Announcement of Opportunity

Radiation Belt Storm Probes Investigations and Geospace-Related Missions of Opportunity

Notice of Intent Due: September 27, 2005
Proposals Due: November 22, 2005

OMB Approval Number 2700-0085
RADIATION BELT STORM PROBES (RBSP) INVESTIGATIONS AND GEOSPACE-RELATED MISSIONS OF OPPORTUNITY

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THE RADIATION BELT STORM PROBES INVESTIGATIONS
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GEOSPACE-RELATED MISSIONS OF OPPORTUNITY

1. DESCRIPTION OF THE OPPORTUNITY

1.1. Announcement Objectives

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) announces the opportunity to conduct space science investigations through the Radiation Belt Storm Probes (RBSP) mission, which is part of the Living with a Star (LWS) Geospace Program. In particular, the opportunity is to provide understanding, ideally to the point of predictability, of how populations of relativistic electrons and ions in space are formed or changed in response to the variable inputs of energy from the Sun (see additional details in section 2 below). Of special interest are the controlling mechanisms of particle and field variations responsible for energetic particle acceleration, transport and loss processes. Investigations should emphasize understanding of the basic physics of the important processes. Investigations should also provide characterization of the energetic particle populations near Earth by determining the average and extreme configurations of the regions under observation and the general character of their response to changing input. Thus, these investigations are expected to provide a level of physical understanding that will lead, in conjunction with other NASA and external programs, to improved characterizations of planetary space environments (space environment specification and climatology) and prediction of potentially hazardous space weather effects (nowcasting and forecasting). The space weather effects specifically targeted by the RBSP science objectives are those that affect space assets, astronauts, and flight crews.

This Announcement of Opportunity (AO) also invites proposals for Missions of Opportunity that effectively fulfill one (or more) LWS Geospace specific objectives through an investigation that is carried on a mission sponsored by an organization(s) other than NASA's Science Mission Directorate.

The LWS Geospace Mission Definition Team (GMDT) sponsored by NASA defined a broad set of scientific objectives for the LWS Geospace program and suggested a complement of measurements that would be sufficient to address those objectives (see Appendix C for information on how to access The LWS Geospace Storm Investigations: Exploring the Extremes of Space Weather report). A prioritized subset of those objectives is targeted with this Announcement. Depending on the proposed costs and available resources, NASA expects to select a complementary set of science investigations that address most of the highest, and perhaps some of the other, priority science objectives as described in Section 2 of this AO.

Although the science investigations for the remaining LWS Geospace program elements will be solicited separately, it is recognized that the Earth's inner magnetosphere and the broader Sun-Earth system are strongly coupled electromagnetically. Full understanding
of the behavior of the connected regions in response to solar inputs requires that they be studied as an integrated system whose components are linked and modified through complex feedback mechanisms operating on a variety of temporal and spatial scales. RBSP science investigators need to demonstrate how they plan to develop close coordination between the disparate targets of study as conducted by themselves as well as other LWS investigations, investigations from other NASA supported programs, and the existing and developing space weather programs supported by other national and international agencies. How the ultimate outcome of these coordinated investigations will be of value to LWS objectives should be addressed.

Therefore, this AO solicits proposals to provide complete scientific research investigations that include each of the following elements:

• development of a science research plan that addresses one or more of the science objectives and societal effects goals as described in Section 2 of this AO;

• design, development, and delivery to NASA of flight experiment hardware in the form of two identical instruments (or two identical suites of instruments) or, for Mission(s) of Opportunity, delivery of a flight experiment to the mission sponsor, see further below;

• active participation in mission integration, science mission planning, and operation of the proposed instrumentation;

• development of a data acquisition, calibration, processing, distribution, and archiving plan to provide one or more complete sets of measurements sufficient to address the proposed research plan and that are suitable for integration into Sun-Solar System Connection Research and Analysis (R&A) Program efforts for the purpose of supporting science understanding studies, characterization studies of the space environment, and studies to enable the prediction of potentially hazardous space weather effects;

• design and development of hardware and software to support the data acquisition, calibration, analysis and processing, distribution, and archiving plan;

• provision in near real time of selected space weather prediction data products of utility to NASA, National Oceanic and Atmospheric Administration (NOAA) and, potentially, other space environment effect prediction communities;

• timely execution of the data acquisition, calibration, processing, distribution, and archiving of the proposed data products; and

• analysis and timely publication in the peer reviewed literature of research based on the integrated data sets that address the objectives described in Section 2 of this AO.
RBSP flight instruments selected in response to this AO will be flown on a pair of NASA-supplied, Sun-pointing spacecraft with a perigee altitude of approximately 500 km and an apogee altitude of approximately 30,600 km (1.08 x 5.8 R\textsubscript{E} geocentric altitude). Inclination will be no greater than 18 degrees. NASA plans to launch the RBSP spacecraft in 2011 for a prime mission of two years. In the case of a Mission of Opportunity (see further below), the investigation will be launched on a spacecraft flown in this same timeframe but provided by an organization other than NASA SMD.

