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

VP53

PROGRAM PLAN
DISCOVERY PROGRAM

September 16, 2008

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1.1 INTRODUCTION

The Discovery Program is a science program of frequent, mid-class spacecraft missions that will perform high-quality focused scientific investigations. Initiated in 1992, the Discovery Program was defined to ensure frequent access to space for planetary system(s) science investigations, emphasizing missions that can be accomplished under the leadership of the scientific research community.

The Program comprises a long-term series of space science missions that are independent and uncoupled, but share a common funding and management structure. Since its inception, Discovery has successfully completed missions to study the moon, inner planets, asteroids, comets, and solar wind. Missions or missions of opportunity currently in development or operations will continue exploration of the inner, outer, and dwarf planets, comets, and extra-solar planetary systems.

The missions are selected through an open science competition and can include any science investigation involving solar system objects, except for the Earth, the Sun, and Mars, which are currently covered by other programs. The Discovery Program includes the following two classes of projects:

> **Discovery Missions** – These Principal Investigator (PI)-led projects are complete, self-standing, and uncoupled Science Mission Directorate (SMD) investigations. The total cost to the National Aeronautics and Space Administration (NASA) for each Discovery mission has a not-to-exceed cost cap ($425M in the 2006 Announcement of Opportunity (AO)) to cover the complete mission, including spacecraft development, mission operations, data analysis, and education and public outreach.
>
> **Missions of Opportunity (MO)** – Also PI-led, these projects are characterized by being an element of another non-Discovery mission of any size, or reusing existing NASA space assets in Phase E. MOs are conducted on a no-exchange-of-funds basis with the organization sponsoring the mission. MOs have a not-to-exceed total cost to NASA ($35M in the 2006 AO). NASA intends to solicit proposals for MOs through a separate AO process starting in late 2008.

Program level requirements for each project are approved by the SMD at the time of project confirmation, prior to the start of project implementation. The PI for each Discovery project is responsible for the overall success of the project, and is accountable to the Associate Administrator (AA) for SMD for the scientific success and to the Discovery Program Manager for the programmatic success.

The Discovery Program is currently in the implementation phase. The Program has an approved Program Commitment Agreement (PCA). The Discovery Program missions approved for implementation as of October 2008 are summarized in Appendix E.

1.2 GOALS AND OBJECTIVES

The Discovery Program is designed to accomplish frequent, high-quality planetary science investigations, using innovative and efficient management approaches. The Program's prime objective is to enhance our understanding of the solar system as it is today and of solar system formation and evolution. In the process, it seeks to contain total mission cost and development time, and improve performance through the use of validated new technology and through commitment to, and control of, design, development and operations costs. Also, it seeks to enhance public awareness of, and appreciation for, space exploration and to incorporate educational and public outreach activities as integral parts of space science investigations.

The Discovery Program directly supports the Agency's Vision and Strategic Plan as they are articulated in the SMD Science Plan. The SMD Science Plan addresses Goal 3 of the Strategic Plan: "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration." The Discovery Program is focused on the Planetary Science discipline of the SMD Science Plan. The Discovery Program solicits only those investigations which lead to flight projects that investigate planetary science, addressing five fundamental questions in planetary science with the program objectives. Figure 1 illustrates the mapping of Discovery Program objectives to the NASA Strategic Plan and the SMD Science Plan.

In pursuing these objectives, the Discovery Program strives to produce the following outcomes:

- Advancement in scientific knowledge and exploration of the elements of our solar system and other planetary systems;
- Addition of scientific data, maps, and other products to the Planetary Data System archive for all scientists to access;
- Announcement of scientific progress and results in the peer-reviewed literature, popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics;
- Expansion of the pool of well-qualified PIs and project managers for implementation of future missions in Discovery and other programs, through current involvement as co-investigators and other team members;
- Implementation of technology advancements proven in related programs.

Section 2.1 identifies the performance measures for confirming the success of the Discovery Program.

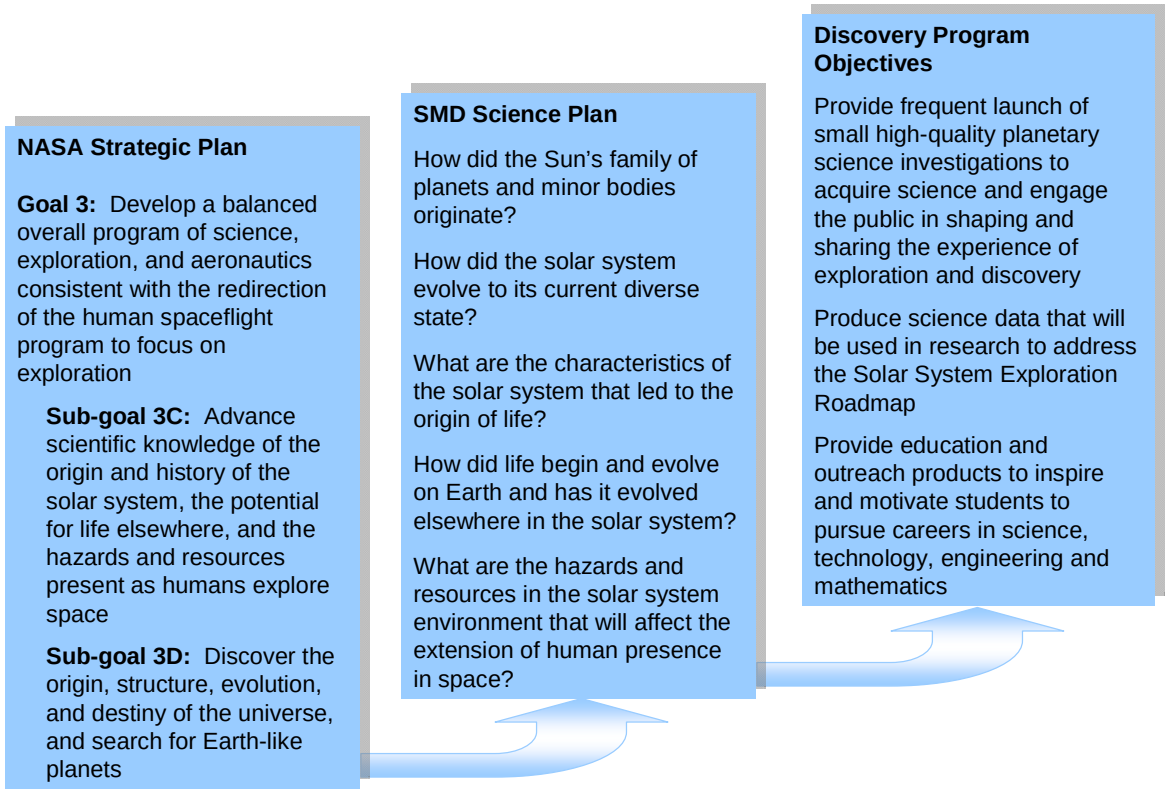

FIGURE 1. DISCOVERY PROGRAM OBJECTIVES

1.3 PROGRAM ARCHITECTURE

Discovery is an uncoupled program composed of a long-term series of space science projects that are independent, but share a common funding and management structure. Each project operates independently in achieving its unique set of mission scientific objectives, which directly contribute to the Program objectives. Because the Program is uncoupled, it does not drive specific requirements for the use of legacy systems, other than such common items as the Planetary Data System (PDS), Deep Space Network (DSN), or use of Expendable Launch Vehicles (ELVs). Individual projects may elect in their proposals to use legacy systems, such as ground command systems, to reduce risk and cost. Projects identify their proposed use of legacy systems during the program's mission proposal and selection process.

Mission description, planned mission results, and data analysis and archiving are documented for each project in the Program in the applicable Program Level Requirements Appendix (PLRA), which is attached to this Program Plan. Each PLRA also addresses each mission cost cap, launch window, required launch vehicle provider, mission planetary constraint, and foreign partners involvement.

1.3.1 RELATIONSHIP TO OTHER NASA ORGANIZATIONS

Launch Services

Discovery mission investigations are typically launched as a primary payload on an ELV. ELVs may either be provided by NASA with NASA funding or by the proposer as a contribution under a cooperative agreement. Each Discovery AO describes the launch vehicle appropriate for the mission classes included in the announcement.

NASA-procured standard ELV launch services are included as specified in the applicable AO. The Kennedy Space Center (KSC) has been designated as the lead Center for the acquisition and management of ELV launch services.

Space Communications

Use of NASA's Ground Network, Space Network, or Deep Space Network may be proposed as appropriate for Discovery missions. Most spacecraft operating in deep space will require use of the DSN, managed by the Jet Propulsion Laboratory (JPL), for navigation, tracking, control, and/or communication services.

Langley Research Center Science Support Office

The Langley Research Center (LaRC) Science Support Office (SSO) performs the following functions for the Discovery Program:

- Assist SMD with the preparation and issuance of AOs;
- Support the evaluation of proposals by conducting reviews of technical, management, cost and other programmatic factors;
- Conduct independent assessments of ongoing missions, when requested; and
- Conduct confirmation assessment reviews, when requested.

Glenn Research Center

Innovative technology solutions, several of which have be developed by Glenn Research Center (GRC), may be made available within proposal opportunities for use by individual Discovery projects if they enable accomplishment of their proposed mission. If individual projects propose use of these new technology solutions as offered in a specific AO, such as advanced ion engines or a new Radioisotope Power System (RPS), it may offered as Government Furnished Equipment (GFE) by NASA through the appropriate program office at GRC, or by the Department of Energy in the case of RPS systems. The costs of the devices would still be included as part of the overall mission costs to NASA/SMD.

1.3.2 RELATIONSHIP TO EXTERNAL ORGANIZATIONS

Individual projects may require external agreements with respect to other US agency, foreign entity, industry, and academia participation in the project. These external agreements for all

Discovery projects are generated when necessary and referenced in the Program Level Requirements Appendix (PLRA) to the Discovery Program Plan.

Department of Energy (DOE)

Individual projects may require the use of smaller radioactive sources, such as ASRGs, radioisotope heater units (RHUs), or radioactive material sources for science instruments. If radioactive sources are proposed for a mission that is selected and confirmed, the radioactive sources are provided by NASA as government-furnished equipment (GFE) from the Department of Energy (DOE).

The relationship between NASA and the DOE is documented in a Memorandum of Understanding (MOU), dated July 26, 1991. The Mission Program Executive at NASA Headquarters (HQ) is responsible for establishing a relationship with the DOE and working any supplemental agreements with the DOE required by a mission. Under these agreements, technical interchanges can be worked directly between Project/Program personnel and DOE personnel/contractors.

Industry and Academia

Individual projects may require contracts or agreements with respect to industry and academia involvement in the mission. These contracts/agreements typically address spacecraft development/operations, instrument development/operations, PI or Co-PI contracts, and/or data analysis. Any agreement or contract which is central to achieving the mission is referenced in the Program Level Requirements Appendix to the Discovery Program Plan.

