

**Program Commitment Agreement**

Living With a Star (LWS) Program

It is the responsibility of each of the signing parties to notify the other in the event that a commitment cannot be met and to initiate the timely renegotiations of the terms of this agreement.

\_\_\_\_\_  
Associate Administrator for the  
Science Mission Directorate

\_\_\_\_\_  
Date

\_\_\_\_\_  
Associate Administrator

\_\_\_\_\_  
Date

# PROGRAM COMMITMENT AGREEMENT

## LIVING WITH A STAR PROGRAM

### 1.0. PROGRAM OBJECTIVES

Our solar system is governed by the sun, a main-sequence star midway through its stellar life. The sun's influence is wielded through gravity, radiation, the solar wind, and magnetic fields as they interact with the masses, fields, and atmospheres of planetary bodies. Through the eyes of multiple spacecraft, we see our solar system as a "heliosphere," a single, interconnected system moving through interstellar space. On Earth, this interaction with our star is experienced through space weather's effects on radio and radar transmissions, electrical power grids, and spacecraft electronics, through modifications to the ozone layer and through climate change. The LWS program seeks to understand how and why the sun varies, how planetary systems respond, and how the variability and response affect human activities. As we reach beyond the confines of Earth, this science will enable the space weather predictions necessary to safeguard the outward journeys of human and robotic explorers.

The LWS program objectives are based upon these goals and are as follows:

1. Understand solar variability and its effects on the space and Earth environments with an ultimate goal of a reliable predictive capability of solar variability and response.
2. Obtain scientific knowledge relevant to mitigation or accommodation of undesirable effects of solar variability on humans and human technology on the ground and in space.
3. Understand how solar variability affects hardware performance and operations in space.

These objectives flow down from Sub-goal 3B, "understand the Sun and its effects on Earth and the solar system," in the *2006 NASA Strategic Plan* and the *Science Plan for NASA's Science Mission Directorate (SMD) 2007-2016*. The LWS objectives also flowed from the precursor documents, the *NASA Strategic Plan* and its applicable science roadmap, the *Sun-Earth Connection (SEC) Roadmap*, which were applicable when the program was in formulation and then approved to begin implementation. An update to the SEC roadmap, *Heliophysics: The New Science of the Sun-Solar System Connection*, that aligns with the *2006 NASA Strategic Plan*, is a reference document.

### 2.0. PROGRAM OVERVIEW

The LWS program is a loosely coupled program wherein each mission has unique science, but the science from one mission can support supplemental investigations in

other LWS missions. The LWS missions are either Category 1, 2, or 3 as defined in NASA Procedural Requirements (NPR) 7120.5D, NASA Program and Project Management, paragraph 2.1.4. The LWS program uses a three-pronged systems approach to implement its objectives:

1. By establishing several new LWS research spacecraft that will each perform mission-unique science and also replace existing assets in or reconfigure the Heliophysics Great Observatory. The Heliophysics Great Observatory is comprised of heliophysics spacecraft from several programs that obtain sets of near-simultaneous heliophysics measurements that are strategically placed to address large-scale “system” heliophysics science problems. Data from the Great Observatory measurements will be used to develop new scientific understanding of the physics, dynamics, and behavior of the Sun-Earth connected system through the range of conditions occurring during solar cycles.
2. By establishing LWS Science (formerly named Theory, Modeling, and Data Analysis), basic and applied research investigations that use existing data and science products to improve knowledge of space environmental conditions and variations over the solar cycle, develop new techniques and models for predicting solar/geospace disturbances, and develop cost-effective techniques for assimilating data from networks of spacecraft.
3. By performing investigations using existing data and using new data from a low-cost Space Environment Testbeds (SET) mission to reduce the uncertainty in the definition of the space environment in the presence of a spacecraft (i.e., the induced environment) as functions of location and time in the solar cycle and to minimize or accommodate space weather effects on space hardware.

The Solar Dynamics Observatory (SDO) project and the SET-1 mission are in implementation. The Geospace-Radiation Belt Storm Probes (G-RBSP) mission and a Geospace-Related Mission of Opportunity (G-MOO), the Balloon Array for RBSP Relativistic Electron Losses (BARREL), in the Geospace Missions project are in formulation. The Solar Orbiter Collaboration, Solar Probe, and Sentinels projects are in preformulation.