1.2. Available NASA Resources

Proposing organizations must recognize that NASA's resources available for this program are constrained and propose accordingly. As a guideline, the total cost to NASA of all investigations selected through this AO from Phase A through Phase E (see definitions in Section 1.3) is approximately $61M in real year dollars with approximately $3M of that amount allocated for Phase A contracts. The amount of funding provided for a Phase A study may vary depending on whether the selected investigation is an instrument or suite of instruments. In addition, up to $47M in real year dollars is available for the LWS Geospace-Related Mission of Opportunity with $1M of that amount reserved for the Phase A study. The amount of funding provided for this Phase A study may vary depending on the selected investigation(s). In any event, the continuation of any aspect of this program shall be contingent upon the availability of appropriate NASA funding through the yearly U.S. Federal Government budget process.

1.3. Overview of Specific Provisions for Proposals

This AO solicits proposals for RBSP scientific investigations from individual Principal Investigators (PIs), aided by a science team consisting of an appropriate and justified number (see Appendix B, Section D.5.d) of Co-Investigators (Co-Is) and/or participating scientists that provide, as well as utilize, the data from the proposed hardware. PIs may be from any category of public or private U.S. or non-U.S. organization (see Section 5.9). In addition, the science team for an investigation may be formed from any combination of institutions, public or private, domestic or foreign.

Proposed investigations must provide identical pairs of individual instruments or identical pairs of various combined sets (i.e., suites) of instruments up to and including an entire complement of integrated instruments sufficient to satisfy all the science objectives of the entire mission. While proposals for multiple instruments (suites) are welcome, they must provide science, technical, and cost information for each instrument sufficient to allow for separate evaluation and selection.

Additionally, investigations proposed to achieve LWS Geospace science objectives through participation in Missions of Opportunity may be selected if their perceived value is high, their performance is within the stated time period desired for the Geospace program, and the proposed NASA cost is within the funding limits for the Mission of Opportunity.
Proposals submitted in response to this AO must be for investigations encompassing all appropriate mission phases. NASA management of projects, as defined by NASA Procedural Requirements (NPR) 7120.5C NASA Program and Project Management Processes and Requirements, is a four-part process, which includes Formulation, Approval, Implementation, and Evaluation. The NASA mission phases are divided as follows. Formulation is divided into: Phase A – Concept Development and Phase B – Preliminary Design. Implementation is divided into: Phase C – Final Design, Phase D – Fabrication, Assembly, and Test, and Phase E – Operations and Sustainment. For the RBSP mission, Phase D includes Launch Operations extending through in-orbit checkout, usually launch plus 30 days. Phase E includes analysis and publication of data in the peer reviewed scientific literature and delivery of the data to an appropriate NASA data archive. All phases are expected to include provisions for the planning and implementation of an appropriate Education and Public Outreach (E/PO) program (see Section 5.12). Proposers are advised that for NASA the evaluation process is not a separate phase but is the ongoing independent review and assessment throughout Formulation and Implementation. The document NPR 7120.5C, that describes the necessary management and review procedures, may be found in the RBSP Library (Appendix C)

The costs proposed for the elements listed in Section 1.1 must be within the cost guidelines in Section 1.2, include all phases A through E, and be given in real year U.S. dollars, including full cost reserves.

1.4. Overview of Proposal Evaluation and Selection Process

Individual instruments or suites of instruments may be proposed. Proposals to this AO will be selected through a single-step process for a Phase A study only with options for further Phases. NASA reserves the right to make partial selections of investigations, as described in Section II of Appendix A. In addition, NASA reserves the right to make tentative selections pending the outcome of Phase A studies (see Appendix A, Section II). More than one instrument of the same type may be selected for Phase A studies. In this case, at the end of the Phase A studies, a review will be held to decide which investigations continue into Phase B. The option on contracts of those not selected to continue will not be executed.

