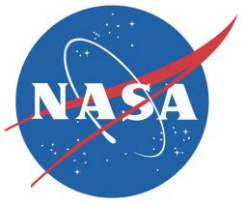

National Aeronautics and
Space Administration

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October 10, 2014

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

# FP20

# PLANETARY MISSIONS PROGRAM PLAN

## *With Change 1 (12/18/2015)*

**October 10, 2014**

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# 1.0 PROGRAM OVERVIEW

## 1.1 INTRODUCTION

In 2014, the Science Mission Directorate (SMD) directed the consolidation of management of missions from Discovery and New Frontiers, and the Solar System Exploration Program (SSEP) into a single management structure. The purpose is to streamline documentation and to ensure that the proven and successful management practices of Discovery and New Frontiers are applied to all assigned planetary missions. This Planetary Missions Program Plan integrates planetary activities authorized by multiple Program Commitment Agreements (PCAs) into a common management system. In this management approach, the individual PCAs remain separate. The program office resides at the Marshall Space Flight Center (MSFC).

The programs are comprised of a series of space science missions that are independent and uncoupled, but share a common management structure. The missions are selected through a competitive process such as an Announcement of Opportunity (AO), or assigned directly to a center by SMD through a project Formulation Authorization Document (FAD). The Programs includes the following three types of projects:

**AO-Selected Missions** – These Principal Investigator (PI)-led missions are complete, self-standing, and uncoupled SMD investigations competed through an AO.

**Directed Missions** – These missions are complete, self-standing, and uncoupled SMD investigations that are assigned directly to a center or implementing organization by the Mission Directorate. Projects assigned directly to a center are typically led by a Project Manager.

**Missions of Opportunity (MO)** – Historically PI-led, these projects are an element (instrument or other hardware contribution) of another mission. MOs are conducted on a no-exchange-of-funds basis with the organization sponsoring the full mission. NASA typically solicits proposals for MOs through the Stand Alone Mission of Opportunity Notice (SALMON) AO process.

Program level requirements for each project are approved by SMD at the time of project confirmation, prior to the start of project implementation. The missions approved for implementation are listed in Appendix F.

## 1.2 GOALS AND OBJECTIVES

NASA's 2014 strategic plan outlines the following science goals for the Agency:

• Expand the frontiers of knowledge, capability, and opportunity in space
• Advance our understanding of our home planet and improve the quality of life on our home planet

NASA's strategic objective in planetary science is to ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere. This goal is pursued by seeking answers to the following fundamental science questions that guide NASA's exploration of the solar system:

- How did our solar system form and evolve?
- Is there life beyond Earth?
- What are the hazards to life on Earth?

The Planetary Science Division has translated these important questions into science goals that guide the focus of the division's science and research activities:

- Explore and observe the objects in the solar system to understand how they formed and evolve
- Advance the understanding of how the chemical and physical processes in our solar system operate, interact and evolve
- Explore and find locations where life could have existed or could exist today.
- Improve our understanding of the origin and evolution of life on Earth to guide our search for life elsewhere
- Identify and characterize objects in the solar system that pose threats to Earth, or offer resources for human exploration

In selecting new missions for development, NASA's Planetary Science Division strives for balance across mission destinations, using different mission types and sizes. Achievement of steady scientific progress requires a commitment to mission success and a steady cadence of missions to multiple locations. Planetary programs strive for a consistent progression of mission types and capabilities, from small and focused, to large and multifaceted, as investigations progress.

## 1.3 PROGRAM ARCHITECTURE

This plan establishes an overall architecture for implementation of Discovery, New Frontiers, and Solar System Exploration Programs. Under this architecture, each project is independent, but shares a common management structure. Each project operates independently in achieving its unique set of mission scientific objectives. NASA Procedural Requirement (NPR) 7120.5 applies to all NASA space flight programs and projects and ground systems that are in direct support of space flight operations. All projects comply with all laws and regulations regarding export control and the transfer of sensitive proprietary technologies.

Uncoupled programs do not drive requirements for the use of specific systems other than common items such as the Planetary Data System (PDS), Deep Space Network (DSN), Astromaterials Curatorial Facility, or Expendable Launch Vehicles (ELVs).

Science, mission, schedule, and cost requirements are documented for each project in the program in the applicable Program Level Requirements Appendix (PLRA), which are listed in this program plan.

### 1.3.1 RELATIONSHIP TO OTHER NASA ORGANIZATIONS

The following NASA-managed programs and services are utilized. Other organizations may be identified to meet the needs of future projects and missions.

**Launch Services**

Missions are typically launched as a primary payload on an ELV. Each AO or project FAD describes the class or target launch vehicle appropriate for the mission. On a case by case basis, other arrangements may be made for the acquisition and management of launch services.

The Launch Services Program (LSP) is responsible for the acquisition and management of ELV launch services, and resides at the Kennedy Space Center.

**Space Communications**

Spacecraft operating in deep space use Space Communication for navigation, tracking, control, and/or communication services. Use of NASA's Near-Earth Network, Space Network, or DSN may be proposed as appropriate for missions. The Space Communications and Navigation (SCaN) Office serves as the program office for all of NASA's space communications activities.

**Planetary Protection**

All projects comply with NASA's planetary protection policies, as implemented by the Planetary Protection Officer (PPO) at NASA Headquarters.

The PPO monitors the planetary protection related activities and development of required documentation by individual missions and approves the final products.

Projects comply with the NASA Procedural Requirements (NPR) 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions. The PPO is responsible for certifying to the SMD Associate Administrator (AA), prior to the launch of a planetary mission, that all planetary protection requirements have been met.

**Office of Evaluation – Independent Program Assessment Office**

The program maintains a relationship with the Office of Evaluation (OE) Independent Program Assessment Office (IPAO). IPAO provides for the independent review of the Agency's programs and select projects at key decision points in the life-cycle to support approval decisions in accordance with 7120.5 and the relevant portions of the Standing Review Board (SRB) Handbook.

**Science Office for Mission Assessments**

Missions are typically selected through a competitive process such as an AO. As requested, the Langley Research Center (LaRC) Science Office for Mission Assessments (SOMA) assists SMD

with the preparation and issuance of AOs, supports the evaluation of proposals, leads special studies, and conducts independent assessments and reviews.

**Radioisotope Power Systems**

Radioisotope Power Systems (RPS) and small radioactive devices, such as Radioisotope Heater Units (RHU) or radioactive sources for science instruments, are permitted on missions in order to operate in some of the most extreme environments in the solar system. Glenn Research Center (GRC) provides missions with required radioisotope power systems as Government Furnished Equipment (GFE) through the Radioisotope Power Systems Program Office at GRC.

**Curation**

Returned spacecraft hardware and extraterrestrial materials are limited national resources, and are released only for approved applications in research, engineering development, and public display. NASA is responsible for maintaining sample(s) not provided to the mission science team or international partners. The NASA Astromaterials Curatorial Facility, located at NASA's Johnson Space Center (JSC), provides curation for any samples of extraterrestrial materials and space-exposed hardware returned by missions. Investigation teams are responsible for all aspects of the delivery and archival of such materials to this facility, including initial funding. This facility is responsible for providing for the physical security, inventory accountability, environmental preservation, and distribution of the samples in support of scientific research programs organized around each mission, including sample processing in support of the mission science team. Additionally, the spacecraft hardware may be valuable to validate or assess future heritage claims.

**Planetary Data System**

Missions typically utilize the Planetary Data System (PDS) to archive, and disseminate data to the scientific community. PDS is provided by the Headquarters (HQ) Planetary Science Research and Analysis Program. PDS Project Management is assigned to the Solar System Exploration Data Services Office at the Goddard Space Flight Center.

### 1.3.2 RELATIONSHIP TO EXTERNAL ORGANIZATIONS

Individual projects may establish external agreements with other U.S. agencies, foreign entities, industry, and academia. These external agreements are generated and negotiated when necessary, and approved by the Program Office and NASA Headquarters, and referenced in the PLRA to the Planetary Missions Program Plan. Each mission complies with the requirements of NPR 2190.1, NASA Export Control Program (see 3.18).

**Department of Energy**

Individual projects may utilize radioisotope-based sources of electrical power requiring a substantial quantity of nuclear material, such as Radioisotope Thermoelectric Generators (RTGs), or smaller radioactive sources such as Radioisotope Heater Units (RHUs) or radioactive

material sources for science instruments. If radioisotope power sources or heating units are proposed for a mission, the radioactive sources are provided by NASA as GFE from the Department of Energy (DOE) through the Radioisotope Power Systems (RPS) Program Office at GRC.

The relationship between NASA and the DOE is documented in a Memorandum of Understanding (MOU). The Mission Program Executive at NASA HQ is responsible for establishing a relationship with the DOE and working any supplemental agreements with the RPS Program.

**Industry and Academia**

Individual projects may establish contracts or agreements with industry and academia. These contracts/agreements typically address spacecraft development/operations, instrument development/operations, key personnel, and/or data analysis. Any agreement or contract which is central to achieving the mission is referenced in the PLRA to the Planetary Missions Program Plan.

## 1.4 STAKEHOLDER DEFINITION

SMD is the overall sponsor of the programs. The primary stakeholders are the planetary scientists within the space science community actively involved in research. Other stakeholders may also include elements of NASA Mission Directorates outside of SMD.

Stakeholder advocacy is achieved through interactions between SMD and the science community. These interactions involve NASA SMD scientific advisory committees, scientific conferences and meetings, and day-to-day contacts by program scientists resident at HQ. Each mission has a PI or Project Scientist who provides the primary science community interface for that specific project. Communication between the Program Manager at MSFC and the science community is typically through the selected PIs or Project Scientists, the Lead Program Scientists, and Mission Program Scientists; often at advisory committee events, AO pre-proposal conferences, scientific meetings, and periodic workshops.

Program Office advocacy within the Science Mission Directorate is achieved through reporting and interaction with the Program Director (PD), Mission and Lead Program Executives (PE), and Mission and Lead Program Scientists (PS).

## 1.5 PROGRAM AUTHORITY, MANAGEMENT APPROACH, AND GOVERNANCE STRUCTURE

Roles and responsibilities of the key program participants are covered in NPR 7120.5, and are further detailed in the Science Mission Directorate Management Handbook. This section serves to summarize, clarify, or supplement the above documents and to provide details of the governance structure. Additionally, Appendix E allocates program management functional roles and responsibilities of the program office and HQ.

### 1.5.1 PLANETARY MISSIONS PROGRAM AUTHORITY

The Agency Program Management Council (APMC) is the governing PMC for programs assigned to the Planetary Missions Program Office. The APMC or Science Mission Directorate PMC (DPMC), depending on mission classification, governs the management of the individual projects within the programs. The program management structure consists of three principal levels of authority:

1. Scientific and strategic management within SMD;
2. Program management within Planetary Science Division (PSD) and at MSFC (program implementation);
3. Management of individual missions by their respective PI-led or Project Manager-led project teams.

The SMD AA is responsible for providing strategic stewardship for the Agency's Science Mission and the programs and projects that implement it.

The Program Director directs the activities of the Program Manager, Lead and Mission Program Executives, and Lead and Mission Program Scientists, as delegated from the SMD AA through the Planetary Science Division Director.

In general, SMD Program Executives, Program Scientists, and Program Analysts (PA) work as a management team for project-level activities. The Program Executive handles management of programmatic matters, while the Program Scientist handles scientific matters. The Program Analyst is responsible for associated resource management activity.

In the Discovery and New Frontiers Programs, the Planetary Science Division has identified Lead Program Executives and Lead Program Scientists to help manage program-level activities. For example, in both Discovery and New Frontiers, the Lead Program Scientist is responsible for managing the acquisition process for AO-selected missions.

Program Management responsibility for implementation has been assigned to the Planetary Missions Program Office, located at MSFC. Program authority is delegated from the SMD AA, through the PSD Director, to the PSD Program Director, and then to the Program Manager at MSFC. The Program Manager performs the responsibilities contained in NPR 7120.5, NASA Space Flight Program and Project Management Requirements. The Program Manager at MSFC serves as the single point of contact for each program. MSFC staffs and manages the Program Office in accordance with the applicable sections of Marshall Procedural Requirements (MPR) 7120.1, MSFC Engineering and Program/Project Management Requirements.

Management authority and leadership for each mission is assigned to the respective PI (for AO-selected missions) or to the Project Manager (for directed missions). As mission lead, the PI or the Project Manager has responsibility for the overall success and safety of the mission and is accountable to the Program Manager for the programmatic success. The PI (or Project Scientist in the case of a Project Manager-led mission) is accountable to the SMD AA for scientific success.

To ensure an unambiguous line of direction and reporting within these levels, all formal direction from Headquarters to MSFC flows from the Program Director to the Program Manager. Similarly, to ensure an unambiguous line of direction and reporting with individual missions, all formal direction from the Program to the Project flows from the Program Manager to the PI or Project Manager.

**Note:** NASA supports the full and open airing of issues of any nature (e.g., programmatic, institutional) including alternative and divergent views. Diverse views are respected in an environment of integrity and trust with no suppression or retribution. In the team environment in which NASA operates, team members often need to determine where they stand on a decision. In assessing a decision or action, a member has three choices: agree, disagree but be willing to fully support the decision, or disagree and raise a Dissenting Opinion. For disagreements that rise to the level of importance that warrant a specific review and decision by a higher level of management, NASA has formalized the Dissenting Opinion process in NASA Policy Directive (NPD) 1000.0, NASA Governance and Strategic Management Handbook.

Figure 1 illustrates the program management structure, including the relationships between the key program participants.

