/LEA/.

The Workshop was a key part of the plan to advise NASA on science associated with the Vision for Space Exploration. The intent is to enable the Council to make recommendations to the Administrator relative to the science theme and related aspects of the exploration architecture under development by NASA. The Workshop was an open meeting, with science community input through the Council and the Science Subcommittee representatives as well as invited presenters. NASA is on a fast track to get to an approved Lunar Architecture in place by July or August 2007. Within each science subgroup, the science objectives were prioritized to the greatest extent possible.

Presentations and white papers have been posted on the LPI website noted above. The Workshop Synthesis Report addresses the science objectives and priorities, what kinds of activities would be required to achieve the science objectives, and what could be achieved or enabled by different types of outposts and by accessing different sites around the Moon either by human explorers or by robots. The Workshop began with a presentation by the Administrator. There was senior leadership attendance from both the Science Mission Directorate (SMD) and the Exploration Systems Mission Directorate (ESMD). NASA's exploration lunar activities address the following themes: human civilization, global partnerships, scientific knowledge, economic expansion, exploration preparation, and public engagement. Dr Jolliff feels that scientific knowledge is key to success in the other five areas, and this is an important message to give to the Administrator.

The key elements of architecture planning include: outpost (versus sortie mode, e.g., Apollo missions), the location of the outpost, outpost buildup, and how scientific and other objectives fit into that context. Several top goals drive to an outpost approach: exploration preparation, advancement of human civilization, and economic expansion. In addition, the outpost approach better enables global partnerships and allows *in situ* resource utilization. Many of the identified science objectives can be satisfied at an outpost. The Architecture Team has focused on the poles as an outpost location for several reasons. The notional site selected (the Shackleton Rim Crater) was discussed in detail at the Workshop.

Dr. Jolliff briefly reviewed some of the highlights from each of the science subgroup discussions. One of the very worthwhile astrophysical opportunities is low-frequency (meter wave-length) radio telescopes on the lunar far side. There is also a good opportunity to study galactic cosmic rays. There are possibilities of some unique observations with very large aperture telescopes with a rotationally shaped liquid mirror. Lunar laser ranging experiments could be used to test theories of gravity. From the standpoint of public engagement, looking at Earth from the Moon would be intriguing. For Earth science, a lunar observatory would provide a unique, stable, serviceable platform for global, continuous, full-spectrum views of the Earth to address a range of Earth science issues over the long-term. From the lunar platform, the heliophysics community could learn more about the interconnection of the Sun, Earth, and Moon as a single system. In particular, the heliophysics community considered the Moon (South Pole) as a site for monitoring of near-Earth space weather in real-time. The lunar return is not a planetary protection issue, but a lunar presence could be very helpful to learn about how to explore Mars and to prepare for future Mars missions. The Moon is the keystone recorder of early solar system processes, especially those pertaining to the Earth-Moon system. The planetary science community identified several major science objectives associated with a lunar presence. One of the clear messages at the Workshop was "Science *and* Exploration," not "Science versus Exploration". Sen. Schmitt emphasized that the results of the Workshop are already in the NASA system; the Council's role at this meeting is to formalize that input. He noted the similarity of this Workshop activity with the science advisory activities prior to Apollo, including

workshops in Ames, Iowa (1962), Falmouth Massachusetts (1965), and Loyola, California (1967).

Dr. Jolliff presented the 35 Workshop recommendations *[in italics]*. He started with the 16 crosscutting recommendations, followed by those from the five science subcommittees.

C-1. Scientific analysis and input should be integral components of the decision-making process for landing-site targets and for exploration planning and execution for a lunar outpost or any lunar mission.

C-2. Science activities enabled by lunar exploration should continue to be evaluated and prioritized within the science community by the decadal survey and science road-mapping processes, with periodic reviews by the Council. There was a clear statement that the Subcommittees want NASA to continue to work through the decadal survey process. All of the decadal surveys were already out before the detailed planning for the return to the Moon commenced, but future information pertaining to the lunar science opportunities should enter the decadal survey process. Dr. Jolliff noted that the National Research Council (NRC) decadals are one input to NASA. Another input is results from current missions. Dr. Fisk commented that astronomy, planetary, and heliophysics are all starting a new round of decadal surveys in 2008, and there will be a good opportunity to put lunar planning into this next round. Sen. Schmitt added that the Science Subcommittees' advice will be provided, through the NAC, to NASA as required by the Administrator and will be an opportunity to provide input on a shorter turnaround than the decadal surveys.

C-3. The architecture should enable the highest priority science activities as long as this is not cost-prohibitive and does not compromise other key objectives. Sen. Schmitt observed that this approach proved to be highly advantageous and flexible during Apollo and was put to good use by the senior managers of that program.

C-4. Regular reviews (e.g., through the NASA Advisory Council structure) of major lunar architecture decisions that may directly or indirectly influence the science productivity of lunar missions should be conducted.

C-5. The Crew Exploration Vehicle (CEV) service module should have a capability conceptually similar to the Apollo science instrument module (SIM) to facilitate scientific measurements and the deployment of payloads from lunar orbit. Sen. Schmitt noted that this is a good example of a recommendation that can't wait for a decadal survey. Dr. Jolliff added that the thrust of this recommendation is currently being worked by NASA.

C-6. NASA should conduct a study to evaluate options to determine if outpost sites other than polar sites might compare favorably in terms of costs and potential to address key objectives of the Vision for Space Exploration, including prioritized science objectives. Dr. Jolliff mentioned that this recommendation was aimed at ensuring that other possible sites be examined.

C-7. *Keep open the possibility of sortie missions (human or robotic) prior to establishment of the outpost site.* Dr. Jolliff said that although the current budget does not look favorable, this recommendation reflects NASA's intent. Precursor missions beyond Lunar Reconnaissance Orbiter (LRO) would help determine the value and reduce risks associated with a polar or other outpost site. Sen. Schmitt added that a geophysical global network would be important in the long-term. In response to a question about from Col. Collins, Sen. Schmitt noted susceptibility of the Moon to orbital debris is not an issue. There is a constant flux of small meteors and we still don't have a very good measure of the absolute flux, but this hazard is fairly low and there is not enough specific information to drive site selection. Dr. Neil Tyson noted that there may be some small effects on the far versus near sides of the Moon due to gravitational focusing by the Earth. Dr. Jolliff indicated that he would pursue this question.

C-8. The Lunar Architecture should include a strategy to maximize the mass and diversity of geological samples (rocks and soils) returned from the Moon, whether through outpost missions or through sortie missions. The Planetary Science Subcommittee (PSS) has requested that Curation and Planning Team for Extraterrestrial Materials (CAPTEM) be asked to study this issue with specific recommendations for sample-return specifications by May 1, 2007 (see CAPTEM report at http://www.lpi.usra.edu/captem/). Dr. David Longnecker emphasized the importance of including biological samples in the recommendation language. Dr. Jolliff agreed to add "biological" to the recommendation, and ensure that the CAPTEM group includes some expertise from the biological community. Senator Schmitt pointed out that the current total return payload allocation of 100kg, including containers, is far less than the 110km of rock samples alone returned on the last lunar mission, Apollo 17, and that a significantly larger total allocation will certainly be required.

C-9. NASA should establish well-defined protocols for the collection, documentation, containment, return, and curation of lunar samples of various types and purposes, with maximum mass and diversity of location, to optimize the scientific return while protecting the integrity of the samples. Mr. Armstrong added that following this recommendation would greatly aid in future prospecting in-situ. The Chairman then pointed out that Mr. Armstrong's decision to fill the Apollo 11 sample return container with lunar regolith before sealing it provided by far the best sample of that material, including its resource potential, obtained during the entire Apollo program.