Proposers must estimate the Total NASA Cost (all costs necessary to complete the investigation beginning with Phase A through Phase E, including reserves) in their proposals (see Appendix B for details) and, if selected for a Phase A study through this AO, in a much more detailed cost plan that is part of the Phase A. Investigators should cost their Phase E efforts to provide for the entire analysis effort for their investigations during the first three years after launch (two years of spacecraft operation plus one year of additional data analysis). The specific cost information required for proposals to this AO is described in Appendix B. During no phase of the investigation shall the proposed cost to NASA of the total for all investigations exceed the NASA cost constraint for this mission. Individual investigations may be descoped or terminated by NASA to meet cost constraints. Therefore, the proposers must describe a management approach that identifies a prioritized plan for investigation descopes, including the decision point and estimated cost savings and resource savings for each descope.
Proposers shall outline their reserves plan indicating the appropriate amounts of technical, schedule, and cost reserves based on design maturity and flight heritage. All investigations must include adequate reserves at every phase of the mission lifecycle. In particular, investigations must plan to maintain a reserve through the end of Phase B of at least 25 percent of all costs through the end of Phase D. A cost reserve for Phase E must also be included as appropriate. Proposers should not assume that the RBSP Project Office will maintain any reserves beyond those proposed. In general, schedule reserve must be approximately four weeks per year for Phases C and D.

It is the intent of NASA to separately, in a future announcement, solicit Interdisciplinary Science (IDS) proposals to conduct additional science analyses that address cross-disciplinary LWS science themes and that several IDS principal investigators (PIs) will be selected no earlier than 2008. The IDS PIs will participate as members of the LWS Geospace Science Working Group (SWG) in an advisory and consultancy capacity on issues relating to LWS science. The IDS funding is separate from the RBSP and is not included in the funding profile for the RBSP included in this AO. RBSP PIs selected through this AO will not be eligible for IDS funding.

2. **SCIENCE OBJECTIVES**

This AO offers a research opportunity to understand the variability in the inner magnetosphere region so as to understand the fundamental mechanisms of particle acceleration to relativistic energies. This mission will employ a dual-spacecraft strategy capable of distinguishing spatial from temporal variations and to distinguish local acceleration processes from those associated with plasma transport. Specifically, a set of science investigations are solicited that will emphasize understanding and characterization of the targeted processes and regions. Both aspects are deemed essential for impacting the development of the physics-based and empirical space environment models that would lead to diagnosing and predicting the wide variety of space weather effects of interest to the LWS program – including those that affect space assets, astronauts, and flight crews.

Of special interest to LWS are the controlling mechanisms of particle and field variations responsible for energetic particle acceleration, transport and loss processes. Investigations should determine the average configurations and the extremes of the targeted regions, the general character of their response to changing input, and the basic physics of the important processes that operate within. The connections between specific mechanisms and the phenomenology of the regions must be established so that a predictive understanding of their behavior may be achieved.

Proposers should be particularly aware of the uniqueness of the LWS program: that the potential to impact the characterization and predictability of the listed space weather effects are a requirement for assessing the relevance of proposed investigations to the program. Therefore, the approach adopted by proposers should keep intact the traceability from the societal impacts throughout the proposed investigation objectives, approach, techniques, measurements, and theory to the resulting potential impact on enabling the specification, nowcasting, and forecasting goals of LWS.
To accomplish these goals, the LWS/Geospace program solicits science investigations that will lead to significant progress on the RBSP prime scientific objective:

**Understand the acceleration, global distribution, and variability of energetic electrons and ions in the inner magnetosphere.**

More specifically, the Radiation Belt Storm Probes prime objective will be fulfilled by meeting these prioritized specific objectives:

1) differentiating among competing processes affecting the acceleration and transport of radiation particles;
2) differentiating among competing processes affecting the precipitation and loss of radiation particles;
3) understanding the creation and decay of new radiation belts;
4) quantifying the relative contribution of adiabatic and nonadiabatic processes on energetic particles;
5) understanding the role of "seed" or source populations for relativistic particle events;
6) understanding the effects of the ring current and other storm phenomena on radiation electrons and ions;
7) understanding how and why the ring current and associated phenomena vary during storms; and
8) developing and validating specification models of the radiation belts for solar cycle time scales.

The prime mission phase of the RBSP spacecraft is planned for two years. To obtain understanding of longer time scale behaviors, the RBSP investigation teams may plan to make use of data from other open and public data sources. It is anticipated that the use of auxiliary, but highly related, data will enable an expansion of the scope of the RBSP investigations, filling gaps in spatial coverage, expanding the temporal coverage and, when combined with the data provided by the RBSP instrumentation, make up the reference databases that must be established by the RBSP investigations for utilization by other NASA and external programs. For example, a RBSP investigation that proposes to supply instrumentation to measure radiation belt electrons from the RBSP satellite for the purpose of understanding the acceleration and loss of radiation belt particles might also propose to integrate similar open-source measurements from other space- or ground-based observatories, concurrent or not, in order to provide standardized, global phase space density maps suitable for further supported studies of the physical causes behind relativistic particle acceleration.