1.4 STAKEHOLDER DEFINITION

The Discovery Program stakeholder base is centered in the space science community (especially within the planetary science community) representing the space science themes included in the Planetary Science Division, excluding Mars. Other major stakeholders include other elements of the Science Mission Directorate, the sponsor of the program.

Discovery Program stakeholder advocacy is achieved through interactions between the Science Mission Directorate and the science community. These interactions involve the NASA SMD scientific advisory committees, scientific conferences and meetings, and day-to-day contacts by Discovery program and discipline scientists resident in the SMD. Each Discovery mission has a PI (and may also have a project scientist at the implementing organization) who provides the primary science community interface for that specific project.

Contact between the Discovery Program Manager at the Marshall Space Flight Center (MSFC) and the science community is typically through the selected PIs, the Discovery Lead Program Scientist, and Mission Program Scientists, advisory committees, AO pre-proposal conferences, scientific meetings, and periodic workshops to solicit feedback on Program processes and Program effectiveness.

Program Office advocacy with the Science Mission Directorate is achieved through monthly reporting and interaction with the Program Director, Lead Program Executive, and Lead Program Scientist.

1.5 PROGRAM AUTHORITY, MANAGEMENT APPROACH, AND GOVERNANCE STRUCTURE

At a high level all Program Implementation, as described within NPR 7120.5, is common and identical. Details begin to vary between program implementation approaches as each lower level is reviewed. The same is true for projects managed within the Discovery Program.

General top level roles and responsibilities of the key program participants are covered in NPR7120.5, as further detailed in Science Mission Directorate Management Handbook dated February 8, 2008 (Section 5). This section of the Discovery Program plan serves to summarize, clarify, or supplement the above documents to provide a clearer understanding of the governance structure for the specific implementation of the Discovery Program. To further ensure effective day-to-day implementation of this uncoupled Program, Appendix D provides a matrix of specific lower-level real-life implementation roles and responsibilities for the Discovery program.

1.5.1 DISCOVERY PROGRAM AUTHORITY

The Agency Program Management Council (PMC) is the governing PMC for the Discovery Program, while the Science Mission Directorate PMC governs the management of the individual projects within the Program.

The Discovery Program management structure consists of three principal levels of authority:

1. Scientific and strategic management within SMD (science/mission selection);
2. Discovery program management at MSFC (program implementation);
3. Management of individual Discovery missions by their respective PI-led project teams.

The SMD/AA is nominally the Selecting Official and the decision authority for individual projects of the Discovery Program, unless precluded from doing so because of conflicts of interest. The SMD/AA has established the Discovery Program Director at NASA Headquarters as the senior Agency official who serves as the SMD focal point for Discovery scientific and strategic management.

Program Management responsibility for implementation has been assigned to the Discovery Program Office, located at the Marshall Space Flight Center (MSFC). Program authority is delegated from the SMD/AA through the Planetary Science Division (PSD) Director to the PSD Discovery Program Director to the Discovery Program Manager at MSFC. The Program Manager performs NPR 7120.5, NASA Space Flight Program and Project Management Requirements, responsibilities. The Discovery Program Manager at MSFC serves as the single point of contact at MSFC for the Discovery Program. The MSFC Center Director is responsible for ensuring that Center resources required to execute the MSFC effort on the Program are provided.

Management authority for each Discovery Mission is assigned to the respective PI. Each PI has responsibility for the overall success and safety of his/her mission and is accountable to the SMD/AA for the scientific success and to the MSFC Program Manager for the programmatic 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 and Project Manager.

Figure 2 illustrates the Discovery Program management structure, including the relationships between the key program participants; Figure 3 illustrates the Discovery Program Office organization at MSFC.

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

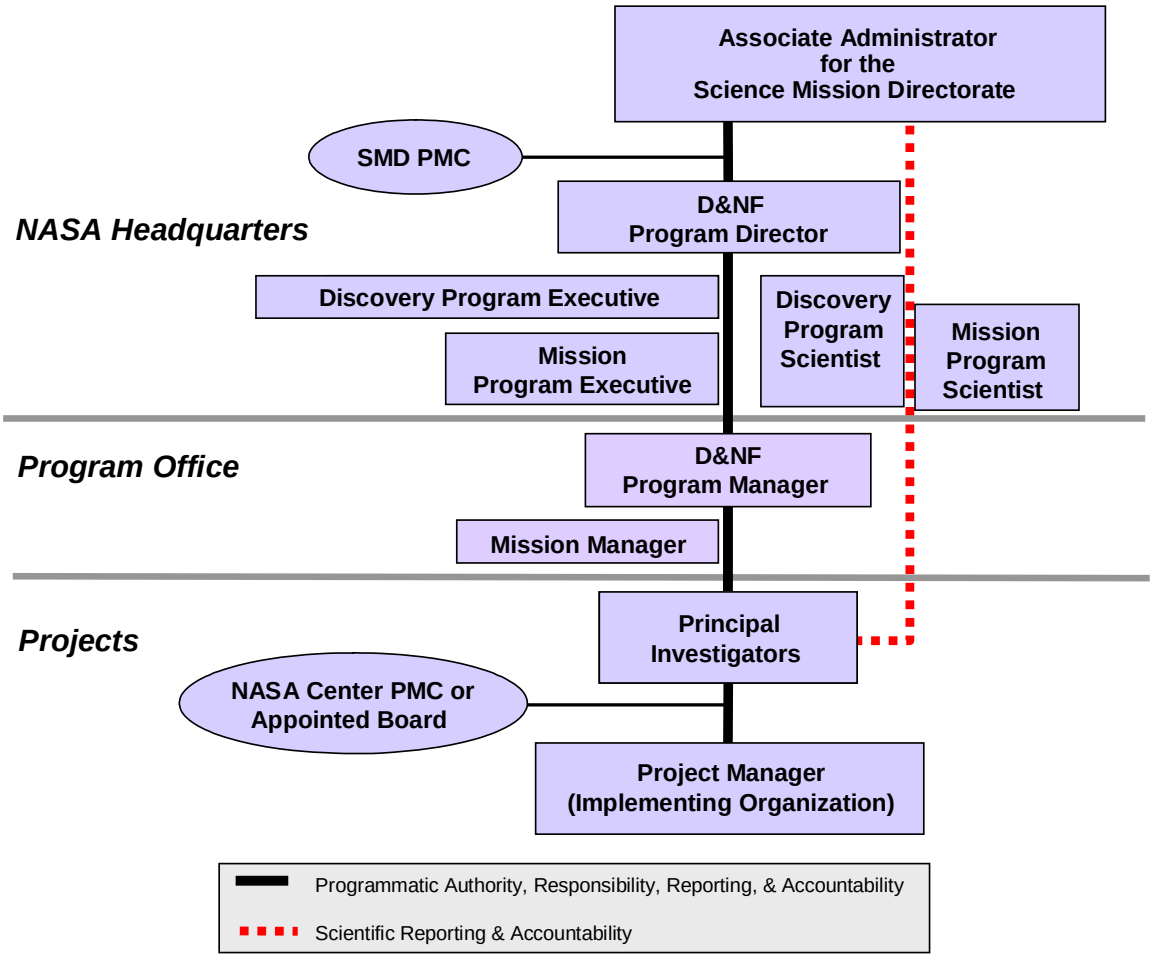

FIGURE 2. DISCOVERY PROGRAM ORGANIZATION

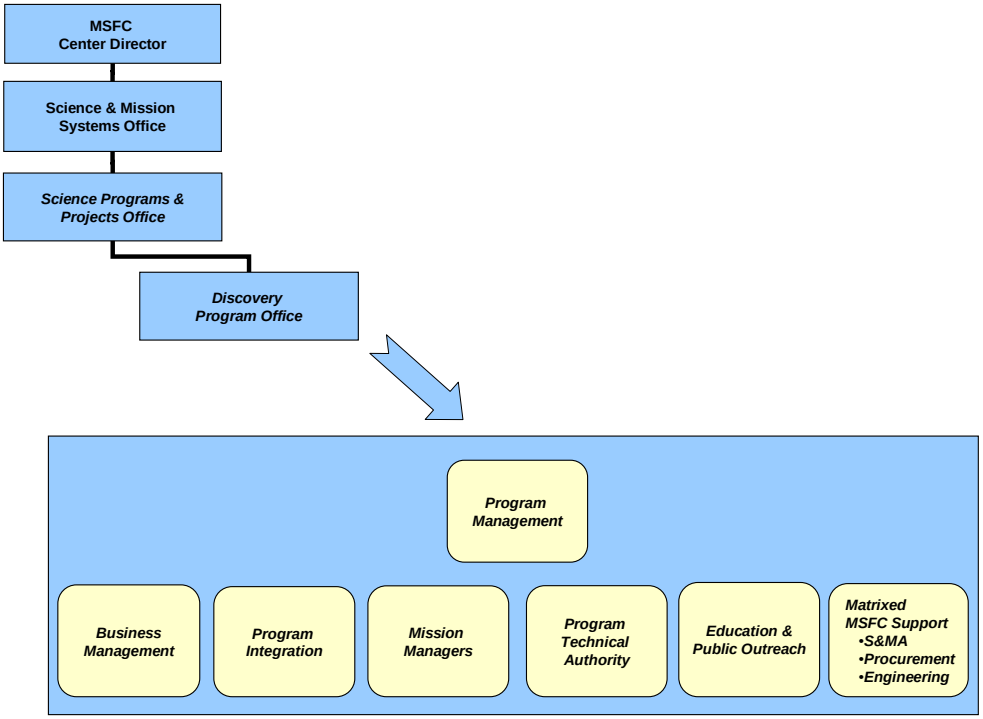

FIGURE 3. DISCOVERY PROGRAM OFFICE AT MSFC

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 Program within the Solar System Exploration theme. The SMD/AA has final authority and responsibility for the Discovery Program.

Discovery Program Director

The Discovery Program Director (PD) in NASA's Science Mission Directorate is the senior official with focused responsibility for the Discovery Program. The Program Director is located in the Planetary Science Division of SMD. The Program Director has overall responsibility for all phases of the Discovery Program and serves as the single focus for the Program within SMD. The Program Director's Roles and Responsibilities are discussed in detail in the NASA Headquarters Science Mission Directorate Management Handbook dated February 8, 2008. For the Discovery Program, these include but are not limited to:

- Establish program and project budgets consistent with division allocations;
- Authorize the total Discovery Program budget; and provide final budget decisions and recommendations to SMD AA;

- Submit Discovery technology needs into the SMD Technology Programs;
- Assess total Program Level cost performance; and
- Assess total Program liens and threats.

Discovery Lead Program Executive

The Discovery Lead Program Executive (PE) at NASA/HQ reports directly to the Program Director and resides administratively in the Planetary Science Division of SMD. The Lead PE's roles and responsibilities are discussed in general in the NASA Headquarters Science Mission Directorate Management Handbook dated February 8, 2008. For the Discovery Program, these include but are not limited to:

- Maintain the Discovery Program Commitment Agreement (PCA);
- Assist the Program Director with development and maintenance of the Program budget through interaction with the SMD and Program Office Resource Analysts;
- Assist the Lead Program Scientist (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;
- Work with the Lead PS to implement the Mission selection process and assignment of selected projects during Phase A (Step 1 and 2) to implementing organizations centers;
- Maintain cognizance of the program's health principally by exposure to reports from the program and project, monthly status, and major milestone reviews;
- Assess Program performance and provide course correction recommendations to the Program Director;
- Support the Program Manager in development of the Program Plan, especially on division policy matters, and interfaces 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..).

