



# **2014 Planetary Mission Senior Review (PMSR)**

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## **Results of the 2014 Planetary Mission Senior Review (PMSR)**

**Planetary Science Division**

**3 September 2014**

**Approved by: James L. Green**



# 2014 Planetary Mission Senior Review (PMSR)

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## 2014 Planetary Mission Senior Review (PMSR)

Planetary Science conducted a review of all operating missions that will have completed prime operations by the end of FY 2014, and could potentially continue as an extended mission in FY 2015. Seven missions were identified for review, most of which were also evaluated in 2012. Deep Impact was not evaluated again, as it was terminated due to a mission anomaly, and MSL was added as it completed its Prime operations in FY 2014. For this review, Cassini was evaluated through its end of mission in FY 2017.

2012 Review	2014 Review
Cassini	Cassini
LRO	LRO
MER	MER
MEX	MEX
Mars Odyssey	Mars Odyssey
MRO	MRO
Deep Impact	MSL

Not reviewed were the Dawn, MAVEN, Juno, and New Horizons missions which are still in prime operations (having not yet arrived at their destinations) through at least all of FY 2015, and MESSENGER which will complete its mission in the first half of FY 2015.



# 2014 Planetary Mission Senior Review (PMSR)

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## Background

- Proposal guidelines were issued to all Flight Projects on 21 Feb 2014, describing desired content of proposals, formatting/length restrictions, science content and grading criteria.
- All Flight Projects were given a page limit of 20 pages for the main proposal, plus appendices. Cassini was given a 30 page limit, since this senior review is intended to cover the mission through entry into Saturn's atmosphere in FY17 (three years covered instead of two).
- Three budget scenarios were requested of the Flight Projects:
  - An In-guide budget request.
  - A multi-tiered de-scope budget request.
  - Flight Projects directed to “peel the onion” with de-scopes until they hit a science floor, after which there is no value to continue science operations.
  - An Over-Guide budget request was allowed.
- Budget guidelines for proposals were issued on 21 Feb 2014. NASA’s final approval of extended missions is tentative, pending resolution of the FY 2015 appropriations process and formulation of the FY 2016 President’s Budget.
- Proposals were due into NSPIRES by midnight EST on 11 Apr 2014



# 2014 Planetary Mission Senior Review (PMSR)

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## Review Panel

- Panelists were selected from the Planetary Science Community to serve on the PMSR Panel based on their expertise in Lunar, Mars, and Outer Planets science related disciplines.
- It was intended to hold one PMSR session; however, a conflict with the MEPAG meeting drastically affected the availability of Mars scientists on the Panel.
- As a result, Panel was split into two sessions: One for Cassini/LRO, one for Mars.
- The Cassini/LRO sub-panel met on May 14-15 at the Columbia, MD Sheraton.
- The Mars sub-panel met on May 20-22 at the BWI Embassy Suites in Linthicum, MD
- The panel met via several telecons to discuss each Project proposal and to generate questions for the Projects.
- These questions formed the basis of the Project presentations to the PMSR Panel during the face-to-face meeting.



# 2014 Planetary Mission Senior Review (PMSR)

## Review Panel

- Members of the 2014 PMSR are shown in the table below.
- Clive Neal served as the PMSR Panel Chair, and was available for both sub-panels.
- Vicki Hamilton also served on both sub-panels.

Cassini/LRO Sub-Panel	Mars Sub-Panel
Clive Neal (Notre Dame)	Clive Neal (Notre Dame)
Vickie Hamilton (SwRI Boulder)	Vickie Hamilton (SwRI Boulder)*
Dan Britt (UCF)	Nadine Barlow (NAU)
Robert Craddock (Smithsonian)	Reta Beebe (NMSU)
Lisa Gaddis (USGS/Flagstaff)	David Brain (LASP)
William McKinnon (Wash U)	Tracy Gregg (U of Buffalo)
Jessica Sunshine (U of MD)	Rob Lillis (UC Berkeley)
Ray Walker (UCLA)	Ralph McNutt (JHU/APL)
	Lynn Neckrase (NMSU)

\* Recused herself from MSL proposal evaluation due to conflict of interest



# 2014 Planetary Mission Senior Review (PMSR)

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## Review Panel (continued)

- Several scientists also provided external reviews as non-voting members:
  - Nancy Chanover (NMSU)  
Cassini, LRO
  - Andrew Dombard (UI Chicago)  
Cassini, LRO, MER, MRO, MSL
  - Greg Delory (UC Berkeley)  
LRO
  - Maria Zuber (MIT)  
Cassini



# 2014 Planetary Mission Senior Review (PMSR)

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## Conduct of the Review

- Each Flight Project was given two hours to present their response to the Panel's written questions (and ad-hoc questions asked in real-time during the review).
- A number of NASA HQ observers were present during the Flight Project presentations.
- The Panel broke into an Executive Session after each Flight Project presentation to discuss the proposal/presentation, conduct an initial grading of science merit, and generate any additional questions for the Flight Project.
- Each Flight Project was then brought back into the meeting room and presented with the additional questions, which were either answered then or on the following day.
- When satisfied with the answers to the questions, the Flight Projects were excused.
- While performing the individual Flight Project evaluations, the Panel conducted additional votes as they deemed necessary to comment on over-guide or de-scope options.
- The PMSR Chair briefed PSD Management on June 25 via telecon.
- The final report from the PMSR Panel was submitted to PSD on July 18.