The science products anticipated to come from the RBSP mission are thus two-fold; understanding and characterization of the mechanisms that cause the dynamic behavior of the radiation environment, and reference databases that will enable further investigations, supported by other NASA and external programs, into the consequences of the dynamic behaviors of this portion of the Earth-Sun system. Only then can theories and models be developed and tested using these data.
Note that, although an element of proposed plans to address space environment nowcasting and forecasting efforts might be the development of models that incorporate the improved physical understanding of the radiation belt regions, the LWS program plans to support these broader modeling efforts through separate announcements. For example, funding for the development and validation of physics-based data assimilation models of the radiation belts is not covered in this AO.

The LWS Geospace Mission Definition Team (GMDT) report titled *The LWS Geospace Storm Investigations: Exploring the Extremes of Space Weather* provides additional background information that may be useful to the proposers who seek to respond to this solicitation. Appendix C provides instructions on accessing various elements of the RBSP Library. It is important to note, however, that this GMDT report describes a mission architecture that includes additional mission concepts that are outside the scope of this Announcement. In addition, the Radiation Belt Storm Probes baseline mission described in that report includes instrumentation recommendations that may exceed the resources available for this mission. In case of a conflict between concepts outlined in this AO and those in the GMDT report, the provisions of this AO take precedence. In particular, to be considered responsive to this Announcement, proposed investigations must address the objectives as described here in Section 2.

The RBSP mission presents a challenge to the geospace science community and it is difficult to make a one-to-one link between individual flight instruments and the mission objectives. It is unlikely that the RBSP spacecraft would be capable of accommodating all desired instrumentation (see Section 5.2). With this in mind, proposers should fully describe how their instrumentation and proposed measurement dataset would contribute to the anticipated science program and how their investigation would address the broadest range of LWS and RBSP science objectives for the minimum cost.

3. **BACKGROUND**

3.1. **ESS Space Science Research Goals**

The Sun-Solar System Connection (SSSC) research focus area within NASA's Earth-Sun System (ESS) Division seeks to better understand why the Sun varies; how the Earth and other planets respond; how solar variability affects Earth's climate, life, and society; and how the heliosphere interacts with the galaxy. The Sun is a variable star whose energy output varies on all time scales. The Earth, planets, and other bodies reside within the Sun's outward flowing atmosphere. This solar wind, consisting of plasma, energetic particles, and magnetic fields, is the extension of the Sun's corona whose outer boundary defines the heliosphere. By analyzing the connections between the Sun, solar wind, planetary space environments, and the Galaxy, ESS-SSSC science works to explain the fundamental physical processes that occur throughout the Universe. These broad objectives are more fully described in the *Sun-Solar System Connection Science and Technology Roadmap 2005-2035* and in *The New Age of Exploration: NASA's Direction for 2005 and Beyond* (see Appendix C for access to this and related documents).
The ESS Division science program sponsors SSSC missions in two programs: Solar Terrestrial Probes (STP) and Living With a Star (LWS). These are in addition to the more widely competed Explorer opportunities.

3.2. Solar Terrestrial Probes and Other Relevant Programs

The STP program addresses the full spectrum of SSSC goals with a sequence of strategic research missions meant to answer tightly focused science questions. STP missions that are expected to operate concurrently with RBSP are Solar-B (sponsored jointly by Japan's Aerospace Exploration Agency (JAXA) and NASA), the Solar Terrestrial Relations Observatories (STEREO), and the Magnetospheric Multi-Scale (MMS) mission. More information on the STP missions can be found at http://stp.gsfc.nasa.gov/.

Additional ground-based and space-based programs may also complement the observations provided by RBSP, including:

- The Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission, sponsored by NASA's Medium-class Explorer (MIDEX) program;
- The Communications Navigation Outage Forecasting System (C/NOFS), sponsored by the United States Air Force;
- The Geosynchronous Operational Environmental Satellites (GOES), Defense Meteorological Satellite Program (DMSP), and National Polar-Orbiting Operational Environmental Satellite System (NPOESS), all sponsored by the National Oceanic and Atmospheric Administration (NOAA);
- The Department of Energy (DOE) and Department of Defense (DoD) sponsored instrumentation in medium Earth orbit (MEO), high Earth orbit (HEO), and geosynchronous (GEO) orbit platforms flown by commercial satellite operators and the DoD; and
- The wide network of ground-based observatories including the Super Dual Auroral Radar Network (SuperDARN) and the Advanced Modular Incoherent Scatter Radar (AMISR), which are sponsored by various national and foreign organizations including agencies in Europe, Canada, Japan, and Russia and, in the U.S., the National Science Foundation (NSF).