Discovery Mission Program Executive

The Discovery Mission PEs at NASA/HQ support the AA for SMD and the Program Director in defining, integrating, and assessing the activities of Discovery Projects. The Mission PE's roles and responsibilities are discussed in detail in the NASA Headquarters Science Mission Directorate Management Handbook dated February 8, 2008. For the Discovery Program, these include but are not limited to:

- Maintain cognizance of the project's programmatic health via regular contact with the project during implementation (Phase B, C, D, E), principally by exposure to reports from the project, monthly status and major milestone reviews, access to assessments coordinated by the Program Office, and ad hoc interactions deemed necessary to assess project performance.
- Facilitate the negotiation of content for agreements with external and international organizations;
- Facilitate the negotiation of content for agreements with other US agencies and organizations;
- In collaboration with the Mission PS, Program Office Mission Manager (MM), and PI, finalize development of the mission Program Level Requirements Appendix (PLRA) and prepare it for formal negotiation and final agreement;
- Participate in annual budget submission reviews with program office;
- Assess project technical, schedule, and cost performance and provide course correction recommendations to the Program Director and directorate management;
- Recommend or concur on chair, membership, and the Terms of Reference (ToR) for Standing Review Board (SRB) independent reviews;
- Prepare launch approval documentation (NEPA materials, contingency plan, approval letters, etc);
- Resolve project issues through the Discovery Program Office; and
- Coordinate project issues with other involved SMD divisions and with HQ Functional offices.

Discovery Lead Program Scientist

The Discovery Lead Program Scientist at NASA Headquarters reports directly to the Program Director and resides administratively in the Planetary Science Division of SMD. The Lead Program Scientist's roles and responsibilities are discussed in general in the NASA Headquarters Science Mission Directorate Management Handbook dated February 8, 2008. For the Discovery Program, these include but are not limited to:

- Manage the science selection process, including definition, timing, preparation, and issuance of Announcement of Opportunities (AOs); pre-proposal conferences; scientific and technical reviews of submitted proposals; and preparation for selection of Discovery investigations;
- Assembly and release of AOs and supporting documentation (assisted by the Lead PE and SSO)
- Manage the down select process, including Concept Study Kickoff, scientific and technical reviews, and preparation for down select of Discovery 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 Science Definition Teams and provide guidance; and
- Maintain traceability of completion of Mission Science objectives for the Program.

Discovery Mission Program Scientist

Discovery Mission Program Scientists at NASA/HQ are responsible to the AA for SMD 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 dated February 8, 2008. For the Discovery Program, these include but are not limited to:

- Collaborate with the Lead Program Scientist, Program Executive, Discovery Program Office, and the PI on the generation of the mission PLRA, particularly the Level 1 Requirements;
- Maintain regular contact with the Mission PI;
- Generate the solicitation for any mission participating scientists 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; and
- Work with the Mission PI to document completion of Mission Science objectives.

1.5.3 DISCOVERY PROGRAM OFFICE ROLES AND RESPONSIBILITIES

The Discovery Program Office at MSFC implements the program on behalf of SMD and within the guidance of the Discovery Program Director.

Discovery Program Manager

The Discovery Program Manager (PM) has responsibility for planning and implementation of the selected and approved Discovery Program consistent with top-level policies, strategies,

requirements, and funding established by NASA HQ. The Program Manager has programmatic management responsibility for Discovery mission project formulation, development, launch, on-orbit checkout, mission operations, and data analysis. The Program Manager is responsible for ensuring that the Discovery projects adhere to committed cost, schedule, and technical performance; reliability and safety requirements, and education and public outreach (E/PO).

The Program Manager's Roles and Responsibilities are discussed in detail in the NASA Headquarters Science Mission Directorate Management Handbook dated February 8, 2008. For the Discovery Program, these include but are not limited to:

- Implement the Discovery Program for the SMD-selected missions for Phase B, C, D, E and F;
- Ensure open communication with Discovery 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 Discovery 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 to support the projects;
- Manage the Discovery Program mission implementation budget. Develop detailed Program Operating Plans and Cost Phasing Plans for the implementation budget. Monitor distribution of funds to implementing organizations;
- Assess the Program for project liens and threats which could impact the Discovery Futures Budget;
- Assign a Program Office Mission Manager to each mission;
- Disposition mission flight and ground hardware;
- Certify program and project readiness to proceed past key decision points (KDPs);
- Provides an assessment of Jet Propulsion Laboratory (JPL) performance on JPL programs or projects as an input to the annual NASA Performance Evaluation of the JPL contract;
- Support SMD in the initiation and preparation of Discovery AOs; and
- Plan, coordinate, and implement an education and outreach program for the Discovery Program.

Discovery Program Chief Engineer

The Discovery Program Chief Engineer (CE) is assigned systems technical authority for communicating technical excellence and exercising technical authority for the Discovery

Program. The Discovery Program CE, in partnership with the Discovery Program manager, ensures an atmosphere of "checks and balances" within the Discovery program and projects. For projects assigned to NASA centers and JPL, the Technical Authority for these projects is delegated from the NASA Office of Chief Engineer directly to the engineering management at that center. For projects assigned to non-NASA centers, the Discovery Program CE has NASA technical authority. The Discovery Program CE responsibilities include:

- Ensure mission success and technical excellence through risk-based technical insight into the Discovery Projects;
- Monitor project execution and issue resolution;
- Serve as a review team member, as appropriate;
- Identify and utilize technical expertise from across NASA, industry and academia to support risk-based insight and resolve technical issues;
- For Discovery Projects assigned to NASA Centers and JPL, work to seek resolution of identified issues. If resolution of issue is not resolved at lower levels, the issue is communicated to the next level of Center or Agency technical authority; and
- For Discovery Projects assigned to non-NASA Centers, the Discovery 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 level of authority.

Discovery Mission Managers

Discovery Program Office Mission Managers function as the Program Manager's day-to-day point of contact and advocate 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 Managers responsibilities include:

- Serve as NASA point of contact (POC) for Projects within the Program to receive direction;
- Interface directly with the PIs and Project Managers 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;
- Perform independent assessments of projects to identify risks and mitigations:
- Identify project liens and threats that could result in mission cost cap breaches;

- Coordinate project funding requirements;
- Provide a monthly project assessment to the Program Executive;
- Serve as the Program Office representative between NASA, other U.S. government agencies, and foreign participants on behalf of assigned missions;
- Ensuring 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 Discovery Program and with the related PIs and Project Managers.

Discovery Program Safety and Mission Assurance Lead

The Discovery Program Safety and Mission Assurance (S&MA) Lead (i.e., Chief Safety and Mission Assurance Officer) is assigned systems S&MA authority for communicating S&MA excellence and exercising S&MA authority for the Discovery Program. The Discovery Program S&MA Lead, in partnership with the Discovery Program manager, ensures an atmosphere of "checks and balances" within the Discovery program and projects. For projects assigned to NASA centers and JPL, the S&MA authority for these projects is delegated from the NASA Safety and Mission Assurance Office directly to the S&MA group at that center. For projects assigned to non-NASA centers, the Discovery Program S&MA Lead has NASA S&MA authority. The Discovery Program S&MA Lead responsibilities include:

- Ensure mission success and safety through risk-based technical insight into the Discovery Projects;
- Monitor project execution and S&MA issue resolution;
- Serve as a review team member, as appropriate;
- For Discovery Projects assigned to NASA Centers and JPL, work to seek resolution of identified issues. If resolution of issue is not resolved at lower levels, the issue is communicated to the next level of Center or Agency S&MA authority; and
- For Discovery Projects assigned to non-NASA Centers, the Discovery Program S&MA Lead retains S&MA authority while working closely with the project S&MA organization to delegate an appropriate level of insight responsibility to the non-NASA center's S&MA authority. Any issues that are identified are resolved at the lowest level of authority.

1.5.4 PRINCIPAL INVESTIGATOR AND PROJECT MANAGER ROLES AND RESPONSIBILITIES

Overall responsibility for scientific integrity and mission success is vested with the PI for each Discovery mission. This individual is the lead scientist, and organizes the team or consortium that develops the mission concept, proposes it, and, if selected, implements the mission under the prescribed guidelines and constraints. The consortium may include members from one or more of the following: industry, Federally Funded Research and Development Centers (FFRDC), universities, nonprofit institutions and/or governmental organizations, such as NASA Centers. The PI chooses the management approach best suited to the mission design, skills/expertise of the team members, and resources.

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

Mission Project Managers are appointed by the implementing organizations with PI concurrence. Each Discovery Project Manager is responsible to the PI for the successful development and implementation of the mission. They report to their institutional management and programmatically through the Discovery Program Manager.

The Discovery 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 Discovery 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.

Each PI, working with the mission Project Manager, has the following specific responsibilities:

- Serve as a scientific spokesperson for the mission and for the scientific investigations;
- Assure dissemination of scientific results through professional publications and education and public outreach;
- Inform the Discovery 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 Discovery Program advocacy;
- Request NASA concurrence on key personnel changes occurring after Phase A down select;
- Plan, develop, and execute a mission to achieve its scientific requirements, within prescribed guidelines and constraints as defined in the PLRA and Project Plan;

- 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 Manager;
- Support independent assessments and confirmation reviews;
- Manage the mission budget. Identify and report liens and threats. Develop Planning, Programming, Budgeting, and Execution (PPBE) submittals and traces;
- Implement a safety and mission assurance program on the mission;
- Develop and implement a risk management process throughout the mission lifecycle. Assess and report project risks to the Discovery Program;
- Develop and maintain the mission Project Plan in accordance with NPR 7120.5;
- Develop and implement an education and public outreach activity for the mission, in coordination with the Discovery Program E/PO;

1.6 IMPLEMENTATION APPROACH

The Discovery Program is an uncoupled program with independent flight missions. Project initiation is targeted to support the Program launch frequency requirement and science goals and objectives, as stated in the Program Commitment Agreement (PCA) and within the availability of Program resource constraints. The Program has established an acquisition strategy that contracts for whole missions (concept through delivery of the science data and analysis). Discovery investigations are selected through the AO process, where multiple investigations are selected for Phase A Concept Studies with a competitive down select to proceed to the Phase B part of Formulation. A Confirmation Review (CR) with the Science Mission Directorate PMC is held at the end of Formulation, soon after the Preliminary Design Review (PDR), to determine whether to confirm the mission to enter Implementation. The NASA Decision Authority (DA) makes all final decisions to proceed to follow-on phases. Selection for Phase A Concept Study and down-selection constitute the KDP-A and KDP-B milestones of of NPR 7120.5 for Discovery Projects. The decision following the CR constitutes the KDP-C milestone of NPR 7120.5 for Discovery Projects.

