1. GENERAL IMPRESSION OF DECADAL RECOMMENDATIONS

2. SPECIFIC DS RECOMMENDATIONS

3. FLAGSHIP DESCOPE PROCESS
   a) Schedule
   b) Minimum Science Issues
   c) Costing Process

Based on OPAG Findings from 17-18 March 2011 Meeting & Breakout Discussion
Participants: Bill McKinnon, Jim Slavin, Louise Prockter (all from PSS), Curt Niebur
(HQ), Scott Hovarter (Lockheed)
OPAG findings in black, Breakout in blue.
1. GENERAL IMPRESSION OF DECADAL RECOMMENDATIONS


OPAG strongly endorses the over-arching premise of V&V that a vibrant planetary program requires frequent access to space and a diversity of missions and scientific objectives. OPAG also recognizes that many scientific disciplines participate in planetary exploration. Thus a planetary program implemented within resource constraints must not abandon a multiplicity of missions, scientific objectives, and solar system objects. OPAG recognizes that the current budget situation is different than that envisioned by V&V, and urges NASA to work in an open manner with the community via PSS and the AGs as it rebalances the PSD portfolio to implement V&V.

*OPAG endorses a program that includes a mix of PI-class Discovery and New Frontier missions, as well as more capable, but less frequent, Flagship missions, to multiple destinations in the solar system.*
1. GENERAL IMPRESSION OF DECADAL RECOMMENDATIONS

From OPAG Finding #1 —

*OPAG endorses a program that includes a mix of PI-class Discovery and New Frontier missions, as well as more capable, but less frequent, Flagship missions, to multiple destinations in the solar system.*

*DS is not a detailed blueprint for a 20-30 yr program. However laudable a goal MSR is as a focus for PSD (“first among equals”), it cannot be a sole focus for PSD flagships over 20-30 yr. This is not scientifically defensible, and it is not what the Decadal calls for. The Decadal is notable for its cost realism. MSR is notable for its ability to proceed in discrete stages. The Decadal calls for the only first element of MSR to be launched in 2013-2022, which allows for the necessary technology development (investment) to return the samples to Earth in the following decade. The Decadal is explicit in its prioritization of a descoped Outer Planets flagship to start later in the decade 2013-2022. This is the “ideal solution,” if the budget beyond the present 5-yr horizon allows.*
2. SPECIFIC DS RECOMMENDATIONS

NEW FRONTIERS

Finding #7 — OPAG urges NASA to pursue non-flagship flight opportunities for outer planets missions.

V&V states that “If NASA wants to explore beyond the orbit of Jupiter, NASA must accept that there are risks associated with that exploration (long timescales, limited power options, etc), and that there are concomitant costs associated with those risks.” These risks uniquely place outer planet missions at a competitive disadvantage. Nevertheless, innovative, focused outer planet missions are possible in smaller mission classes. For example, New Horizons is en route to Pluto, Juno will be launched this year, and V&V lists two missions (Saturn Probe and Io Observer) as New Frontiers candidates. In addition, the modified parameters of the recent Discovery AO (offering GFE technologies including ASRG, increasing the cost cap, removing the launch vehicle from the cost cap, etc.) enabled a new class of missions to be competitive in the Discovery program.
2. SPECIFIC DS RECOMMENDATIONS

NEW FRONTIERS

Finding #7 cont’ — OPAG urges NASA to pursue non-flagship flight opportunities for outer planets missions.

OPAG strongly endorses the V&V recommendation “changing the New Frontiers cost cap to $1.0 billion FY2015, excluding launch costs.”

OPAG further urges PSD to continue to identify and implement innovative policies to address the unavoidable risks integral to outer planet missions, in order to enable these concepts to compete effectively outside of the flagship mission class.

The present 5-yr budget does not allow for an Outer Planets Flagship. Given the physical realities of Outer Planets exploration, focus must necessarily fall to the New Frontiers mission class (and perhaps Discovery, depending on D12 selections).
Outer Solar System Missions proceed over long time scales

End of Outer Planet Exploration?
2. SPECIFIC DS RECOMMENDATIONS

AVAILABILITY OF PLUTONIUM-238

Finding #6 — OPAG vigorously supports the V&V recommendation for a restart of domestic plutonium-238 (Pu-238) production.