Relationships with external organizations are as follows:

- The SET-1 mission depends upon investigations provided by the British National Space Centre (BNSC), the Centre National d’Etudes Spatiales (CNES), and a spacecraft provided by the Air Force Research Laboratory.
- The G-RBSP mission has one investigation, the Proton Spectrometer Belt Research (PSBR), which is contributed by the National Reconnaissance Office (NRO) and one partnership with the Czech Republic for the Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) investigation.

- The Solar Orbiter Collaboration will depend upon the European Space Agency (ESA) to meet mission objectives. Other dependencies for this mission will be determined after investigations are selected from the Announcement of Opportunity (AO).

Products and data resulting from the LWS program and its missions will be made available for public access consistent with the SMD's open data policy, International Traffic in Arms Regulations, and Export Administration Regulations.

### **3.0. PROGRAM AUTHORITY**

The LWS program is a multiproject program with the Goddard Space Flight Center (GSFC) designated as the managing Center for the program. The LWS program manager resides at GSFC, reporting to the Center Director and the GSFC Center Management Council (CMC) and, functionally, through the Heliophysics Division Director to the SMD Associate Administrator at Headquarters. The governing responsibility for the LWS program is the Agency Program Management Council (PMC). The Agency PMC is the approving council for Category 1 projects, and the Associate Administrator for the SMD is the decision authority for Category 2 and 3 projects. The SMD PMC also has governing responsibility for the SDO project and the SET-1 and G-RBSP missions; it decides on the governing PMC beyond Phase A for each new mission or project when each new project transitions from Phase A to Phase B in accordance with the effective version of NPR 7120.5D at the time that the transition occurs.

The LWS projects report to the LWS program manager at GSFC. The project managers for the SDO project and SET-1 mission reside at GSFC. The G-RBSP project is being implemented by the Johns Hopkins University/Applied Physics Laboratory (JHU/APL) and funded through tasks on the LWS contract that is administered by the NASA Management Office. The G-RBSP project office and project manager reside at the JHU/APL and report to the G-RBSP Task Monitor, who is a member of the LWS program office. The BARREL project manager resides at Wallops Flight Facility; the BARREL project is a balloon project and is governed by NPR 7120.8, NASA Research and Technology Program and Project Management Requirements instead of NPR 7120.5D, because balloon projects are categorized as basic and applied research.

### **4.0. TECHNICAL PERFORMANCE COMMITMENT**

The goals of the LWS program derive from the heliophysics science goal, NASA strategic Sub-goal 3B. This Sub-goal has three research objectives. The objectives together with the major and supporting contributions of the LWS program components to achieving the research objectives for the heliophysics science goal are given in Table 4.0-1.

<b>NASA Strategic Goal 3:</b> Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.			
<b>NASA Strategic Sub-goal 3B and Heliophysics Science Goal:</b> Understand the sun and its effects on Earth and the solar system.			
<b>LWS Program Components</b>	<b>Applicability of Research Objectives for Heliophysics Science Goal to LWS Program Components</b>		
	Understand the fundamental physical processes of the space environment from the sun to Earth, to other planets, and beyond to the interstellar medium	Understand how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields	Maximize the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space
<b>Science Missions</b>			
SDO	M	M	S
G-RBSP	M	M	M
BARREL	M	M	M
Solar Orbiter Collaboration	M	S	S
Solar Probe	M	S	M
Solar Sentinels	M	M	M
Science	M	M	M
SET-1		M	

\*Key: M=Major contribution; S=Supporting contribution

Table 4.0-1. Major and supporting contributions of the LWS program components to achieving the research objectives for the heliophysics science goal in the *Science Plan for NASA's Science Mission Directorate 2007-2016*.

The technical performance requirements for the missions and projects in the LWS program are detailed in appendixes to the LWS Program Plan and are baselined when each mission or project begins implementation; they are summarized here in Table 4.0-2. "Baselines" as described in NPR 7120.5D are listed in the LWS Program Plan Appendixes as "full mission success criteria," and "thresholds" are listed as "minimum mission success criteria."

<b>Mission</b>	<b>Full Mission Success Criteria</b>	<b>Minimum Mission Success Criteria</b>
SDO	The SDO shall obtain twenty-two 72-day intervals of data from all instruments during the SDO prime mission lifetime.	The SDO shall obtain eleven 72-day intervals of data from two instruments during the SDO prime mission lifetime.
SET-1	The SET-1 mission payload shall deliver 95 percent of the data obtained from experiment operations for a minimum time period of 40 weeks and a goal of two years using resources provided by the host spacecraft.	The SET-1 mission payload shall deliver 95 percent of the data obtained from experiment operations for a minimum time period of 12 weeks using resources provided by the host spacecraft.