NASA gives the PI and his/her team the ability to use their own management processes, procedures, and methods to the fullest extent practical. Therefore, proposers to a Discovery Program AO define the management approach (compliant with NPR 7120.5) 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

customized Work Breakdown Structure (WBS) that best fits its organizational approach and mission design concept.

2.0 PROGRAM BASELINE

2.1.1 PROGRAM REQUIREMENTS BASELINE

Discovery Projects are independently proposed and competitively selected PI-led missions, addressing planetary science themes under a common program funding/management structure. The Program requirements in this section are flowed into the acquisition process (AO) used to select missions. Once selected, the mission-specific requirements for each Discovery project are set forth in a PLRA to this document, approved by the PI, the Program Manager, and SMD. The PLRA constitutes the Level I requirements for each mission.

2.1.1.1 LAUNCH RATE

The Discovery Program shall launch an average of one mission per 24 months (threshold); the Discovery program should launch an average of one mission per 18 months (goal). This requirement is commensurate with the availability of adequate funding for new project starts and ongoing mission development and operations. This performance count does not include Discovery Missions of Opportunity. (The launch of Missions of Opportunity (MOs) is as appropriate, based on date selected, funding profiles, and expected launch dates for the host missions).

2.1.1.2 IMPLEMENTATION PHASE DURATION

The schedule for all Discovery missions shall be such that launch occurs as required in the appropriate Discovery Program AO, usually within 35 months from the start of Phase C (the project implementation phase). No constraint is placed on the total length of project formulation (Phase B) or mission operations and data analysis phases.

2.1.1.3 LAUNCH VEHICLE

Discovery Projects shall use a cost-effective, domestic, flight-proven Expendable Launch Vehicle (ELV). Each Discovery AO describes the launch vehicle details, appropriate options for access to space, and the approach for launch vehicle funding (within or outside the mission cost cap). Foreign launch vehicles may be utilized only if contributed by the foreign organization (on a no-exchange-of-funds basis) and the launch vehicle meets NASA quality and reliability standards. Purchase of foreign launch vehicles requires a Presidential waiver and is not a recommended option under the Discovery Program.

2.1.2 PROJECT REQUIREMENTS BASELINE

Program-level requirements specific to each project (science requirements, launch timeframe, and mission cost cap) shall be documented in the mission-specific PLRA. The following sections specify programmatic requirements levied on all Discovery projects. Additional requirements can be, and typically are, included in the AO used to select the mission.

2.1.2.1 PROJECT SCIENCE REQUIREMENTS

Discovery missions shall achieve their science requirements while meeting their mission-specific cost cap, as specified in their PLRA.

The technical success criteria for each mission is developed and documented in the PLRA as the Baseline Science Requirements and Threshold Science Requirements. Each mission-specific PLRA shall define both the baseline and the threshold science requirements based on the selected proposal and according to the following definitions:

- Baseline Science Requirements – That mission which, if fully implemented, accomplishes the entire set of scientific objectives identified at the initiation of the mission.
- Threshold Science Requirements – The minimum scientific requirements below which the mission is not considered justifiable for the proposed cost. Threshold science requirements are also referred to as minimum science requirements or science floor.

The PI shall have the flexibility to descope the project science requirements from the baseline to the threshold science requirements in incremental fashion as delineated in the approved proposal and Concept Study Report. These project descopes are a means for mitigating cost and schedule risks associated with cost-capped missions, and are documented in an update to the project PLRA. Projects without significant descope options during formulation and implementation may be considered to be higher risk.

The Discovery Program Manager, Mission Program Scientist, and Program Director shall concur on any descope before the option is exercised.

2.1.2.2 PROJECT COST REQUIREMENTS

All Discovery projects are cost-capped. The maximum allowable cost cap for each Discovery class mission is defined in the applicable AO. A not-to-exceed mission cost cap is established for each project through the proposal and formulation process, and formally documented at project confirmation.

The cost cap shall apply to the full life-cycle cost (LCC): formulation, implementation, launch and on-orbit checkout, Phase E operations, data analysis and archive, and closeout, for all elements needed by the mission.

The cost cap shall include all project-held reserves. Each mission is required to show a budget reserve posture at the end of phase B commensurate with the risk associated with the implementation of the mission. Typically, the overall budget reserve posture is no less than 25% of cost-to-go through the end of Phase D, excluding the cost of the ELV. An appropriate cost reserve for Phase E shall also be included;

Each mission shall allocate adequate funds (separate from PDS data archiving) to allow participation by the science community in mission data analysis. In addition, Participating Scientist Programs (PSPs), Data Analysis Programs (DAPs), or Guest Observer (GO) Programs are encouraged and supported by HQ.

Full cost accounting practices shall be used in developing the total cost to NASA.

The sum of external or foreign contributions of any kind to the entirety of the flight hardware for a Discovery Mission may not exceed one third (1/3) of the estimated total cost, in U.S. dollars, for that hardware.

2.1.2.3 PROJECT VERIFICATION AND VALIDATION

Performance of Discovery flight and ground elements shall be 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 shall be responsible for physical integration of the spacecraft with the launch vehicle, and for verifying the integrated system integrity. The project shall be 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) shall be accomplished in accordance with NPD 8730.4, Software Independent Verification and Validation Policy. While mission teams have the freedom to use their own processes, procedures, and methods to meet the requirements of NPR 7120.5, they must plan to obtain IV&V from the NASA IV&V Facility in Fairmont, West Virginia, for all flight and ground software.

2.1.2.4 PROJECT IMPLEMENTATION REQUIREMENTS

Each mission shall develop a mission-unique Project Plan that defines the approach to the implementation of the project.

Earned Value Management (EVM) shall be implemented for the Phase C & D development activities of all Discovery Missions, as required by EIA-748-A, NPR 7120.5 and NPD 9501.3. Due to the low total life cycle cost for Discovery MOs, EVM is not required for these projects.

Each Discovery Project shall have an effective safety and mission assurance (S&MA) program as required by NPD 8700.1, NASA Policy for Safety and Mission Success. This S&MA program shall include a quality assurance program that is consistent with the SAE AS9100, Quality Management Systems - Aerospace- Requirements – Technically Equivalent to AECMA prEN9100.

Each mission shall develop and submit a Project Safety and Mission Assurance Plan, which can be included in the Project Plan, for review which complies with DISC-RQMT-002, Discovery Program Safety and Mission Assurance Guidelines and Requirements. The plan shall include provisions for a Closed Loop Problem Reporting and Resolution System that provides a well-defined data collection system and process for hardware and software problem and anomaly reports, problem analysis, and corrective action. Projects that reside at institutions that currently have a NASA-approved S&MA program may utilize their own institutional practices in lieu of this document.

Missions of Opportunity shall be developed using their implementing organization's internal quality management system. The mission assurance requirements are tailored for each project as identified in the proposal submitted in response to the AO (or subsequently amended).

All Discovery projects shall comply with the applicable provisions of directives implementing NASA's planetary protection policy in NPD 8020.7, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft, and NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions. Discovery investigations shall follow established protocols that address forward and back contamination with respect to other solar system bodies per NASA Procedural Directive (NPD) 8020.7. The return of samples from certain target bodies may be subjected to rigorous containment and biohazard testing protocols in accordance with NASA Procedural Requirement NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions.

Each Discovery project shall prepare a science data management plan for approval by the PI, project scientist, and the SMD program scientist assigned to that project. Each PI-led Discovery mission or mission of opportunity science team shall be responsible for initial analysis of mission data, data delivery to the Planetary Data System (PDS), the publication of scientific findings, and communication of the results to the public. Each Discovery mission or Mission of Opportunity shall comply 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.

Each Discovery project shall prepare a final report documenting the status of the Level 1 requirements, identifying how science and technical requirements have been met by the execution of the mission.

Any new technology transfer, exchange, or partnership agreements for Discovery Projects shall comply with all laws and regulations regarding export control and the transfer of sensitive proprietary technologies, including the requirements of NPR 2190.1, NASA Export Control Program and the provisions of the ITAR, 22 CFR 120-130, et seq.

A portion of the total NASA SMD cost for the mission (excluding launch vehicles) shall be allocated to education and public outreach. The required E/PO support for a particular mission is specified in the AO. Discovery E/PO is coordinated at the Program level to leverage resources and increase efficiency.

2.2 WBS BASELINE

The Discovery Program is an uncoupled program and therefore does not implement a program level WBS baseline. The Projects, which are not integrated with each other, each develop and implement a customized WBS structure (in accordance with NPR 7120.5) that best fits their organizational approach and mission design concept.

2.3 SCHEDULE BASELINE

A summary schedule for the (uncoupled) missions of the Discovery Program is shown in Appendix E. This schedule is updated annually to reflect changes and to include new missions and/or missions of opportunity selections. The Planetary Science Division (PSD) at NASA/HQ SMD conducts the final evaluation of program schedule performance. The Program Office gives input to this evaluation (such as launch frequency assessments).

Each individual Discovery project develops and maintains an integrated master schedule for their project, 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 complete each task and meet the critical milestones.

2.4 RESOURCE BASELINE

Because the Discovery Program consists of a series of independent science missions, the Program resource and workforce levels adjust in accordance with the mission traffic model, which is based upon program budget constraints and the mission selection rate. As such, a benchmark plan does not exist. Appendix E contains the Discovery Program budget designated for implementation, along with the current mission traffic model phasing and workforce requirements. The total Program budget is updated annually as part of the NASA Planning, Programming, Budgeting, and Execution (PPBE) process. Project resource constraints and guidelines are provided by each AO.

Earned Value Management (EVM) is not performed at the integrated Program level, because of the autonomy of the Discovery Projects.

3.0 PROGRAM CONTROL PLANS

3.1 TECHNICAL, SCHEDULE, AND COST CONTROL PLAN

Each new Discovery project is validated for compliance with Discovery Program requirements through three processes: the selection/acquisition process; the mission requirement development process, and the mission project plan review and approval process. Once a Discovery project is selected for Phase B formulation, the Discovery Program Office provides frequent formal and informal communication with the projects to ensure continued compliance with Discovery Program requirements; timely identification of issues or areas of technical, schedule, or cost risk; and the application of appropriate mitigation or recovery activities. The following sections describe the processes involved at each of these steps.

3.1.1 MISSION EVALUATION AND SELECTION

Mission selection and acquisition is performed using an AO process, which is based upon the Discovery Program requirements and applicable NASA requirements. Each proposal is evaluated for compliance with the AO requirements along with science merit and technical, cost, and

schedule risk. As a result of the AO evaluation, one or more missions are selected for continued concept formulation (Phase A Concept Studies).

