

**NASA ADVISORY COUNCIL (NAC)  
Ad-Hoc Task Force on Planetary Defense**

**CORRECTED MINUTES**

Meeting Date: April 15-16, 2010

AGENDA:

- Ad-Hoc Task Force Terms of Reference
- NASA Near Earth Objects Observation (NEOO) Program Status; FY11 Budget for NEO Research
- National Research Council NEO Report (Jan 2010) – Summary of Findings
- United Nations NEO Threat Response; UN NEO Working Group in Committee on the Peaceful Uses of Outer Space (COPUOS)
- Status of Congressional Directive to Office of Science & Technology Policy (OSTP)
- NEOs in the Context of the Augustine Committee Report (October 2009)
- NASA Exploration Systems Mission Directorate – NEO Exploration Status
- Ad-Hoc Task Force Views on NASA Neo Activities and Priorities

ATTENDING:

Ad-Hoc Task Force: Tom Jones (Co-Chair), Rusty Schweickart (Co-Chair), Richard Binzel, Clark Chapman, Lindley Johnson, Brian Wilcox, Donald Yeomans, Bette Siegel, Jane Parham

Presenters: Irwin Shapiro, Edward Crawley, Michael Wargo

Others: Brian Marsden, Tim Spahr, Jeff Hoffman, Alli Cocuzzo (see details p.8)

**ACTIONS**

**NAC.TF\_100415\_001:** *Task Force (TF) members.* Review NAC Planetary Protection committee Terms of Reference.

**NAC.TF\_100415\_002:** *TF members.* Download ASE Report; focus on global response to asteroid threat.

**NAC.TF\_100415\_003:** *TF members.* Identify appropriate individuals with whom ESMD can engage in the planetary defense community and provide to Mike Wargo.

**NAC.TF\_100415\_004:** *TF members.* Read the NRC Report, especially Chapter 7 – national aspect, and the ASE Report – international aspect. Each member is to identify the two top issues he believes need to be resolved in order for the planetary defense challenge to move ahead appropriately. Target date to provide to Mr. Schweickart and Dr. Jones: April 30.

**NAC.TF\_100415\_005:** *Tom Jones.* Procure latest document from ASE and send with notations to TF members. (completed)

**NAC.TF\_100415\_008:** *Tom Jones and Rusty Schweickart.* Coordinate with NAC Chair the best way to communicate need for OSTP to define NASA roles and responsibilities regarding planetary defense in a timely manner. It is a most opportune time to understand the full extent of what NASA's responsibilities will be in planetary defense as NASA re-plans its exploration initiative

**NAC.TF\_100415\_009:** *Tom Jones.* Draft recommendation and distribute for review of TF members. The recommendation is that NASA seek timely direction from OSTP on what NASA's role will be, in context of other USG agencies, in warning and mitigation elements of planetary defense.

## DISCUSSION

### Ad-Hoc Task Force Terms of Reference (TOR) – Charter, Schedule, Deliverables

#### Discussion Points

- Task Force needs to define Planetary Defense and scope of Task Force activity.
- Task Force recommendations will be based on the TOR first paragraph and overall outline (“The scope of the Committee includes all NASA programs, projects, activities and facilities related to planetary defense”). Breadth, specificity, and nature of Task Force output are works in progress. Co-Chairs will discuss with NAC.
- Task Force should review the TOR for the NAC Planetary Protection committee. **(Action 001)**
- TOR suggests membership of 5 to 15. Additional members, subcommittees, or community-wide analysis groups are possible. Suggestion: add member from the field of disaster management response.
- Intersection between exploration and in situ utilization of resources and interactions between planetary defense and human exploration are appropriate subjects.
- Based on cursory discussions with NAC Chair, the NAC expects a Task Force report including recommendations, findings, and conclusions. The Task Force must deliberate on scope. Primary output will go to NAC; NAC by law advises the NASA Administrator. Task Force will base work on Annual NAC Work Plan and requests from NAC Chair.
- The Task Force should recommend efforts that NASA is not doing now but which the Task Force believes NASA should be doing. The Task Force may include recommendations on interfaces with other organizations in government and community, and may advise clarification of NASA’s role in planetary defense.
- Recommendations should be as specific and actionable as possible.
- The Task Force must stay within NASA charter and authorization bill, which does not include deflecting asteroids nor disaster preparedness, but could be everything up to enabling deflection – survey, characterization and forewarning of near earth impacts.