C-10. The selection, roles, and capabilities of astronauts in the deployment, operation, and servicing of science activities, sampling, instruments, and facilities within the context of the planned architecture need to be clearly defined and supported. Dr. Jolliff remarked that although there is much experience through Apollo, Skylab, Shuttle, and the International Space Station (ISS), the specific roles and capabilities for future lunar missions need to be defined in light of the requirements of those missions, new technologies, and the current state of knowledge and interpretations of lunar origin and evolution.

C-11. A program of astronaut exploration training and of development of selection criteria should be initiated as an integral part of the lunar exploration architecture. Simulation-based team training experience that was gained during the Apollo era needs to be passed on to the next generation of trainers and astronauts. Sen. Schmitt noted that the Field Exploration Activities Team (FEAT) tries to organize, in the outside community, the expertise in field exploration and provide input to NASA. He offered to send information on this activity to Council members; in particular a White Paper FEAT has produced that begins this process of preparation for lunar mission training. In response to a question from Col. Eileen Collins, Sen. Schmitt observed that there would probably be teams of two astronauts working together, and at least one, and possibly both, would have professional experience in field geological, geophysical and/or biological exploration. She questioned whether the recommendation should be more specific. Dr. Jolliff noted that there is now a sophisticated suite of new instrumentation and new techniques and capabilities. Training is especially important. This recommendation has a strong feed forward to human exploration of Mars. Dr. Covert added that the people who actually took part in all of the past exploration activities represent an important reservoir of experience, and someone should try to capture that experience. It would be very useful for future missions. Sen. Schmitt added that there is now an annotated (by the Apollo astronauts) transcript of everything that was said on the Moon. The web site, the Apollo Lunar Surface Journal (Dr. Eric Jones, webmaster), is a living site and includes links to related photographs, videos, checklists, flight plans, etc., information that has been pulled together in a readily useful form. Dr. Jolliff observed that, on an encouraging note, the FEAT is very interested in passing along information, and ESMD clearly saw the need for more activities like this.

C-12. A vigorous program is needed to significantly improve astronaut capabilities in EVA suits. For example, suit agility and glove dexterity must be improved relative to Apollo suits. Other areas of suit improvement should include automated documentation of samples and position, and interaction with robotic assist technologies.

C-13. Lunar orbital data sets should be geodetically controlled and accurately co-registered to create cartographic products that will enable fusion, integration, and manipulation of all past and future data relevant to lunar exploration. Sen. Schmitt noted that this is the initial foundation on which the orbiter and lander are tied to a landing site. Currently, the data is not very good for pinpoint landings at the poles, and the LRO will augment that data set. In the final analysis, the fusion of all past and future lunar data related to precise navigation and landing will be critical, as will the operational lessons from Apollo that permitted pinpoint landings during that program.

C-14. Instruments and procedures should be developed and used to understand the electromagnetic and charged-dust environment at a potential outpost or other lunar site. Sen. Schmitt noted that on Apollo, the subtle physiological issues related to dust were often not noticed until afterward and none appear to have created long term effects; however, chronic exposure to dust is very different from the limited exposure experienced on Apollo. Major equipment design issues related to dust are well defined, however, can be addressed by various engineering solutions.

C-15. To maximize use of the Moon as a recorder of past solar activity, lunar surface operations should include sampling of the surface regolith and regolith strata as a high priority, within the context of the overall geologic setting at the outpost or other sites.

C-16. NASA should assess the mobility or emplacement capabilities needed to deploy high-priority science experiments such as dipole antennae, retroreflector/transponders, and geophysical instruments or packages across broad areas of the Moon. In response to a question from Dr. Tyson regarding international implications, Dr. Jolliff noted that if high-priority objectives could be affected from other activities on the Moon, the international aspects would be important. Dr. Covert commented that this recommendation implies covering distances on the Moon in an efficient way. Dr. Jolliff indicated that the science community would like to see some further definition in this area. Sen. Schmitt added that the definition of the design of the Lunar Lander is in Phase A (definition). One aspect of that is the question of whether the design could be compatible, long-term, with a refueling to go elsewhere on the Moon.

There were three astrophysics recommendations:

APS-1. Appropriate steps should be taken (without imposing prohibitive cost requirements) throughout architecture planning to ensure that a radio-quiet environment can be maintained on the lunar far side at a site suitable for deployment of a low-frequency radio observatory and that infrastructure is defined that would enable eventual deployment of such a facility. Dr. Jolliff noted that this very important recommendation may be difficult to implement as it has implications for other activities, including international partners. However, there are ways to mitigate the consequences of this recommendation. Another issue is cost.

APS-2. NASA should conduct trade studies (including cost analysis) to investigate ways in which the exploration architecture can be enabling for astrophysics science through human and robotic operations, and deployment and servicing capabilities for experiments and instruments, including maintenance, refurbishment, and upgrade opportunities that might be integrated with other operations. Dr. Jolliff noted that there are trades—opportunities as well as detractors (e.g., dust, gravity, etc.)—and the studies need to be done to determine the optimum way of conducting the science.

APS-3. NASA should conduct a study to determine the future feasibility of using Constellation heavy lift capability (Ares V) to deliver large astrophysics payloads to space. The community immediately seized on the opportunity of Ares V for large and highly capable astrophysics instruments in space. Mr. Ted McPherson noted that with a few exceptions, the cross-cutting and astrophysics recommendations focus on process and techniques, and some articulation of what the key scientific questions are would clarify the recommendations. Sen. Schmitt indicated that there is a layer of detail in the accompanying Synthesis Report and Subcommittee reports that includes this information. Dr. Jolliff added that the focus on key science questions is sometimes lost in the

recommendation, but the background information provides insight into the science objectives.

There were two Earth science recommendations:

ESS-1. The lunar architecture should not preclude full-disc viewing of the Earth from an outpost site. Dr. Jolliff noted that this is an example of how the background material discusses the science objectives. The point of the recommendation is to say what is important. Sen. Schmitt added that there is a unique value to viewing the Earth from the Moon. Dr. Jolliff observed that the Earth science community felt strongly that lunar observations should not supplant orbital observations; they should be complementary, providing full temporal context for such observations.

ESS-2. The architecture should include provisions for mobility to access a suitable location such as the slope of an Earth-facing terrain feature that provides a full-disc vantage point if an outpost site is chosen that does not afford a full-disc view of Earth. This is similar to the first recommendation, but is specifically related to the notional polar outpost architecture that was provided to Workshop participants. Dr. Mark Robinson suggested that these two recommendations be combined into one and this will be considered.

There were four heliophysics recommendations:

HPS-1. Early in the human exploration program, efforts should be made to develop space-weather predictive capabilities to enable safe, sustained operations on the Moon. This gives emphasis to something that the heliophysics community needs to do to support the Vision for Space Exploration and relates to its overarching theme of "safeguarding the journey."

HPS-2. Several of the high priority heliophysics objectives can best be achieved from lunar orbit. Consideration should be given to deployment of such sensors as drop-off satellites (see recommendation C-5).

HPS-3. Locate real-time space weather monitoring measurements as close to the solar source as feasible. Dr. Jolliff said that this recommendation reinforces the position that real-time monitoring needs to be done not only on the Moon but elsewhere. In response to a question from the Chairman, Dr. Owen Garriott and Dr. Fisk discussed where the monitoring site should be set up and to make observations. Dr. Fisk noted that the largest solar flare risks are broad in longitude. The particles are accelerated in the large shock wave and spread over a large range. The most likely strategy would be to observe the Sun from Earth orbit, and use that information to provide alerts. The strongest recommendation is the first one (HPS-1). This third recommendation is interesting, but is not really useful for hazard avoidance. The most important thing is to take the assets to a higher level of predictive capability, and then decide the best place to locate them. Dr. Jolliff suggested a re-write: *Determine optimal location for real-time space weather*

monitoring. Dr. Fisk agreed that this would be a better way to express the recommendation.