The product of the Phase A studies are Concept Study Reports (CSRs). 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 assessment of the Concept Study is similar to the proposal evaluation, but considers the increasingly detailed information provided. Past performance of the partners in the implementation of previous or current space missions, particularly cost capped missions such as NASA's Explorer or Discovery missions, is one of the factors used in assessing cost risk, schedule risk, and the risk of failure in technical performance. In addition, NASA may request in-person presentations and/or site visits to review the Phase A Concept Study with the investigation teams. As a result of the CSR evaluation, one or more missions are selected for preliminary design formulation (Phase B).

The AO development, AO proposal evaluation, and CSR evaluation processes are managed by the Lead PS, supported by the Lead PE and the LaRC SSO. However, a MM 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 the mission is selected for implementation.

3.1.2 MISSION REQUIREMENTS AND PROJECT PLANNING

Program-level requirements specific to each project (science requirements, launch timeframe, and mission cost cap) are documented in the mission-specific PLRA. The PLRA is drafted initially by the PI as part of the Concept Study Report, prior to downselect. An updated draft of the PLRA is provided by the mission PE to support the mission System Requirements Review (SRR). The mission PE coordinates the PLRA with the MM, mission PS, and PI with a goal of baselining the PLRA at SRR +30 days.

A unique project plan is developed for each Discovery mission that tailors institutional processes and defines the approach to the implementation of the project. The project plan is prepared by the PI/Implementing Organization. The project plan is evaluated for compliance with the requirements of NPR 7120.5 and this Program Plan. The evaluation also includes an assessment of project schedules for overall implementation strategy and credibility, project budgets through operations and data analysis, and the approach for contractor/subcontractor management and coordination. The project plan is approved by the Program Manager.

3.1.3 PROJECT TECHNICAL, COST, AND SCHEDULE INSIGHT

The Discovery Program Office regularly reviews the status and projected ability of each project to meet its approved PLRA. The MM is the primary POC for program insight into the technical, cost, and schedule status of each Discovery 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 any emerging risks. Whenever possible, the MM utilizes existing institutional processes and reviews (e.g., monthly financial data (533Ms and 533Qs) submittals,

EVM data for projects in Phase C/D development, weekly project status reports, and monthly project reviews) to maintain cognizance of project status, minimizing the additional reporting imposed on projects. In addition, the MM draws on program personnel: PEs and PSs at HQ, CEs, Program Integration, and S&MA, as necessary, to provide additional insight or support.

The MM reviews overall project status and areas of immediate concern weekly with the Program Manager and Program Director, and other interested parties. Formal program status reviews, including a detailed assessment of each project, are held monthly with the Program Director and Program Manager (Discovery Joint Program Review), as well as separately with SMD management (PSD Flight Programs Review). The program also provides input to the agency-level Baseline Performance Review (BPR) process for the Discovery Program and selected Discovery projects. Table 1 lists the weekly, monthly, and quarterly reporting activities at all levels: project to program, internal program, and program to SMD and center management.

Table 1. PROGRAM/PROJECT REPORTING

Org.	Reporting Forum	Content	Customer	Schedule
HQ/PSD	PSD Division Quarterly Status	Technical, cost, schedule, and risk	Agency PMC	Quarterly
	PSD Monthly Flight Programs Review (FPR)	Technical, cost, schedule, and risk	SMD Deputy AA	Monthly
Discovery PO	Quarterly Financial Review	Budget status, recent actions, issues	PD, PM, & PAs	Quarterly
	Program Office CMC Status Review	Programs/Projects status (executive level)	MSFC Director & CMC	Quarterly
	Joint Program Review (Report and Briefing)	Technical, cost, schedule, and risk	PD, PM, & PEs	Monthly
	Program Office Status (S&MS)	Programs/Projects Status	MSFC S&MS Office	Monthly
	Baseline Performance Report (BPR) Inputs	Program/Project status	HQ PA&E	Monthly
	Program Tag-Up	Program, Project, and management topics	PD & PM	Weekly
	Mission Manager Weekly Notes	MM status and assessment of projects	PD, PM, & PEs	Weekly (electronic)
Project	Quarterly Project Reviews	Technical, cost, schedule, and risk	DPO, PSD	Quarterly
	Project Financial Reports	Financial management data (533Ms, 533Qs)	DPO	Quarterly/ Monthly
	Monthly Project Status Reviews	Technical, cost, schedule, and risk	DPO, PSD	Monthly
	Baseline Performance Report (BPR) Inputs	Project status	HQ PA&E	Monthly

Org.	Reporting Forum	Content	Customer	Schedule
	Weekly Status Report	Project status (performance and issues)	DPO, PSD	Weekly (electronic)

The Program Office performs risk-based insight of the Discovery projects, chartering risk assessments if needed, throughout the life-cycle of the mission. As issues are identified, Program Manager may elect to use program office personnel or program implementation funds to provide additional insight or oversight in a particular area. The expertise draws from program office personnel, other MSFC center personnel (e.g., optical instrument handling), or experts from NASA, academia, or industry as applicable.

If at any time a project appears unlikely to meet its requirements, it is subject to a special review, and possible cancellation by the AA for SMD.

3.1.4 SCHEDULE REVIEW AND CONTROL

The control of Level I Project schedule milestones (launch, encounter, etc.) is the responsibility of PSD. This is performed through the project PLRA to the Program Plan. The Program Office provides inputs and configuration management of the PLRA but SMD performs the final approval for any changes to a baseline.

The Program Office performs studies of funding availability against program costs, projected costs threats, and projected new project cost profiles, and provides recommendations to PSD as to program level schedule of activities (such as AO release dates, directed project timing, etc.). PSD establishes final program level milestones.

3.1.5 COST REVIEW AND CONTROL

3.1.5.1 PROGRAM BUDGET REVIEW AND CONTROL

The Discovery PPBE is implemented in the following process. Top-level, multi-year Discovery Program budget guidelines are developed by the Discovery Program Manager for release through the Program Director. The Program Manager works directly with the Project implementing organizations to develop budget submittals for each mission. The Program Director provides the budget submittal for the Discovery futures budget. The Program Director is responsible for integrating all budget elements together to form a workable total Program budget and submitting it to the AA for SMD for approval. The Program Manager supports 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 Office of Management and Budget (OMB).

The Program Director and the Program Manager agree on the top-level breakdown of the budget during the PPBE process. 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 against the Discovery futures budget. The Program Director manages and administers the Discovery futures budget. Movement of funds between

major program line items requires 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. In general, unforeseen mission costs will be accommodated through adjustments to mission scope and/or schedule, where consistent with Program priorities.

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

Coordination between the Program Director and Program Manager, and the Discovery Program Business Management Office at MSFC and the SMD Business Office, is maintained by frequent formal and informal communications. Immediate issues are addressed weekly as part of the Program Tag-Ups with the Program Manager and Program Director. Coordination meetings are held monthly between the Discovery Business Management Office and the SMD Business Office. Full Program Budget Review meetings are held quarterly with the Program Director and Program Manager as shown in Table 1, above.

The PCAs and Appendix D of this Program Plan are updated whenever budget changes greater than 20 percent (20%) in a given year, or ten percent (10%) within a five-year horizon, occur. Otherwise, changes to the PCA cost, schedule, or technical requirements are approved by the Discovery Program Manager and Program Director for immediate implementation, and reflected in the next annual document update.

3.1.5.2 PROJECT BUDGET REVIEW AND CONTROL

Discovery Project budgets are initially estimated in the acquisition process as part of the original mission proposal and subsequent Concept Study Report. The total full cost to NASA for all phases of a Discovery 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 Discovery Program Manager.

At confirmation, the mission-specific cost cap for the project is documented in the associated PLRA. Because Discovery projects are selected through a competitive proposal process and firm mission cost caps are established upon selection, if at any time during Implementation of a project, the estimated cost-to-complete exceeds the firm mission cost cap, the project is subject to a termination review. Cost increases that are completely beyond the control of the PI and Project may be an exception that could result in an increase to the cost cap.

Changes to this confirmation cost cap are documented in 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 reflected in an update to the respective Project-unique PBR.
- **Project-driven cost cap breaches:** Upon identification of a potential cost cap breach, the project prepares an assessment of the magnitude, impacts, and any potential options (descope, etc.) to resolve the breach. 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 will present their findings jointly to the Program Director (or Governing Headquarters PMC, as directed). The Program Manager provides a recommendation and supporting rationale for or against proceeding with a Termination Review of the Mission. If the final program decision is to provide additional funding, the respective project-unique PBR is revised.

Within the approved project budget, the PI and associated Project Manager have full discretion in applying the 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 even above the detailed CSR cost estimates. Therefore, selected investigations that are unable to show an unencumbered reserve at the time of their confirmation for development (i.e., the end of Phase B) of at least 25 percent of all development costs in Phases C and D (excluding ELV) and a 70% confidence level for the independent life cycle cost estimate are likely to be judged as having an unacceptably high cost risk and, therefore, are unlikely to be confirmed for further development.

3.2 SAFETY AND MISSION ASSURANCE PLAN

The Discovery Program is an uncoupled program comprising multiple independent missions. Although the Program Manager holds ultimate responsibility for the safety, reliability, maintainability, and quality of the Discovery Program, implementation of the Discovery Program Safety and Mission Assurance processes are split between the program office and the implementing projects.

Each independent Discovery project develops and implements an effective safety and mission assurance program in accordance with NPR 8700.1, NASA Policy for Safety and Mission Success. These programs include a quality assurance program that is consistent with the SAE AS9100, Quality Systems - Aerospace - Requirements - Technically Equivalent AECMA. Specific program-level guidelines and requirements for the implementing projects are documented in the Discovery Program Safety and Mission Assurance Guidelines and Requirements document, DISC-RQMT-002. This includes flow-down of NASA institutional requirements; documentation, review, and problem reporting requirements; and implementation standards.

3.3 RISK MANAGEMENT PLAN

Technical, management, and cost risks for each individual Project are initially examined by the Program as part of the mission selection review process. Because selected Discovery Projects

are independent and each is unique, it is understood that each Project may manage their risk process differently. However, each project has a risk management plan, which may be documented in its Project Plan, consistent with the intent of NPR 8000.4, NASA Risk Management Procedural Requirements. The primary risk management tools for Discovery Projects are schedule and financial reserves, as well as descoping of mission requirements above the threshold science requirements.

The Discovery Program Risk Management Plan (DISC-PLAN-004) is consistent with NPR 8000.4, NASA Risk Management Procedural Requirements. Under the Program Office risk process, the Program Office (1) assesses significant project-identified risks and mitigations and monitors their resolution; (2) independently identifies and assesses program-level project risks and mitigations, and (3) identifies and assesses cross-cutting programmatic risks and mitigations. The results of these activities forms the basis for the Program's risk-based insight of the projects, where the depth of technical insight applied to ensure project success is proportional to the severity of the known risks and within the balance of the total Program's priorities and limited resources.

Identified Discovery Program risks are maintained in the Discovery Program risk system and reviewed monthly with the Program Manager and Program Director.