### NASA Near Earth Object Observations (NEOO) Program

Lindley Johnson, Program Executive for NEOO at NASA Headquarters, presented status of NASA’s ongoing effort to find the natural objects in the Solar System with potential to (1) pose a serious impact hazard to Earth and (2) provide exploration destinations. Mr. Johnson outlined NEOO Program basics, NEO statistics on discovery, close approaches, and impacts, National Research Center NEO recommendations, NASA support of the Minor Planet Center at Harvard-Smithsonian Center for Astrophysics, and the FY2011 proposed budget for NEOO.

#### Discussion Points

- The Minor Planet Center (MPC) is a fundamental component in planetary defense. This needs to be enforced in the minds of the Smithsonian Astrophysical Observatory. There is a serious problem at MPC because the computers are behind Smithsonian firewalls; thus, MPC web page is nonfunctional. MPC needs to become a higher priority at Smithsonian.
- MPC is currently in a single point failure status. The international community, especially the European Space Agency (ESA), is interested in supporting the NEO database and processing system, starting with support to the NEO Dynamics System (NEODyS). There needs to be some level of backup to the MPC functions

established in case it should, for whatever reason, be knocked out of operations for an extended period.

- If a comet enters inner solar system, it can become a NEO. By their nature, it is difficult to include long-period objects from the outer solar system in planetary defense capabilities.
- Ground-based aspect is under debate at NASA, whether or not to move to space-based capabilities and let National Science Foundation lead ground-based activities.
- Similar discussion exists on radar and characterization spending. Task Force should define characterization in context of planetary defense, as opposed to characterization in general.
- NASA use of data from the DoD Space Surveillance Telescope (SST) may be useful to the Task Force.
- 

### **National Research Council NEO Report (Jan 2010) – Summary of Findings**

Irwin Shapiro, Professor of Astrophysics at Harvard and leader of the National Research Council (NRC) NEO Report published in January 2010, provided his thoughts on the NRC process and what should be emphasized from this effort:

#### Key Points:

- A primary factor is budget constraint.
- Surveillance is as important as surveys. It is worth investing the money to keep constant surveillance.
- The next important thing is characterization. In situ characterization is a fool's errand, because there is such variety out there. Money is better spent elsewhere than in situ investigation of classes of asteroids.
- We should do as much as we can with ground characterization, which is relatively cheap and informative.
- Next is the question of mitigation - how to do active defense. A serious concern is building up nukes and kinetic impactors ready to deploy at a minute's notice, in the absence of a known threat. It is not practical and not cost effective, as technology will change on a large scale.
- This is an international problem, requiring international collaboration and advance preparation. A subject such as this - of interest to the whole world - is a neutral ground where cooperation and mutual confidence can be built up. This was a lesser recommendation.
- Research in understanding what size and kinds of objects we need to worry about and what we can learn from them is fairly cheap.
- When NEOs come close to Earth and there is only one pass and optical predictions of future orbits is poor, radar is valuable either to calm the population or really worry them.
- The NRC study was charged with meeting the Brown survey. We decided we have to delay 2020, so we selected 2030 as the date we could meet the Brown survey.

#### Discussion Points

- Strongly recommending a planetary defense research program is a possibility. The Task Force should consider candidate elements for this program, including radar efforts.
- There is a host of research that has not been approached, beyond discovery, tracking and cataloging. What level of improved public safety do you get for every dollar spent? Task Force will propose the questions. We should keep to issues that can use current technology – within the next 30 years, such as

nuclear, kinetic impact, and gravity tractor technology. When those three things are juxtaposed with characterization, characterization gets quite narrow. World space agencies need to identify and pursue this research.