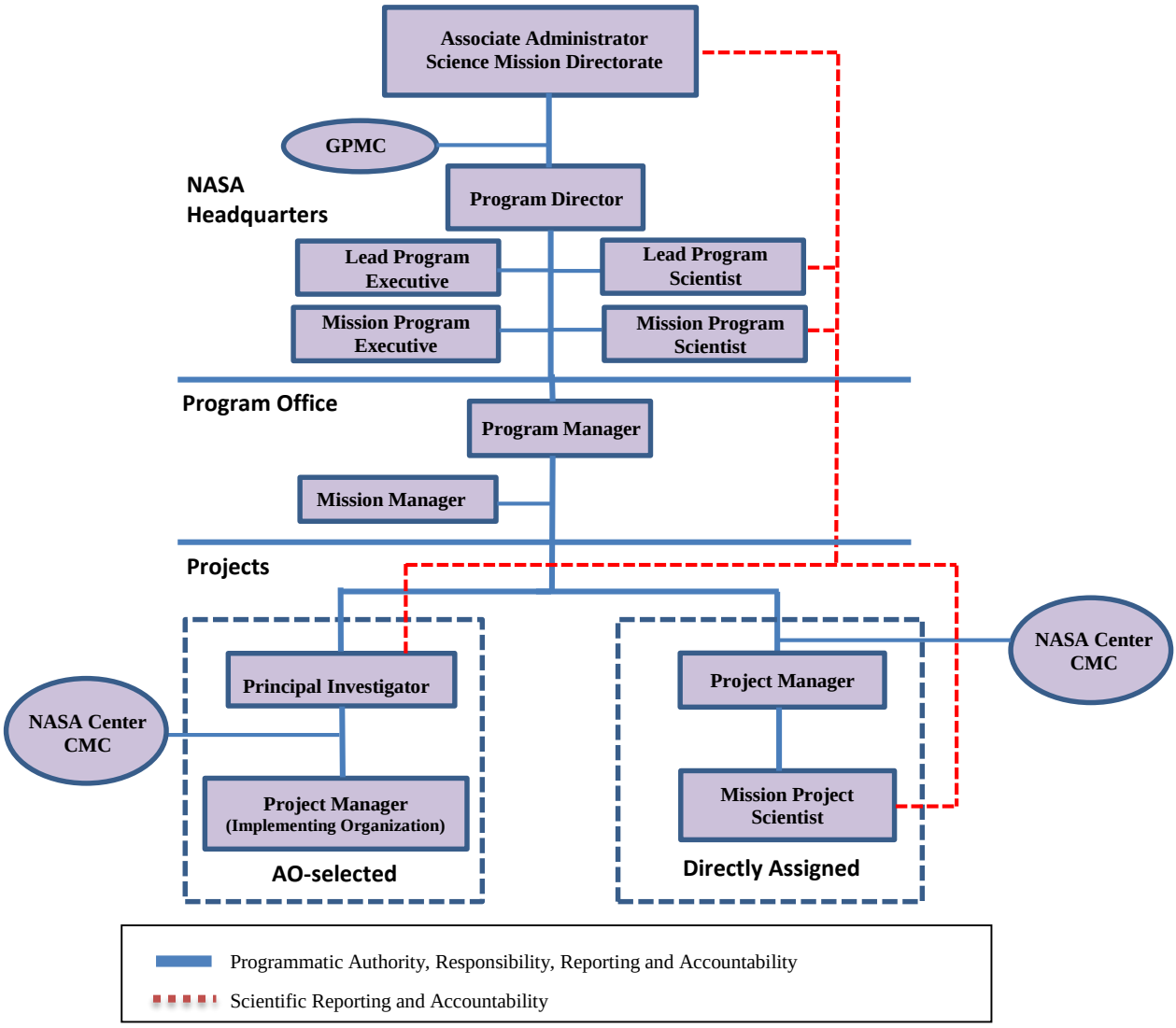


**FIGURE 1. PLANETARY MISSIONS PROGRAM ORGANIZATION**

Projects that are AO-selected are PI-led with Project Manager support at the implementing organization. Projects assigned directly to the center by SMD are Project Manager-led.

The Planetary Missions Program Office location in the MSFC institutional organization is illustrated in Figure 2.

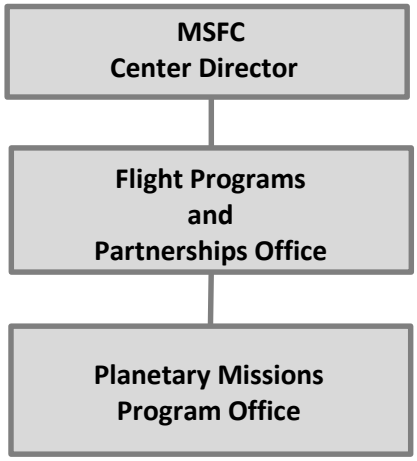


**FIGURE 2.** Planetary Missions Program Office at MSFC

The roles and responsibilities of the key participants in the programs are defined in the following sections.

### 1.5.2 SCIENCE MISSION DIRECTORATE ROLES AND RESPONSIBILITIES

The Science Mission Directorate within NASA HQ has the responsibility for the scientific and strategic direction of the Discovery, New Frontiers, and Solar System Exploration Programs. The NASA AA has final authority and responsibility for each program.

**Program Director**

The Program Director in NASA's Science Mission Directorate is the senior official with focused responsibility for the program. The Program Director is located in the Planetary Science Division of SMD. The roles and responsibilities include but are not limited to:

- Establish program and project budgets and requirements consistent with division allocations;
- Submit technology needs into SMD Technology Programs; and
- Assess total Program-level cost, schedule, technical performance, and risk.

**Lead Program Executive**

For the Discovery and New Frontiers Programs, the Planetary Science Division has identified a Lead Program Executive and a Lead Program Scientist to help manage Program-level activities.

The Lead Program Executive at NASA HQ reports directly to the Program Director. The Lead PE's roles and responsibilities are derived from the PE roles in the NASA Headquarters Science Mission Directorate Management Handbook. These include, but are not limited to:

- Maintain the PCAs;
- Track Directorate-initiated studies to define new missions and determine their feasibility and desirability;
- Assist the Program Director with development and maintenance of the Program budget through interaction with SMD and Program Office Resource Analysts;
- Assist the Lead PS in assembly and release of AOs and supporting documentation;
- Recommend program launch vehicle and technology needs through the Program Director in SMD launch support and technology development processes;
- Maintain cognizance of the program's health, principally through standard periodic status reports and major milestone reviews;
- Assess program performance and provide recommendations to the Program Director;
- Support the Program Manager on division policy matters, and interface with HQ functional offices;
- Coordinate Program issues with other SMD divisions and with HQ Functional offices; and
- Ensure consistency across program mission documentation (PLRAs etc...).

**Mission Program Executive**

The Mission Program Executives at NASA HQ supports the SMD AA and the Program Director in defining, integrating, and assessing the activities of missions. The Mission PE's roles and responsibilities are discussed in detail in the NASA Headquarters Science Mission Directorate Management Handbook. These include, but are not limited to:

- Write the FAD for new projects, and negotiate approval;
- Maintain cognizance of the project's programmatic health via regular contact with the Program Office Mission Manager (MM) and the project during implementation, principally through standard periodic status reports and major milestone reviews, access to assessments coordinated by the Program Office, and ad hoc interactions, as required;
- Facilitate the negotiation of content for agreements with external and international organizations;
- Facilitate the negotiation of content for agreements with other U.S. agencies and organizations;

- In collaboration with the Mission PS, Program Office MM, and PI or Project Scientist, finalize development of the mission PLRA and prepare it for formal negotiation and final agreement;
- Participate in annual budget submission reviews with Program Office and makes recommendations;
- Assess project technical, schedule, and cost performance and provide course correction recommendations to the Program Director and directorate management;
- Recommend chair, membership, and the Terms of Reference (ToR) for Standing Review Board independent reviews, if required;
- Prepare launch approval documentation (National Environmental Policy Act (NEPA) materials, contingency plan, approval letters, etc.);
- Resolve project issues through the Program Office;
- Coordinate project issues with other involved SMD divisions and with HQ Functional offices (i.e. legal, launch vehicle Representative, Export Control, etc.); and
- For assigned mission(s), serve as primary interface between PSD and the Program Office through the MM.

**Lead Program Scientist**

The Lead Program Scientist at NASA Headquarters reports directly to the Program Director. The Lead Program Scientist's roles and responsibilities include, but are not limited to:

- Manage the science selection process, including definition, timing, preparation, and issuance of AOs; pre-proposal conferences; scientific and technical reviews of submitted proposals; and preparation for selection of investigations;
- Assembly and release of AOs and supporting documentation (assisted by the Lead PE and SOMA);
- Manage the selection process, including Concept Study Kickoff, scientific and technical reviews, and preparation for down select of investigations;
- Develop the scientific strategy, goals, and objectives for the Program;
- Serve as the primary science spokesperson for the Program and the primary interface with customers, stakeholders, and external elements for scientific objectives and accomplishments;
- Charter program science working groups as required;
- Form and guide Science and Technology Definition Teams or Science Definition Teams, as required;
- Assist the Lead PE in development of the program budget; and

- Maintain cognizance of science objectives and performance for completed missions.

**Mission Program Scientist**

The Mission Program Scientists at NASA HQ are responsible to the SMD AA and the Program Director for the scientific integrity of specific assigned missions and for maximizing mission science return within Program constraints. The Mission Program Scientist's roles and responsibilities are discussed in detail in the NASA Headquarters Science Mission Directorate Management Handbook. These include, but are not limited to:

- Collaborate with the Lead Program Scientist (for Discovery and New Frontiers), Program Executive, Program Office, and the PI or Project Scientist on the generation of the mission PLRA, particularly the Level 1 Requirements;
- Maintain regular contact with the Mission PI or Project Scientist;
- Generate the solicitation for any mission participating scientists or guest investigators beyond the PI team, and manage the proposal review process leading to selection;
- Assess project status against top-level (Level 1) science requirements & mission success criteria;
- Monitor the impact of proposed mission changes on the Level 1 Requirements;
- Monitor and provide regular reports to NASA on science-related issues;
- Provide regular updates to NASA and the broad community on mission science results;
- Work with the Mission PI or Project Scientist to document completion of mission science results against the PLRA; and
- Manage Co-Investigator selection and change process.

### 1.5.3 PROGRAM LEVEL ROLES AND RESPONSIBILITIES

The Planetary Missions Program Office at MSFC implements the programs on behalf of SMD and under the guidance or direction of the Program Director.

**Program Manager**

The Program Manager (PM) has responsibility for planning and implementation of the program consistent with top-level policies, strategies, requirements, and funding established by NASA HQ. The Program Manager has programmatic management responsibility for mission project formulation, development, launch, on-orbit checkout, mission operations, and data analysis. The Program Manager is responsible for ensuring that the projects adhere to committed cost, schedule, and technical performance; reliability and safety requirements.

The Program Manager is certified in compliance with the Office of Management and Budget (OMB) Federal acquisition program/project management certification requirements.

The Program Manager's roles and responsibilities are detailed in the NASA Headquarters Science Mission Directorate Management Handbook. These include, but are not limited to:

- Support NASA HQ in conducting mission studies to develop mission concepts and determine feasibility;
- Support and conduct program-level concept studies with direction and guidance from the Program Director;
- Support NASA HQ in new project start approval activities and concur in the appointment of project managers;
- Support NASA HQ in the preparation of domestic and/or foreign agreements;
- Monitor and direct the projects within each program;
- Ensure open communication with program customers and communicate program customer needs to SMD;
- Develop and manage program-level metrics to assess the performance and health of the program;
- Maintain the Planetary Missions Program Plan in accordance with NPR 7120.5;
- Independently evaluate and assess program and project technical, schedule, and cost performance, and take action, as appropriate, to mitigate risks;
- Provide program technical experts, as required;
- Assist the Program Director in management of the Program mission implementation budget, develop detailed Program Planning Budget Execution (PPBE) Plans and Operating Plans for the implementation budget;
- Assess the program for liens and threats, and communicate potential impacts to the Program Director;
- Assign a Program Office Mission Manager to each mission;
- Disposition mission flight and ground hardware;
- Assess program and project readiness to progress to the next phase of the life cycle;
- Support SMD in the initiation and preparation of AOs; and
- Plan, coordinate, and implement education and communication programs for the program, consistent with current policy.

**Program Chief Engineer**

The Program Chief Engineer (CE) is the Engineering Technical Authority (ETA) for the program. The Program CE, in partnership with the Program Manager, ensures an atmosphere of technical "checks and balances" within the program and projects. Paramount criteria for carrying out this duty include a sufficiently detailed understanding of the system and an in-depth

knowledge of the technical work to make sound, responsible technical decisions to determine whether the appropriate technical requirements have been applied to the program/project and to ensure that the upper level requirements are properly flowed down.

For projects assigned to NASA centers and Jet Propulsion Laboratory (JPL), the ETA for these projects is delegated from the NASA Office of the Chief Engineer through the Center Director to engineering management at that center.

For projects assigned to non-NASA centers, the ETA is delegated through the MSFC Center Director and Engineering Director to the Program CE. For these projects, the Program CE serves as the ETA for all program/project milestone reviews. While the CE has the overall responsibility for ensuring that appropriate specifications and standards have been imposed on the programs/projects, they seek advice from the experts in Engineering and Safety and Mission Assurance (SMA) to determine the appropriate specifications and standards requirements to ensure success. In addition, as the ETA, the CE ensures that application of requirements matches the needs of the program/project for success and affordability.

The Program CE responsibilities include, but are not limited to:

- Work with implementing organization to ensure that the quality and integrity of program or project processes, products, and standards of performance related to engineering reflect the level of excellence expected by the implementing organization or, where appropriate, by the NASA TA community;
- Monitor project execution and issue resolution;
- Serve as a member of a project or program technical review team, such as milestone peer reviews, as appropriate;
- Identify and utilize technical expertise from across NASA, industry, independent experts, and academia to support risk-based insight and resolve technical issues;
- For projects assigned to NASA Centers and JPL, work to seek resolution of identified issues. If resolution of an issue is not successful at lower levels, the issue is communicated to the next level of Center or Agency technical authority; and
- For projects assigned to non-NASA Centers, the Program CE retains technical authority while working closely with the project engineering organization to delegate an appropriate level of insight responsibility to the non-NASA center's engineering authority. Any issues that are identified are resolved at the lowest appropriate level of authority.

**Mission Managers**

Program Office Mission Managers function as the Program Manager's day-to-day point of contact and oversight for all assigned projects, performing technical and programmatic management functions on behalf of the Program Manager, ensuring the Program Manager

maintains an awareness of the project status and that the programmatic needs of the assigned projects are being adequately addressed. The Mission Manager's responsibilities include:

- Serve as NASA Point Of Contact (POC) for assigned projects within the program;
- Interface directly with the PIs, Project Managers, PEs and PSs to develop inputs for program planning and integration, or to resolve project issues;
- Establish and perform technical and resource management oversight of mission contracts and task orders;
- Perform independent evaluation of project metrics, schedule, cost data, management, and issues for the Program Manager;
- Provide Mission Program Executive with recommendations for chair, membership, and the Terms of Reference (ToR) for Standing Review Board independent reviews, if required;
- Perform independent assessments of projects to identify risks and corresponding mitigations, as needed;
- Perform independent assessments of project liens and threats, especially those that could result in total mission cost cap breaches;
- Coordinate project funding requirements;
- Provide a monthly project assessment to the Mission Program Executive;
- Serve as the Program Office representative between NASA, other U.S. government agencies, and foreign participants on behalf of assigned missions;
- Ensure that appropriate program resources are provided to the projects in a timely manner;
- Serve as the Program Office advocate to NASA management, the public, and other government entities for assigned projects; and
- Lead the development of decision packages or products that are fully coordinated within the Program and with the PIs and Project Managers.

**Program Safety and Mission Assurance**

At MSFC, the Program Chief Safety and Mission Assurance Officer (CSO) functions as the focal point for program activities. The CSO executes the SMA Technical Authority (TA) through delegation from the MSFC SMA Director. The CSO has overall responsibility for assuring that appropriate specifications and standards have been integrated and adopted by the program, and ensures an atmosphere of technical "checks and balances" is maintained. The CSO relies on systems experts and discipline experts residing within the agency-wide institutional SMA organization (and elsewhere) to determine that the requirements and their associated standards are appropriate to assure safe flight.

For projects assigned to NASA centers and JPL, the SMA TA is delegated from the NASA Office of Safety and Mission Assurance through the Center Director to the SMA group at that center. For projects assigned to non-NASA centers, the SMA TA is delegated through the MSFC Center Director and SMA Director to the Program CSO.