3.4 ACQUISITION PLAN

The Discovery Program has established an acquisition strategy that contracts for whole missions (concept through delivery of the science data and analysis). Discovery investigations are selected through the AO process, where multiple investigations are selected for Phase A Concept Studies with a competitive down select to proceed to the Phase B part of Formulation. 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 CR with the Science Mission Directorate PMC is held at the end of Formulation, soon after the PDR, to determine whether to confirm the mission to enter Implementation. The NASA Decision Authority will make all final decisions to proceed to follow-on phases.

The Discovery Program selects missions through a fully-open and competitive process. Investigation teams are to be led by a single PI, with participation open to all categories of organizations, both foreign (generally on a no exchange of funds basis) and domestic, including educational institutions, industry, nonprofit organizations, NASA centers, FFRDCs, and other Government agencies. The PI forms the mission team from any combination of these institutions.

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 (FAR) and the NASA Federal Acquisition Regulations (FAR) Supplement. The Discovery Program Office reviews the draft AO for compliance with Program requirements and to ensure incorporation of lessons learned from current mission development cycles. The LaRCs Science Support Office conducts technical/management/cost/other (TMCO) reviews of proposals in support of the SMD Phase A acquisition selection.

The Discovery Program Office establishes contractual vehicles for candidate missions during Phase A, as directed by the Lead Program Scientist. After selection, the Discovery Program Office requests a proposal for cost and pricing data and negotiates the contract prior to the start of each phase (B, C/D, and E). Due to time constraints, however, a letter contract is typically issued after selection and prior to finalizing the full Phase B contract. This still requires a proposal up front, before work starts on Phase B, but because the proposal is for a shorter time frame, the UCA can be turned around more rapidly. 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 that project. For NASA PI-led missions, authority to contract is dependent on proof of compliance with FAR supplement 1872.308.

The Discovery Program Office does not participate in the competitive evaluation of mission proposals. The Discovery Program Office at MSFC may shadow TMCO review activities, during Phase A in order to gain a greater understanding of any unique mission risks that should be monitored if the mission is selected for implementation. However, direct interaction between the Discovery Program Office and the mission begins after competitive selection, at the end of Phase A (Reference Figure 3). In cases where MSFC offices or personnel are involved directly in Discovery proposals, clear and strict firewalls will be established and implemented to separate those activities from the Discovery Program Office personnel.

Discovery 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. Contracts resulting from Discovery AOs 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 US agency and foreign participation in the project. These external agreements for all Discovery projects are generated when necessary, and are referenced in the appropriate Program Level Requirements Appendix to the Discovery Program Plan.

Under specified AOs, Discovery 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, Discovery 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 Discovery Program Office maintains cognizance over the development, implementation, and operations phases of such missions of opportunity as discussed elsewhere in this document. The Discovery Program Office works with NASA Headquarters to resolve any inter-organizational issues arising during the implementation phase.

SMD provides launch vehicle funding for each selected Discovery mission. The AO under which the mission is selected specifies whether the launch vehicle funding is included within the total mission cost cap.

3.5 TECHNOLOGY DEVELOPMENT PLAN

The cost cap for Discovery projects often necessitates reliance on heritage hardware and software designs. However, there are commercialization opportunities that may be exploited by organizations developing new instrumentation or other technology for Discovery missions, due to their state-of-the-art nature. The inclusion of new technologies to achieve performance enhancements or to reduce total mission cost is encouraged in Discovery proposals provided that appropriate risk mitigation measures are also included. In addition, the teaming of industry, university, and government is meant to foster an environment conducive to technology development, utilization, and commercialization.

Discovery AOs may specify limitations on new technology and/or highlight new technologies to be considered by proposers. Discovery AOs also identify any requirements on proposing missions regarding identification of planned technology development/infusion/transfer objectives in the proposal and/or Concept Study Report.

The Discovery Program Director assesses the need for new program-driven technologies, i.e. those that can strategically support multiple future flight missions. When key gaps are identified, the Program may elect to fund development and maturation of the technology to the point that it can be included as GFE in an AO.

3.6 SYSTEMS ENGINEERING MANAGEMENT PLAN

The Discovery Program is an uncoupled program. Intra-Program System Engineering activities (implementation and/or integration, verification and validation, and transition) are not applicable to this class of program. Technical management processes are directed towards the successful engineering of each project. No Systems Engineering Management Plan is required.

3.7 REVIEW PLAN

The Discovery Program has completed its program-level Non-Advocate Review (NAR) and is in Implementation. During the implementation phase, a program-level Standing Review Board (SRB) conducts an independent Program Implementation Review (PIR) approximately every 2 years. Because the Discovery Program is an uncoupled program, other typical life cycle reviews (PDR, Critical Design Review (CDR), etc.) are not applicable at the program level.

Each Discovery project follows the standard NASA development life cycle shown in Figure 4 below.

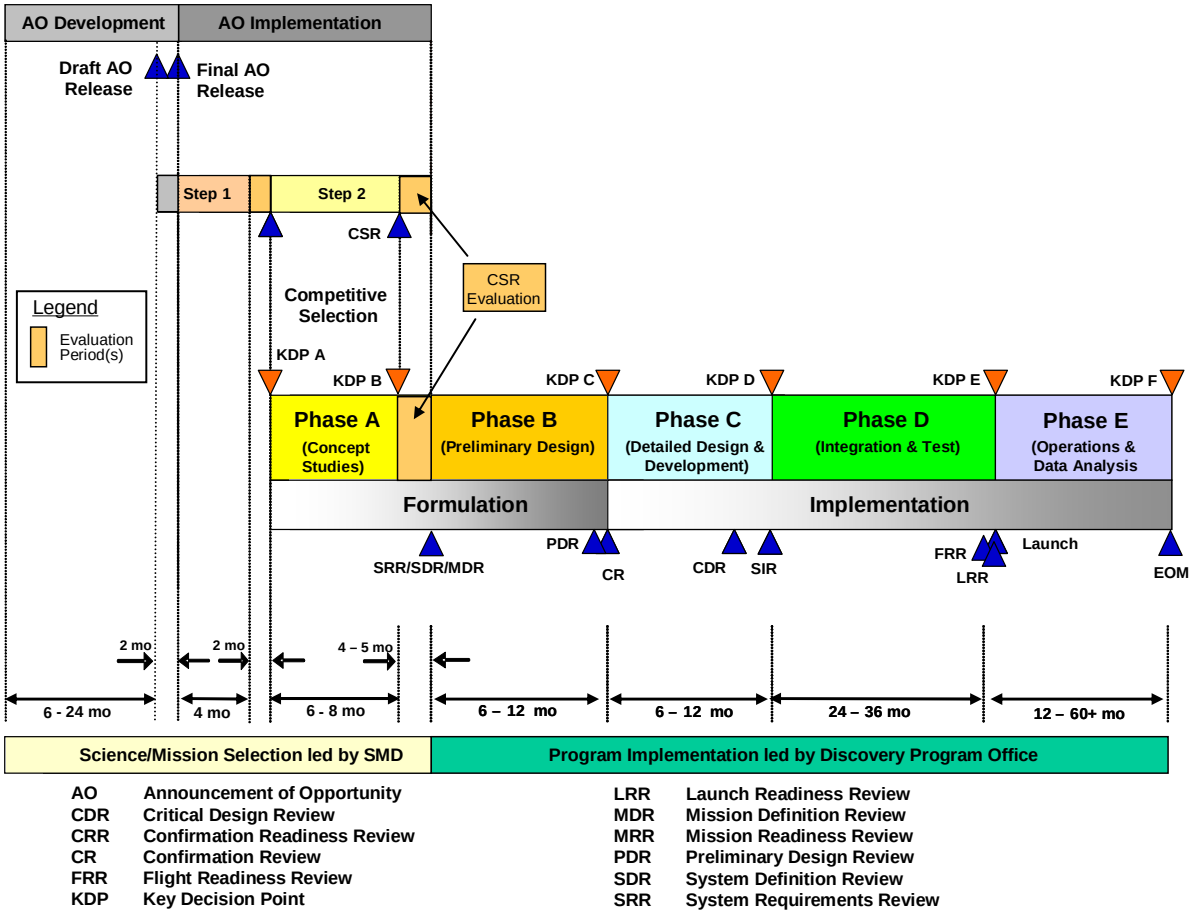

FIGURE 4. DISCOVERY PROJECT LIFE CYCLE

Table 2 below identifies the minimum reviews associated with a Discovery mission, along with the Control Authority for each review. Each mission project establishes a specific set of reviews, compliant with the Discovery Program Safety and Mission Assurance Guidelines and Requirements (DISC-RQMT-002), 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 GPMC or Senior Board.

Table 2. DISCOVERY PROJECT REVIEWS

Review	Program Office Involvement	Control Authority
System Requirement Review (SRR)	Discovery Program CE is a Review Board Member	GPMC or Appointed Board at the Project Implementing Organization
Preliminary Design Review (PDR)	Discovery Program CE is a Review Board Member	GPMC or Appointed Board at the Project Implementing Organization

Review	Program Office Involvement	Control Authority
Non-Advocate Review (NAR)	Participate in the debrief	Standing Review Board
Confirmation Review (CR)	Present Program Office evaluation	AA for SMD
Critical Design Review (CDR)	Discovery Program CE is a Review Board Member	GPMC or Appointed Board at the Project Implementing Organization
Safety and Mission Success Review (SMSR)	Participate in the review as necessary	Office of Safety and Mission Assurance
Environmental Test Readiness Review*	Board Member	Project Manager
Pre-Ship Review*	Board Member	Project Manager
Flight Readiness Review (FRR)	Board Member	NASA Launch Manager or designee
Launch Readiness Review (LRR)	Board Member	NASA /HQ AAA for Launch Services and the Spacecraft Mission Director
Post-Launch Assessment Review (PLAR)	Board Member	Project Manager
Critical Events Readiness Review (CERR)	Board Member	Project Manager
Termination Review (as directed)	Ad hoc member of the SMD PMC for the review	AA for SMD

*Additional Project reviews not required by 7120.5

For Category 2 projects such as Discovery's, the SMD/PMC serves as the governing PMC and recommends approval or disapproval to the Decision Authority (DA) regarding entry to the next phase, which constitutes the KDP. Each Discovery project has a Standing Review Board (SRB), formed according to the NPR 7120.5 process, to conduct life-cycle reviews during their development and implementation.

Owing to the complexity expected of Discovery missions, NASA maintains a significant degree of insight into mission development. The Discovery Program Office participates in all project reviews. The Science Mission Directorate may charter the Discovery Program Office to establish special purpose and standing Independent Assessment Teams (IAT) to evaluate the status of mission progress and risk. The Program Office coordinates the formation of each IAT with the Program Director and the Program Executive.

At any point during the life cycle of the Discovery Program or a Discovery Project, the Discovery Program Director may initiate a Termination Review. The Discovery Program Director utilizes the following criteria in evaluating the need to perform a Termination Review of the Discovery Program or a Discovery Project:

- **Program Criteria:** Inadequate Program funding profile to maintain consecutive mission development

- **Project Criteria:** The Project cannot demonstrate the ability to meet the threshold science objectives within the stated cost cap

The review is performed by an IAT, supported as appropriate by the Discovery Program Office. The result of the Termination Review is a recommendation for termination or continuance of the Program or Project to the DA.