3.3. The Living With a Star Program

The LWS program sponsors targeted basic research that addresses that subset of SSSC science specifically required to develop knowledge and understanding of aspects of the connected Sun-Earth system that directly affect life and society. In particular, LWS seeks to:

- Understand solar variability and its effects on space and Earth environments;
- Provide information for mitigating effects of solar variability on technology; and
- Determine how solar variability can affect life on Earth, and specifically:
- Understand the relative importance of global climate changes caused by the Sun and other natural and anthropogenic drivers;
- Understand how interplanetary space and the Earth's environment respond to solar variability with the ultimate goal of a reliable predictive capability.
- Understand how space weather affects hardware performance and operation in space, and
- Predict how stellar variability may affect life in other stellar systems.

LWS includes four major elements: 1) a Space Weather Research Network of solar-terrestrial spacecraft; 2) a Targeted Research and Technology (TR&T) program; 3) a Space Environment Test beds (SET) program to infuse new technologies into space programs; and 4) development of partnerships with national and international agencies and industry.

The Solar Dynamics Observatory (SDO) – SDO is the first mission element of the Space Weather Research Network recommended in NASA's Space Science Enterprise Strategy and endorsed by the LWS Science Architecture Team (SAT) to accomplish the goals of the LWS program.

The LWS Geospace Program – A program of "targeted" basic research aimed at advancing our understanding of solar variability on those geospace phenomena that most affect life and society. For the 2005-2012 time frame, those phenomena are the acceleration, global distribution and variability of the radiation-level electrons and ions that produce the harsh environment for spacecraft and humans; and the ionospheric-thermospheric system variabilities and irregularities that affect communications, navigation and radar systems. The program plan includes a Geospace Missions Network (of which the RBSP mission is a part), Missions of Opportunity, and Leveraged Programs.

LWS Sentinels – As currently envisioned, Sentinels will probe the connections between solar phenomena and geospace disturbances using multiple spacecraft in different heliocentric orbits to determine: 1) the structure and long-term variations of the solar wind; 2) how solar wind structures propagate and evolve between the Sun and Earth; 3) which solar dynamic processes are responsible for the release of geo-effective events; and 4) how and where energetic particles are released and accelerated. Coordination with missions sponsored by International Living With a Star partners, e.g., ESA's Solar Orbiter mission, will influence the mission architectures of the LWS Sentinels.

While these individual missions would doubtless produce exciting discoveries about the complex Earth-Sun system, together they will greatly improve the ability to predict weather in space, enhance knowledge of solar influences on climate change, and give fresh insight into the origins and future of life on Earth.

3.4. The Radiation Belt Storm Probes Mission

Understanding the particle acceleration processes within the radiation belt region and the dynamic processes that drive both long-term and short-term variations have been of great importance to the U.S. space program ever since the first observations were performed by instruments on NASA's Explorer-1 satellite in 1958. The ability of NASA space
missions to deploy multiple, smaller spacecraft through these regions with the range of instrumentation necessary to unambiguously resolve the parameters of most interest have been possible only more recently. The ability to specify and forecast trapped ions and electrons from 1 to 12 \( R_E \), is explicitly recommended by the National Space Weather Program Implementation Plan, July 2000 (see Appendix C for access to this document).

The RBSP mission is the second Space Weather Research Network mission in the NASA Living with a Star program and is also one mission element of the Geospace program within LWS. Other planned LWS Geospace flight program elements include the Ionosphere-Thermosphere Storm Probes (ITSP) and the Ionosphere-Thermosphere Imager. The Living with a Star Program is managed by the Earth-Sun System Division of the Science Mission Directorate (SMD) within NASA.

The RBSP mission was originally included as a central LWS element called the Radiation Belt Mappers within the LWS Science Architecture Team (SAT) report. The mission further derives from the Radiation Belt Storm Probes mission defined in the LWS Geospace Mission Definition Team (GMDT) report. RBSP is included as a strategic element in the Sun-Earth Connection (SEC) Roadmap 2003-2028. The Geospace Network is also recommended for high priority development in the National Research Council's decadal survey planning report, The Sun to the Earth – and Beyond: A Decadal Research Strategy in Solar and Space Physics.

4. PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This Announcement of Opportunity solicits proposals for a single opportunity in accordance with the following schedule:

- AO release: August 23, 2005
- Preproposal Conference: September 9, 2005
- Notice of Intent to Propose due: September 27, 2005
- Proposal submittal due by 4 p.m. Eastern time including all letter(s) of endorsement: November 22, 2005
- Selections for Phase A: February 2006
- Instrument Phase A start: March 2006
5. RBSP GUIDELINES, REQUIREMENTS, AND CONSTRAINTS

5.1. Introduction

A RBSP proposal must be for a science investigation whose implementation requires the delivery of two identical sets of flight experiment hardware to be accommodated on the two LWS Radiation Belt Storm Probes spacecraft. The Principal Investigator is responsible to NASA not only for the scientific integrity of the investigation, but also for the management of the implementation of the investigation, including provision of the flight hardware, the flight hardware ground system, dissemination of the data to the scientific and space operations community, the analysis and publication of data in the peer reviewed scientific literature, and delivery of the data to an appropriate NASA data archive.

5.2. Technical Approach Requirements

5.2.1. Scope of Mission

The subsections below present the results of a mission implementation concept study that can achieve the scientific goals described in Section 2 of this AO. The topics include measurement objectives, a concept payload and NASA provided concept spacecraft, provisions for instrument accommodation, a scenario of mission operations support, and a mission schedule.

Program planning for the RBSP mission includes two spacecraft launched together on an Expendable Launch Vehicle (ELV) directly to the nominal mission orbit. The highly elliptical orbit will have a perigee altitude of approximately 500 km and an apogee altitude of approximately 30,600 km (1.08 x 5.8 RE geocentric altitude). Inclination will be no greater than 18 degrees.

At deployment, a small delta-v between the two spacecraft will produce a small change in velocity that will result in each spacecraft being in nearly identical orbits that slowly drift apart. The velocity difference will be sufficient for the leading spacecraft to lap the lagging spacecraft several times during the mission allowing spatial and temporal measurements to be performed at separation times and distances that vary with mission duration.

Based on a preliminary analysis of the science requirements, the spacecraft orientation for science operations will be such that the spin axis is maintained roughly parallel to sun line with a spin rate of approximately 5 revolutions per minute (RPM). The RBSP mission is currently planned to have an operational duration of two years.

5.2.2. Candidate Instruments for the RBSP Payload

Science investigations proposed to the RBSP mission must address the prioritized scientific objectives as summarized in Section 2 of this AO. The associated flight hardware must return measurements of a quantity and quality appropriate to achieving the proposed science investigation.
Below is a candidate set of measurements, as recommended by the LWS Geospace Mission Definition Team, that have been identified as being of highest priority.

- Radiation belt electrons
- Vector magnetic field
- Ring current particles
- AC magnetic fields
- DC/AC electric fields

In addition to the above, the following set of candidate measurements have been identified as being of lower priority.

- Radiation belt ions
- Inner belt protons
- Low-energy ions and electrons

Further details on the scope of the candidate measurements, as envisioned by the LWS Geospace Mission Definition Team, are provided in the referenced GMDT report.

In order to give prospective proposers the fullest possible understanding of the scope of the RBSP mission, Table 5.1 below provides a description of one possible instrument complement that can achieve a substantial portion of the mission science objectives. The list of candidate instrument types is not intended to restrict the possible approaches, nor is the list intended to preclude consideration of investigations that propose other instruments or combinations of instruments that can provide the necessary observations. The list simply describes a sample instrument complement that is expected to be able to meet both the mission science objectives and reflects the resource envelope that NASA expects to be able to select. In all cases, however, it is emphasized that this AO solicits complete science investigations, of which these candidate measurements and concept instruments may be only one means for obtaining the necessary data (see Appendix C, RBSP Library, for additional information on the concept payload resources). In designing this concept payload, it was assumed that one engineering test unit (ETU) would be required.

### Table 5.1 Concept RBSP Payload Used for Spacecraft Trade Studies

<table>
<thead>
<tr>
<th>Instrument Type</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation belt electrons and protons</td>
<td>20 keV – 1 MeV electron distributions</td>
</tr>
<tr>
<td></td>
<td>1 MeV – 10 MeV electron distributions</td>
</tr>
<tr>
<td></td>
<td>1 – 20 MeV proton distributions</td>
</tr>
<tr>
<td>Fluxgate magnetometer</td>
<td>Vector magnetic field</td>
</tr>
<tr>
<td>Ion composition</td>
<td>20 – 600 keV H+ and O+ distributions</td>
</tr>
<tr>
<td>Fields and waves</td>
<td>AC magnetic field</td>
</tr>
<tr>
<td></td>
<td>DC/AC electric field</td>
</tr>
<tr>
<td></td>
<td>Plasma waves</td>
</tr>
</tbody>
</table>
A preliminary engineering evaluation has been performed to determine the physical resources available to the RBSP science payload. Table 5.2 provides a guideline of instrument resource requirements compatible with the concept spacecraft capabilities. More efficient instrument design may allow selection of a more complete payload. Proposals will be evaluated in the context of the maximum payload resources in Table 5.2.