The MSFC SMA organization provides the Program SMA Lead to ensure the CSO has timely access to program information, impending decisions, and analysis or verification results The Program SMA Lead responsibilities include, but are not limited to:

- Work with implementing organization to ensure that the quality and integrity of program or project processes, products, and standards of performance related to SMA reflect the level of excellence expected by the implementing organization or, where appropriate, by the NASA TA community;
- Coordinate the day-to-day SMA activities of the program office;
- Monitor project execution and SMA issue resolution;
- Serve as a member of a project or program technical review team, such as milestone peer reviews, as appropriate;
- For projects assigned to NASA Centers and JPL, work to seek resolution of identified issues. If resolution of an issue is not successful at lower levels, the issue is communicated to the next level of Center or Agency SMA TA; and
- For projects assigned to non-NASA Centers, the Program CSO retains TA, and along with the Program SMA Lead works closely with the project SMA organization to delegate an appropriate level of insight responsibility to the non-NASA center's SMA authority. Any issues that are identified are resolved at the lowest appropriate level of authority.

### 1.5.4 PROJECT LEVEL ROLES AND RESPONSIBILITIES

PI-led missions are supported by a Project Manager at the implementing organization. Project Manager-led Missions (with Project Scientist support) are assigned directly to a center by SMD.

Overall responsibility for scientific integrity and mission success is vested with either the PI or Project Manager (PI for AO-selected missions, Project Manager for directed missions) for each mission. The PI or Project Manager organizes a team to develop the mission concept and implements the mission under the prescribed guidelines and constraints. The PI or Project Manager chooses the management approach best suited to the mission design, skills/expertise of the team members and resources. The approach and allocated responsibilities are further documented in the Project Plan.

It is in the best interest of the Program, and the scientific community in general, for less experienced scientists to gain experience through this program. Therefore, PIs and Project Managers are encouraged to include a mix of experienced and less experienced members in their teams, as long as the key decision-making roles are filled with experienced team members.

NASA holds the mission lead (PI or Project Manager) accountable for proper execution of all aspects of the mission, particularly as outlined in the mission's original AO or FAD, accepted Concept Study Report (CSR) or Formulation Agreement (FA), and mission PLRA. It is incumbent upon the PI or Project Manager in any management arrangement to notify the Program Manager if the successful achievement of the threshold scientific objectives is not possible within the prescribed programmatic constraints.

If key personnel or teaming arrangements are to be changed, the project or implementing organization sends written notification to the Program Office. Proposed changes are subject to review and approval by the Program Manager and Program Director. (Key personnel are identified in the CSR, FA, PLRA or Project Plan.) In addition, the SMD AA has final approval for PI, Deputy PI, Project Scientist, and Project Manager changes.

**Project Manager (Directly Assigned Missions)**

For projects with a life-cycle cost greater than $250 million, Project Managers are certified in compliance with the OMB's Federal acquisition program/project management certification requirements. For a directly assigned mission, Project Manager responsibilities include, but are not limited to:

- Lead pre-project or project team in early trades and analysis for designing an optimal science mission;
- Design an assigned mission;
- Plan, develop, and execute a mission to achieve its scientific requirements, within prescribed guidelines and constraints as defined in the PLRA and Project Plan;
- Represent the Project to NASA, other government agencies, industry, and institutions as required on matters pertaining to the mission. Support NASA in performing program advocacy;
- Request NASA concurrence on key personnel changes;
- Document status of Level 1 requirements, particularly mission science requirements, at end of mission;
- Develop project-level implementation plans, schedules, and budgets in accordance with Program requirements, project objectives and constraints, and with other applicable NASA policies;
- Communicate urgent/significant design, test, or operational anomalies to the Program Office;
- Support independent assessments and confirmation reviews;
- Manage the mission budget, identify and report liens and threats, develop PPBE submittals and traces;
- Provide input, review, and concurrence for the Project Budget Report (PBR);

- Provide input, review, and concurrence for the OMB quarterly financial reports as required;
- Implement an SMA program for the mission;
- Develop and implement a risk management process throughout the mission life cycle;
- Assess and report project risks to the program;
- Develop and maintain the mission Project Plan in accordance with NPR 7120.5; and
- Develop and implement education and communication activities for the mission, in coordination with program guidance and in accordance with current policies.

**Mission Project Scientist**

For directly assigned missions, the Mission Project Scientist, functions as a Project Manager's science advocate for each mission ensuring the Project Manager maintains an awareness of the science status and that the science objectives are being adequately addressed throughout the project lifecycle. SMD's science interface with the Mission Project Scientist is the Mission Program Scientist (see Figure 1 above). The Mission Project Scientist responsibilities include, but are not limited to:

- Serve as a scientific spokesperson for the mission and for the scientific investigations;
- Ensure timely archiving of mission data in the appropriate science data archive, typically NASA's Planetary Data System;
- Assure dissemination of scientific results through professional publications and education and communication, in coordination with program guidance; and
- Inform the Mission Program Scientist of status, changes, or results in the mission science.

**Principal Investigator**

For PI-led missions, the PI is also the lead scientist on the project. The PI is supported by the mission Project Manager at the implementing organization. PI responsibilities include, but are not limited to:

- Serve as a scientific spokesperson for the mission and for the scientific investigations;
- Assure dissemination of scientific results through professional publications and education and communication activities, in coordination with education and communication program guidance;
- Inform the Mission Program Scientist of status, changes, or results in the mission science;
- Represent the project to NASA, other government agencies, industry, and institutions as required on matters pertaining to the mission. Support NASA in performing program advocacy;

- Ensure timely archiving of mission data in the appropriate science data archive, typically NASA's Planetary Data System;
- Document status of Level 1 requirements, particularly mission science requirements, at end of mission;
- Develop and maintain the mission Project Plan in accordance with NPR 7120.5;
- Plan, develop, and execute a mission to achieve its scientific requirements, within prescribed guidelines and constraints as defined in the PLRA and Project Plan;
- Request NASA concurrence on key personnel changes occurring after KDP B;
- Develop project-level implementation plans, schedules, and budgets in accordance with Program requirements, project objectives and constraints, and with other applicable NASA policies;
- Manage the mission budget, identify and report liens and threats, develop Planning, Programming, Budgeting, and Execution (PPBE) submittals and traces;
- Provide input, review, and concurrence for the PBR;
- Provide input, review, and concurrence for the OMB quarterly financial reports as required;
- Communicate urgent/significant design, test, or operational anomalies or changes to the Program Office;
- Ensure that the mission as-built can meet the mission success criteria as documented in the PLRA;
- Support independent assessments and confirmation reviews;
- Implement an SMA program for the mission;
- Develop and implement a risk management process throughout the mission life cycle;
- Assess and report project risks to the program; and
- Develop and implement education and communication activities for the mission, in coordination with program guidance and in accordance with current policies.

**Project Manager (PI-led Missions)**

For AO-selected missions, Project Managers are appointed by the implementing organizations with PI concurrence. Each Project Manager is responsible to the PI for the successful development and implementation of the mission. They report to their institutional management and programmatically to the Program Manager. For projects with a life-cycle cost greater than $250 million, Project Managers are certified in compliance with the OMB's Federal acquisition program/project management certification requirements.

The Program Office establishes an interface directly to the mission Project Manager at the implementing organization. This organization may be either a government organization or

another type of institution depending on the particular mission. The Program Office works directly with the Project Manager in accomplishing the mission, particularly in the areas of resource allocation and utilization, oversight, reporting, and resolution of project issues.

## 1.6 IMPLEMENTATION APPROACH

The Program Office implements uncoupled programs. SMD has established a strategy that contracts for whole missions (concept through delivery of the science data and analysis). Investigations may be assigned directly to a center by SMD or selected through the AO process.

For directly assigned missions, a project Formulation Authorization Document (FAD) is prepared by SMD. It authorizes a project manager to initiate the planning of a new project and to perform the analysis of alternatives required to formulate a sound Formulation Agreement (FA) and subsequent Project Plan and contains requirements, schedules, and project funding requirements. Projects with an estimated life-cycle cost greater than $250 million provide a range of cost and a range for schedule at KDP B, each range (with confidence levels identified for the low and high values of the range) established by a probabilistic analysis and based on identified resources and associated uncertainties by fiscal year. The Formulation Agreement is prepared by the project in response to the FAD to establish the technical and acquisition work that needs to be conducted during Formulation and defines the schedule and funding requirements during Phase A and Phase B.

For AO-selected projects, the AO serves as the FAD and the CSR serves as the FA for the competitive Phase A. For most AOs, multiple proposers are selected for competitive Phase A activities. Once downselected for Phase B, projects immediately begin Formulation activities.

In some cases, an AO mission may be selected for an extended Phase A (for example, if a specific technology requires maturation), with the parameters of the extension defined by the SMD AA. When this happens, the project subsequently utilizes the KDP B review process for a directly assigned mission.

Confirmation is the SMD process for approval of projects to transition from Formulation to Implementation phase. A Confirmation Review (CR) with the Governing Program Management Council (GPMC) is held soon after the Preliminary Design Review (PDR) to determine whether to confirm the mission to enter implementation.

NASA gives the PI or Project Manager and the team the ability to use their management processes, procedures, and methods to the fullest extent practical. As a result, the management approach (compliant with NPR 7120.5) is best suited for their particular teaming arrangement commensurate with the investigation's implementation approach, while retaining a simple and effective management structure that assures adequate control of development within the cost and schedule constraints. The investigation team develops a Work Breakdown Structure (WBS) based on the standard elements to Level 2 in the NASA Space Flight Program and Project Management Handbook, and then customizes the lower level WBS that best fits the organizational approach and mission design concept.

# 2.0 PROGRAM BASELINE

## 2.1 REQUIREMENTS BASELINE

Projects are competitively selected PI-led missions or directly assigned Project Manager-led missions, addressing planetary science themes. Mission requirements are documented in the AO or the FAD. The mission-specific requirements for each project are set forth in a PLRA to this document, and are approved by the PI or the Project Manager, the Program Manager, and SMD.

Program-level requirements specific to each project (science requirements, launch timeframe, total mission cost cap, and PI or Project Manager-managed mission cost cap) are documented in the mission-specific PLRA.

For each mission, Mission Success Criteria, Baseline Science Requirements, and Threshold Science Requirements are developed and documented in the PLRA. Mission Success Criteria are used to specify how the mission must perform in order to be successful. Baseline and threshold requirements flow down from the Mission Success Criteria.

Each mission-specific PLRA defines the baseline and the threshold science requirements according to the following definitions:

- Baseline Science Requirements – The mission performance requirements necessary to achieve the full science objectives of the mission.
- Threshold Science Requirements – The mission performance requirements necessary to achieve the minimum science acceptable for the investment. Threshold Science requirements are also referred to as the "science floor."

Projects include appropriate descope options from the baseline to the threshold science requirements in incremental fashion as delineated in the CSR or FA and Project Plan. These project descopes are a means for mitigating risks associated with cost-capped missions. The Project Plan includes potential descopes and the time frame in which they can be implemented.

- Any reduction in scientific capability that does not impact baseline requirements is implemented only after consultation with the Program Scientist.
- The Program Manager, Program Scientist, and Program Director concur on any descope that threatens the baseline requirements before the option is exercised.
- The SMD AA concurs on any descope option that threatens the threshold requirements.

All projects are cost-capped. The not-to-exceed mission cost cap is proposed during the formulation process in compliance with the AO or FAD. The cost cap may be adjusted during formulation at the mutual agreement of the project and SMD, and is formally determined and documented at project confirmation.

The PI or Project Manager-managed cost cap as documented at confirmation is also called the Management Agreement, and includes all project-held reserves. Each mission is required to show a reserve posture at the end of Phase B commensurate with the risk associated with the

implementation of the mission. Appropriate levels of reserve are usually specified in the AO or FAD.

The program may provide funds excluded from the PI or Project-Manager managed mission cost cap, to allow participation by the science and education community.

SMD strives to maintain a launch cadence as documented in the individual program PCAs.

Projects typically use a domestic, flight-proven launch vehicle. Each AO or FAD describes the launch vehicle details, appropriate options for access to space, and the approach for launch vehicle funding (within or outside the PI or Project Manager-managed mission cost cap).

Launch schedule requirements are identified in the AO or FAD, and are subsequently documented in the PLRA.

Performance of flight and ground elements is verified by the individual projects through a combination of analysis, inspection, demonstration, similarity, and test, with particular emphasis on incremental, integrated, and concurrent testing. The launch vehicle supplier is responsible for physical integration of the spacecraft with the launch vehicle, and for verifying the integrated system integrity. The project is responsible for the end-to-end flight/ground system performance verification. Verification by test, rather than analysis, is preferred.

Flight and ground software Independent Verification and Validation (IV&V) is accomplished in accordance with NPR 7150.2, NASA Software Engineering Requirements. Each mission develops a mission-unique Project Plan that defines the approach to the implementation of the project compliant with NPR 7120.5.

Projects in phases C and D with a life cycle cost estimated to be greater than $20 million and Phase E project modifications, enhancements, or upgrades with an estimated development cost greater than $20 million perform earned value management (EVM) with an EVM system that complies with the guidelines in ANSI/EIA-748, Standard for Earned Value Management Systems.

A review of the project's technical, cost, schedule, and risk baselines, including planned EVM processes and methodologies, is conducted as part of preparation for KDP C. This review, which may be included as part of the life cycle review, is to ensure that the project's work is properly integrated and systems are in place to monitor and evaluate project performance. A formal Project Integrated Baseline Review (IBR) is conducted early in Phase C. For contracts requiring EVM, an IBR is conducted within 180 days after contract award and prior to the Project IBR. The Project IBR is conducted by the Program Office.

Each project has an effective SMA program as required by NPD 8700.1, NASA Policy for Safety and Mission Success.

Projects assigned to non-NASA centers or institutions develop and submit a Project Safety and Mission Assurance Plan, which can be included in the Project Plan, for review that complies with PMP-RQMT-002, Planetary Programs Safety and Mission Assurance Guidelines and Requirements.

Projects provide final mission reports to the Program Office. The reports are due to the program prior to project close-out. Each report is described below:

**Mission Report**

At least 90 days before project close-out the PI or Project Manager sends a Mission Report (on the order of 15 pages) to the mission Program Scientist outlining how the mission accomplished the Level 1 requirements or why the Level 1 requirements were not achieved. The report includes a bibliography of papers published by the mission team as well as other information needed for contract close-out. The report is reviewed for completeness and accuracy by the mission Program Scientist. The mission Program Scientist determines if the data archiving requirements have been met or if a reasonable plan is in place. If the report and archiving progress are acceptable, the mission Program Scientist notifies the Program Office and the PI or Project Manager.

If a project is granted an extended mission after completion of its primary mission, an additional Mission Report is delivered within 90 days of completion of the extended mission documenting accomplishment of relevant extended mission Level 1 requirements.

**Mission Lessons Learned Report**

Prior to contract close-out, the Project provides a Mission Lessons Learned Report to the Program Office summarizing the technical performance of the spacecraft, science instruments, and project, and any lessons learned, through all phases of the project life cycle.

## 2.2 WBS BASELINE

The Program Office implements uncoupled programs and therefore is not required to implement a program level WBS baseline. The projects develop and implement a WBS structure to level 2 in accordance with section 5.9 of the NASA Space Flight Program and Project Management Handbook, "The Work Breakdown Structure and Relationship to Agency Financial Processes." The lower level WBS is tailored to the projects unique organizational approach and mission design concept schedule baseline.

## 2.3 SCHEDULE BASELINE

The Program Office maintains a summary program integrated schedule that contains major program and project milestones and events.

Each individual project develops and maintains an integrated master schedule, including all critical milestones, major events, and Agency and project-level reviews throughout the project life cycle. These schedules identify any interdependencies for the critical milestones and the project critical paths, and are tied to the resources required to meet the critical milestones.