HPS-4. Improved measurements of solar wind composition and flux as well as those of interplanetary and interstellar grains bombarding the lunar surface, and imaging of high-energy x-rays and gamma rays, should be accomplished on the lunar surface.

There were five planetary protection recommendations:

Dr. Jolliff explained that the key focus of the planetary protection group was to figure out how to do Mars exploration, but they recognized that the Moon is an excellent test bed for developing technologies.

PPS-1. Contamination control technologies should be developed before human missions are sent to Mars.
In response to a question from Sen. Schmitt, Dr. Jolliff indicated that he was not aware of use of the present lunar samples to address these issues. With the impending re-release of information about the current sample sets, there will be some attention on them. Sen. Schmitt suggested that CAPTEM look at this if it has not already done so, and Dr. Jolliff agreed to relay this suggestion to CAPTEM.

PPS-2. Technologies and experimental equipment to perform planetary protection assays should be reinvestigated for relevance to human exploration requirements and considered for inclusion in up-mass to the lunar outpost. A great deal of work has been done to look for life robotically. Some of the tests have been done on Earth in remote locations, and these technologies and techniques could be applied to human exploration of the Moon. There may be organic materials in the polar cold traps as well as information on organic and chemical contamination resulting from human and robotic activities.

PPS-3. In-situ investigation of lunar sites using highly sensitive instruments designed to search for introduced biologically derived or other organic compounds should be given high priority.

PPS-4. Make use of the opportunity of lunar exploration to develop planetary protection protocols that will be needed for exploration of Mars. The group wants to make sure that the architecture considers these objectives and activities.

PPS-5. The Moon should be used as a testbed of advanced life support systems for Mars exploration. One of the ideas is to look at the efficiency and effectiveness of closed systems. Dr. Tom Jones suggested adding "ISS" to the recommendation. i.e., "*ISS and the Moon should be used….*" Dr. Tyson suggested using that inclusion to give some emphasis to the ISS as a National Laboratory. Dr. Jolliff agreed that he would add something to the background information on that subject. In response to a comment, he noted that there had been a recommendation to use dust as a surrogate in studying

contamination and containment systems, but somehow this got dropped in the editing; he agreed to reinstate it.

There were five planetary science recommendations:

Sen. Schmitt noted that a number of planetary science recommendations ultimately ended up as cross-cutting recommendations.

PSS-1. Understanding the record of impacts in the solar system requires access to and sampling of many impact basins and craters on the Moon and return of samples to Earth for age dating. The Lunar Architecture should be enabling for this high-priority objective.

PSS-2. The Lunar Architecture should include plans to place a long-lived geophysical measurement station at every lunar landing site, including an outpost site. Such packages should contain a seismometer, a heat-flow probe, a magnetometer, and possibly an optical reflector. Efforts should be made to coordinate with international partners on the emplacement and standardization of geophysical stations at landing sites established by other partner space agencies. Dr. Jolliff noted that this is a high priority for exploration as well as science. If deployed at every landing site, an effective network would be created. Dr. Mark Robinson suggested that the recommendation clearly state every "*human or robotic*" landing site. Dr. Jolliff agreed to add this clarification.

PSS-3. To maximize scientific return within the current lunar exploration architecture, options should be defined for local (up to 50 km), regional (up to 500 km), and global access from an outpost location. In response to a question from Sen. Schmitt, Dr. Jolliff agreed to include mention of the usefulness of being able to use rovers robotically.

PSS-4. A lunar instrument and technology development program is needed to provide focused technological development for applications on the lunar surface. Dr. Jolliff noted some important comments in the background information—the need for long-lived (6-year life-time minimum) power supplies, especially in the 1-10 W range, as well as a number of other technology needs. In response to comments, Dr. Jolliff agreed to re-write the background information to note that an appropriate wattage range for the power supplies should be investigated.

Dr. Longnecker asked about the overarching lunar objectives stated by NASA. It doesn't appear that the recommendations reference these objectives or suggest revisions. Dr. Jolliff noted that those are an integral part of the Workshop Synthesis Report, and could serve as an endorsement of these objectives. Dr. Mark Robinson commented that the report provides the context for the recommendations, and perhaps should be primary, not as an attachment to the recommendations. Dr. Jolliff noted that the point was well-taken. The context is in the report, and it needs to be there. He suggested that the endorsement of NASA's objectives should perhaps be in the cover letter, rather than an additional recommendation. Mr. Armstrong applauded the synthesis team for its activity. The recommendations have logic and rationale. He queried whether the recommendations

would be prioritized, since a number of these will have resource implications. Also, what is the timeframe in which the recommendations fit? Dr. Jolliff indicated that the recommendations could be categorized, and the ones that could have significant resource implications could be identified.

Sen. Schmitt stated that he expects the recommendations to be delivered to the Mission Directorates, through the Administrator. The Mission Directorates will begin to look at them in terms of the factors noted by Mr. Armstrong (cost, feasibility of implementation, etc.), and it is not the responsibility of the Council to consider these issues at this time. Dr. Jolliff added that there is an inter-directorate working group that could look at these and help the Administrator understand and organize them. He proposed that he work with the Chairs of the Science Subcommittees and organize the recommendations in some fashion. Dr. Donald Fraser commented that the notional architecture as well as the science objectives and recommendations are now on the table and there may be some "freebies." Sen. Schmitt agreed that there should be continuous feedback between the people who made the recommendations and the people in ESMD and SMD.

Dr. Maddox congratulated Dr. Jolliff on the comprehensive package. In response to his question on safety, Dr. Jolliff indicated that if safety was an issue with the science, then it was addressed; however, the purely engineering safety elements were not addressed. Dr. Fisk commented that there were earlier NASA studies that looked at what could be done on the Moon. Some of those prospects have disappeared. One of the implications is that the areas of science included in this report are those that should be pursued. Dr. Jolliff noted that the Subcommittees did not generate the initial list of objectives that came from the Lunar Architecture Team, but they did prioritize them. Of all the objectives brought forward, some did not make the cut or received lower priority; however, it is possible that someone will come forward with an observation not listed. Dr. Fisk stated that this report is very useful guidance—these are the scientific objectives that should drive the architecture. Dr. Tyson noted that many of the scientific ambitions will be competed, and if someone has an idea that is evaluated higher than these suggestions, those should be pursued. Sen. Schmitt agreed that these recommendations should be re-visited frequently.

Subject to amendments as discussed, the Council approved the Lunar Science Workshop recommendations.

Human Capital Committee Report and Discussion

The Tempe Workshop Outreach Committee

Before giving his report on the Human Capital Committee meeting, Dr. Kulcinski provided a summary of what the ad hoc Outreach Committee he chaired did at the Lunar Science Workshop in Tempe. Some of the outreach ideas were incorporated into the science recommendations and background information. The Outreach Committee listened to all of the Workshop presentations, discussions, and proposed recommendations, and developed the following: the top three overall messages from the

Workshop to the general public and scientific community; the top three messages to the general public from each of the five subcommittee thrust areas; and the top three messages to the scientific community for each of the five thrust areas.