3.8 MISSION OPERATIONS PLAN

The Discovery Program is an uncoupled program. Operations occurs only at the project level, and each Discovery mission operates independently of the other Discovery missions. Technical management processes are directed towards the successful operation of each independent project. No program level Mission Operations Plan is required.

3.9 ENVIRONMENTAL MANAGEMENT PLAN

The Discovery Program is an uncoupled program. Development and operations occurs only at the project level, and each Discovery mission operates independently of the other Discovery missions. No program level Environmental Management Plan is required.

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

Advanced Stirling Radioisotope Generator (ASRG) and smaller radioactive devices, such as Radioisotope Heater Units (RHUs) or radioactive sources for science instruments, are permitted on Discovery 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," dated June 2002 and Finding of No Significant Impact (FONSI) dated June 18, 2002, (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.

3.10 LOGISTICS PLAN

The Discovery Program is an uncoupled program. Development and operations occurs only at the project level, and each Discovery mission operates independently of the other Discovery missions. No program level Logistics Plan is required.

For Discovery missions, institutional facility needs, use of existing equipment, project part sparing and ground system maintenance, are project-unique activities. Each Discovery project develops a logistics approach that is based on the mission operations concept, appropriate for a Discovery-class mission, and consistent with the intent of NPD 7500.1, Program and Project Logistics Policy. This approach is addressed in the individual Discovery proposals and/or project plans.

Project transportation activities are addressed in individual Discovery project plans. Transportation in and around the NASA/KSC facility is provided by KSC, the organization responsible for ground processing at the launch site, and/or the organization providing the launch vehicles. Requirements (i.e., loads and environments) will be levied on the transport and handling processes of structures, subsystems, and instruments by the appropriate cognizant organizations/engineers for each project. ASRGs, Radioisotope Thermoelectric Generators (RTGs), and RHUs, if used, are transported under the authority of the Department of Energy (DoE) and the manufacturer.

3.11 SCIENCE DATA MANAGEMENT PLAN

The Discovery Program is an uncoupled program. The science teams for each PI-led Discovery mission or Mission of Opportunity are responsible for initial analysis of mission data, data delivery to the Planetary Data System (PDS), the publication of scientific findings, and communication of the results to the public. No program level Science Data Management Plan is required.

Each Discovery 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) for approval by the PI, project scientist, and the SMD program scientist assigned to that project. 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. Discovery PI teams 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.

As part of the mission close-out process, each Discovery PI also prepares a final report detailing the status of the Level 1 requirements and how each requirement has been met by the execution of the mission. The report is reviewed and approved by the mission PS and, as appropriate, the

mission manager and mission PE, and serves as final documentation of the science performance of each Discovery mission.

Sample return missions include their plans to comply with planetary protection requirements in their Project Plan. The Project Plan documents how any physical samples will be collected, stored during the mission, and managed when returned to Earth, including contamination control and curation laboratory requirements. Mission life-cycle costs cover the preliminary examination of any extraterrestrial samples, including the funding of the Astromaterials Curatorial Facility to support their mission.

The NASA Astromaterials Curatorial Facility, located at NASA's Johnson Space Center (JSC), provides curation for any samples of extraterrestrial materials returned by Discovery missions. Investigation teams are responsible for all aspects of the delivery of such materials to this facility, and 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. NASA is responsible to maintain (including funding) the remainder of the sample(s) not provided to the science team or international partners.

3.12 INFORMATION AND CONFIGURATION MANAGEMENT PLAN

The Discovery Program Data Management Plan (DISC-PLAN-003) defines the requirements and processes for identification/definition, preparation, control, and disposition (storage, access, and records) of Discovery Program data. Change control for the Discovery Program and its project documentation is consistent with NASA change control policies and procedures, to enable visibility into all interactions and interdependencies within the Program.

Development and control of configuration items occurs only at the project level. Each Discovery project develops an Information and Configuration Management Plan, consistent with the host institution procedures and compliant with NPR 7123.1, NPR 1440.6, and NPR 1444.1.

The Discovery Program has a vigorous process for capturing and disseminating lessons learned. Discovery Program Integration collects and archives lessons learned from a number of sources both within and external to the Discovery Program:

- Routine interactions with Discovery Project development and operations teams;
- SRB reports, replan assessments, and Independent Assessment Team reports;
- Cross-pollination of lessons from the New Frontiers and other programs;
- Special studies chartered by the Program Manager;
- Special study reports performed by external groups (e.g., IPAO)
- 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. The program office also works with the Lead PS and the LaRC SSO to ensure that experiences with previously selected missions are factored as appropriate into subsequent AOs and TMCO evaluations. Lessons learned are provided to the proposal community at large through Discovery Program conferences and AO proposal workshops.

Beyond the lessons learned activities described above, and the analysis, archive, and dissemination of science and associated technical data described in Section 3.11, the Discovery Program does not have a formal knowledge capture program. If a need is identified through the program management or lessons learned processes, the Program Manager has the authority to initiate additional activities within the resources of the Discovery Program.

3.13 SECURITY PLAN

The Discovery Program 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. Facility access and physical security is provided to the Discovery Program by the National Space Science and Technology Center (NSSTC). Information technology, personnel background investigations, and security awareness/education (e.g. Information & Technology, Export Control, counterterrorism, etc.) are provided to the Discovery Program by the Protective Services Office at Marshall Space Flight Center (MSFC). 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).

The Discovery Program has no identified NASA Mission Essential Infrastructure (MEI), and thus, emergency response is limited to program documentation/information and personnel. All program documentation/information is maintained electronically on a central server, with periodic backups, and retained in accordance with NASA Records Retention Schedules (NPR 1440.1). Weather or facility related emergencies are announced via the NSSTC public address system. For other types of emergencies, the Discovery Program follows the emergency policies and directives of MSFC. After normal duty hours, emergency instructions are provided through the news media. 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 Planning Procedurals Requirements, and MPR 1040.4, Continuity of Operations Planning).

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.

3.14 EXPORT CONTROL PLAN

The Discovery Program has no direct Technical Assistance Agreements (TAAs) or MOUs with any foreign entities. If such contracts or agreements are established in the future, the Discovery Program Office will coordinate these activities with the NASA Headquarters Export Administrator (HEA) and the MSFC Center Export Representative (CER), and comply 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 Discovery Program Office, with the help of NASA HQ and MSFC center export representatives, will identify the applicable license required and submit the appropriate application to Department of Commerce or US State Department.

Each Discovery 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) process. Through this process, proposers are required to disclose and discuss any international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities. Additionally, 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. (see AO Section 5.10).

3.15 EDUCATION AND PUBLIC OUTREACH PLAN

Contributing to the enhancement of the quality of science, mathematics, and technical education and the public understanding of space science are explicit goals of SMD and the Discovery Program. The Discovery Program is committed to incorporating program elements directed toward informing the public and providing educational opportunities that support local, state, regional, and national educational objectives and reform efforts. The primary Discovery Program education/outreach (E/PO) emphasis is at the individual project level. However, the Discovery Program also implements program-level education and public outreach aimed at raising public awareness of the program and its missions, and fostering collaboration between the program and the missions to increase the impact of individual mission E/PO programs. This

program-level E/PO effort is documented in the Discovery Program Education and Public Outreach Plan, DISC-PLAN-005.

A substantive education/outreach program is an integral element of every Discovery project, and the approach for each project's outreach program is consistent with and coordinated with the outreach program for the relevant SMD science theme. Discovery Program AOs specify the level of support within the project budget to be used for E/PO and require that each PI document in his/her proposal the approach for planning an education/outreach program. Costs for such activities are phased as a part of the mission costs.

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

The SMD recognizes the value of directly involving a student population in a spaceflight experience. PIs are encouraged to propose innovative ways to directly involve students in their prospective missions. Proposers may define a Student Collaboration (SC) that may be an instrument, investigation, hardware, or software and may be included on either the flight system or ground system, as long as the proposed SC is clearly separable from the proposed baseline investigation and the performance floor science investigation.

4.0 WAIVERS LOG

No Program level NPR 7120.5D waivers have been identified. Waivers for individual uncoupled projects will be documented separately, reviewed for rationale, and approved according to NPR 7120.5D on a case-by-case basis.

5.0 CHANGE LOG

The Program Manager monitors NASA policies, directives, and requirements for changes affecting the Discovery Program. Updates to key top level Program or Project documentation are directed immediately if required, or performed in annual updates.

The Program Manager annually evaluates the need for modifications of this Program Plan and the PCA due to project changes and other activities within the program, or as driven by the above NASA documentation changes. The Program shall update the PCA and Appendix D of this Program Plan whenever budget changes greater than 20 percent (20%) in a given year, or ten percent (10%) within a five-year horizon, occur. Otherwise, changes to the PCA cost, schedule, or technical requirements can be approved by the Discovery Program Manager and Program Director for immediate implementation, and reflected in the next annual document update.

REV	DESCRIPTION	PUB. DATE
-	Initial Baseline	9/99
A	General update to reflect new Discovery Program Goals – Requirements-Outcomes, program Office changes, NASA policy changes, and new NASA requirements enunciated in NPR 7120.5C, and 2005 PIR findings	9/05
B	General update to clarify roles and responsibilities and to comply with NPR 7120.5D	8/08

The Program Manager also annually evaluates, and coordinates with the Lead PE, the need for modifications to the Discovery PCA due to project changes and other activities within the program, or as driven by NASA documentation changes.