## 2.4 RESOURCE BASELINE

Program resource and workforce levels adjust in accordance with the number of active missions, which in turn is based on program budget constraints. Program budgets are updated annually as

part of the NASA PPBE process. Project resource constraints and guidelines are initially provided by each AO or FAD, and are subsequently reviewed or updated as part of the PPBE process or KDP gate reviews.

EVM is not performed at the program level.

### 2.5 JOINT COST AND SCHEDULE CONFIDENCE LEVEL

Joint cost and schedule confidence levels (JCL) are not required to be developed for uncoupled programs.

At KDP C, the Agency makes project technical, cost, and schedule commitments to its external stakeholders at the established JCL in accordance with NPR 7120.5 requirements. Projects are planned and budgeted based on a 70 percent joint cost and schedule confidence level, or as approved by the Decision Authority.

Any JCL approved by the Decision Authority at less than 70 percent is justified and documented. For these projects, SMD funding is provided in accordance with the relevant Management Agreement. In each case, funding is equivalent to at least 50 percent JCL.

## 3.0 PROGRAM CONTROL PLANS

### 3.1 TECHNICAL, SCHEDULE, AND COST CONTROL PLAN

Each project complies with Program requirements through three processes: the selection/acquisition process, the mission requirement development process, and the mission project plan review and approval process.

**Selection/Acquisition - Competed Missions**

The selection of a competed mission is typically performed using an AO process. Each proposal is evaluated for compliance with the AO requirements along with science merit, science implementation merit, and technical, cost, and schedule feasibility. As a result of the AO evaluation, one or more missions are selected for continued concept formulation (Phase A Concept Study).

The product of the Phase A study is the Concept Study Report. The scientific, technical, management, cost, and other aspects of the Concept Study are assessed according to the criteria defined in the "Guidelines and Criteria for the Phase A Concept Study" document by a panel of individuals who are experts in each of the areas to be evaluated.

The Lead PS, supported by the Lead PE and the LaRC SOMA, manages the AO development, AO proposal evaluation, and CSR evaluation processes. The assessment of the Concept Study is similar to the initial proposal evaluation, but considers the increasingly detailed information provided. The Program Office typically follows the CSR evaluation process in order to gain insight into the issues discussed by the evaluation team and any unique mission risks that should be monitored if one or more mission is selected for implementation. After downselection to proceed into Phase B, SOMA briefs the Program Office on the new mission(s).

### Selection/Acquisition - Directed Missions

The assignment of directed missions is authorized by the SMD AA. Prior to initiating a new project, SMD, supported by the Program Office if requested, provides resources for concept studies. During Pre-Phase A, a pre-project team studies a broad range of mission concepts that contribute to program and Mission Directorate goals and objectives. These advance studies, along with interactions with customers and other potential stakeholders, help the team to identify promising mission concepts(s) and to draft project-level requirements. SMD uses the results of this work to determine if these mission concepts warrant continued development. If, at the end of pre-formulation, SMD determines the mission concepts warrant continued development, a project FAD is issued authorizing Formulation to begin. The project FAD describes the purpose of the project and the funding to be committed to the project during each year of Formulation. The project team supports the program manager and the SMD AA in the development of the preliminary project requirements. The project also supports the program manager and the SMD AA in ensuring alignment of the project requirements with the Program Plan and applicable Agency strategic goals.

### Requirement Development and Approval

Once a project is selected for Phase B formulation, the Program Office provides frequent formal and informal communication with the project to ensure continued compliance with program requirements; timely identification of issues or areas of technical, schedule, or cost risk; and the application of appropriate mitigation or recovery activities.

Program-level requirements specific to each project (science requirements, launch timeframe, total mission cost cap and PI or Project Manager-managed mission cost cap) are documented in the mission-specific PLRA.

For AO-selected projects, PEs and PSs work with the PI to convert requirements from the Phase A Concept Study Report into a PLRA as soon as Phase B begins.

For directed missions, through coordination with the mission PS, the Program Manager, the Project Manager, and/or the Project Scientist and the Project Manager, the mission PE typically drafts the PLRA after SRR but before KDP B to document the negotiated program-level requirements for the new project.

For both competed and directed missions, PSD places the negotiated PLRA under configuration control as soon as practical. During Phase B, the Program Manager obtains the appropriate signatures and submits the appendix to the mission PE for HQ approval.

### Project Plans

A unique project plan is developed for each mission that tailors institutional processes and defines the approach to the implementation of the project. The project plan is evaluated for compliance with the requirements of NPR 7120.5 and this Program Plan. The project plan is approved by the Program Manager, the implementing Center Director (or implementing organization), and the SMD AA.

The Program Office MM is the primary POC for program insight into each mission. Through frequent communication with the PI and Project Manager, both formal and informal, the MM maintains cognizance of the project performance against the project integrated master schedule, budget, and performance requirements, as well as the Management Agreement from the previous KDP.

As issues are identified, the Program Manager may elect to use program office personnel or program funds to provide additional insight or oversight in a particular area.

Table 1 lists the typical weekly, monthly, and quarterly reporting activities.

**Table 1. PROGRAM/PROJECT REPORTING**

| Org. | Reporting Forum | Content | Customer | Schedule |
|---|---|---|---|---|
| HQ/PSD | PSD Quarterly Status | Technical, cost, schedule, and risk | NASA AA (BPR) | Quarterly |
| | PSD Monthly Flight Programs Review (FPR) | Technical, cost, schedule, and risk status | SMD Deputy AA | Monthly |
| Planetary Missions PO | Quarterly Financial Review | Budget status, recent actions, issues | PD, PM, PEs & PAs | Quarterly |
| | Program Office Center Management Council (CMC) Status Review | Programs/Projects status (executive level) | MSFC Director & CMC | Quarterly |
| | Monthly Program Review (Briefing) | Technical, cost, schedule, and risk | PM | Monthly |
| | Monthly Program Report | Technical, cost, schedule, and risk status | PD & PEs | Monthly |
| | Program Office Status (FPPO) | Programs/Projects Status | MSFC FPPO Office | Monthly |
| | Baseline Performance Report (BPR) Inputs | Program/Project status | MSFC CD | Monthly |
| | Program Tag-Up | Program, Project, and management topics | PD, PE, & PM | Weekly |
| | Mission Manager Weekly Notes | MM status and assessment of projects | PD, PM, & PEs | Weekly (electronic) |
| Project | Quarterly Project Reviews | Technical, cost, schedule, education, communication and risk | Planetary PO, PD & PEs | Quarterly |
| | Project Financial Reports | Financial management data (533Ms, 533Qs) | Planetary PO | Quarterly/ Monthly |
| | Monthly Project Status Reviews | Technical, cost, schedule, and risk | Planetary PO, PD & PEs | Monthly |
| | Baseline Performance Report (BPR) Inputs | Project status | HQ | Monthly |

| Org. | Reporting Forum | Content | Customer | Schedule |
|---|---|---|---|---|
| | EVM Reporting | EVM Data | SMD | Monthly |
| | Weekly Status Report | Project status (performance and issues) | Planetary PO, & PEs | Weekly (electronic) |

Level I project schedule milestones (launch, encounter, etc.) are under the control of the SMD AA. This is documented and controlled through the project PLRA to the program plan. The Program Office provides inputs and configuration management of the PLRA. SMD approves changes to a project schedule baseline.

The Program Director working with the Program Manager, appropriate Program Executive, and PA agree on the top-level breakdown of the budget during the PPBE process. The Program Manager works directly with the Project implementing organizations to develop budget submittals for each mission. In addition to budget submittals for existing missions, the applicable Program Executive provides the budget submittal for potential new missions.

The Program Director is responsible for integrating all budget elements together to form a workable total Program budget and submitting it to the PSD Director for integration into the PSD submittal to the SMD AA for approval. The Program Manager and the Program Executive support the Program Director in advocating and negotiating budget requirements for the Program within SMD, and in providing supporting information to the NASA Office of the Chief Financial Officer (CFO) and to the OMB.

Once negotiated, the Program Manager is responsible for the management and administration of the program implementation budget, including the identification of potential project cost threats. For Discovery and New Frontiers, the Lead Program Executive manages and administers unallocated budget. For Solar System Exploration, the Mission Program Executive manages and administers unallocated budget. Movement of funds between projects is accomplished with the approval of the Program Director. Any Program decision to reallocate funds between program elements (i.e., projects) is made only after the net programmatic budget, schedule, science, and risk impacts of those modifications have been assessed and reviewed.

Movement of approved implementation budget funds, such as bypass funding to other agencies and NASA Centers, is based on coordination between the MSFC Program Business Office and the SMD Resource Management Division. The SMD Resource Management Division pre-coordinates with the MSFC Program Business Office, prior to issuing any changes to the Program implementation budget.

Coordination between the Program Director, Lead and Mission Program Executives, Program Manager, Program Business Office at MSFC, and SMD Resource Management Division is maintained by frequent formal and informal communications. Immediate issues are addressed weekly as part of Program management tag-ups. Coordination meetings are held monthly between the MSFC Program Business Management Office and the SMD Resource Management Division. Full Program Budget Review meetings are held quarterly with the Program Director, Program Executives, Program Analysts, and Program Manager as shown in Table 1, above.

Project budgets for AO-selected projects are initially estimated in the acquisition process as part of the original mission proposal and subsequent Concept Study Report. Project budgets for directly assigned projects are initially estimated in the FAD and subsequent FA. The cost to NASA for all phases of a Planetary investigation, including the definition, development, launch service, mission operations (including communications costs) and data analysis, and reserves is included. Independent cost estimates and/or independent review boards are used to verify estimates provided by the implementing organization as specified in NPR 7120.5 or at the discretion of the Program Manager.

At confirmation, the total mission cost cap and PI or Project Manager-managed mission cost cap for the project are documented in the associated PLRA. Cost increases that are beyond the control of the Project may be an exception that could result in an increase to the cost caps.

Changes to cost caps are documented in revisions to the PLRA and the associated mission-unique Project Budget Report (PBR) as follows:

- **Program-driven cost changes:** Program approved changes to the mission budget are documented in a HQ Decision Memorandum and are reflected in an update to the respective Project-unique PBR and PLRA.
- **Project-driven total mission cost cap increases:** Upon identification of a potential total mission cost cap increase, the project prepares an assessment of the magnitude, impacts, and any potential options (descope, etc.) to resolve the increase. The Program Manager may also elect to perform an independent evaluation of the project issues and cost impacts in parallel with the Project-performed assessment. The Project and Program Office present their findings jointly to the Program Director (or Governing PMC, as directed). The Program Manager provides a recommendation and supporting rationale for or against providing additional funding, or proceeding with a Termination Review of the Mission. If the final program decision is to provide additional funding, a HQ Decision Memorandum is issued, and the respective project-unique PBR and PLRA are revised.

Within the approved project budget, the PI or Project Manager has full discretion in applying the project-held cost reserve in a given fiscal year.

Even with innovative cost features and independent cost estimates, historic data shows significant growth for NASA missions above the proposed cost estimates and above the detailed CSR or FA cost estimates. Selected investigations that are unable to show adequate unencumbered reserve and NASA-approved confidence levels at the time of their Confirmation Review are likely to be judged as having an unacceptably high cost risk and are unlikely to be confirmed.

On a quarterly basis, the Office of Chief Financial Officer (OCFO) collects information from SMD regarding initial or updated project cost (estimate at completion), schedule (estimate at completion), and content, as well as, the reason for any changes in the project, as required for standardized reporting to the Office of Management and Budget, Congress, and the Government Accountability Office (GAO). The OCFO also compares these current cost and schedule estimates to the project baseline estimates to determine whether any thresholds that trigger

additional reporting detail have been breached. The Project Manager or PI, Program Manager, PE, Program Analyst, and Associate Administrator sign the final submission.

Each project office provides the SMD POC with completed data templates and baseline reports. After reviewing the project submissions with the Project, Program Manager, the PE, and PA, the SMD POC provides the OCFO with a consolidated set of submissions.

Cost and schedule information is reported by projects that:

(1) Are in development with a current expected LCC of $75 million or greater;
(2) Are in formulation with a current rough order of magnitude (ROM) LCC estimate of $250 million or greater, and with at least one contract which includes development activities valued at greater than $50 million; or
(3) Entered operations after being included in this reporting during development and have not completed operations with a final cost profile.

## 3.2 SAFETY AND MISSION ASSURANCE PLAN

The Program Office implements uncoupled programs. Although the Program Manager holds ultimate responsibility for the safety, reliability, maintainability, and quality of the programs and missions, implementation of the Safety and Mission Assurance processes is split between the program office and the implementing projects.

Each project develops and implements an effective safety and mission assurance program in accordance with NPD 8700.1, NASA Policy for Safety and Mission Success. These programs include a quality assurance program that is consistent with the SAE AS9100, Quality Management Systems Requirements for Aviation, Space and Defense Organizations. Specific program-level guidelines and requirements for the implementing projects are documented in the Planetary Programs Safety and Mission Assurance Guidelines and Requirements document, PMP-RQMT-002, as well as the Planetary Programs SMA Implementation Plan, PMP-PLAN-006. This includes flow-down of NASA institutional requirements; documentation, review, and problem reporting requirements; and implementation standards.

## 3.3 RISK MANAGEMENT PLAN

The Planetary Programs Risk Management Plan (PMP-PLAN-004) is consistent with NPR 8000.4, Agency Risk Management Procedural Requirements. The Program Office:

- Assesses significant project-identified risks and mitigations and monitors their resolution;
- Identifies and assesses program-level project risks and mitigations; and
- Identifies and assesses cross-cutting programmatic risks and mitigations.

The depth of insight applied to ensure project success is generally proportional to the severity and probability of the known risks. Additionally, the Program Office may conduct program-level activities to further investigate, analyze, and mitigate program-level risks.

Identified program risks are maintained in the program risk system and reported monthly to the Program Manager, Program Executives, and the Program Director.

Technical, management, and cost risks for each individual project are initially examined as part of the mission selection process. Each project develops a risk management plan, which implements Risk-Informed Decision Making and Continuous Risk Management processes described in NPR 8000.4.

## 3.4 ACQUISITION PLAN

Typically, investigations are competitively selected through the AO process. The program has established a process that contracts for whole missions (concept through delivery of the science data and analysis).

For AO-selected projects, multiple proposers are selected for competitive Phase A activities. Once a downselect for Phase B is accomplished, each selected project immediately begins Phase B Formulation activities.

Investigations typically are selected to proceed from one phase to the next through execution of contract options based on successful technical, cost and schedule performance in the previous phases. A Confirmation Review with the Governing PMC is held at the end of Phase B to determine whether to confirm the mission to enter Phase C. The NASA Decision Authority makes all final decisions to proceed to follow-on phases.

AO development, proposal review, and PI/mission selection are the responsibility of SMD and are carried out to meet the requirements of the Federal Acquisition Regulations and the NASA Federal Acquisition Regulations Supplement. The Program Office reviews the draft AO for compliance with Program requirements and to ensure incorporation of lessons learned from current mission development cycles.

The LaRC SOMA conducts Technical, Management, and Cost (TMC) evaluation of proposals in support of the selection process. The Program Office does not participate in the evaluation of mission proposals. The Program Office may shadow SOMA review and evaluation activities during Phase A to gain a greater understanding of mission(s) selected for implementation.

Direct interaction between the Program Office and the mission begins at the end of Phase A.