The overall messages from the Workshop are: 1) the Moon is witness to 4.5 billion years of solar system history, and human exploration of the Moon will contribute greatly to discovering the origins of the Earth and ourselves; 2) the Moon is a unique location from which to observe and analyze the ever-changing nature of the Earth, Sun, and Universe; and 3) the Moon is a fundamental stepping stone to the human exploration of Mars and the rest of the Solar System.

The Earth Sciences messages to the public are: 1) the "Blue Planet Webcam"- the view from the Moon offers a unique perspective of the full Earth, all at once, over time; 2) from an Earth Observatory on the Moon, we can take the pulse of the Earth from the Moon by monitoring Earth events such as climate variability, air pollution sources and transport, natural hazards, and polar ice seasonal and long-term variations; and 3) by viewing the Earth from a distance we can collect data to help us to detect and study far away and Earth-like planets.

The Earth Sciences messages to the scientific community are: 1) a lunar observatory provides a unique, stable, serviceable platform for global, continuous full-spectrum view of the Earth to address a range of Earth science issues over the long-term; 2) synergy of current assets with lunar instrumentation will ensure the collection of the widest array of information from a lunar base; and 3) there are numerous atmospheric profiling opportunities from visible (stars) to microwave (GPS) to VHF (communications).

The Astrophysics messages to the public are: 1) the far-side of the moon provides a radio quiet zone that enables astronomers to look back in time and find out when the first stars were born; 2) astronauts can carry relatively small astronomy experiments with them to the Moon and these packages can accomplish a wide range of science from understanding how gravity really works to using the full view of our own Earth in understanding how to search for signs of life on other worlds; and 3) the rockets that will take us back to the moon give astronomers the heavy lifting they need to put bigger and better telescopes in space. Among other things, these telescopes will look for Earth-like planets beyond our solar system, investigate the environment around black holes, and probe the dark energy that makes up most of our universe.

The Astrophysics messages to the scientists are: 1) the return to the Moon will enable progress in astrophysics through the associated infrastructure, and some important astrophysics observations, as well as a few smaller experiments, can be uniquely carried out from the lunar surface and in lunar orbit; 2) observations from free space (in particular Lagrange points) enabled by the lunar architecture offer the most promise for broad areas of astrophysics; and 3) the Vision for Space Exploration should be planned so as not to preclude—and to the extent possible to include—capabilities that will enable astrophysics from free space.

The Planetary Protection messages to the public are: 1) based on international treaties, policies, and decades of research experience on protecting planetary bodies during exploration, lunar missions will not require special planetary protection controls; 2) lunar exploration provides good opportunities for testing technologies and methods to understand and control mission-associated contamination on long-duration expeditions; and 3) lessons learned on the Moon will provide essential information to ensure protection of planetary environments and humans as we explore Mars and other destinations.

Planetary protection is an important on-going focus of both science research and mission planning to safeguard planetary environments and exploration throughout the solar system. The planetary protection messages to the scientists are: 1) based on the Outer Space Treaty, international policies, and decades of research and experience on protecting planetary bodies during exploration, lunar missions will not require special planetary protection controls; 2) lunar exploration provides the opportunity for an integrated testbed of sophisticated technologies and methods needed to understand and control mission-associated contamination on long-duration expeditions; and 3) lessons learned on the Moon will provide essential, enabling, and comparative information to ensure protection of planetary environments and humans as we explore Mars and other destinations (e.g., understanding background and mission-associated organic and inorganic contaminants, dusts, and microbes from the outpost).

The Planetary Sciences messages to the general public are: 1) the Moon has a record of the early history of terrestrial planetary information and change that is absent on other planets because they have active resurfacing processes like weathering and plate tectonics; 2) we are in a position to build on four decades of lunar science, and there is much more new information to learn about our Moon and, from the Moon, about our Earth; and 3) the lunar outpost will serve as a testbed for science and exploration of the Moon, Mars and beyond.

The Planetary Sciences messages to the scientific community are: 1) the Moon is critical for accessing the early formation, differentiation, and impact history of the terrestrial planets – and biotic evolution of Earth and Mars; 2) additional data are needed (e.g., geophysical and geochemical data to determine the composition, structure, condition, and evolution of the lunar interior; data from the lunar surface to understand the processes that have occurred during its evolution, such as the history of impact cratering and formation of regolith, and the distribution of resources; and data to inform us more about the lunar environment); and 3) these new data will enable us to validate lunar science process models, understand the early history and evolution of Earth and other terrestrial planets, and prepare for human habitation of the Moon and beyond.

With respect to lunar access, the messages to the scientific community are: 1) the architecture as presented (South Pole Aitkin Basic access) will enable long-term lunar science in a region of high interest and will address several scientific questions, e.g., crust to upper mantle access and impact processes; 2) the scientific goals will have to be prioritized in a cohesive vision across a timeline, and this long-term planning will need to

encompass robotic and robotic/human sorties to acquire distributed samples and samples from diverse locations on the lunar surface and sub-surface; and 3) the community needs to actively participate in the development of human capital to fuel the pipeline of scientists and engineers.

The Heliophysics messages for both the general public and scientists are: 1) understanding our space environment is the first step to "safeguarding our journey;" 2) the moon can be used as a unique vantage point to better understand the Sun-Earth space environment (our "home in space"); and 3) the analysis of lunar regolith will provide a history of the Sun's brightness and radiation output and reveal how the Sun-Earth connection has changed through the ages.

Dr. Kulcinski noted that the report has some good "soundbites" on space weather, how bases on the Moon help us understand our home in space, and how the Moon is a natural laboratory for space physics.

Dr. Jolliff observed that the Outreach Committee captured the results of the Workshop in a very positive way. The report provides many soundbites and reinforces the notion that there are many good reasons for going back to the Moon. Dr. Tyson commented that the simple statement "stepping stone to Mars" may lead some people into thinking that Moon may be used as a "launch pad" for vehicles to Mars. Dr. Jones suggested using "milestone" rather than "stepping stone." Dr. Tyson commended the Committee on capturing some very good soundbites. He noted that one of the comments to the public was that sending humans to the Moon will help us learn more about Earth. He felt that the statement would be stronger if "human" was omitted from the earlier phrase, because it may be needlessly contentious. Dr. Kulcinski felt, on the contrary, that having "human" in the phrase would stimulate the public sentiment. Sen. Schmitt indicated that he would take Dr. Tyson's comment under advisement. In response to a question on how to get this report to public affairs, Dr. Kulcinski indicated that the Outreach Committee report has been given to NASA, and could be provided to the entire Council. It is on the post-meeting website: www.lpi.usra.edu/meetings/LEA/. Mr. Blackerby added that the report has been forward to NASA's Office of Strategic Communications.

Human Capital Committee Report

Dr. Kulcinski reported on the Human Capital Committee fact finding meeting of April 18 and presented the Committee's observations. He noted that there has been significant positive direction on manpower and education at the last two meetings. The Committee was enthused to hear that in the Partnership for Public Service and the American University's Institute for the Study of Public Policy Implementation 2007 rankings of the Best Places to Work in the Federal Government, NASA was number 4th out of 30 large agencies ranked (up from 6th in 2005). There were several presentations and discussions with NASA personnel: Potential Future NASA Science Technology Engineering and Mathematics (STEM) Activities by Ms. Joyce Winterton (Assistant Administrator for Education); NASA's Workforce Implementation Plan by Ms. Toni Dawsey (AA for Human Capital Management); Human Spaceflight Workforce Transition by Ms. Suzanne

Leibert and Mr. John Olson, and Human Capital Information Environment (HCIE) and Competency Management System (CMS) by Ms. Candy Irwin.