Table 5.2 Maximum Payload Resources for each Spacecraft*

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Totals</td>
<td>67</td>
<td>27</td>
<td>40</td>
<td>10</td>
<td>9.4</td>
<td>64</td>
</tr>
</tbody>
</table>

* Inclusive of all margins and reserves  ** Includes CCSDS Packet Headers (Section 5.3.4)

Proposals must separately and clearly identify (1) estimated allocation for each instrument resource, including the basis of the estimate, and (2) adequate reserves for each resource along with a rationale based on requirements uncertainty, design maturity, flight heritage, and risk. Investigators are responsible for the design, qualification, and delivery of any deployed structures or components required by their instruments, including, but not limited to, elements such as radiation shielding, support booms, armatures, intra-instrument harnessing, thermal blankets, covers, or operational heaters. The characteristics of these structures will be coordinated between the spacecraft vendor and investigator. Proposed instruments and resource requirements will be reviewed for compatibility with the spacecraft and launch vehicle interfaces during Phase A studies (see Section 1.4). Ultimately, interfaces and resource allocations will be documented in Interface Control Documents (ICDs) between the instruments and the spacecraft.

A critical parameter in designing instrumentation for the Radiation Belt Storm Probes (RBSP) mission is the angle "alpha" between the spacecraft spin axis and the local, instantaneous magnetic field vector. The angle alpha will depend on a variety of factors including Earth's orientation with respect to the Sun, spacecraft orbit orientation, the tilt of the Earth's magnetic axis, the instantaneous position of the spacecraft within its orbital trajectory, and magnetic storm-time distortions of the magnetic field configuration. Proposals must provide analysis that demonstrates how the proposed concept for sensors will successfully achieve the goals of the proposed investigation for the potentially broad alpha-angle distribution over the mission lifetime.

It should also be noted that the RBSP orbit presents significant environmental hazards for the spacecraft and payload. Proposals must provide analysis and a concept for sensors and electronic components, including margin, that demonstrates instrument compatibility and robustness with respect to the mission environment. At a minimum, instruments must be designed to preclude permanent damage and mitigate operational outages due to single event effects (SEE) and single event upsets (SEU) related to high-energy particles and due to internal and deep dielectric charging. Payload providers will be required to
verify through design analysis that sensors and electronic components will not incur permanent damage or create discharge hazards that could impact spacecraft or payload health as a result of instrument component internal charging phenomena.

The spacecraft and instrument interfaces and performance envelopes indicated in this AO are preliminary and should be expected to evolve after the science investigations are selected, the instruments and spacecraft are further defined, and design trade-offs are made. Therefore, successful proposers should expect to revise their designs as needed to meet different spacecraft and mission requirements and specifications. Any significant update to the mission specifications in this AO will be posted as amendments or clarifications at the Web location where this AO is posted. For evaluation purposes, proposals will be judged against the amended interface and performance specifications provided at the above Web site.

Proposals may reflect changes to the concept payload, concept spacecraft interfaces, or other spacecraft characteristics as necessary in order to achieve their proposed science goals. However, any changes to the nominal payload resources or concept spacecraft characteristics needed by a proposed payload must be clearly indicated and justified in the proposal.

5.3. Description of the NASA-Provided Concept Spacecraft

NASA's LWS Geospace Missions project office developed a notional spacecraft concept. Each spacecraft has eight rectangular sides; two octagonal ends, and resembles an octagonal column. The Sun-facing octagonal end contains the solar array, and a portion of the side panels may also be populated with cells. The anti-Sun end of the spacecraft contains the main radiator.

The spacecraft spins about an axis that passes through the center of each octagonal end. The axis will be maintained approximately parallel to the Sun vector. The height and mass distributions of the spacecraft are constrained to ensure stability while it is spinning. The spacecraft will be spin-stabilized with the spin axis pointing to within 15 degrees (half-cone angle) of the solar vector over the required lifetime of the mission. The spin rate will be approximately 5 RPM. Periodic attitude control maneuvers using an onboard propulsion system will be used to maintain the spin axis orientation. The spin axis adjustment period will be determined during Phase A to minimize the impact of the maneuvers on the science data collection.

The spacecraft subsystems are located inside the spacecraft; they use passive thermal control by conductively coupling to the spacecraft structure. The internal structure and mounting surfaces will be maintained between -20 and +40°C; it is expected that, during normal operations, the temperatures will be stable to ±5°C over an orbit.