The Program Office establishes contractual vehicles for candidate missions during Phase A, as directed by the appropriate Program Scientist. After selection, the Program Office requests a proposal for cost and pricing data and negotiates the contract prior to the start of each phase. An undefinitized contract action (UCA) (letter contract) is typically issued after selection and prior to finalizing the full Phase B contract. For non-NASA PI-led missions, the AO selection provides the full authority necessary to contract with all members of a selected team without further competition. For NASA PI-led missions, authority to contract is dependent on proof of compliance with Federal Acquisition Regulations (FAR) supplement 1872.308.

Projects use their best efforts to assist NASA in achieving its goal for the participation of small disadvantaged businesses, women-owned small businesses, Historically Black Colleges and

Universities, and other Minority Educational Institutions in NASA procurements. Typically, contracts contain a subcontracting plan that includes goals for subcontracting with small, disadvantaged, and women-owned small businesses.

Individual projects may require external agreements with respect to other U.S. agency and foreign participation in the project. These external agreements for all projects are generated when necessary, and are referenced in the appropriate Program Level Requirements Appendix to the Planetary Missions Program Plan.

Under specified AOs, missions may fly as secondary payloads on spacecraft flown under other programs by NASA, other U.S. Government organizations, commercial organizations, or foreign organizations. In particular, Planetary Missions of Opportunity may include the contribution of an instrument or other mission component to a non-U.S. Government flight mission. NASA Headquarters manages the selection of such Missions of Opportunity and executes such international agreements, as may be required. The Program Office maintains cognizance over the development, implementation, and operations phases of such Missions of Opportunity. The Program Office works with NASA Headquarters to resolve any inter-organizational issues arising during the implementation phase.

For missions directly assigned to JPL or a non-NASA center (e.g. APL), acquisitions are managed by the HQ Resident Management Office on behalf of the program. As with competed missions, the intent is for directed missions to proceed from one phase to the next through execution of contract options based on successful technical, cost and schedule performance in the previous phases. For these missions, direct interaction between the Program Office and the mission begins shortly after the Formulation Authorization Document is approved.

## 3.5 TECHNOLOGY DEVELOPMENT PLAN

Opportunities may be identified by organizations developing instrumentation or other technologies for new missions. The inclusion of new technologies is encouraged in proposals provided that appropriate risk mitigation measures are included. Project-specific technologies and the associated costs are typically included in the total mission cost for the project.

For competed missions, the AO identifies requirements and/or opportunities for GFE or project-led technology development, maturation, and infusion.

Technology development, instrument development support, and technology special studies may be initiated by HQ or the Program Manager to strategically support future flight missions.

## 3.6 SYSTEMS ENGINEERING MANAGEMENT PLAN

The Program Office implements uncoupled programs. Technical management processes are directed towards the successful engineering of each project. No program-level Systems Engineering Management Plan (SEMP) is required.

The Program Office may conduct trade studies and analyses for the identification, assessment, and requirements development of hardware and software applicable to multiple project systems (e.g., to avoid unnecessary duplication of effort).

System engineering management functions are conducted at the project level according to each project's approved SEMP.

## 3.7 PRODUCT DATA AND LIFE CYCLE MANAGEMENT PLAN

The Program Office implements uncoupled programs, therefore, no program-level plan is required.

## 3.8 VERIFICATION AND VALIDATION PLAN

The Program Office implements uncoupled programs. Verification and validation activities at the program-level (test, analysis, inspection, or demonstration) are not applicable. Each project develops and implements an effective Verification and Validation Plan, consistent with the implementing organization procedures and compliant with NPR 7123.1, NASA Systems Engineering Processes and Requirements.

## 3.9 INFORMATION TECHNOLOGY PLAN

The Planetary Programs Data Management Plan (PMP-PLAN-003) defines the requirements and processes for identification/definition, preparation, control, and disposition (storage, access, and records) of Program data. The Planetary Programs Data Management Plan is compliant with NPD 1440.6, NASA Records Management, and NPR 1441.1, NASA Records Retention Schedules.

Each project develops and implements an Information Technology Plan, consistent with implementing organization procedures and compliant with NPD 2200.1, Management of NASA Scientific and Technical Information, and NPR 2200.2, Requirements for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information.

## 3.10 REVIEW PLAN

Programs managed under this plan are in Implementation. During the implementation phase, a program-level Standing Review Board (SRB) conducts an independent Program Implementation Review (PIR) at the direction of the Decision Authority. This determination is made on an annual basis.

Projects use a single, independent life cycle review board approach. Each major review is designed to provide a periodic assessment of a Program or Project technical and programmatic status and health at a key point in its life cycle, and is an important part of NASA's system of checks and balances. Each mission follows the standard NASA development life cycle with reviews as directed in NPR 7120.5 for robotic missions.

Each mission and mission of opportunity establishes a specific set of reviews, compliant with NPR 7120.5, and their associated timeline in their Project Plan that ensures that the project is ready to proceed to the next phase. The project's review plan may include additional reviews as directed by the implementing organization Governing Program Management Council (GPMC) or Senior Board. The Program Office participates in most project reviews.

NASA maintains a significant degree of insight into mission development. The Science Mission Directorate may charter the Program Office to establish special purpose teams to evaluate the status of mission progress and risk. The Program Office coordinates the formation of each team with the Program Director and the Program Executive.

The Decision Authority may initiate a Termination Review for projects that fail to stay within the parameters or levels specified in controlling documents. The result of the Termination Review is a recommendation for termination or continuance to the DA.

## 3.11 MISSION OPERATIONS PLAN

The Program Office implements uncoupled programs. Operations occur at the project level, and each mission operates independently of the other missions. No program-level Mission Operations Plan is required.

## 3.12 ENVIRONMENTAL MANAGEMENT PLAN

The Program Office implements uncoupled programs. Environmental management occurs at the project level. No program-level Environmental Management Plan is required.

All projects develop environmental review documentation consistent with the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), NASA policy and procedures (14 CFR Part 1216, Subpart 1216.3 and NPR 8580.1, NASA National Environmental Policy Act Management Requirements and Executive Order 12114), and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500-1508).

Radioisotope Power Systems (RPS) and small radioactive devices, such as Radioisotope Heater Units (RHU) or radioactive sources for science instruments, are permitted on missions. Missions using such devices develop additional environmental review documentation, including an Environmental Assessment or an Environmental Impact Statement, to satisfy the NEPA requirements and completion of a detailed and rigorous nuclear safety launch approval process.

Depending on the potential environmental impacts of the proposed mission, either (1) adoption of the "Final Environmental Assessment of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station Florida and Vandenberg Air Force Base California," and Finding of No Significant Impact (FONSI), (2) preparation of a mission unique Environmental Assessment, or (3) preparation of a mission unique Environmental Impact Statement is necessary to satisfy NEPA requirements.

If the mission has the potential to have environmental effects abroad (e.g., launches from a foreign territory), then the mission provides environmental review documentation consistent with NASA policy and procedures for complying with Executive Order 12114 (14 CFR part 1216.321) and NPR 8580.1.

## 3.13 INTEGRATED LOGISTICS SUPPORT PLAN

The Program Office implements uncoupled programs. Integrated logistics support occurs only at the project level. No program-level Integrated Logistics Support Plan is required.

Each mission institutional facility needs, use of existing equipment, project part sparing and ground system maintenance, are project-unique activities. Each project develops a logistics approach that is based on the mission operations concept, and consistent with the intent of NPD 7500.1, Program and Project Life-Cycle Logistics Support Policy. This approach is addressed in the individual project plans.

Project transportation activities are addressed in individual project plans. Requirements (e.g., loads and environments) are levied on the transport and handling processes of structures, subsystems, and instruments by the appropriate cognizant organizations/engineers for each project. RTGs and RHUs, if used, are transported under the authority of the Department of Energy and the manufacturer.

## 3.14 SCIENCE DATA MANAGEMENT PLAN

The Program Office implements uncoupled programs. The science teams for each mission or Mission of Opportunity are responsible for initial analysis of mission data, data delivery to the PDS, the publication of scientific findings, and communication of the results to the public. No program-level Science Data Management Plan is required.

Each project prepares a Science Data Management Plan compliant with NPD 2200.1, Management of NASA Scientific and Technical Information, NPR 2200.2, Requirements for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information, NPR 1441.1, NASA Records Retention Schedules (as applicable to program science data). In accordance with NASA policy, data are released as soon as possible after a brief validation period appropriate for the mission. Data are made fully public through the PDS in a usable form, typically within six months following its collection. The PI or Project Manager and science team are responsible for collecting and making available the scientific, engineering, and ancillary information necessary to validate, calibrate, and reduce the scientific data. Archival data products also include data and derived data products, documentation, and related software or other tools necessary to interpret the data.

Missions include their plans to comply with planetary protection requirements NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions in their project plan. Mission life cycle costs cover the preliminary examination of any extraterrestrial samples, including the funding of the Astromaterials Curatorial Facility to support their mission.

## 3.15 CONFIGURATION MANAGEMENT PLAN

The Program Office implements uncoupled programs. Configuration management occurs only at the project level. A program-level Configuration Management Plan is not required.

Each project develops plans consistent with the implementing organization procedures and compliant with NPR 7123.1, NPD 1440.6, and NPR 1441.1.

## 3.16 SECURITY PLAN

The Program Office provides protection for sensitive and accountable classified documents/material/information, working documents, or by-products commensurate with the assigned classification level and prevents unauthorized persons from gaining access during its use, dissemination, storage, movement, or transmission. NASA Headquarters and the National Space Science and Technology Center (NSSTC) provide facility access and physical security for the programs at HQ and MSFC, respectively. The Protective Services Office at HQ and MSFC provide information technology, personnel background investigations, and security awareness/education (e.g., Information & Technology, Export Control, counterterrorism, etc.) to the Planetary Programs. All security processes and procedures are implemented in accordance with NASA and MSFC security policies and requirements (NPR 2810.1, NPD 1600.2, NPR 1600.1, and MPR 1600.1).

At the program level, no NASA Mission Essential Infrastructure has been identified. Therefore, emergency response is limited to program documentation/information and personnel. All program documentation/information is maintained electronically on institutionally-managed servers, with periodic backups, and retained in accordance with NASA Records Retention Schedules (NPR 1440.1). Weather or facility related emergencies are announced via the NASA and NSSTC public address system.

For other types of emergencies, the Planetary Missions Program Office follows the appropriate policies and directives of MSFC and the NSSTC. All emergency response processes and procedures are implemented in accordance with NASA and MSFC emergency policies and requirements (NPR 1040.1, NASA Continuity of Operations (COOP) Planning Procedurals Requirements.

The Astromaterials Curator at the Johnson Space Center is responsible for the physical security, documentation, inventory accountability, environmental preservation, and distribution of any returned samples and space-exposed hardware delivered to the Curation Facility.

Physical and Information Technology Security for each project is the responsibility of the implementing organization. Each project works to identify and control threats to personnel and hardware through the use of access controls and other safeguards, and establishes appropriate security procedures that meet the intent of NPR 1600.1, NASA Security Program Procedural Requirements. Each project is responsible for protecting the integrity, availability, and confidentiality of project information systems, software applications, data, and information generated within their projects through the implementation of a security plan that meets the intent of NPR 2810.1, Security of Information Technology, and NPD 2810.1, NASA Information

Security Policy. Finally, each project establishes the appropriate emergency response protocols in accordance with the approved processes at the project institution.

## 3.17 THREAT SUMMARY

Threat summaries attempt to document the threat environment that a NASA space system is most likely to encounter as it reaches operational capability. These documents contain Top Secret/Sensitive Compartmented Information and are the basis for establishing threat levels that are used to develop survivability strategies and risk avoidance or mitigation measures. Threat summaries draw their information from intelligence community documents and address all segments of a space system with emphasis on the space segment. Whenever possible coordinated intelligence community documents, i.e., National Intelligence Estimates and Intelligence Community Briefs are used as reference sources in writing the summaries. Where there is a difference of opinion between organizations about a threat, the threat summary gives a range of threat estimates and identifies each agency's position.

The Program has no space assets or supporting infrastructures to protect from disruption, degradation or destruction from environmental, mechanical, electronic, or hostile actions. Space assets and supporting infrastructure are developed and maintained by the missions. Projects are responsible for protection and survivability engineering throughout the entire design and development of the space system.

In response to the viable threats documented in the Threat Summary for a specific mission, a Project Protection Plan is developed to document the survivability strategy(s) used by the project, to identify the valid threats and corresponding vulnerabilities to the mission, and to recommend potential countermeasures to ensure the protection of infrastructure elements that support a civil space system.

## 3.18 TECHNOLOGY TRANSFER CONTROL PLAN

The programs have no direct Technical Assistance Agreements or MOUs with any foreign entities. If such contracts or agreements are established in the future, the Program Office coordinates these activities with the NASA Headquarters Export Administrator (HEA) and the MSFC Center Export Representative (CER), and complies with the requirements of NPR 2190.1, NASA Export Control Program.

Most export or re-export activities at the program level involve the transfer of documentation/information within Export Administration Regulations (EAR) or International Traffic in Arms Regulations (ITAR) license exceptions. If, in the future, exports are identified that are not permitted under an existing license exception, the Program Office, with the help of NASA HQ and MSFC center export representatives, identify the applicable license required and submit the appropriate application to Department of Commerce or U.S. State Department.

Each mission implements an export control process, compliant with the requirements of NPR 2190.1, NASA Export Control Program. Requirement compliance is flowed to the projects through the mission selection (AO or FAD) process. This process discloses and discusses any

international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities. Typically, the AO advises proposers that under U.S. law and regulation, spacecraft and their specifically designed, modified, or configured systems, components, parts, etc., such as the instrumentation being sought under the AO, are generally considered "Defense Articles" on the U.S. Munitions List and, therefore, subject to the provisions of the ITAR, 22 CFR 120-130, et seq.

## 3.19 EDUCATION PLAN

NASA education is defined as those activities designed to enhance learning in science, technology, engineering and mathematics (STEM) content areas using NASA's unique capabilities. SMD develops policies and processes for implementing a more focused and cohesive portfolio of education programs. SMD's overarching vision for science education is to further enable NASA scientists and engineers to engage more effectively with learners of all ages. Four objectives have been established: enable STEM education; improve U.S. scientific literacy; advance National educational goals, and leverage these efforts through partnerships.

In previous years, science education activities were embedded in the individual missions, which allocated a portion of their budgets for education. SMD now separately funds science education on a science discipline, or thematic, basis to better align with SMD's vision. Mission and non-mission activities are expected to support SMD Objectives by funding infrastructure, scientists and engineers, as appropriate, and that funding support is embedded. Support to the SMD education effort is documented in the Planetary Missions Program Education Plan, PMP-PLAN-005.

## 3.20 COMMUNICATIONS PLAN

NASA has a responsibility to communicate information about its programs and scientific discoveries to the public, and this responsibility is highlighted in NASA's founding legislation. SMD directs communication projects, initiatives, and activities and supports specific initiatives as needed.

Typically, communication activities are embedded in the individual missions, which allocate a portion of their budgets for communication. These missions develop plans during the early phases of the mission life cycle, and these plans are subjected to thorough review and approval.

The Program Office also implements program-level communication activities aimed at raising awareness of the program and its missions, and fostering collaboration between the program and the missions to increase the impact of individual mission communication programs.

This program-level effort is documented in the Planetary Missions Program Communications Plan, PMP-PLAN-007.