6.0 APPENDICES

A: Acronyms and Abbreviations

B: Definitions

C: Program Reference Documents

D: Functional Assignments For The Discovery Program

E. Discovery Program Budget and Summary Schedule

F. Program Level Requirements Appendices (PLRAs)

APPENDIX A – ACRONYMS AND ABBREVIATIONS

AA	Associate Administrator
AAA	Assistant Associate Administrator
APL	Applied Physics Laboratory (Johns Hopkins University)
AO	Announcement of Opportunity
ASRG	Advanced Stirling Radioisotope Generator
BPR	Baseline Performance Review
CDR	Critical Design Review
CFO	Chief Financial Officer
CE	Chief Engineer
CERR	Critical Events Readiness Review
CFR	Code of Federal Regulations
CMC	Center Management Council
CR	Confirmation Review
CRR	Confirmation Readiness Review
CSR	Concept Study Report
DA	Decision Authority
DAP	Data Analysis Program
DOE	U.S. Department of Energy
DPO	Discovery Program Office
DSN	Deep Space Network
ELV	Expendable Launch Vehicle
EOM	End of Mission
E/PO	Education and Public Outreach
ESA	European Space Agency
EVM	Earned Value Management
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center

FPR	Flight Programs Review
FRR	Flight Readiness Review
GFE	Government Furnished Equipment
GO	Guest Observer
GPMC	Governing Program Management Council
GRC	Glenn Research Center
HQ	Headquarters
IAT	Independent Assessment Team
IPAO	Independent Program Assessment Office
ISRO	Indian Space Research Organization
ITAR	International Traffic in Arms Regulations
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KDP	Key Decision Point
KSC	Kennedy Space Center
LaRC	Langley Research Center
LCC	Life Cycle Cost
LRR	Launch Readiness Review
MDAA	Mission Directorate Associate Administrator
MDR	Mission Definition Review
MM	Mission Manager
MO	Mission of Opportunity
MOU	Memorandum of Understanding
MRR	Mission Readiness Review
MSFC	Marshall Space Flight Center
NAR	Non-Advocate Review
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act

NOA	New Obligation Authority
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NSSTC	National Space Science and Technology Center
OMB	Office of Management and Budget
PA	Program Analyst
PA&E	Program Analysis and Evaluation
PCA	Program Commitment Agreement
PD	Program Director
PDR	Preliminary Design Review
PDS	Planetary Data System
PE	Program Executive
PI	Principal Investigator
PIR	Program Implementation Review
PLAR	Post-Launch Assessment Review
PLRA	Program Level Requirements Appendix
PM	Program Manager
PMC	Program Management Council
PO	Program Office
POC	Point of Contact
POP	Program Operating Plan
PPBE	Planning, Programming, Budgeting, and Execution
PS	Program Scientist
PSD	Planetary Science Division
PSP	Participating Scientist Program
PSR	Pre-Ship Review
RHU	Radioisotope Heater Unit
RTG	Radioisotope Thermoelectric Generator
S&MA	Safety and Mission Assurance

S&MS	Science and Mission Systems
SDR	System Definition Review
SMD	Science Mission Directorate
SIR	System Integration Review
SMSR	Safety and Mission Success Review
SRB	Standing Review Board
SRR	System Requirements Review
SSO	Science Support Office (NASA LaRC)
WBS	Work Breakdown Structure

APPENDIX B – DEFINITIONS

Baseline Science Requirements – That mission which, if fully implemented, accomplishes the entire set of scientific objectives identified at the initiation of the mission.

Cost Cap – The maximum allowable cost, specified in the applicable AO, for each Discovery proposed mission. See also Mission Cost Cap.

Discovery Mission –Principal Investigator-led, cost-capped projects that are complete (concept through implementation, operations, and disposal), self-standing, and uncoupled science investigations.

Discovery Mission of Opportunity (MO) –Principal Investigator-led, cost-capped projects that may be an element of another non-Discovery mission of any size (e.g., science instrument), or may reuse existing NASA space assets in Phase E, to perform a self-standing and uncoupled science investigation.

Minimum Science – See Threshold Science.

Threshold Science – The minimum scientific requirements below which the mission is not considered justifiable for the proposed cost. Also referred to as **Minimum Science** and **Science Floor**.

Mission Cost Cap – The maximum allowable cost, established for each project through the proposal and formulation process, for a specific Discovery mission.

Science Floor – See Threshold Science.

APPENDIX C – PROGRAM REFERENCE DOCUMENTS

NASA Program and Project Management Processes and Requirements, NPR 7120.5

SMD Management Handbook (February 2008)

Office of Space Science (OSS) Education/Public Outreach Strategy (October 1996)

Environmental Quality Regulations, 40 CFR Parts 1500-1508

Quality Systems - Aerospace- Requirements - Technically Equivalent to AECMA PrEN9100, SAE AS9100

Risk Classification for NASA Payloads, NPR 8705.4

NASA Policy for Safety and Mission Success, NPD 8700.1

Software Independent Verification and Validation Policy, NPD 8730.4

Risk Management Procedural Requirements, NPR 8000.4

Biological Contamination Control for Outbound and Inbound Planetary Spacecraft, NPD 8020.7

Planetary Protection Provisions for Robotic Extraterrestrial Missions, NPR 8020.12

NASA Information Security Policy, NPD 2810.1

NASA Security of Information Technology, NPR 2810.1

NASA Security Program Procedural Requirements, NPR 1600.1

Implementing the National Environmental Policy Act and Executive Order 12114, NPR 8580.1

The National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.

Executive Order 12114 (14 CFR part 1216.321)

NASA Systems Engineering Processes and Requirements, NPR 7123.1

NASA Records Management, NPD 1440.6

NASA Records Retention Schedules, NPR 1441.1

Management of NASA Scientific and Technical Information, NPD 2200.1

Requirements for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information, NPR 2200.2

Discovery Program Data Management Plan, DISC-PLAN-003

Discovery Program Education and Public Outreach Plan, DISC-PLAN-005

Discovery Program Risk Management Plan, DISC-PLAN-004

Discovery Program Safety & Mission Assurance Guidelines and Requirements, DISC-RQMT-002

APPENDIX D – FUNCTIONAL ASSIGNMENTS FOR THE DISCOVERY PROGRAM (UNCOUPLED)

Program Management Function: Management	Discovery		Notes
	DPO	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 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	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 Futures line. 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
Provide KDP recommendation on projects to AA	X		PO provides a Program Office recommendation to AA at KDPs (Phase B to F). PSD provides Division recommendation at KDPs (Phase A to F).
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 in 15 minutes, 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 Direct is present. PD represents final authority (but will poll 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.
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.

Program Management Function: Technical	Discovery		Notes
	DPO	PSD	
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 performs this using Phase A TMCO 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

Program Management Function: Schedule	Discovery		Notes
	DPO	PSD	
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
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 which are not Level 1 controlled PLRA.

Program Management Function: Cost	Discovery		Notes
	DPO	PSD	
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 monthly Program Budget Review of entire Program
Manage program reserves		X	PSD controls Program Futures line. PO supports with data and analysis. PSD and PO conduct joint monthly Program Budget Review of entire Program. PO provides recommendations on the application/usage of the Program Futures line.
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 monthly 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 B – F.
Perform cost studies to recommend AO release timing or directed project start dates	X		PO Function

Perform independent cost evaluations of poor 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 POP inputs	**X**		PO Function
Coordinate and integrate Project cost phasing annual bypass plans.	**X**		PO Function
Program Management Function: Risk	**DPO**	**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 E – DISCOVERY PROGRAM BUDGET & SUMMARY SCHEDULE

The Program Director and the Program Manager agree on the top-level breakdown of the budget each year, and document it in this appendix. At the same time, the list of missions confirmed by SMD for implementation is updated, along with the associated phasing schedule. This appendix is updated yearly with the PPBE process, or as required.

Figure E-1, below, provides the Discovery 2008 pre-decisional budget agreed to by SMD and the Program Office. The summary schedule provides a reference phasing of the mission activity planned against this budget.

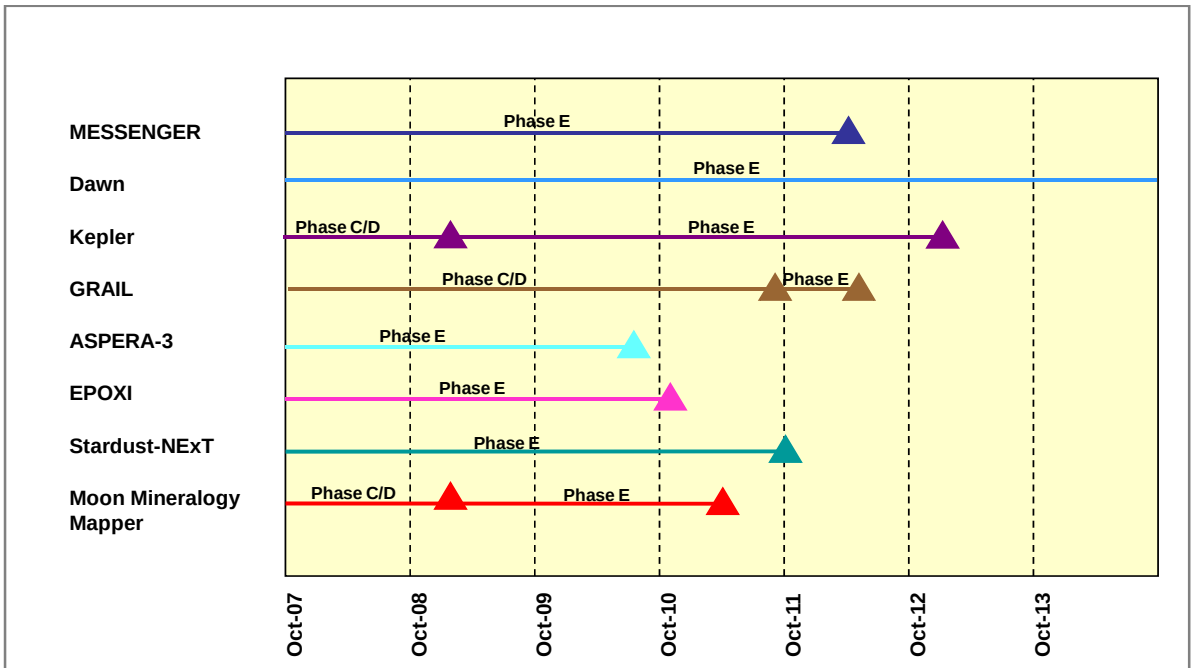

FIGURE E-1. DISCOVERY PROGRAM SUMMARY SCHEDULE, BUDGET, AND WORKFORCE

Key program controlled milestones (launch window date, end of mission date, etc.) for each mission are identified as appropriate during the Discovery selection process. These milestones

are benchmarked at confirmation in a mission unique Program Level Requirements Appendix to this plan, which is approved by SMD. The active milestone schedule for project implementation is documented in the mission project plan, which is approved by the Discovery Program Office. The project plan schedule will be updated annually with the PPBE cycle to reflect funding changes, or to reflect a breach in the launch schedule.

Life-cycle costs for each mission are established during the Discovery selection process. A confirmation cost cap is then documented in a mission unique PLRA to this plan.

The list of Discovery missions approved for implementation by the AA of the Science Mission Directorate is shown in Table E-1.

TABLE E-1. MISSIONS OF THE DISCOVERY PROGRAM

Mission No.	Discovery Project Name	Mission Type[1]	Mission Objective	Launch Date	Implementing Organizations	Mission Status
1	NEAR	FM	Answer fundamental questions about the nature and origin of asteroids and comets over a one-year period	Feb 1996	APL	Complete (EOM: February 2001)
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	Complete (EOM: September 1997)
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	Complete (EOM: June 1999)
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	Complete (EOM: January 2006)
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	Complete (EOM: September 2004)
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	Failed after launch
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	In Operation
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	Jan 2005	JPL	Complete (EOM: July 2005)

			and asteroids			
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	In operation
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.	Feb 2009	JPL/ARC	In Phase C/D
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	In Phase B
	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.			Discontinued prior to Confirmation
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	In operation
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	October 2008	JPL	In phase C/D

			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			
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 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.	N/A	JPL	In operation
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	In operation

[1]FM- Full Discovery Mission; MO- Mission of Opportunity
[2]EPOXI and NExT MOs selected at the same time, from Discovery AO 2006

APPENDIX F – DISCOVERY PROGRAM LEVEL REQUIREMENTS APPENDICES