Two potential STEM activities were discussed: 1) a workshop, that NASA is considering sponsoring, that addresses the question of "What Next After the 'Gathering Storm'" in the fall of 2007. This would be a one-day meeting of national leaders in academia, industry, and government to assess the status of STEM legislation evolving from the NRC report, "Rising Above the Gathering Storm".; and 2) the process for attracting academically successful students into NASA. This would be a small meeting associated with STS-120, consisting of highly academically successful students, high-tech people in industry, and leaders in identifying and supporting such students. The objective is to explore ways to encourage and support students entering STEM fields for careers in NASA.

The Committee was briefed by the Assistant Administrator for Human Capital Management, Toni Dawsey, who is, also, the Agency's Chief Human Capital Officer. Ms. Dawsey is responsible for the strategic management of human capital, understanding mission requirements, aligning the workforce, etc. Ms. Dawsey reported that at the time of the FY 08 President's budget submit, NASA had no unfunded Full-Time Equivalent (FTE) for FY 08. NASA has reduced the "uncovered capacity" to less than 200 FTE and is working to retrain them, find work for them, or help place them elsewhere within or outside of the Agency. She and her staff have made significant progress in putting together a Workforce Implementation Plan. The Committee would like a including a "hands-on" demonstration, of the workforce data cubes at the next meeting.

There was a discussion on the fall-off of the Shuttle civil service and contractor workforce. It seems that NASA has a good handle on this issue. Sen. Schmitt noted that both the Exploration Committee and the Space Operations Committee heard the presentation. Based on employee surveys, Dr. Kulcinski reported that about 65% of the Space Shuttle Program workforce indicated that they would stay with the Program. Several items influenced this decision: having meaningful work in the Shuttle Program; their commitment to the Program and/or NASA; the ability to make a difference in the Shuttle Program; and assurances by NASA that the employee would have interesting work when the Program is over. The survey responses also indicated that about 70% of the people are not currently looking for work outside the Space Shuttle Program, but if they were presented with the right opportunity, about three quarters of those people would leave. In response to a question, Dr. Kulcinski indicated that this survey included only civil servants. In the workforce transition area, the Committee would like an additional briefing in the fall of 2007 on the results of the Shuttle Workforce Mapping activity.

Through the Competency Management System (CMS), NASA has a very good profile of the competencies of the current staff, and this database will be very important for the transition. Integration with employee development programs helps to align the training needs with the Agency's workforce plans. The CMS can provide breakdowns of expertise at each Center to a fairly high level of granularity. NASA is already starting to

work with the data to get a view of what the Agency currently has, competency-wise, and what it will need in the future. The Committee would like an additional briefing in the fall of 2007 to see the results of the CMS activity. Dr. Maddox added that this particular software was developed at NASA, and other agencies have requested the tool. This is a ground-breaking product.

Dr. Fisk noted that on Monday, the NRC will release a report on building a better NASA workforce. It deals with what is needed in the attraction and training of people in the Agency. He suggested that the Human Capital Committee take a look at this report, and Dr. Kulcinski agreed. Mr. McPherson noted that NASA could take more of an entrepreneurial approach to acquiring people with the talent it requires, e.g., get on the recruiting schedules with universities. The Agency should compete for the talent at both entry and executive levels and Mr. McPherson asked whether 50 "high-quality sales calls" could capture talent. Dr. Paul Robinson commented that Sandia National Labs started this by inviting the Deans of Science and Engineering to Sandia to talk about what Sandia could do in terms of recruiting. The professors then started targeting the people early on and Sandia had employees signed up to work there well before they got their degrees. Dr. Kulcinski noted that Ms. Joann DiGennaro (member of the Human Capital Committee that was not able to attend this meeting) has a list of organizations that concentrate on the best students. This might help focus some NASA efforts. Dr. Fisk observed that certain NASA Centers have developed strategic alliances with universities, e.g., NASA's Jet Propulsion Laboratory has alliances with universities that provide scientific and engineering talent. This could be encouraged more broadly across the Agency.

The members broke for lunch from 12:15 pm to 1:30 pm.

Audit and Finance Committee Report and Discussion

ITAR Drafting Committee Report

Before Mr. Robert Hanisee gave the Audit and Finance Committee report, Mr. Howard Stanislawski presented the findings of the Council's Ad Hoc group on the International Traffic in Arms Regulations (ITAR). The conclusion of the group is that the implementation of the Arms Control Act/ITAR was delegated by the President through an Executive Order to the State Department. The Directorate of Defense Trade Controls (DDTC) at the Department of State is the organization that currently supervises this program. The implementation has been extremely narrow, and there have been recent recommendations aimed at supporting an initiative for an ITAR exemption for NASA, similar to that that was given to DOD. The proposed recommendation endorses the proposal to seek an exemption for NASA as well as a Congressional review of the entire system.

Proposed recommendation: *NASA should be delegated authority to adopt additional export control policies and procedures that it would communicate regularly to DDTC by means of institutionalized reporting responsibilities. Consistent with the existing*

statutory authority embodied in 22 USC 2778(b) (2), NASA would be able to implement export control policies and procedures to fulfill its Presidential and Congressionally authorized mission. Under the authority of its export control office, NASA would be able to establish a rigorous structure that should allow for effective communications and implementation of export control-related programs involving the US, our international partners and the space agencies, US contractors, and contractors based in international partner countries. Through such a NASA-based export control program, under the rubric of exiting law, and in cooperation with DDTC, the Vision for Space Exploration could be pursued in the most effective, expeditious, controlled and productive manner.

Dr. Robinson and Dr. Covert were concerned that there would be a reaction to the first sentence, especially the word "additional." Mr. Stanislawski proposed deleting "*additional*" from the first sentence, and the Council agreed with this amendment. Sen. Schmitt indicated that the intent of the recommendation is to support NASA in seeking the delegated authority. The statute itself doesn't establish which agency would issue regulations or have authority. The State Department was delegated this authority under Executive Order. Gen. Abrahamson added that the issue is not whether NASA has authority; the problem is with the way it has been delegated and has been implemented under the control of the State Department. The essence of the recommendation should recognize that NASA has the authority. Dr. Covert raised the question: what would be the consequences of this recommendation? If the legal authorities agree that NASA already has this authority, and NASA proceeds with taking it, what would happen? Gen. Abrahamson agreed that there does have to be some reasonable accommodation to the bureaucracy, but NASA should not "seek authority" that it already has inherently under the law. The Administrator should recognize that NASA has the authority, and then work with the State Department to ensure that State is comfortable with the way that NASA is implementing the regulation. Under the current regulatory environment, critical decisions cannot be made in a timely fashion. If NASA has the authority, the consequences will transcend the ISS program and affect international cooperation Agency-wide. Sen. Schmitt indicated that the recommendation language would be modified to clarify this. Gen. Lyles added that precedent has already been established with the DOD, and NASA would be happy to have the same kind of flexibility that DOD has. Mr. Stanislawski noted that the Executive Order delegates authority to the State Department, so NASA must confront the issue of the Executive Order. That is why the Agency is seeking an exemption similar to DOD.

Mr. Stanislawski noted that there are two possibilities: 1) modifying the Executive Order; and 2) obtaining an exemption from the State Department. The Administrator has been pursuing the latter, and has not been successful to date. The Council wants to lend its support to whatever channel could accomplish the desired result. The route that NASA seeks should be left to the discretion of the Administrator. He is in the best position to know which avenue he would be most successful in pursuing. Dr. Tyson suggested deleting "controlled" from the last sentence. Mr. Stanislawski commented that that the recommendation states the most preferred avenue, but the language will be modified to reflect the Council's discussion. The Council agreed that the language of the

report should outline the various possibilities, but the recommendation itself should not cite a specific route.