## 3.21 LESSONS LEARNED PLAN

Planetary Programs have a process for capturing and disseminating lessons learned, in accordance with the NPD 7120.6, NASA Knowledge Policy on Programs and Projects. The

Program Office collects and archives lessons learned from a number of sources, both internal and external. These sources include:

- Routine interactions with project development and operations teams;
- SRB reports, replan assessments, and Independent Assessment Team reports;
- Lessons from other programs;
- Special studies chartered by the Program Manager;
- Special study reports performed by external groups (e.g., SOMA); and
- Workshops and conferences organized or attended by Program Office personnel.

The mission managers serve as the primary focus for disseminating the information to each individual project, through special lessons learned discussions at the start of each development phase and day-to-day meetings and reviews with the projects, for inclusion into the project's lessons learned document. The Program Office also works with PSD and the LaRC SOMA to ensure that experiences with previously selected missions are factored, as appropriate, into subsequent FADs, AOs and TMC evaluations.

### 3.22 HUMAN RATING CERTIFICATION PACKAGE

The Program Office implements robotic space science programs. Therefore, human rating certification is not applicable.

## 4.0 WAIVERS OR DEVIATIONS LOG

No program-level NPR 7120.5 waivers have been identified. At the project level, requests for NPR 7120.5 requirement tailoring may be submitted in the form of the Compliance Matrix or submitted as an individual waiver or as part of a group of waivers. Regardless of whether the waiver is approved as a standalone document or as part of the Compliance Matrix, the required signatures from the responsible organizations or their designee are obtained in accordance with NPR 7120.5 and the NASA Space Flight Program and Project Management Handbook.

## 5.0 CHANGE LOG

The Program Manager monitors NASA policies, directives, and requirements for changes affecting the Programs.

The Program Manager and the Program Director routinely evaluate the need for modifications of this Program Plan and the PCAs due to project changes and other activities within the programs, or as driven by the above NASA documentation changes.

| REV | DESCRIPTION | PUB. DATE |
|---|---|---|
| - | Initial Release per Directive PP1-00-0001 | 10/10/2014 |
| Change 1 | The following editorial updates have been made:<br>1. Pg. 9 Reference to a Space-Exposed Hardware Allocation Committee (SEHAC) has been deleted to reflect that a SEHAC no longer exists<br>2. Pg. 42 Document number corrected for the PMP Communications Plan, PMP-PLAN-007 (was incorrectly numbered -006)<br>3. Appendix D document numbers corrected: SMA Implementation Plan is PMP-PLAN-006 and the Communication Plan is PMP-PLAN-007. General cleanup of other documents referenced in Appendix D.<br>4. Updated Appendix F to include the Europa Mission.<br>5. Pg. 8 Clarified statement on PLRAs. Was: "…in the applicable Program Level Requirements Appendix (PLRA), which is attached to this program plan". Is: "…in the applicable Program Level Requirements Appendix (PLRA), which are listed in this program plan." | 12/18/2015 |
| | | |
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## 6.0 APPENDICES

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| APPENDIX A | Acronyms and Abbreviations |
| APPENDIX B | Definitions |
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| APPENDIX D | Program Reference Documents |
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| APPENDIX F | Planetary Projects and Program Level Requirements Appendices (PLRAs) |

# APPENDIX A – ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AA | Associate Administrator |
| ABC | Agency Baseline Commitment |
| APL | Applied Physics Laboratory (Johns Hopkins University) |
| AO | Announcement of Opportunity |
| BPR | Baseline Performance Review |
| CD | Center Director |
| CDR | Critical Design Review |
| CFO | Chief Financial Officer |
| CE | Chief Engineer |
| CER | Critical Events Readiness |
| CEQ | Council of Environmental Quality |
| CFR | Code of Federal Regulations |
| CMC | Center Management Council |
| CoSTEM | Committee on STEM Education |
| CR | Confirmation Review |
| CSO | Chief SMA Officer |
| CSR | Concept Study Report |
| DOE | U.S. Department of Energy |
| DPMC | Directorate Program Management Council |
| DSN | Deep Space Network |
| EAR | Export Administration Regulations |
| ELV | Expendable Launch Vehicle |
| ETA | Engineering Technical Authority |
| EVM | Earned Value Management |
| FA | Formulation Agreement |
| FAD | Formulation Authorization Document |
| FAR | Federal Acquisition Regulations |
| FONSI | Finding of No Significant Impact |

| | |
|---|---|
| FPPO | Flight Projects and Partnership Office |
| FPR | Flight Programs Review |
| GAO | Government Accountability Office |
| GFE | Government Furnished Equipment |
| GPMC | Governing Program Management Council |
| GRC | Glenn Research Center |
| HQ | Headquarters |
| IPAO | Independent Program Assessment Office |
| ITAR | International Traffic in Arms Regulations |
| IV&V | Independent Verification and Validation |
| JCL | Joint Cost and Schedule Confidence Level |
| JPL | Jet Propulsion Laboratory |
| JSC | Johnson Space Center |
| KDP | Key Decision Point |
| LaRC | Langley Research Center |
| LCC | Life Cycle Cost |
| MD | Mission Directorate |
| MDAA | Mission Directorate Associate Administrator |
| MDR | Mission Definition Review |
| MM | Mission Manager |
| MO | Mission of Opportunity |
| MOU | Memorandum of Understanding |
| MPR | Marshall Procedural Requirement |
| MSFC | Marshall Space Flight Center |
| NASA | National Aeronautics and Space Administration |
| NEPA | National Environmental Policy Act |
| NPD | NASA Policy Directive |
| NPR | NASA Procedural Requirements |
| NSSTC | National Space Science and Technology Center |

| | |
|---|---|
| OCE | Office of the Chief Engineer |
| OCFO | Office of the Chief Financial Officer |
| OMB | Office of Management and Budget |
| ORR | Operations Readiness Review |
| OSMA | Office of Safety and Mission Assurance |
| PA | Program Analyst |
| PBR | Project Budget Report |
| PCA | Program Commitment Agreement |
| PD | Program Director |
| PDLM | Product Data and Life Cycle Management |
| PDR | Preliminary Design Review |
| PDS | Planetary Data System |
| PE | Program Executive |
| PI | Principal Investigator |
| PIR | Program Implementation Review |
| PLRA | Program Level Requirements Appendix |
| PM | Program Manager |
| PMC | Program Management Council |
| PO | Program Office |
| POC | Point of Contact |
| PPBE | Planning, Programming, Budgeting, and Execution |
| PPO | Planetary Protection Officer |
| PS | Program Scientist |
| PSD | Planetary Science Division |
| RHU | Radioisotope Heater Unit |
| RPS | Radioisotope Power Systems |
| RTG | Radioisotope Thermoelectric Generator |
| SALMON | Stand Alone Mission of Opportunity Notice |
| SCaN | Space Communications and Navigation |

| | |
|---|---|
| SMA | Safety and Mission Assurance |
| SDR | System Definition Review |
| SEMP | Systems Engineering Management Plan |
| SMD | Science Mission Directorate |
| SOMA | Science Office for Mission Assessments |
| SIR | System Integration Review |
| SRB | Standing Review Board |
| SRR | System Requirements Review |
| STEM | Science, Technology, Engineering, and Mathematics |
| TA | Technical Authority |
| TMC | Technical, Management and Cost |
| ToR | Terms of Reference |
| UCA | Undefinitized Contract Actions |
| UFE | Unallocated Future Expenses |
| WBS | Work Breakdown Structure |

# APPENDIX B – DEFINITIONS

**Agency Baseline Commitment –** Establishes and documents an integrated set of project requirements, cost, schedule, technical content, and an agreed-to JCL that forms the basis for NASA's commitment to the external entities of OMB and Congress. Only one official baseline exists for a NASA program or project, and it is the Agency Baseline Commitment.

**Baseline Science Requirements** – The mission performance requirements necessary to achieve the full science objectives of the mission. (Also see Threshold Science Requirements.)

**Decision Authority -** The Decision Authority is the Agency individual who is responsible for making the KDP determination on whether and how a program or project proceeds through the life cycle and for authorizing the key program cost, schedule, and content parameters that govern the remaining life-cycle activities.

**Decision Memorandum -** The document that summarizes the decisions made at Key Decision Points (KDPs) or as necessary in between KDPs. The decision memorandum includes the Agency Baseline Commitment (ABC) (if applicable), Management Agreement cost and schedule, Unallocated Future Expenses (UFE), and schedule margin managed above the project (that is, outside of the Management Agreement approved cost), as well as life-cycle cost and schedule estimates, as required.

**Formulation Authorization Document -** This is the document issued by the Mission Directorate Associate Administrator (MDAA) to authorize the formulation of a program whose goals will fulfill part of the Agency's Strategic Plan and Mission Directorate strategies and establish the expectations and constraints for activity in the Formulation Phase. In addition, a FAD or equivalent is used to authorize the formulation of a project.

**Joint Cost and Schedule Confidence Level –** (1) The probability that cost will be equal to or less than the targeted cost and schedule will be equal to or less than the targeted schedule date. (2) A process and product that helps inform management of the likelihood of a project's programmatic success. (3) A process that combines a project's cost, schedule, and risk into a complete picture. JCL is not a specific methodology (e.g., resource-loaded schedule) or a product from a specific tool. The JCL calculation includes consideration of the risk associated with all elements, regardless of whether or not they are funded from appropriations or managed outside of the project. JCL calculations include the period from Key Decision Point (KDP) C through the hand over to operations, i.e., end of the on-orbit checkout.

**Life Cycle Cost** – The total of the direct, indirect, recurring, nonrecurring, and other related expenses both incurred and estimated to be incurred in the design, development, verification, production, deployment, prime mission operation, maintenance, support, and disposal of a project, including closeout, but not extended operations. The LCC includes the cost of the launch vehicle. Also referred to as the Total Mission Cost Cap.

**Principal Investigator –** A person who conceives an investigation and is responsible for carrying it out and reporting its results. In some cases, Principal Investigators (PIs) from industry

and academia act as project managers for smaller development efforts with NASA personnel providing oversight.

**PI/Project Manager-Managed Mission Cost Cap** – Within the Decision Memorandum, the parameters and authorities over which the program or project manager has management control. Also referred to as the Management Agreement.

**Science Floor** – See Threshold Science.

**Technical Authority –** Part of NASA's system of checks and balances that provides independent oversight of programs and projects in support of safety and mission success through the selection of individuals at delegated levels of authority. These individuals are the TAs. TA delegations are formal and traceable to the NASA Administrator. Individuals with TA are funded independently of a program or project.

**Terms of Reference –** A document specifying the nature, scope, schedule, and ground rules for an independent review or independent assessment.

**Threshold Science** – The mission performance requirements necessary to achieve the minimum science acceptable for the investment. Threshold Science requirements are also referred to as the "science floor."

**Total Mission Cost Cap** – See Life Cycle Cost (LCC).

**Unallocated Future Expenses –** The portion of estimated cost required to meet specified confidence level that cannot yet be allocated to the specific project Work Breakdown Structure (WBS) sub-elements because the estimate includes probabilistic risks and specific needs that are not known until these risks are realized.

**Uncoupled Programs –** Programs implemented under a broad theme and/ or a common program implementation concept, such as providing frequent flight opportunities for cost-capped projects selected through Announcements of Opportunity (AO) or NASA Research Announcements. Each such project is independent of the other projects within the program.