V&V states that “Without a restart of plutonium-238 production, it will be impossible for the United States... to conduct certain important types of planetary missions after this decade.” Due to low light levels in the outer Solar System, nearly all conceivable missions to destinations beyond Jupiter require some form of Radioisotope Power Source, which requires Pu-238. OPAG also endorses the V&V recommendation that enabling ASRG technology be developed to flight readiness in a timely fashion (2014 in the case of potential use by the upcoming Discovery selections).
2. SPECIFIC DS RECOMMENDATIONS — TECHNOLOGY INVESTMENTS

Finding #4 — OPAG laments that no future Titan mission was included in the V&V as a potential mission at any level for the coming decade. OPAG urges that NASA consider how technology improvements could enable future exploration of this V&V priority.

V&V states that “Further exploration of Titan is a very high priority for satellite science.” V&V further states that the proposed Titan Saturn System Mission concept “has the highest priority among the deferred missions to the satellites of the outer planets.” V&V concludes that “technology investments must be made in the decade 2013-2022 in order to enable this mission and reduce its cost and risk.” OPAG judges that Titan science, mission concepts, and technology needs should be reassessed in light of V&V’s findings and the current budget environment.

*OPAG concludes that technology and study investments should be guided by this reassessment and made in the coming decade to enable Titan exploration.*
2. SPECIFIC DS RECOMMENDATIONS

TECHNOLOGY INVESTMENTS

Finding #5 — OPAG endorses the Technology recommendations in V&V, and specifically urges a technology effort over a range of planning horizons.

OPAG suggests an early comprehensive technology planning effort to ensure that both competed and flagship missions recommended in the report can be achieved. This long range planning effort should be followed by implementing a well-balanced technology development program that, as advocated in V&V, looks to the next decade as well as this one. For the outer planets, it is clear that a well thought-out plan to address power, propulsion, communication, probe technologies and instrument needs is critical.

We (PSS) support PSD plan to incorporate technology activities into a single, supported line.
2. SPECIFIC DS RECOMMENDATIONS

INTERNATIONAL COLLABORATION

Finding #3 — OPAG strongly endorses the V&V recommendation that NASA vigorously pursue international cooperation in planning and executing planetary missions in the Outer Solar System. OPAG fully endorses the ESA Jupiter Ganymede Orbiter (JGO) mission concept.

OPAG acknowledges missions under study in Europe that are synergistic with proposed US missions, and recognizes that international collaborations have led to incredibly fruitful results. Exploration of Ganymede in particular has strong potential for collaboration with Europe, as well as the potential to return important Jupiter system and icy satellite science.
2. SPECIFIC DS RECOMMENDATIONS

INTERNATIONAL COLLABORATION

From OPAG Finding #3 — OPAG fully endorses the ESA Jupiter Ganymede Orbiter (JGO) mission concept.

Ganymede possesses an intrinsic magnetic field, diverse geology, and a probable subsurface ocean. The Planetary Science Decadal Survey identifies Ganymede as an important object to study, addressing the theme of Building New Worlds. The *ESA Jupiter Ganymede Orbiter (JGO)* mission would characterize Ganymede as a planetary object, including its potential habitability, as described in the 2010 Joint Jupiter Science Definition Team reports to NASA and ESA. JGO was designed to fly along with the NASA Jupiter Europa Orbiter (JEO) as part of the Europa Jupiter Science Mission (EJSM), but JGO is in itself an outstanding standalone mission.

*OPAG fully endorses the ESA JGO mission concept and PSD’s commitment to contribute instruments through the SALMON process. OPAG encourages continued collaboration between NASA and ESA as well as the US and European scientific communities during the extended study phase for JGO.*
3. FLAGSHIP DESCOPE PROCESS

From OPAG Finding #1

OPAG recognizes that the current budget situation is different than that envisioned by V&V, and urges NASA to work in an open manner with the community via PSS and the AGs as it rebalances the PSD portfolio to implement V&V.