# 2014 Planetary Mission Senior Review (PMSR)

## Review Panel Report

- Panel Report: “The science value (or science per dollar) of the extended missions exceeds the science gain from any planned mission, and all have important strengths. That is, they all represent added value to the Planetary Science Division and the American taxpayer because they are essentially new missions without the development and launch costs.”

Panel voted on Guideline proposal plus an alternate mission content covering over-guide or de-scope options as the panel found appropriate.

Mission	Guideline Proposal	Alternate
	Rating	Rating
Cassini	<b>E</b>	
LRO	VG/G	<b>E/VG</b>
Opportunity	<b>E/VG</b>	
MRO	<b>E/VG</b>	
MEX	G/F	<b>VG</b>
ODY	VG/G	<b>VG</b>
Curiosity	VG/G	<b>VG/G</b>

Legend: E = Excellent, VG = Very Good, G = Good, F = Fair, P = Poor

**Red** = Final rating by PMSR Panel

- The final ratings include specific findings from the PMSR as to the best science investment PSD can make for a given Flight Project, identifying appropriate de-scopes or support for over-guides.



# Cassini – Panel Findings and PSD Response

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## Panel Findings:

- Received the highest rating of EXCELLENT for the guideline mission.
- Cassini has contributed groundbreaking science in the past and has the potential to continue this during the final three-year Northern Summer Mission. Seventeen new science objectives will focus on five areas of investigation: Titan, icy satellites, rings, magnetosphere, and Saturn. The conclusion of the mission will be the F Ring Proximal Orbit phase, offering unique measurements of the mass of the B ring, and Saturn's gravity, magnetic field, upper atmosphere, and ionosphere.
- The proposed mission has a high likelihood of success based upon past performance, spacecraft condition, and the unique aspect of new observations.

## PSD Response:

- PSD concurs with the Panel findings, and approves the proposed extended mission plan.



# Lunar Reconnaissance Orbiter – Panel Findings and PSD Response

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## **Panel Findings:**

- The second extended mission for LRO will characterize changes in the lunar surface, beneath the surface, and in the exosphere. Five broad areas of investigation: seasonal volatile cycle, flux of small meteorites and their impact dynamics, vertical and horizontal structure of the regolith, the Moon's interaction with the space environment, and probing the interior using observations of the surface.
- Some instruments are at the end of their useful science mission, and suggest de-scoping (in order of preference) Mini-RF, LAMP and CRaTER instruments. Based upon the suggested de-scopes the panel rating was raised from VG/G to E/VG.

## **PSD Response:**

- PSD accepts the panel findings and has decided to de-scope (terminate) Mini-RF instrument operations.
- PSD accepts the panel finding that the LAMP and CRaTER instruments are potentially descopable – providing less ground breaking Lunar Science than the other instruments. However, PSD has decided to continue operations of both instruments because of their HIGH programmatic value to:
  - PSD: LAMP is reporting on lunar Water contents; a current significant area of research, and CRaTER is providing new data using Lunar Albedo Protons {LAPs}, a new technique for probing the compositions variation in the regolith – including Hydrogen;
  - HEO: LAMP is reporting on Lunar Water {ISRU} and CRaTER is reporting on the Lunar Radiation environment; both important measurements for the Exploration Community, and
  - HELIO/HEO: CRaTER is reporting on Solar Energetic Particles (SEPs).



# Mars Exploration Rover (Opportunity) – Panel Findings and PSD Response

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## Panel Findings:

- Opportunity continues to make important scientific discoveries on the surface of Mars. In the next extended mission it proposes to determine the aqueous, environmental, and geologic conditions that constrain past and present habitability, and examine present climate variability. The extended mission will focus on the orbitally-detected phyllosilicate deposits near Endeavor crater, which are considered to represent deposits from the ancient Noachian period.
- Received a grade of E/VG by the Panel for the guideline mission.

## PSD Response:

- PSD concurs with the Panel findings, and approves the proposed extended mission plan.



# Mars Reconnaissance Orbiter – Panel Findings and PSD Response

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## Panel Findings:

- MRO identified 21 investigations in six broad categories: habitability and aqueous environments of early Mars, recent climate variability, contemporary surface changes, atmospheric observations, and campaigns of opportunity. MRO will also continue to provide programmatic support for landing site characterization and communications relay.
- The Project was lauded for the high number of quality science publications (~120/year), including many from non-team members.
- The spacecraft was recognized to be in relatively good condition.
- Received a grade of E/VG by the Panel for the guideline mission.