# APPENDIX C – NPR 7120.5 COMPLIANCE MATRIX

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| 1.1.2 | NASA Centers, Mission Directorates, and other organizations that have programs or projects shall develop appropriate documentation to implement the requirements of this NPR. | OCE | X | A | A | | FC | | |
| 1.1.3 | The Mission Directorate shall submit their plan for phased tailoring of the requirements of this NPR within 60 days of the effective date of this NPR. | OCE | X | A | | | FC | | |
| 2.1.1 | Regardless of the structure of a program or project meeting the criteria of Section P.2, this NPR shall apply to the full scope of the program or project and all the activities under it. | OCE | X | | | A | FC | | |
| 2.1.4.1 | Projects are Category 1, 2, or 3 and shall be assigned to a category based initially on: (1) the project life-cycle cost (LCC) estimate, the inclusion of significant radioactive material, and whether or not the system being developed is for human space flight; and (2) the priority level, which is related to the importance of the activity to NASA, the extent of international participation (or joint effort with other government agencies), the degree of uncertainty surrounding the application of new or untested technologies, and spacecraft/payload development risk classification. | OCE | X | A | | | FC | | |
| 2.1.4.2 | When projects are initiated, they are assigned to a NASA Center or implementing organization by the MDAA consistent with direction and guidance from the strategic planning process. They are either assigned directly to a Center by the Mission Directorate or are selected through a competitive process such as an Announcement of Opportunity (AO). For Category 1 projects, the assignment shall be with the concurrence of the NASA AA. | OCE | X | A | | | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| 2.2.1 | Programs and projects shall follow their appropriate life cycle, which includes life-cycle phases; life-cycle gates and major events, including KDPs; major life-cycle reviews (LCRs); principal documents that govern the conduct of each phase; and the process of recycling through Formulation when program changes warrant such action. | OCE | | | | A | FC | | |
| 2.2.2 | Each program and project performs the work required for each phase, which is described in the NASA Space Flight Program and Project Management Handbook and NPR 7123.1. This work shall be organized by a product-based WBS developed in accordance with the Program and Project Plan templates (appendices G and H). | OCE | | | | A | FC | | |
| 2.2.3 | The documents shown on the life-cycle figures and described below shall be prepared in accordance with the templates in appendices D, E, F, G, and H. | OCE | | | | A | FC | | |
| 2.2.4 | Each program and project shall perform the LCRs identified in its respective figure in accordance with NPR 7123.1, applicable Center practices, and the requirements of this document. | OCE | | | | A | FC | | |
| 2.2.5 | The program or project and an independent Standing Review Board (SRB) shall conduct the SRR, SDR/MDR, PDR, CDR, SIR, ORR, and PIR LCRs in figures 2-2, 2-3, 2-4, and 2-5. | OCE | X | | | A | FC | | |
| 2.2.5.1 | The Conflict of Interest (COI) procedures detailed in the NASA Standing Review Board Handbook shall be strictly adhered to. | OCE | X | A | A | A | FC | | |
| 2.2.5.2 | The portion of the LCR conducted by the SRB shall be convened by the Convening Authorities in accordance with Table 2-2. | OCE | X | A | A | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| 2.2.5.3 | The program or project manager, the SRB chair, and the Center Director (or designated Engineering Technical Authority representative) shall mutually assess the program or project's expected readiness for the LCR and report any disagreements to the Decision Authority for final decision. | OCE | X | | A | A | FC | | |
| 2.2.6 | In preparation for these LCRs, the program or project shall generate the appropriate documentation per the Appendix I tables of this document, NPR 7123.1, and Center practices, as necessary, to demonstrate that the program or project's definition and associated plans are sufficiently mature to execute the follow-on phase(s) with acceptable technical, safety, and programmatic risk. | OCE | X | | | A | FC | | |
| | **Table I-1 Uncoupled and Loosely Coupled Program Milestone Products and Control Plans Maturity Matrix** | | | | | | | | |
| Tabl I-1 | 1. FAD [Baseline at SRR] | OCE | | A | | A | NA | The Planetary Missions Program is in Implementation | Approved by Center Director Signature on Program Plan title page (7120.5, app C) |
| Tabl I-1 | 2. PCA [Baseline at KDP I] | OCE | | A | | | FC | | |
| Tabl I-1 | 3. Program Plan [Baseline at SDR] | OCE | | A | A | A | FC | | |
| Tabl I-1 | 3.a. Mission Directorate requirements and constraints [Baseline at SRR] | OCE | | A | | A | FC | | |
| Tabl I-1 | 3.b. Traceability of program-level requirements on projects to the Agency strategic goals and Mission | OCE | | A | | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| | Directorate requirements and constraints [Baseline at SDR] | | | | | | | | |
| Tabl I-1 | 3.c. Documentation of driving ground rules and assumptions on the program [Baseline at SDR] | OCE | | A | | A | FC | | |
| Tabl I-1 | 4. Interagency and international agreements [Baseline at SDR] | OCE | | A | | A | FC | | |
| Tabl I-1 | 5. ASM minutes | OCE | | A | | A | NA | The Planetary Missions Program is in Implementation | See I-1, No 1 above |
| Tabl I-1 | 6. Risk mitigation plans and resources for significant risks | OCE | | | | A | FC | | |
| Tabl I-1 | 7. Documented Cost and Schedule Baselines [Baseline at SDR] | OCE | | | | A | NA | Program budgets are updated annually as part of the NASA Planning, Programming, Budgeting, and Execution (PPBE) process | See I-1, No 1 above |
| Tabl I-1 | 8. Documentation of Basis of Estimate (cost and schedule) [Baseline at SDR] | OCE | | | | A | NA | Program budgets are updated annually as part of the NASA Planning, Programming, Budgeting, and Execution (PPBE) process | See I-1, No 1 above |
| Tabl I-1 | 9. Documentation of Performance against plan/baseline, including status/closure of formal actions from previous KDP | OCE | | | | A | FC | | |
| Tabl I-1 | 10. Plans for work to be accomplished during Implementation | OCE | | | | A | FC | | |
| | **Program Plan Control Plans** | | | | | | | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| Tabl I-1 | 1. Technical, Schedule, and Cost Control Plan [Baseline at SDR] | OCE | | | | A | FC | | |
| Tabl I-1 | 2. Safety and Mission Assurance Plan [Baseline at SDR] [per NPDs 8730.5 and 8720.1, NPRs 8715.3, 8705.2, 8705.6 and 8735.2, and NASA Stds 8719.13 and 8739.8] | OSMA | | | | A | FC | | |
| Tabl I-1 | 3. Risk Management Plan [Baseline at SDR] [per NPR 8000.4] | OSMA | | | | A | FC | | |
| Tabl I-1 | 4. Acquisition Plan [Baseline at SDR] | OCE | | | | A | FC | | |
| Tabl I-1 | 5. Technology Development Plan [Baseline at SDR] [per NPD 7500.2 and NPR 7500.1] | OCT | | | | A | FC | | |
| Tabl I-1 | 6. Systems Engineering Management Plan [Baseline at SDR] | OCE | | | | A | FC | | |
| Tabl I-1 | 7. PDLM Plan [Preliminary at SDR] [per NPR 7120.9] | OCE | | | | A | NA | The Planetary Missions Program is uncoupled and, therefore, does not use Product Data and Life Cycle Management (PDLM) services. | See I-1, No 1 above |
| Tabl I-1 | 8. Review Plan [Baseline at SRR] | OCE | | | | A | FC | | |
| Tabl I-1 | 9. Environmental Management Plan [Baseline at SDR] [per NPR 8580.1] | EMD | | | | A | FC | | |
| Tabl I-1 | 10. Configuration Management Plan [Baseline at SDR] | OCE | | | | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| Tabl I-1 | 11. Security Plan [Baseline at SDR] [per NPD 1600.2 and NPRs 1600.1, 1040.1, and 2810.1] | OPS OCIO | | | | A | FC | | |
| Tabl I-1 | 12. Threat Summary [Baseline at SDR] | OCE | X | | | A | FC | | |
| Tabl I-1 | 13. Technology Transfer (formerly Export) Control Plan [Baseline at SDR] [per NPR 2190.1] | OIIR | | | | A | FC | | |
| Tabl I-1 | 14. Education Plan [Baseline at SDR] | OE | | | | A | FC | | |
| Tabl I-1 | 15. Communications Plan [Baseline at SDR] | OComm | | | | A | FC | | |
| Tabl I-1 | 16. Lessons Learned Plan [Baseline at SDR] [per NPD 7120.4 and NPR 7120.6] | OCE | | | | A | FC | | |
| 2.2.8 | Projects in phases C and D (and programs at the discretion of the MDAA) with a life-cycle cost estimated to be greater than $20 million and Phase E project modifications, enhancements, or upgrades with an estimated development cost greater than $20 million shall perform earned value management (EVM) with an EVM system that complies with the guidelines in ANSI/EIA-748, Standard for Earned Value Management Systems. | OCE | X | A | | A | FC | | |
| 2.2.8.1 | EVM system requirements shall be applied to appropriate suppliers, in accordance with the NASA Federal Acquisition Regulation (FAR) Supplement, and to in-house work elements. | OCE | X | | | A | FC | | |
| 2.2.8.2 | For projects requiring EVM, Mission Directorates shall conduct a pre-approval integrated baseline review as part of their preparations for KDP C to ensure that the project's work is properly linked with its cost, schedule, and risk and that the | OCE | | A | | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| | management processes are in place to conduct project-level EVM. | | | | | | | | |
| 2.2.10 | Each program and project shall complete and maintain a Compliance Matrix (see Appendix C) for this NPR and attach it to the Formulation Agreement for projects in Formulation and/or the Program or Project Plan. The program or project will use the Compliance Matrix to demonstrate how it is complying with the requirements of this document and verify the compliance of other responsible parties. | OCE | X | | | A | FC | | |
| 2.3.1 | Each program and project shall have a Decision Authority who is the Agency's responsible individual who determines whether and how the program or project proceeds through the life cycle and the key program or project cost, schedule, and content parameters that govern the remaining life-cycle activities. | OCE | X | A | | | FC | | |
| 2.3.1.1 | The NASA AA shall approve all Agency Baseline Commitments (ABCs) for programs requiring an ABC and projects with a life-cycle cost greater than $250 million. | OCE | X | A | | A | FC | | |
| 2.3.2 | Each program and project shall have a governing PMC. | OCE | X | A | | | FC | | |
| 2.3.3 | The Center Director (or designee) shall oversee programs and projects usually through the CMC, which monitors and evaluates all program and project work (regardless of category) executed at that Center. | OCE | X | | A | | FC | | |
| 2.3.4 | Following each LCR, the independent SRB and the program or project shall brief the applicable management councils on the results of the LCR to support the councils' assessments. | OCE | X | A | A | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| 2.4.1 | After reviewing the supporting material and completing discussions with concerned parties, the Decision Authority determines whether and how the program or project proceeds into the next phase and approves any additional actions. These decisions shall be summarized and recorded in the Decision Memorandum signed at the conclusion of the governing PMC by all parties with supporting responsibilities, accepting their respective roles. | OCE | X | A | | | FC | | |
| 2.4.1.1 | The Decision Memorandum shall describe the constraints and parameters within which the Agency, the program manager, and the project manager will operate; the extent to which changes in plans may be made without additional approval; any additional actions that came out of the KDP; and the supporting data (i.e., the cost and schedule datasheet) that provide further details. | OCE | X | A | | A | FC | | |
| 2.4.1.2 | A divergence from the Management Agreement that any party identifies as significant shall be accompanied by an amendment to the Decision Memorandum. | OCE | X | A | | A | FC | | |
| 2.4.1.3 | During Formulation, the Decision Memorandum shall establish a target life-cycle cost range (and schedule range, if applicable) as well as the Management Agreement addressing the schedule and resources required to complete Formulation. | OCE | X | A | | A | FC | | |
| 2.4.1.5 | All projects and single-project programs shall document the Agency's life-cycle cost estimate and other parameters in the Decision Memorandum for Implementation (KDP C), and this becomes the ABC. | OCE | X | A | | A | FC | | |
| | | | | | | | | | |
| 2.4.1.7 | Programs or projects shall be rebaselined when: (1) the estimated development cost exceeds the ABC development cost by 30 percent or more (for projects over | OFCO | X | A | | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| | $250 million, also that Congress has reauthorized the project); (2) the NASA AA judges that events external to the Agency make a rebaseline appropriate; or (3) the NASA AA judges that the program or project scope defined in the ABC has been changed or the tightly coupled program or project has been interrupted. | | | | | | | | |
| 2.4.2 | All programs and projects develop cost estimates and planned schedules for the work to be performed in the current and following life-cycle phases (see Appendix I tables). As part of developing these estimates, the program or project shall document the basis of estimate (BOE) in retrievable program or project records. | OCE | X | | | A | FC | | |
| 2.4.3 | Tightly coupled and single-project programs (regardless of life-cycle cost) and projects (with an estimated life-cycle cost greater than $250 million) shall develop probabilistic analyses of cost and schedule estimates to obtain a quantitative measure of the likelihood that the estimate will be met in accordance with the following requirements. | CAD | X | | | A | FC | | |
| 2.4.3.1 | Tightly coupled and single-project programs (regardless of life-cycle cost) and projects (with an estimated life-cycle cost greater than $250 million) shall provide a range of cost and a range for schedule at KDP 0/KDP B, each range (with confidence levels identified for the low and high values of the range) established by a probabilistic analysis and based on identified resources and associated uncertainties by fiscal year. | CAD | X | | | A | FC | | |
| 2.4.3.2 | At KDP I/KDP C, tightly coupled and single-project programs (regardless of life-cycle cost) and projects (with an estimated life-cycle cost greater than $250 million) shall develop a resource-loaded schedule and perform a risk-informed probabilistic analysis that produces a JCL. | CAD | X | | | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| 2.4.4 | Mission Directorates shall plan and budget tightly coupled and single-project programs (regardless of life-cycle cost) and projects (with an estimated life-cycle cost greater than $250 million) based on a 70 percent joint cost and schedule confidence level or as approved by the Decision Authority. | CAD | X | A | | | FC | | |
| 2.4.4.1 | Any JCL approved by the Decision Authority at less than 70 percent shall be justified and documented. | CAD | X | A | | A | FC | | |
| 2.4.4.2 | Mission Directorates shall ensure funding for these projects is consistent with the Management Agreement and in no case less than the equivalent of a 50 percent JCL. | CAD | X | A | | | FC | | |
| 2.4.5 | Loosely coupled and uncoupled programs are not required to develop program cost and schedule confidence levels. These programs shall provide analysis that provides a status of the program's risk posture that is presented to the governing PMC as each new project reaches KDP B and C or when a project's ABC is rebaselined. | OCE | X | A | | A | FC | | |
| 3.3.1 | Programs and projects shall follow the Technical Authority process established in Section 3.3 of this NPR. | OCE | X | A | A | A | FC | | |
| 3.4.1 | Programs and projects shall follow the Dissenting Opinion process in this Section 3.4. | OCE | X | A | A | A | FC | | |
| 3.5.1 | Programs and projects shall follow the tailoring process in this Section 3.5. | OCE | X | A | A | A | FC | | |
| 3.5.5 | A request for a permanent change to a prescribed requirement in an Agency or Center document that is applicable to all programs and projects shall be submitted as a "change request" to the office responsible for the requirements policy document unless formally delegated elsewhere. | OCE | X | A | A | A | FC | | |

| Para # | NPR 7120.5 Requirement Statement | Require-ment Owner | Tailor | MD AA | CD | PM | Com-ply? | Justification | Approval |
|---|---|---|---|---|---|---|---|---|---|
| 3.6.1 | A Center negotiating reimbursable space flight work with another agency shall propose NPR 7120.5 as the basis by which it will perform the space flight work. | OCE | X | | A | A | FC | | |
| 3.7.1 | Each program and project shall perform and document an assessment to determine an approach that maximizes the use of SI. | OCE | X | | | A | FC | | |

Legend: A: Applicable; FC: Fully Compliant; T: Tailored; NA: Not Applicable

# APPENDIX D – PROGRAM REFERENCE DOCUMENTS

| | |
|---|---|
| | NASA Space Flight Program and Project Management Handbook |
| | SMD Management Handbook |
| | Environmental Quality Regulations, 40 CFR Parts 1500-1508 |
| | The National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq. |
| | Executive Order 12114 (14 CFR part 1216.321) |
| FAR supplement 1872.308 | NASA Federal Acquisition Regulations (FAR) supplement |
| ITAR, 22 CFR 120-130, et seq | International Traffic in Arms Requlations |
| ANSI/EIA-748 | Standard for Earned Value Management Systems |
| MPR 1600.1 | MSFC Security Procedural Requirements |
| MPR 7120.1 | MSFC Engineering and Program/Project Management Requirements |
| NPD 1000.0 | NASA Governance and Strategic Management Handbook |
| NPD 1440.6 | NASA Records Management |
| NPD 1600.2 | NASA Classified National Security Information (CNSI) |
| NPD 2200.1 | Management of NASA Scientific and Technical Information |
| NPD 2810.1 | NASA Information Security Policy |

| | |
|---|---|
| NPD 7120.4 | NASA Engineering and Program/Project Management Policy |
| NPD 7120.6 | Knowledge Policy on Programs and Projects |
| NPD 7500.1 | Program and Project Life-Cycle Logistics Support Policy |
| NPD 8700.1 | NASA Policy for Safety and Mission Success |
| NPR 8735.2 | Management of Government Quality Assurance Functions for NASA Contracts |
| NPR 1040.1 | NASA Continuity of Operations (COOP) Planning Procedurals Requirements |
| NPR 1441.1 | NASA Records Retention Schedules |
| NPR 1600.1 | NASA Security Program Procedural Requirements |
| NPR 2190.1 | NASA Export Control Program |
| NPR 2200.2 | Requirements for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information |
| NPR 2810.1 | Security of Information Technology |
| NPR 7120.5 | NASA Space Flight Program and Project Management Processes and Requirements |
| NPR 7120.9 | NASA Product Data and Life-Cycle Management (PDLM) for Flight Programs and Projects |
| NPR 7123.1 | NASA Systems Engineering Processes and Requirements |
| NPR 7150.2 | NASA Software Engineering Requirements |

| | |
|---|---|
| NPR 8000.4 | Agency Risk Management Procedural Requirements |
| NPR 8020.12 | Planetary Protection Provisions for Robotic Extraterrestrial Missions |
| NPR 8580.1 | NASA National Environmental Policy Act Management Requirements |
| NPR 8705.4 | Risk Classification for NASA Payloads |
| PMP-PLAN-003 | Planetary Missions Program Data Management Plan |
| PMP-PLAN-004 | Planetary Missions Program Risk Management Plan |
| PMP-PLAN-005 | Planetary Missions Program Education Plan |
| PMP-PLAN-006 | Planetary Missions Program SMA Implementation Plan |
| PMP-PLAN-007 | Planetary Missions Program Communications Plan |
| PMP-RQMT-002 | Planetary Missions Program Safety & Mission Assurance Guidelines and Requirements |
| SAE AS9100 | Quality Management Systems Requirements for Aviation, Space and Defense Organizations |