Table 4.0-2. Success criteria for LWS missions in implementation.

## 5.0. SCHEDULE COMMITMENT

The LWS program is comprised of investigations defined in concert with the heliophysics science community. Table 5.0-1 defines the key dates and time frames for the phase transitions for each project based upon the fiscal year (FY) 2009 President's Budget Request as defined in NASA's FY 2009 Integrated Budget and Performance Document (IBPD). Dates and costs for projects in preformulation and formulation are guidelines for planning purposes and are subject to change as the LWS program matures.

Project	Start Formulation	Mission Design Review (MDR)/ Preliminary NAR	Start Implementation	Ready for Launch	Start Prime Operations	End Prime Operations	Direct Life Cycle Cost for Prime Mission (\$M)
<i>Projects in Implementation</i>							
SDO	8/2002	4/2003	7/2004	12/2008	2/2009	1/2014	798.5.
SET-1	5/2003	11/2003	5/2005	6/2008	11/2010	10/2011	37.2
<i>Projects in Formulation</i>							
Geospace Missions							
G-RBSP	1/2007	10/2007	11/2008	3/2012	5/2012	4/2014	600-700
G-MOO BARREL	9/2006	1/2008	2/2009	6/2012	7/2012	6/2014	11-14
<i>Projects in Pre-Formulation</i>							
Solar Orbiter Collaboration	2008	2009	2010	2015	2015	2021	200-350
Solar Probe	2009	2011	2013	2017	2017	2024	1000-1400
Solar Sentinels	2015	2016	2017	2021	2021	2024	700-1000

\*The date for end of the prime mission assumes launch on the Launch Readiness Date as a primary payload. However, the SET project and the G-MOO are piggyback payloads; the launch readiness dates for piggyback missions define the dates that the piggyback payloads are shipped to the host spacecraft for integration with the host spacecraft. The dates for the ends of the prime mission for piggyback payloads will depend upon the launch dates for the host spacecraft.

Table 5.0-1. Key dates or target dates and time frames for the phase transitions for each project based upon the FY 2009 President's Budget Request as defined in NASA's FY 2009 IBPD.

## 6.0. COST COMMITMENT

The maximum cost for the LWS program, from FY 2009 through FY 2018, is \$2,399 million including:

- \$ 89.8 million for the SDO project in implementation.

- \$ 1.3 million for the SET-1 mission in implementation.
- \$ 240 million for LWS Science investigations.
- \$ 2,067 million for LWS program management, missions in formulation, and future missions.

This cost includes all full-cost data necessary to perform the program, including, but not limited to, standard project activities, facility costs, launch vehicles, tracking, prime mission operations, maintenance, data analysis, disposal, and LWS Science investigations. It excludes prior year costs and thus does not reflect the total life-cycle cost. The actual cost plan is developed during the annual budget process and is reflected in the IBPD.

## **7.0. ACQUISITION STRATEGY**

For each science mission, the Director of the heliophysics science theme will charter at least one Science and Technology Definition Team (STDT) before the start of formulation to prioritize the science and define the technical performance requirements for the mission. Engineering support for the team develops a preconcept that satisfies the technical performance requirements and constraints as well as identifies the technology development requirements for the proposed project. These requirements form the basis for an AO to acquire scientific investigations that include science instruments.

The LWS Science (renamed from Theory, Modeling, and Data Analysis in the FY 2005 Budget Request) solicits fundamental research investigations in the yearly NASA Research Announcement (NRA), “Research Opportunities in Space and Earth Science.” Requirements for investigations for the SET have been derived from workshops dedicated to that purpose and were the basis for NRAs that solicited investigations and partnerships that included investigations.

All scientific instruments and science investigations, including LWS Science investigations, will use full and open competitions to the greatest extent possible. Predetermined instruments, missions, or mission systems may be implemented without competition (such as through intergovernmental or international partnerships) provided that there is a clear mutual scientific or technological benefit and as approved by the Associate Administrator for the SMD.