## PSD Response:

- PSD concurs with the Panel findings, and approves the proposed extended mission plan.



# Mars Express – Panel Findings and PSD Response

## Panel Findings:

- US participation in Mars Express is dominated by the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) and the Analyzer of Space Plasma and Energetic Atoms (ASPERA) neutral and charged particle instrument.
- The Panel found that both the Proposal and Presentation lacked adequate justification for:
  - how individuals supported in the extended mission would be involved in the analysis that would result in attaining the cited goals of the proposal;
  - why a mission in its 11<sup>th</sup> year still requires funding for the High Resolution Stereo Camera (HRSC) image calibration and validation, and
  - the strategy for prioritization between the Sub-Surface Sounding Radar Altimeter (MARSIS) modes, which made it unclear whether science goals for these modes could be attained
- The Panel finds only automated aspects of HRSC image processing should be supported at a very low FTE level and all other US support for HRSC be terminated.
- Found that the MARSIS Active Ionospheric Sounding (AIS) coordinated ionospheric observations with MAVEN should be funded
- Panel rating increases from G/F to VG based upon their suggested changes.

## PSD Response:

- PSD concurs with the Panel findings, and approves the extended mission plan without the HRSC science team, and adding the MARSIS AIS collaboration with MAVEN.



# Mars Odyssey – Panel Findings and PSD Response

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## Panel Findings:

- Odyssey will be moved into a new terminator orbit for its sixth extended mission. The mission will: provide an understanding of the distribution of water, CO<sub>2</sub> and dust in the atmosphere; generate a global picture of surface mineralogy, geomorphology and thermophysical properties; provide an understanding of the radiation environment; and serve as an observatory for cosmic gamma ray bursts.
- The Gamma-Ray Spectrometer (GRS) instrument suite, which was found to primarily address Heliophysics and Astrophysics objectives, is not needed for Planetary Science, and can be de-scoped entirely.
- The Java Mission-planning and Analysis for Remote Sensing (JMARS) geospatial information system was observed to be highly valuable to the Mars community, as well as the general public, and would be detrimental to science productivity if lost, and its continued support was requested.
- Panel rating increases from VG/G to VG based upon their proposed changes, but noted that Odyssey may be coming to the end of its productive science life as highlighted by declining rate of publications using Odyssey data.

## PSD Response:

- PSD decided that the radiation environment/atmospheric science is still a priority for human exploration of Mars, and approves the proposed extended mission plan.



# Mars Science Laboratory/Curiosity – Panel Findings and PSD Response

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## Panel Findings:

- In MSL's first extended mission proposal, Curiosity will traverse 8 km, visiting four areas representing different climactic stages in the history of Mars. The science focuses on identifying habitable environments capable of preserving organic compounds and characterizing the major environmental transition from freshwater deposits to those produced under acidic conditions.
- Although several strengths were noted by the Panel, the panel found problems with the proposal were sufficiently severe they need addressing at the earliest opportunity:
  - Curiosity provides the only current way to make certain measurements at the Mars surface (detect carbon, in situ age-dating, measure ionizing particle flux), however, only eight drilling samples are planned to be taken during the two-year extended mission, which the panel considered a poor science return for such a large investment.
  - The proposal lacked specific scientific questions and testable hypotheses.
  - The roles of ChemCam and Mastcam were not adequately discussed.
  - Lack of convincing argument for reaching upper-most sulfate unit at the potential expense of observations in the clays, which may be more relevant to habitability.
- Panel found that a de-scope in traverse distance with a focus on Paintbrush, Hematite, and possibly the Clay units, and better characterizing these sites, would better serve science.
- Panel rating for MSL was VG/G.





# Mars Science Laboratory/Curiosity – Panel Findings and PSD Response

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## PSD Response:

PSD concurs with the panel's finding that efficiency of analytical sampling needs to be improved and that greater emphasis be given to in-depth characterization of geologic units.

PSD approves the extended mission plan, but asks Project to develop a new task plan that:

- Focuses on the importance of exploring and characterizing a geologic unit(s) in lieu of the advantages of covering additional geologic units;
- Explains the role of remote and contact measurements used to develop a deep understanding of the regional context and of the specific site, before any decision to drill for analytical samples;
- Delineates the worthy science that is accomplished whether or not the environment preserved organic material;
- Places the mission's objectives in the broader context of PSD goals and objectives, and
- Shows how results from MSL benefit other missions, such as providing ground-truth for orbital assets.



# Lessons Learned

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## Panel Findings:

The panel should meet as a single review panel at the same time. Composition of the panel is critical to ensure fairness. Early identification of a panel chair and review members is important.

At least two weeks is necessary for panel members to prepare questions for each mission team.

An entire panel day free of presentations is needed for the panel to complete its business.

Lead project scientist or principle investigator is needed to eliminate confusion during the presentation sessions. Their presence should be required.

NRESS staff did an excellent job in supporting the panel.

Proposals should address why operations can not be reduced in preference to science.