# APPENDIX E – FUNCTIONAL ASSIGNMENTS FOR THE PLANETARY PROGRAMS (UNCOUPLED)

| Program Management Function: Management | Planetary Programs | | Notes |
|---|---|---|---|
| | PO | PSD | |
| Communicate project performance issues and risks to Mission Directorate management and present recovery plans | | X | PO communicates issues and risks to PSD Management. PSD has the lead to communicate project issues with Mission Directorate Associate Administrator (MDAA). The PO supports PSD as needed in reporting to MDAA. |
| Conduct planning, etc. to support the MDAA in initiating the project selections process | | X | For AO-selected missions, PSD has the lead to work Phase A. PSD works directly with the MDAA in implementing the project selection process. The PO supports the selection process as directed by PSD (such as performing studies to assess the AO release dates, putting contract in place, shadowing the selection process for understanding of project risk, etc.) |
| Manage program resources | | X | PSD controls Program unallocated budget. PO controls PO budget to conduct oversight activities. PSD and PO conduct joint monthly Program Budget Review, to assess total program resources. |
| Maintain programmatic oversight of the projects and report their status periodically. | X | | PO function. PO provides programmatic oversight of projects. PO provide weekly notes and monthly report to PSD |

| Program Management Function: Management | Planetary Programs | | Notes |
|---|---|---|---|
| | PO | PSD | |
| Provide KDP recommendation on projects to AA | X | | PO provides a Program Office recommendation to AA at KDPs. PSD provides Division recommendation at KDPs. |
| Manage/direct Program contracts/task orders | X | | PO function. PO manages and directs Program contracts and task orders with missions. |
| Serve as NASA Point of Contact for Projects within the Program | X | | PO serves as NASA POC for Project direction within the Program. The PE/PS/ PA may contact the Projects for discussion and information. PE and MMs should work as a team and coordinate and focus project contacts when possible. Actions and direction to the Project go to the MM to work, except where PE has extenuating circumstances, such as urgent deadline (i.e. HQ needs answer the same day, etc.) and needs to work directly with the Project. |
| Represent Program at Project reviews or meetings | X | | Program Manager represents Program when present, except if Program Director is present. PD represents final authority (but polls PM and PE for inclusion in decisions). |
| Provide programmatic direction to projects within program | X | | PO has authority to issue direction to the Projects as needed. PO should make PSD aware of direction, as appropriate. |
| Assess/monitor project performance take action, as appropriate, to mitigate risks | X | | PO has authority to take action or provide project direction to mitigate risks. PO should make PSD aware of direction, as appropriate. |

| **Program Management Function: Management** | **Planetary Programs** | | **Notes** |
|---|---|---|---|
| | **PO** | **PSD** | |
| Conduct Monthly review with Projects | **X** | | PO has lead to conduct monthlies with Projects as necessary to assess/monitor performance and risks. |
| Establish project technical, schedule, and cost status reporting | **X** | | PO has lead to establish appropriate level and content of Project reporting to the Program. |
| Communicate project technical issues and risks with recovery plans to MDAA | | **X** | PO communicates through PSD. PSD has lead role to communicate with MDAA |
| Perform technical evaluation of proposed Mission Concepts | | **X** | PSD typically performs this using Phase A TMC process. PO supports as requested by PSD. |
| Direct Institution to perform technical evaluation of a project within the program | **X** | | PO Function |
| Perform program acceptance of resolution of high risk project technical issues | **X** | | PO has authority to conduct reviews and accept project technical assessments within the baseline. PO outbriefs PSD management on PO review and acceptance. PO to use discretion on when “high risk” requires PSD management prior to acceptance. |
| Direct project to perform special studies of high risk issues | **X** | | PO Function |
| Independently assess Project for technical risk | **X** | | PO Function |
| Maintain technical oversight of the projects | **X** | | PO Function |
| Assess program schedule performance | | **X** | PO provides inputs (such as launch frequency assessments) to PSD. PSD conducts final evaluation of program schedule performance. |
| Control Level 1 program schedule milestones | | **X** | PSD (HQ) Function |

| Program Management Function: Management | Planetary Programs | | Notes |
|---|---|---|---|
| | PO | PSD | |
| Control Level 1 Project Milestones (Launch Encounter, etc.) | | X | This is performed through the Program Level Requirements Appendix to the Program Plan. PO provides inputs and CM of document, SMD performs final approval. |
| Establish/recommend Program Schedule Milestones (AO release, directed project timing, etc.) | | X | PO performs studies of funding availability against program cost threats and projected new project cost profiles, and provides recommendations to PSD as to program level schedule. PSD establishes final program level milestones (i.e. AO release dates). |
| Assess monthly Project Schedule Performance | X | | PO Function |
| Assess Project Schedule for overall implementation strategy and credibility | X | | PO Function |
| Establish/Control significant Project Schedule Milestones | X | | PO coordinates with Project and approves milestone dates that are not Level 1 controlled PLRA. |
| Program budget strategic planning | | X | PSD (HQ) function |
| Final Decisions and recommendations to MDAA | | X | PSD (HQ) function |
| Assess program level cost performance | | X | PSD (HQ) leads this function. PO supports with data and analysis. PSD and PO conduct joint quarterly Program Budget Review of entire Program |
| Manage program reserves | | X | PSD controls Program unallocated budget. PO supports with data and analysis. PSD and PO conduct joint quarterly Program Budget Review of entire Program. PO provides recommendations on the application/usage of the Program unallocated budget. |

| Program Management Function: Management | Planetary Programs | | Notes |
|---|---|---|---|
| | PO | PSD | |
| Assess total program liens and threats | | X | PSD collects total Program liens and threats. PO identifies Project and Program liens and threats related to mission implementation. PSD and PO conduct joint quarterly Program Budget Review of entire Program |
| Establish funding priorities between projects | | X | PSD makes final decisions. PO has involvement and input into establishing priorities |
| Perform Risks and Trades Analysis of Program budget impacts | X | | PO performs analysis using PSD supplied guidelines and cost data. |
| Gather all budget inputs and prepare annual program budget submission input | | X | PSD collects budget data for the entire Program. PO submits data for Project in Phase A – F, as required.. |
| Perform cost studies to recommend AO release timing or directed project start dates | X | | PO Function |
| Perform independent cost evaluations of poorly performing projects | X | | PO Function |
| Independently assess Project for liens and threats, track those with Program Impacts | X | | PO Function. PO provides assessments to PSD. |
| Review and approve annual project budget submission inputs | X | | PO Function |
| Assess monthly Project cost performance | X | | PO Function |
| Gather project data and PPBE inputs | X | | PO Function |
| Coordinate and integrate Project cost phasing annual bypass plans. | X | | PO Function |

| Program Management Function: Management | Planetary Programs | | Notes |
|---|---|---|---|
| | PO | PSD | |
| Accept program risks | | X | PSD Function. PO supports with data as required. |
| Perform risk assessment of Program & conduct activities to mitigate | X | | PO Function |
| Utilize Program resources to assist in mitigation of Project risks | X | | PO Function. PO uses combination of existing office core support staff and modulated technical support to assist Project in mitigating risks. |
| "Accept" Project risks | X | | PO has authority to review and accept risks within the baseline. PO outbriefs PSD management as appropriate. PO uses discretion on when "high risk" requires PSD management agreement prior to acceptance. |
| Independently assess Projects for risks | X | | PO Function |
| Assess adequacy of project risk mitigation plans | X | | PO Function |

# APPENDIX F – PLANETARY MISSIONS AND PROGRAM LEVEL REQUIREMENTS APPENDICES

**Table 2. Discovery Program Missions**

| Mission No. | Discovery Project Name | Mission Type[1] | Mission Objective | Launch Date | Implementing Organization |
|---|---|---|---|---|---|
| 1 | NEAR | FM | Answer fundamental questions about the nature and origin of asteroids and comets over a one-year period | Feb 1996 | APL |
| 2 | Mars Pathfinder | FM | Demonstrate a low-cost method of delivering science instruments and a free-ranging rover to the surface of Mars | Dec 1996 | JPL |
| 3 | Lunar Prospector | FM | Provide insights into lunar origin and evolution and determine whether or not water ice is present in the Moon's polar regions | Jan 1998 | NASA/ARC |
| 4 | Stardust | FM | Recover and analyze from Comet Wild 2 more than one thousand particles larger than 15 microns in diameter, and particles of interstellar dust, to gain insights into evolution of the Sun and planets | Feb 1999 | JPL |
| 5 | Genesis | FM | Collect material from solar wind for 26 months, return sample to Earth to compare the Sun's composition against known planetary composition data sets | Aug 2001 | JPL |
| 6 | CONTOUR | FM | Encounter and study two very different comets from as close as 60 miles to take high resolution pictures, analyze gas and dust in the near-nucleus environment, and determine the comet's precise orbit, to improve knowledge of key characteristics of comet nuclei and assess their diversity | Jul 2002 | APL |

| | | | | | |
|---|---|---|---|---|---|
| 7 | MESSENGER | FM | Perform multiple flybys and one year of orbit of Mercury to provide opportunities for global mapping and detailed characterization of the surface, interior, atmosphere, and magnetosphere | Aug 2004 | APL |
| 8 | Deep Impact | FM | Excavate a deep crater in a comet nucleus to observe the gasses that are released and how the crater forms to provide important information about the composition and structure, and add new data to that of other missions that study the surface layers and coma of comets and asteroids | Jan 2005 | JPL |
| 9 | Dawn | FM | Understand the conditions and processes in place at the beginning of solar system formation, and gain new understanding of the role of water in asteroid evolution | Sept 2007 | JPL |
| 10 | Kepler | FM | Explore the structure and diversity of planetary systems, emphasizing the detection of Earth-size planets. Survey the extended solar neighborhood to detect and characterize terrestrial and larger planets in or near the "habitable zone," the distance from a star where liquid water can exist on a planet's surface, to yield a broad understanding of planetary formation, frequency of formation, structure of individual planetary systems, and characteristics of stars with terrestrial planets. | Mar 2009 | JPL/ARC |
| 11 | GRAIL | FM | Understand the internal structure and thermal evolution of the Moon in order to provide key information on the origin and evolution of that body as well as all terrestrial planets in the early stages of the solar system history | Sept 2011 | JPL |
| 12 | InSight | FM | InSight investigates the interior structure and processes of Mars, relating these to the evolution of all rocky planets, and determines its present level of tectonic activity and | | JPL |

| | | | | | |
|---|---|---|---|---|---|
| | | | impact flux. InSight reveals the processes of formation and differentiation of the martian core and crust, and illuminates the evolution of its interior. | | |
| | Netlander | MO | Deploy the first extraterrestrial geophysical network on the surface of Mars, composed of four identical landers. Acquire information about the planet at a global scale: internal structure, meteorological studies, and geodesy. | | |
| MO-1 | ASPERA-3 | MO | Instrument carried on ESA's Mars Express. Study the interaction between the solar wind and the atmosphere of Mars and characterize the plasma and neutral gas environment in the near-Mars space. Use Energetic Neutral Atom (ENA) imaging to visualize the charged and neutral gas environments around Mars | June 2003 | Southwest Research Institute |
| MO-2 | Moon Mineralogy Mapper | MO | Instrument carried on ISRO's Chandrayaan-1 mission to the Moon. Characterize and map the lunar surface composition in the context of its geologic evolution. Evaluate primary crustal components and their distribution across the highlands. Characterize the diversity and extent of different types of basaltic volcanism. Map fresh craters to assess abundance of small impacts in the recent past. Identify and assess deposits containing volatiles. Identify and evaluate concentrations of unusual/unexpected minerals | October 2008 | JPL |
| MO-3[2] | EPOXI | MO | Reuse of the Deep Impact spacecraft bus. Observe several nearby bright stars (65 to 650 light-years) to characterize properties of known orbiting giant planets and search for smaller Earth-sized planets. Measure the mid-infrared spectrum of the Earth to provide comparative data for | N/A | JPL |

| | | | | | |
|---|---|---|---|---|---|
| | | | future efforts to study the atmospheres of extrasolar planets. Continue comparative studies based on multiple comet discoveries (such as by Deep Impact at comet Tempel 1) by visiting comet Hartley-2. | | |
| MO-4[2] | Stardust/NExT | MO | Reuse of the Stardust spacecraft bus. Fly within 200km of comet Tempel 1 to complete the exploration of this important comet initiated by Deep Impact. Provide additional information on layering and flow features discovered by the Deep Impact mission. Document the surface changes on a comet nucleus between successive perihelion passages and due to the Deep Impact experiment. Measure with identical instruments the dust properties of two comets (Wild 2 and Tempel 1) | N/A | JPL |
| MO-5[3] | Strofio | MO | Strofio is a scientific instrument carried on the European Space Agency (ESA) BepiColombo mission to the planet Mercury. Strofio is part of the SERENA instrument suite. Strofio addresses the scientific questions:<br>What is the composition of Mercury's exosphere?<br>How do Mercury's exosphere and magnetosphere interact?<br>How do Mercury's exosphere and surface interact?<br>What is the composition of Mercury's surface? | | SwRI |
| EM-1[4] | LRO | EM | LRO advances lunar and planetary science with targeted investigations of geologically recent and current processes at the Moon. | June 2009 | GSFC |

[1]FM- Full Planetary Mission; MO- Mission of Opportunity; EM- Extended Mission
[2]EPOXI and NExT MOs selected at the same time, from Discovery AO 2006
[3]Strofio selected from Stand Alone Mission of Opportunity Notice (SALMON) 2008 AO
[4]Lunar Reconnaissance Orbiter completed its Exploration mission, transitioned to SMD (Lunar Quest) for Science in 2012, and placed in Discovery in 2014

**Table 3. New Frontiers Program Missions**

| Mission No. | New Frontiers Project Name | Mission Type[1] | Mission Objective | Launch Date | Implementing Organization |
|---|---|---|---|---|---|
| 1 | New Horizons | FM | Characterize geology, surface composition, and the atmosphere of Pluto | January 2006 | APL |
| 2 | Juno | FM | Understand the origin and evolution of the gas giant planet, Jupiter, which will pave the way to a better understanding of our solar system and other planetary systems. | August 2011 | JPL |
| 3 | OSIRIS-REx | FM | The OSIRIS-REx mission will return the first pristine samples of carbonaceous material from the surface of a primitive asteroid. OSIRIS-REx's target asteroid is (101955) 1999 RQ36 (recently named "Bennu") | | GSFC |

[1]FM- Full Planetary Mission; MO- Mission of Opportunity; EM- Extended Mission

**Table 4. Solar System Exploration Program Missions**

| Mission No. | Solar System Exploration Project Name | Mission Type[1] | Mission Objective | Launch Date | Implementing Organizations |
|---|---|---|---|---|---|
| 1 | JUICE-UVS | MO | JUICE Missions of Opportunity are scheduled to fly on a European Space Agency JUpiter ICy moons Explorer; UVS – UltraViolet imaging Spectrograph | | Southwest Research Institute |

| | | | | | |
|---|---|---|---|---|---|
| 2 | JUICE-JEPI | MO | JUICE Missions of Opportunity are scheduled to fly on a European Space Agency JUpiter ICy moons Explorer; JEPI - Jovian Energetic Particle Investigation | | APL |
| 3 | JUICE-RIME | MO | JUICE Missions of Opportunity are scheduled to fly on a European Space Agency JUpiter ICy moons Explorer. RIME – Radar for Icy Moon Explorer | | JPL |
| 4 | Europa | FM | Mission to Europa | | JPL |

[1]FM- Full Planetary Mission; MO- Mission of Opportunity; EM- Extended Mission