Either GSFC or the JHU/APL will manage the implementation of each LWS project as a component of the LWS program. The Associate Administrator for the SMD will recommend to senior Agency management, via the acquisition strategy meeting or another equivalent means, whether each spacecraft for each science mission will be built in-house at GSFC or JHU/APL to maintain core competency or whether it will be built out-of-house. Missions implemented by the JHU/APL will still report to the LWS Program Office at GSFC.

Launch vehicles will be acquired through existing contracts in the Space Operations Mission Directorate, except when provided by an international partner under an approved

agreement or when the LWS mission is not a primary payload on the launch vehicle. In the latter case, arrangements for access to space will be made on a case-by-case basis and documented using agreements. Acquisitions for operations services will be consistent with NASA policy.

## **8.0. HIGH-RISK AREAS**

Risks in the LWS program will be managed via a risk management program that is documented in the LWS Program Plan. In accordance with these requirements, every LWS project will establish a risk management plan that identifies the cost, schedule, and technical risks within the project and methods to accommodate or mitigate them. Details of the project's risk management plan will be described in its project plan in accordance with the requirements of NPR 7120.5D.

Reliance on other Government agencies or international partners to provide components of LWS projects is a moderate risk, because NASA cannot control the policy, technical performance, and schedule associated with the external commitments. To minimize this risk, the SMD seeks to conclude explicit and timely agreements that establish the overall policies for each partnership.

A second risk with lower probability than the partnership is the under-estimation of the complexity and cost of a mission due to optimism in instrument and spacecraft proposals before and during Phase A. To mitigate this risk, the SMD will utilize technical and cost estimates independent from the project prior to instrument selection to start Phase A; it will also utilize chartered Standing Review Boards for projects to obtain independent cost, technical, and schedule estimates prior to the transitions from Phase A to B and from Phase B to C.

## **9.0. INTERNAL AGREEMENTS**

The program is not dependent on other NASA activities outside the control of the Associate Administrator for the SMD.

## **10.0. EXTERNAL AGREEMENTS**

The SDO project does not contain any external agreements. It depends upon S-band and Ka-band radiofrequency authorizations (RFA) for the spacecraft and S-band RFA for the dedicated ground stations to transmit that are granted by the National Telecommunications and Information Administration in the U.S. Department of Commerce.

The SET-1 mission depends upon investigations provided by the BNSC and the CNES. It is a piggyback payload on the Air Force Research Laboratory's DSX spacecraft. The DSX spacecraft is a secondary payload that depends upon the Air Force Space Test Program for access to space.

The G-RBSP mission has one investigation, the PSBR, which is contributed by NRO and

one partnership with the Czech Republic for the EMFISIS investigation.

The G-MOO investigation, BARREL, is funded entirely by the LWS program.

The Solar Orbiter Collaboration will depend upon ESA for the spacecraft bus, telemetry, mission operations, and data from other Solar Orbiter science instruments. Requirements for other external agreements for this mission will be determined after investigations are selected from the AO.

Requirements for external agreements for the Solar Probe and Sentinels missions will be established when science investigations are selected from AOs that have not been issued.

When external agreements are needed and made, their documentation is part of the project-specific requirements appendix to the LWS Program Plan that is finalized when each project is confirmed to start implementation.

## **11.0. REVIEWS**

The SMD has established a Standing Review Board (SRB) for the LWS program in accordance with the requirements of NPR 7120.5D. The LWS SRB shall perform biennial LWS Program Implementation Reviews and report its findings to the Agency PMC.

The LWS Independent Review Team (IRT) was the review team for the SDO project before the effective date of NPR 7120.5D. The SDO project was in Phase D on the effective date of NPR 7120.5D. In accordance with paragraph 2.5.2, of NPR 7120.5D, a project already in Phase D (or beyond) at the effective date of NPR 7120.5D need not have a new review board established. The SDO project is retaining the IRT as the SDO IRT and not establishing a new review team.

The G-RBSP mission has established a G-RBSP SRB for the mission. This SRB has performed the reviews including the preliminary Non-Advocate Review (NAR) near the end of Phase A and will perform the Preliminary Design Review and NAR near the end of Phase B.

The SET-1 mission is a category III project as defined by NPR 7120.5D, paragraph 2.1.4, and is a Class D mission as defined by NPR 8705.4, Risk Classification for NASA Payloads. The GSFC CMC was the Governing Program Management Council (GPMC) for the SET project with the Systems Review Office (SRO) as the independent assessment organization under NPR 7120.5B, NASA Performance Report, FY 2000 and NPR 7120.5C, NASA Program and Project Management Processes and Requirements, the SMD PMC is now the GPMC under NPR 7120.5D.