Gen. Abrahamson added that the State Department's administration of the ITAR process is under much criticism from many parts of the government as well as from industry. The Department is embattled and sensitive. Despite all of the recommendations from the Defense Science Board, academia, industry, etc., for whatever reason, at the Presidential level, the status quo has remained. The paper needs to emphasize the issue in past programs and NASA's willingness to keep in contact with the State Department on how the regulation is being implemented in order to deal with the situation. Mr. McPherson suggested that if there is sufficient affirmation by the NAC, the recommendation should proceed rather than go back for more "word-polishing." Dr. Robinson suggested the following modification: "*The Council recommends that NASA be delegated the authority to fulfill its Presidential and Congressionally authorized mission…*", and then pick up the rest of the language.

Sen. Schmitt indicated that a revised recommendation would be drafted and circulated to Council members, and that an approved, revised recommendation would go to the Administrator as soon as possible.

Audit and Finance Committee Report

Mr. Hanisee reviewed the Audit and Finance Committee's previously reported status, and presented the progress since then. At the last meeting, two of the four aspects got passing grades—Fund Balance with Treasury and Environmental Liability. At the end of March, the fund balance was down to $2 million. Mr. Hanisee emphasized that it is important that NASA continue to protect these success items. Environmental Liability is still in good shape, but the team that designed and implemented the fix has moved on. NASA needs to continue to monitor this closely as well. NASA's financial team is still 10 FTEs below the full complement. Since the last meeting, only two new people have been hired. There is a critical shortage of qualified accounting people in the Washington DC area as well as nationwide. "Grant accounting" continues to be an issue. This activity was scheduled to be transferred into the NASA Shared Service Center, but that has been put on hold due to on-going concerns. "Unobligated balances" continues to be an issue as well.

At the last meeting, it was reported that NASA was producing a software patch to fix a data mapping glitch in the SAP accounting system. Since then, the problem has metastasized to ten major items. Ms. Shana Dale, NASA Deputy Administrator, personally contacted the CEO of SAP and has been successful in getting some action on a resolution to the problems. Most items are now cleared-up, but the leadership needs to stay on the case and assure attention at the highest level. The "long pole in the tent" has been Property Plant and Equipment (PP&E). The Financial Standards Accounting Board is meeting in May and is expected to take action on NASA's request to write off space assets. However, this doesn't solve the larger problem. The real PP&E problem is with contractor purchased and held equipment and is primarily due to the lack of traceability.

The Chief Financial Officer (CFO) has proposed that contractors submit to NASA on a regular basis identification of specific equipment but this could be applied easily only to new contracts.

As of the last Council meeting, 23 functions had been transferred to the NASA Shared Services Center (NSSC). The Committee had expressed a concern that this could go "off track" and recommended that the CFO control the rate at which new items and functions were transferred. No new functions have been transferred, and the CFO has implemented a more prudent timeline. The Committee is encouraging the CFO to develop a full transfer plan before any further transfers.

Mr. Hanisee reviewed some of the previous recommendations. Several have been implemented including a recommendation for center CFOs to report to HQ, Office of CFO staff responsibility for financial control deficiencies, and tracking of environmental liabilities. Recommendations in the process of being implemented at NASA are: the JSC error tracking tool, which has been presented to all Centers; and the customer satisfaction tool. The external auditor, Ernst and Young, has not submitted a written audit plan for the Agency; Mr. Hanisee noted that in the private sector, this is demanded. The Committee proposed a recommendation that the CFO request the external auditor provide a written audit plan early in the year and that it be available to the Committee as well as the CFO. The Council had no objections to this recommendation, and Sen. Schmitt agreed to work the specific language of the recommendation with Mr. Hanisee.

Mr. Hanisee reviewed some of the future Committee actions, including: explore options on Property Plant and Equipment; review and monitor financial and control systems; conduct a fact-finding meeting with Bobby German on Integrated Enterprise Management Program (IEMP); conduct a fact-finding meeting on grant accounting; conduct a fact-finding meeting on unobligated balances; continue monitoring the NSSC; and schedule a meeting on costs and internal controls for NASA's new projects (ARES, Orion, COTS) and ISS.

Dr. Fisk observed that the funding distribution system for grants is so broken that it is almost bringing the research system to a halt. Customers of NASA's financial system should be surveyed to see where the real issues are and how they could be fixed. Mr. Hanisee agreed to take action on this. The Audit and Finance Committee plans to hold a future fact-finding meeting with NASA managers on this process. He noted that the transfer of grants accounting to the NSSC was put on hold for that reason.

Mr. Michael Montelongo complemented the KSC team on what they are doing with their contracting. They have pursued some work with the USAF on some joint contracts. This collaborative effort makes sense and reflects good stewardship. He extended compliments to the Director of Procurement and CFO at KSC. Mr. Hanisee noted that of the four centers visited so far, only the Goddard Space Flight Center (GSFC) seems to have major contracting problems relative to the other Centers. This will continue to be monitored by the Committee.

Aeronautics Committee Report and Discussion

Mr. Armstrong briefly reviewed the areas of interest previously explored by the Committee, including: a more comprehensive briefing by Mr. Charlie Leader, Director of the Joint Planning and Development Office (JPDO), on the Next Generation Air Transportation System (NextGen); and a briefing by Mr. J.D. Kundu, OMB Examiner for Aeronautics Research and Exploration Systems.

Gen. Lester Lyles discussed NextGen and some of the challenges. FAA is the lead agency, but NASA is a key participant. He reviewed the Public Law on the next generation air transportation system. The responsibilities of the JPDO are to create and carry out the Next Gen Plan, coordinate the goals and priorities, and operate within the constraints in the participating agencies. Gen. Lyles showed the top-level JPDO organization. There are lots of coordinating activities and working groups. Notwithstanding the daunting tasks, they have had several accomplishments. Dr. John Sullivan reviewed how the NextGen will build capabilities. He described some examples of things that have been implemented that are already having positive impacts on the system, e.g., more direct routes through air traffic data communications to aircraft, reducing fuel burn and noise patterns, improved general aviation safety through instantaneous display of weather, and improving controller productivity. NASA's role in NextGen is to provide the foundational research and deliver research results to the FAA for implementation.

Gen. Lyles reported on the Committee's discussion with Mr. Kundu. He was very frank and the Committee had a very open discussion. The three major elements that Mr. Kundu said OMB looks for in federal R&D programs are: 1) the relevance of the program to the customers; 2) the quality of the program (focusing on processes and innovative ideas); and 3) the performance of the program (clear goals, metrics, milestones, etc.). In response to a question, Gen. Lyles noted that this is not consist of just one examiner looking at things—he brings in peers, other experts, and groups like the Aeronautics Committee to understand how performance is perceived. There was a sense that in the Aeronautics Program, NASA is doing the right things. The Agency is meeting the three primary criteria of relevance, quality, and performance. Mr. Sullivan commented that it is difficult to see how OMB can have the bottom line stated in the presentation (the importance of aeronautics to the NASA mission) and receive only 3% of the budget.

From Mr. Kundu's perspective, the Aeronautics Program is important; however, the Director of OMB and the President have to decide where this fits into overall national priorities. Dr. Covert added that nowhere in the President's top priorities was there anything to indicate that aeronautics was high on the President's list. Gen. Lyles noted that the Committee challenged Mr. Kundu and OMB to look at how NASA contributes to the President's top priorities, e.g., education and economic security, and take these into account. Mr. Armstrong indicated that Mr. Kundu also gave the Committee his understanding of the Agency's top priorities, and he felt that Aeronautics did not fall into them. The Committee challenged him on this, and he seemed to take the point. Mr. McPherson noted that OMB tries to manage according to a portfolio approach. In the last

two years, OMB has changed how it looks at R&D across the government, and it is up to the Agency to equip OMB and the senior staff with what the portfolio values are.