OPAG encourages NASA to develop a comprehensive framework for its flagship decision process, including decision timelines, technical readiness, independent STMC (Science, Technical, Management, and Cost) reviews, resource requirements, and schedule.
3. FLAGSHIP DESCOPE PROCESS

Finding #2 — OPAG strongly urges continued NASA investment in a variety of mission concept studies and their independent review.

As demonstrated by the Decadal process and the Outer Planet Flagship study effort, NASA investment in mission concept studies is beneficial in improving the readiness of mission concepts and in aiding the decision process. However, to the extent possible, such investment should apply a common study framework, including common ground rules, study outputs, and non-advocate evaluation methodology. Mission concept studies should begin with the top flagship priorities listed in V&V: Mars, Europa, and Uranus.

Flagships are critical for outer solar system exploration. OPAG lauds the selection of two potential strategic missions to the Outer Solar System, in priority order from V&V: Jupiter Europa Orbiter, and Uranus Orbiter with Probe. OPAG recognizes that current budgetary constraints require reductions to the scope and cost of such ambitious missions, if flagship missions are to be achieved in the near future.
3. FLAGSHIP DESCOPE PROCESS

From OPAG Finding #2 —

OPAG strongly urges mission studies for the following flagship priorities:

1) A redesigned Jupiter-Europa mission. V&V stated that “The Europa Geophysical Explorer, from which the JEO [Jupiter Europa Orbiter] concept is derived, was the one Flagship mission recommended in the previous planetary decadal survey. The scientific case for this mission was compelling then, and it remains compelling now.” V&V concludes that “The second highest priority Flagship mission for the decade 2013-2022 is JEO. However, its cost as currently designed is so high that both a decrease in mission scope and cost ... are necessary to make it affordable” and that “NASA should immediately undertake an effort to find major cost reductions for JEO...”

OPAG strongly urged that studies of a descoped Jupiter-Europa mission be initiated very soon and completed in a timely fashion, with coordinated inputs from the science community.
### 3. FLAGSHIP DESCOPE PROCESS — Schedule

**Outer Planets Milestones**

<p>| FY 11 | “New Europa” SDT study |
| Oct 2011 | OPAG Meeting |
| Nov 2011 | NASA-ESA bilateral |
| FY 12 | Detailed descoped Europa mission study |
| Feb 2012 | ESA L-class “Decision” |
| April/May 2012 | FY 13 planning |
| Aug 2012 | MSL Arrival |
| FY13 | Continued Europa mission study &amp; technology development |</p>
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<tbody>
<tr>
<td>Europa Orbiter</td>
<td>10 kg Science payload, minimal shielding</td>
</tr>
<tr>
<td>JIMO</td>
<td>Nuclear reactors in space</td>
</tr>
<tr>
<td>JEO</td>
<td>New generation of radiation-resistant instruments, mission creep</td>
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Need fiscally realistic, “technological feasible today” Europa mission, if we hope to fly in our lifetimes

Descopes are far from fatal (e.g., Viking, Grand Tour, VOIR, SOP, CRAF/Cassini)

...even Mars Observer loss largely recovered with MGS
3. FLAGSHIP DESCOPE PROCESS

From OPAG Finding #2 —

*OPAG strongly urges mission studies for the following flagship priorities:*

2) **A Uranus Orbiter with Probe mission.** OPAG endorses the Uranus flagship mission proposed by the Decadal Survey. This will be our first detailed look at an Ice Giant, its magnetosphere, and its system of satellites and rings. Unlike the rocky terrestrial planets or the gas giants composed mostly of hydrogen (Jupiter and Saturn), we know very little about the properties of the ice giants. A mission to Uranus offers enormous potential for new discoveries. We encourage NASA to undertake more detailed Uranus mission studies. The insights gained into the science goals, measurement objectives, instruments, and trajectories will help assure a successful, well-costed mission.

*OPAG encourages NASA to undertake Uranus mission studies in the near future.*

* A logical time to initiate UOP mission studies would be FY 2013, after the situations with regard to “Joint-Lander–C”, Europa flagship, and Ganymede (Laplace) are further clarified.*