- Dr. Shapiro noted that remote characterization would at best tell you something about the surface, but not about potential impact.
- It was pointed out that if you were going to deflect a NEO, you most likely would have time to study it with an observer spacecraft before you deflect it. Dr. Shapiro added that there would be always the issue of when to pull the trigger, what probability threshold will determine the time. The NRC study did not address this. The NRC committee was split on whether we should go with most cost effective which takes a few more years, or vice versa.
- Regarding the value to society of an early goal, Dr. Shapiro commented that it is a question of probability. If we can determine probability, waiting a few years or longer will not matter. You have to look at specific scenarios.
- It was pointed out that studies have all been general, which is why we need concept studies. It takes both space and ground systems to find out maximum information possible about NEO population – where they are and where they are going.

#### **United Nations NEO Threat Response: UN NEO Working Group in Committee on the Peaceful Uses of Outer Space (COPUOS)**

Tom Jones described the Association of Space Explorers' (ASE) participation in the COPUOS NEO Working Group. ASE has observer status. Their expertise in space operations and critical decision-making can contribute to solving the world problem of asteroid threats.

ASE organized an independent panel of 18 advisory experts not currently involved in government and industry. After four workshops they prepared a report entitled ASTEROID THREATS: A CALL FOR GLOBAL RESPONSE, which is available on the Space Explorers' web site [www.space-explorers.org/ATACGR.pdf](http://www.space-explorers.org/ATACGR.pdf). The report proposed a decision-making process to deal with future threats from asteroids and was presented to the UN Action Team 14 and formally submitted to COPUOS in February 2009.

In the intervening years, the UN Action Team has incorporated functional outlines from that report into its three-year work plan. The Working Group continues, with the goal of producing a report of recommendations due to COPUOS in February 2011. Elements of the report may go to the UN Security Council.

About 12 international space agencies are active in the UN Action Team, and a number of other organizations participate, including the Planetary Society.

The Secure World Foundation and ASE held a workshop in January 2010, which addressed implementation issues for their recommended Information, Analysis and Warning Network (IAWN). The UN Action Team is planning future workshops, and ASE and SWF are working toward an implementation workshop of the Mission Planning and Operations Group (MPOG) in the Fall of 2010.

ASE has been supporting this effort for five years. The UN hopes to have agreement in three years. The goal is to prepare the international community for timely decision-making re NEO impact threats via coordinated agreement under UN auspices.

#### **Discussion Points**

- Mr. Schweickart stated his view that NASA should assume a leadership role in coordinating world response to planetary defense. In order to do that, we are going to have to assess politics and other factors involved.
- Mr. Johnson added that in order for NASA to lead in the UN, the US Government has to have its roles and responsibilities worked out concerning planetary defense.
- Task Force members should all download the ASE report. Refer especially to functional element – coordinated global response to asteroid threat: how to deflect, who pays, who takes responsibility, how to decide. **(Action 002)**
- Use of nuclear deflection would be a delicate issue to take up with the UN. The ASE report emphasizes that a small percent of deflections would require nuclear explosives. It is generally accepted that nuclear deflection is a last resort, only if necessary. There is no national position on this in any nation.
- Prevention of panic would be important function of NASA, not only preventing a catastrophe. For example, if a small NEO enters over Los Angeles, NASA should provide as accurate information as possible, even if no loss of life is expected. And in doing that, confidence is built up for a larger impact threat issue.
- Regarding behavioral issues in disasters, Task Force should consider a sociologist member who is expert in this area. This would emphasize the need for research, since one expert said that people don't panic on warnings, they panic when they don't have information. Thus, a responsibility of NASA is to provide as much precise and credible information as possible.
- We need more knowledge about effect of close gravitational encounters (keyhole passages) some number of years ahead of Earth impact that set up that impact. This has not been systematically studied, and it should be. It is cheaper to gain information that helps avoid decision points. It is more expensive to act one time unnecessarily in the face of uncertainty.

#### **Status of Congressional Directive to Office of Science & Technology Policy (OSTP)**

Rusty Schweickart reported his meeting with John Holdren, Director of OSTP, which occurred approximately six months ago. Purpose was clarification of background of the legislative direction given by Congress to OSTP concerning planetary defense.