Mr. Armstrong reviewed next steps for the Aeronautics Committee: investigate further the detailed research requirements of NextGen and how they are being met by NASA and DOD; and investigate further the issues associated with Mars entry, descent, and launch (EDL)—both thermal and aero. The discussion with the examiner suggested that there are individuals outside of NASA, mostly industry, that do not look favorably on "stuffing" the Aeronautics budget with space items; however, the Committee needs more information before it can make any conclusion on this issue.

Space Operations Committee Report and Discussion

Dr. Paul Robinson reviewed the current status of Space Shuttle operations. The Space Operations Mission Directorate (SOMD) has many challenges to finish the ISS with a fixed number of Shuttle flights. The Committee had some discussion relative to the damage to the External Tank (ET) from a very localized recent hailstorm. Although the damage was extensive, Dr. Robinson felt that all of the damage spots are within past experience where fixes were successful. Col. Collins added that NASA is still looking at options relative to this issue. Dr. Jones commented that he would like to see what the subsequent performance of the ET was on past missions where there were damage repairs of this nature. It is important to note that the Committee has not seen the technical rationale on this issue.

Dr. Robinson observed that the Committee spent much of its time examining the shift from Shuttle launches to the Ares I and eventually the Ares V program. There will be major modifications to Pad B. The Committee reviewed Ground Operations and scaled the heights of Launch Pad 39B (site of the first launch of the Ares vehicle), including climbing the entire launch tower and launch platform. Pad 39B also has to be maintained for possible launch of a Shuttle for the Hubble Space Telescope (HST) servicing mission in 2008. That mission will be flown from Pad A, but a contingency Shuttle will be rolled out on Pad B to enable to rescue mission should it be required. If the second Shuttle is not needed for HST, it will be rolled to Pad A for a future ISS mission, and modifications for Ares I will precede.

The Committee received an outstanding briefing and discussion during the Pad B walkdown from Mr. Billy Stover, Ground Systems Manager for KSC Launch Facilities. Committee members got an excellent feel for how the new launch capability will use the integrated experience of Apollo, Shuttle, and all past launch operations, including military launches. The Administrator has challenged the program to simplify launch preparations and decrease “touch labor” by about 75%. The key to this is a reduction of Ares-Orion exposure (from launch roll-out from Vehicle Assembly Building) to ready-to-launch to only seven days. Areas for special attention include assurances that the high-aspect ratio Ares I launch vehicle can withstand wind loads during that seven-day period as well as lightning protection. The planned lightning protection approach was used at the Titan complex and should substantially raise the level of lightning protection. Sen.

Schmitt noted that ice external to the cryo-tanks will change the wind dynamics, and suggested that the Committee might want to look at this area.

Dr. Robinson noted that there is a new approach to crew rescue for Ares-Orion on the Pad—a rail-based, vertical crew egress capability which is much faster than the current "basket" system. There is also a new approach to the hold-down post system which eliminates the use of pyrotechnic nuts. Dr. Robinson observed that the two former Shuttle astronauts on the Committee (Col. Collins and Dr. Jones) are carefully attuned to these improvements and are excited about them.

The Committee was asked to help out in the review of the transition planning for Ground Support and KSC operations. A lot of progress has been made, and on the NASA civil service side, the planning is well underway; however, more workforce planning is needed on the contractor side. Trade studies based on Constellation program rebaseline activities are ongoing, and these trade studies will help NASA develop detailed competency maps and plans for transitioning workforce between Shuttle and Constellation.

The Space Operations Committee was in a support role to the Science Committee in looking at medium lift launch vehicle capabilities. Because of the way decisions have been made by DOD, the NRO, and NASA, as well as foreign launchers, the launch supplier community in this payload class is almost totally dominated by foreign sources. Many of the U.S. programs that were going to move forward (e.g., in communications) have folded. Alternatives for the US are going to be quite expensive unless alternative launch providers can emerge. There are solutions: lower-cost solution/higher risk; or higher-cost/lower risk. Time may be the most important ingredient—sources for medium launchers appear to be a problem, but there may be a different situation a year from now. The US alternative suppliers have not been focused on these missions due to uncertainties in demand and in plans for the Delta II, but that could change. There is no need for a final decision today since Delta II vehicles are available through about 2009. Within the Council this challenge will be jointly examined between the Exploration and Space Operations Committees.

Gen. Abrahamson noted that the US has ceded away medium lift launch capability, although there is currently no budget for it. He suggested that perhaps the Committees could take a broader look at this issue and provide a report in July. Sen. Schmitt inquired about the feasibility of refurbishing the Delta II line. Dr. Robinson indicated that the Space Operations Committee looked at this, and it would be a very expensive solution. Dr. Covert asked about conversion of the Delta IV to a smaller load-carrying capability by removing some of the boosters. Dr. Robinson observed that people have not been concentrating on the smaller capability, but Gen. Lyles indicated that this is still a viable option, although it might be too expensive. Gen. Lyles also volunteered to provide some information on Department of Defense Expendable Launch Vehicles at the meeting in July.

In response to a question from Dr. Owen Garriott about what the "tall pole" is that delays the Crew Exploration Vehicle (CEV) until 2015, Col. Collins observed that upper stage development is probably one of the areas.

The Committee is still working on the question about ISS as a National Laboratory. Sen. Schmitt indicated that the Council, primarily the ad hoc Biomedical Committee, helped in editing NASA's response to the Congress on the National Laboratory (REF).

The process of getting a Memorandum of Understanding (MOU) between NASA and the National Institutes of Health (NIH) is in its final stages. This should encourage the interactions between the agencies and the potential for world-class animal care and research facilities on the ISS as well as at the Centers.

Exploration Committee Report and Discussion

Gen. Abrahamson presented a summary report on the Exploration Committee. Sen. Schmitt noted that Dr. Ken Ford, a recently approved Council member, will serve on the Exploration Committee and should be at the next meeting. With respect to reviewing requirements documents, Gen. Abrahamson reported that this is an ongoing review, but the Committee does not intend to insert itself into the process in an "inspector general-type" manner. The Committee sub-team sampled key Orion (and specifically CEV) requirements and contractual documents to validate processes and requirements interconnectivity. Very positive initial impressions were expressed by each member of the review sub-team. However, the trade-off process could easily get out of sync, and needs to be attended closely. The Committee is broadening its document review to higher levels of requirements and the work breakdown structure. Gen. Abrahamson emphasized that this activity is strictly fact-finding, and there will be a more significant report to the Council at the July meeting.

Gen. Abrahamson noted several joint efforts of the Exploration Committee with other Committees, including: ITAR, a review of launch options and alternatives, and a review of transition management. The Exploration Committee will conduct new fact-finding activities in power alternatives and Lunar and Mars surface activities and Lunar and Mars EDL (entry, descent and landing) issues. Sen. Schmitt observed that a number of simulations could be conducted during flight operations within the Lunar Architecture. In response to a question from Dr. Jones regarding power, Gen. Abrahamson indicated that the Committee did get some reporting on the prospects of nuclear power, but it was pleased to see a rather attractive set of boundaries for solar-power capability. What is missing is a process to know what the extreme demands will be and how to ensure that loads can be shunted during potential failures. Sen. Schmitt added that there is a battery issue in getting through even a limited duration period of darkness without nuclear or fuel-cell availability. He suggested that NASA may want look at the closed solar-fuel cell cycle as an option in addition to nuclear. Dr. Edward David commented there is a new technology using metallic feeds (aluminum or zinc) in fuel cells, and it is reasonably well developed. He indicated that he would send the references on this subject to Gen. Abrahamson.