The GSFC SRO will chair the subordinate reviews, i.e., those not specifically called out in NPR 7120.5D, for the SDO and SET-1 projects in accordance with the requirements of NPR 7123.1A, System Engineering Processes and Requirements. The JHU/APL equivalent organization will chair the subordinate reviews for the G-RBSP mission.

## **12.0. OUTCOMES**

Progress toward achieving the multiyear outcomes defined in paragraph 4.0 is validated annually by external review. In addition, each NASA IBPD contains yearly performance metrics for the LWS program. The FY 2009 IBPD contains the following metrics for FY 2009 for the LWS program:

- Launch SDO and commission the spacecraft.
- Complete Phase B for the G-RBSP mission.
- Complete Phase B for BARREL.
- Select instruments for the Solar Orbiter Collaboration.
- Select instruments for the Solar Probe mission.

The LWS program will be successful if all the annual ratings of multiyear outcomes are “green” (or satisfactory progress) and it meets its plans in the FY 2009 IBPD. These ratings are documented in annual updates in the NASA Performance and Accountability Report.

## **13.0. WAIVERS**

The DPMC approved waivers and deviations to requirements in NPR 7120.5C that were not in NPR 7120.5B and are applicable to time periods in the LWS program and the SDO and SET projects prior to the date that NPR 7120.5D was baselined. These waivers and deviations can be partitioned into categories and are documented by requirement in the NPR 7120.5 compliance matrices that are appended to the LWS Program Plan. Many of these waivers and deviations are applicable to the requirements in NPR 7120.5D, but waivers and deviations to the requirements of NPR 7120.5D have not been submitted for approval.

The following approved waiver to the requirements in NPR 7120.5C for the SDO project will not be submitted for approval:

- Retention of the SMD PMC as the GPMC for the SDO project.

The categories of approved waivers and deviations to the requirements in NPR 7120.5C for the LWS program and the SDO and SET projects that may be submitted for approval are:

- Declaration that the SDO and SET projects and the SDO and SET Project Plans are compliant with the requirements of NPR 7120.5D even though the formats of the program and project plans do not comply with the format specified in NPR 7120.5D.

- Exemption from Technical Warrant Holder (TWH) and Technical Authority (TA) requirements for formulation and implementation prior to the time that NPR 7120.5C was baselined, because the TWH/ITA requirements did not exist in NPR 7120.5B, the document applicable when the LWS program and the SDO and SET projects were in formulation.
- Exemption from Cost Analysis Data Requirement (CADRe) submittals for SDO and SET, because the projects have passed the dates when CADRe submittals are required, the entire cost of the projects cannot be captured in full cost due to the use of the business-as-usual budget formulation for a portion of both projects, and the requirements did not exist when the projects were in formulation.
- Exemption from implementing the NPR 7120.5C-specified work breakdown structure in the requirements, documentation, and design (i.e., beyond the budget beginning in fiscal year 2006) to the SDO and SET projects to avoid cost and risk.

The SMD PMC approved a deviation to requirements in NPR 8010.2, Use of the Metric System of Measurement in NASA Programs, to provide for the controlled use of hybrid English and metric units in the LWS program and all its projects, because the complete use of metric units is not feasible. Plans for using hybrid units are described in the LWS Program Plan as required in NPR 8010.2. It also approved (1) deviations to all circular requirements in NPR 7120.5C; (2) a waiver to the requirement for the submittal of winning proposals for AO-driven projects in lieu of a CADRe at the end of Phase A; and, (3) deviations to requirements for using Earned Value Management (EVM) when the financial systems of the project-implementing organizations support methods equivalent to EVM but not EVM.

**14.0**

**PCA ACTIVITIES LOG**

<b>Date</b>	<b>Event</b>	<b>Change</b>	<b>Addendum</b>	<b>Cancellation Review Req'd</b>	<b>MDAA or MSOD Signature</b>	<b>Deputy Administrator Signature</b>
06/02/04	Initial Baseline at Confirmation of LWS program and SDO project	None	N/A	No		07/02/04
TBD	Update using Vision for Space Exploration priorities and FY 2009 President's Budget Request	NPR 7120.5D format and content; revised program information	N/A	No		