*[The 2005 NASA Authorization Act states: "The Congress declares that the general welfare and security of the United States require that the unique competence of NASA be directed to detecting, tracking, cataloguing, and characterizing near-Earth asteroids and comets in order to provide warning and mitigation of the potential hazard of such near-Earth objects to the Earth."]*

The driving forces that led Congress to formulate the directive were:

- (1) Due to the increasing discovery rate of NEOs and the fact that it's not just the impact rate that will determine decision-making, a decision to act will most frequently need to be made before impact is determined to be certain.
- (2) The necessity of international coordination. Because of the uncertain nature of predicting impact and the deflection dynamics, we have an inherent international issue. US should be in a leadership position in coordinating international action.

OSTP has not determined the process by which they will address the charge they have been given. Two possibilities are under consideration. One possibility is to integrate this directive into the overall US Space Policy revision, with which OSTP is also charged. Second is to address it as a stand-alone proposition. The target date is October 2010.

OSTP stated that they would appreciate input from this Task Force.

Discussion Points:

- OSTP will make a recommendation to Congress. Remember that OSTP and NASA are both part of the Executive Branch.
- NRC recommends that OSTP establish a standing committee of relevant agencies (NASA, DOD, DOE, EPA, DHS) with a lead agency identified as coordinating it, strongly implied as NASA.
- It may be outside the scope of this Task Force to recommend that NASA request a new program in mitigation research.
- The language in the directive is .... "IN ORDER TO", rather than "AND," provide warning and mitigation. Thus, it was politically acceptable to Congress.
- The Task Force cannot get into the internal NASA organization to recommend specific actions. We should state a principle that this responsibility be clearly defined in such a way that it is understood that money is not being taken away from ongoing NASA responsibilities to fund a new responsibility.

**NEOs in the Context of the Augustine Committee Report (October 2009)**

Edward Crawley, MIT Professor of Aeronautics and Astronautics, provided a synopsis of the results of the US Human Space Flight Plans Committee (the Augustine Committee). Key points included reasons why humans explore, measures for evaluation of exploration results, plans and strategies for exploration, values of "flexible path," and lunar options.

Discussion Points:

- Expanding human civilization includes protection of Earth.
- Unlikely that moon is in the critical path, other than as a test of Mars missions.
- It is not necessary to spend 300 days on Mars surface. Alternatively, stay in orbit for the full duration and go to the surface only for a week.
- There are many destinations requiring less energy than going to the moon or Mars. Human proximity interaction with small bodies is valuable, landing on a few places, utilizing the natural synthesis of humans and robotics.
- A NEO is the first tangible destination outside of the Earth/Moon system. There is a range of NEOs, with opportunities to do a fast mission (50 days) or longer (200 days). Reasons are to test systems for exploration and encounters, planetary defense, and also science and resources.
- The phrase, "planetary defense," is not presented as a reason for exploration in the Augustine Committee Report. It came up in a short discussion during testimony.
- In his speech at KSC April 15, the President reiterated that we are eliminating the Constellation Program and the moon as a target. NASA will pursue the "flexible path" approach. The President did not rule out the possibility that if the NASA team develops a plan that includes the moon as a sensible stop on a path to Mars, he would look at that idea.

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

Michael Wargo, Chief Lunar Scientist for Exploration Systems, NASA Headquarters, presented an overview of ESMD's high-level strategy for human exploration of space beyond Low Earth Orbit, with focus on guidelines for and status of Exploration Precursor Robotic Missions (xPRM) planning: (1) xScouts Program and (2) Exploration Precursor Robotic Program (xPRP), with mention of NASA's limited science-based flight missions to NEOs. Dr. Wargo characterized this as the "plan for the plan."

Dr. Wargo provided a summary of the FY2011 President's budget as well as ESMD's FY2010 activities, which include study teams to plan transition from large, mission operations program to a diverse technology development, demonstration, and precursor focus.

Dr. Wargo noted that Planetary Defense is not part of xPRM's charter and is not currently in historical NASA human exploration Needs, Goals, and Objectives. However, ESMD's notional NEO activities may have benefit to planetary defense objectives.