This concluded the Committee reports and Council discussion. The next Council meeting will be at MSFC on July 17-19, 2007.

Sen. Schmitt adjourned the meeting at 4:15 pm.

NASA Advisory Council Meeting
Cocoa Beach, FL
April 19, 2007

Meeting Location
Seashore Ballroom
Hilton Cocoa Beach
1550 North Atlantic Ave
Cocoa Beach, Florida
Tel: 321-799-0003

8:00 a.m.	Opening Remarks	Hon. Harrison Schmitt
8:10 a.m.	Science Committee Report and Discussion	Dr. Edward David
10:00 a.m.	Break	
10:15 a.m.	Council discussion and approval of Science Recommendations	
11:15 a.m.	Human Capital Committee Report and Discussion	Dr. Gerald Kulcinski
12:00 p.m.	Lunch	
1:30 p.m.	Audit and Finance Committee Report and Discussion	Mr. Robert Hanisee
2:15 p.m.	Aeronautics Committee Report and Discussion	Mr. Neil Armstrong
3:00 p.m.	Break	
3:15 p.m.	Space Operations Committee Report and Discussion	Dr. C. Paul Robinson
4:00 pm.	Exploration Committee Report and Discussion	Gen. James Abrahamson
4:45 p.m.	Council Discussion and Agreement on Recommendations	
5:00 p.m.	Adjournment	

Appendix B

NASA Advisory Council Members
April 19, 2007

Chair	• Hon. Harrison H. Schmitt, Apollo 17 Astronaut and Scientist
Aeronautics Committee	• *Chair: Mr. Neil Armstrong, Apollo 11 Astronaut* • General Lester L. Lyles, USAF (Ret.), Consultant, The Lyles Group • Dr. Eugene Covert, T. Wilson Professor of Aeronautics, Emeritus, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology • Dr. John Sullivan, Professor of Aeronautics and Astronautics Director of the Center for Advanced Manufacturing, Purdue University
Audit and Finance Committee	• *Chair: Mr. Robert M. Hanisee, Trust Company of the West* • Hon. Edward R. "Ted" McPherson, Chief Executive, Intersolve Group, Inc. • Hon. Michael Montelongo, Senior Vice President, Strategic Marketing, Sodexho, Inc. • Mr. Howard J. Stanislawski, Partner, Sidley Austin, LLP
Exploration Committee	• *Chair: Lieutenant General James A. Abrahamson, USAF (Ret.)* • Dr. Wanda Austin, Senior Vice President, National Systems Group, The Aerospace Corporation • Dr. Donald Fraser, DRS Technologies
Human Capital Committee	• *Chair: Dr. Gerald L. Kulcinski, Associate Dean of Research, College of Engineering, University of Wisconsin-Madison* • Ms. Kay Coles James, President, The Gloucester Institute • Mr. Wendell Maddox, President and Chief Executive Officer, ION Corporation • Dr. R. James Milgram, Professor, Department of Mathematics, Stanford University
Science Committee	• *Chair: Dr. Edward David, President, EED, Inc.* • Dr. Owen Garriott, Astronaut (ret.) • Dr. Bradley Jolliff, Research Associate Professor, Department of Earth and Planetary Sciences, Washington University • Dr. Mark S. Robinson, Research Associate Professor, Department of Geological Sciences, Arizona State University • Dr. Byron Tapley, Director, Center for Space Research, Professor, Aerospace Engineering, University of Texas, Austin • Dr. Neil DeGrasse Tyson, Frederick P. Rose Director, Hayden Planetarium, Department of Astrophysics, American Museum of Natural History
Space Operations Committee	• *Chair: Dr. C. Paul Robinson, Former President and Director, Sandia National Labs (Ret.)* • Col. Eileen Collins, Astronaut (ret.) • Dr. Pat Condon, Senior Consultant, Logistic Specialties, Inc. • Dr. Thomas Jones, Astronaut (ret.) • Dr. David Longnecker, Institute of Medicine, National Research Council
Ex-Officio	• Dr. Lennard A. Fisk, Chair, Space Studies Board, National Research Council
Unable to Attend	• Dr. Raymond S. Colladay, Chair, Aeronautics and Space Engineering Board, National Research Council • Ms. Joann DiGennaro, President, Center for Excellence in Education • Capt. Rick Hauck, USN (ret.), Astronaut (ret.) • Dr. Stephen I. Katz, M.D., Ph.D., Director, National Institute of Arthritis and Musculoskeletal and Skin Diseases • Dr. John Logsdon, Director, Space Policy Institute, George Washington University • Adm. Benjamin Montoya, CEO, SmartSystems Technologies

NASA ADVISORY COUNCIL
Hilton Cocoa Beach Oceanfront
Cocoa Beach, FL
April 19, 2007

ATTENDEES

Council Members	*NASA Attendees*
Abrahamson, James A.	Cunningham, Suzy
Armstrong, Neil	Dunwoody, Cathy
Austin, Wanda	Freeman, Robert K.
Blackerby, Christopher *(Executive Director)*	Hartman, Colleen
Collins, Eileen	King, Marla
Condon, Pat	Krezel, Jonathan
Covert, Eugene E.	Ostrach, Louis
David, Edward	Parham, Jane
Fisk, Lennard A.	Pellis, Neal
Fraser, Donald	Wargo, Michael
Garriott, Owen	Williams, Greg
Hanisee, Robert M.	
James, Kay Coles	
Jolliff, Bradley L.	
Jones, Thomas	
Kulcinski, Gerald L.	
Longnecker, David	
Lyles, Lester L.	
Maddox, Wendell	
Milgram, R. James	
Montelongo, Michael	
Montoya, Benjamin	
Robinson, Mark	
Robinson, C. Paul	
Schmitt, Harrison H.	
Stanislawski, Howard J.	
Sullivan, John	
Tapley, Byron	
Tyson, Neil DeGrasse	

Other Attendees:

Beattie, Don	NASA alumni
Dana, Pamella	IHMC
Frankel, Paula	*consultant*
Halvorson, Todd	Florida Today
Parnell, N.	*not affiliated*
Parnell, Robert F.	*not affiliated*
Robinson, Barbara	*not affiliated*
Schneider, Mike	Associated Press

NASA ADVISORY COUNCIL
Hilton Cocoa Beach Oceanfront
Cocoa Beach, FL
April 19, 2007

LIST OF PRESENTATION MATERIAL[1]

Reports from:

1) Science Committee [Jolliff]
2) Human Capital Committee [Kulcinski]
3) Audit and Finance Committee [Hanisee]
4) Aeronautics Committee [Armstrong]
5) Space Operations Committee [P. Robinson]
6) Exploration Committee [Abrahamson]

Other material distributed at the meeting:

1) Summary of Strategic Planning for NASA's Science Mission Directorate, 2007-2016
2) Strategic Planning for NASA's Science Mission Directorate, 2007-2016
3) NASA Advisory Council February Meeting Minutes and Letter from Chair
4) NASA Response to NASA Advisory Council Recommendations S-06-9, S-06-10, and A-06-4
5) Bio for new member of the Exploration Committee, Hon. Donald Fraser

[1] Presentation and other material distributed at the meeting are on file at NASA Headquarters, OER/ACMD, 300 E Street SW, Washington, DC 20546.