Discussion Points:

- Multiple locations are under consideration – moon, NEOs, Mars, and vicinity of Mars. Driver is what is needed to inform human exploration Needs, Goals and Objectives (NGOs). There is not currently an NGO that has been approved by NASA management. The NGO in place was for President Bush's Vision for Space Exploration.
- ESMD's Objectives and Requirements Definition Teams (ORDTs) will be used to inform development of objectives. (Ref Chart 14)
- The Task Force could provide valuable input to this process by identifying appropriate individuals with whom ESMD can engage in the planetary defense community (**Action 003**)
- Docking to a NEO is an unknown risk to human exploration and is also of great scientific value.
- Scientific objectives could be developed – same set of knowledge objectives needed for hazard mitigation and measurements of environment for human safety. Then work back to technology needed to accomplish objectives.
- Line up objectives in categories – human exploration, science, and planetary defense – and develop NGOs for each. Opportunities will become apparent.
- Dr. Wargo's response to the question of whether ESMD has the capability to add the category of planetary defense to current work, or whether it needs a new initiative was that since there is no current NGO in place, ESMD is extremely flexible.
- Lindley Johnson noted that his Near Earth Object Observation Program, in NASA's Science Mission Directorate, is already working with ESMD.
- Dr. Wargo added that individuals at NASA recognize that we can cover a breadth across science, human exploration, and planetary defense. This is at the beginning – a plan for a plan.
- It is important for the Task Force to recommend beyond what is already being done at NASA, possibly endorsing planetary defense work already going on in conjunction with ESMD and SMD without official recognition.
- There is a great synergy between what science and exploration need to learn, more now than in the past.
- Dr. Wargo pointed out that there is valuable information to be learned from the moon. It is not reasonable to simply say that we have been there and done that.
- Public engagement is a big part of what NASA needs. The public understands NASA's role in visiting NEOs and in planetary defense: NASA working for the preservation of Earth as well as to expand our knowledge of the universe. This would strengthen ESMD.
- The direction has to come from above NASA – the roles and responsibilities work of OSTP.
- The Task Force asked Dr. Wargo for continued input as ESMD considers planetary defense.
- Regarding validation of deflection concepts, early planning is important. ESMD is responsible for developing new capabilities beyond Shuttle and Space Station; SOMD is responsible for operations of Shuttle and Station.

**Ad-Hoc Task Force Views on NASA Neo Activities and Priorities**

- Mr. Schweickart asked each Task Force member to read the NRC Report, especially Chapter 7 – national aspect, and the ASE Report – international aspect. Each member will then identify the two top issues he believes need to be resolved in order for the planetary defense challenge to move ahead appropriately. Freely consider what needs to get done; we will add constraints later in terms of NAC, NASA, etc. Target date to provide to Mr. Schweickart and Dr. Jones: April 30. **(Action 004)**
- Dr. Jones will get latest document from ASE and will send notated article to Task Force members **(Action 005)**
- Regarding Task Force report to NAC: the Task Force met, took in key background elements, looking to NAC for guidance.
- Regarding the OSTP directive, we need roles and responsibilities of planetary defense clearly defined as soon as possible. It is a most opportune time to understand the full extent of what NASA’s responsibilities will be in planetary defense as it replans it’s exploration initiatives.
- We would like to see immediate direction from OSTP that NASA should include planetary defense in its current planning. Request should come from NASA Administrator. Dr. Jones and Mr. Schweickart will coordinate with NAC Chair the best way to communicate this. Recommend to the NAC that the Administrator personally request of OSTP timely action on their roles and responsibilities policy review. **(Action 006)**
- Dr. Jones will draft recommendation and distribute for review of Task Force members. The recommendation is that NASA needs to understand from OSTP what is NASA’s role in warning and mitigation elements of planetary defense. **(Action 007)**
- Dr. Binzel suggested a second Task Force finding – encouraging the synergy between human exploration, science, and planetary defense and encourage activities where they intersect.
- For the next Task Force meeting, what additional input would help shape our recommendations:
  - Short-term warning issues and capability
  - Disaster management
  - Public communication
- Mr. Johnson suggested adding a disaster management member to Task Force.

See next page for attendees other than Task Force members:

Jeff	Hoffman	MIT	Professor
Alli	Cocuzzo	MIT	Admin Asst.
Brian	Marsden	Minor Planet Center	Director Emeritus
Tim	Spahr	Minor Planet Center	Director