The spacecraft's Earth and Sun sensors will provide attitude knowledge to within 1-degree (3-sigma) accuracy and spin phase information to within 2 degrees with 3-sigma accuracy. Attitude sensor information will be stored in spacecraft housekeeping data and downlinked during ground contact periods.
The spacecraft command and data handling system controls all observatory operations. It routes communications between the ground and instruments using Consultative Committee for Space Data Systems (CCSDS) command and telemetry formatted data packets; forwards the uplinked packets to the instruments; provides a time reference data packet to instruments; and collects, stores, and forwards instrument telemetry packets to the ground.

The communications subsystem provides a bidirectional link that is compatible with commercial ground network assets. It is sized to downlink a 24-hour volume of science and ancillary spacecraft housekeeping data using one contact per day. Uplink command rates vary between 100 bps and 2 kbps depending on the proximity of the spacecraft to Earth, the angular aspect of the ground station, and the ground station characteristics.

The power system provides primary power distribution, power switch control, and power fault isolation. Primary power is unregulated voltage between 21 and 35 Volts DC. A battery provides power to the spacecraft and instruments during eclipse periods.

Each spacecraft will have a monopropellant hydrazine propulsion subsystem to provide spin control during deployment and spin axis control throughout the mission. Thruster placement, plume impingements, and instrument locations will be coordinated with the science teams during Phases A and B.

5.4. Instrument Accommodation

5.4.1. Mechanical and Structural

Six areas on the sides of the external structure of the spacecraft are reserved for instruments. See Figure 5.4.1-1. Each area is 854.5 cm$^2$. The areas may be used to mount instruments to the external structure or to provide penetrations for instruments that are mounted to the internal structure. Two areas on the anti-Sun octagonal end, each equal to 2344.5 cm$^2$, may also be used for instrument mountings or penetrations subject to successful negotiation with the spacecraft provider. No areas on the Sun-facing octagonal end are available for instrument mounting or penetration, and no instruments or instrument appendages may shadow this end.

The internal structure of the spacecraft consists of four decks forming a "double H" core. See Figure 5.4.1-2. The central box-portion of the "double H" structure houses most of the spacecraft subsystems. Shaded portions of the "double H" structure are reserved instrument mountings. The volume located between the shaded portion of the "double H" structure and the exterior spacecraft walls are reserved for instrument components. Four rectangular volumes are provided, and each contains 55,000 cm$^3$. Four triangular volumes that are each bisected by a double-sided mounting structure are also provided, and each contains 12,000 cm$^3$.

The instrument mechanical design requirements shall comply with requirements for proto-flight components as defined in the General Environment and Verification Specification (GEVS) for STS and ELV Payloads, Subsystems and Components, Revision A (see Appendix C for access). Instruments shall be compatible with the acoustic environment defined for the Delta 2925H ELV.
Figure 5.4.1-1. Configuration of the external structure of the RBSP spacecraft. The six shaded areas on the sides of the structure denote locations reserved for instrument mountings or penetrations by instrument components for instruments mounted inside the external structure. The shaded area on the anti-Sun octagonal end may be used for instrument penetrations or mountings only after successful negotiation with the spacecraft provider.

Figure 5.4.1-2. Configuration of the interior structure of the RBSP spacecraft concept. The shaded areas denote locations reserved for mounting instruments to structure. Volumes adjacent to the shaded areas and the external side surfaces are reserved for instrument accommodations.
The dynamic behavior of the spacecraft system will depend on the specific implementation of deployed appendages. Instrument-deployed structures shall be designed and analyzed to ensure system stability before, during, and after deployment. They shall be asymptotically stable for any fixed length. Only bounded stability of the antennas is required during deployment.

The length of time for an attitude disturbance following spacecraft maneuvers depends upon the flexible modes of the instrument appendages. Instrument appendages may be required to satisfy minimum stiffness requirements or employ mechanical damping features to minimize this disturbance period. Spacecraft spin balance shall be maintained in the deployed configuration. Instrument appendages shall implement fail-safe features such as retractable booms or cable cutters that can be used in a contingency event such as deployed hardware failure in a manner that precludes the spacecraft from maintaining spin balance.

Instrument providers shall provide dynamic models of instrument appendages in both the stowed and deployed configurations to support the spacecraft system design. Requirements and resources for instruments, including the protrusion through deck structures and the dynamics and mass properties of instrument-deployed items will be iterated with the spacecraft developer/integrator during Phases A and Phase B. Instrument providers should not assume that heritage mechanical interfaces can be accommodated without modification.

5.4.2. Thermal Control

Instrument providers are responsible for providing a thermal control design and the associated thermal control hardware for all their proposed instrument components. When instrument components are mounted internally, they may radiate into the interior of the spacecraft and can use passive thermal control by conductively coupling to the spacecraft structure provided that the nominal heat transfer capacity does not exceed 0.06 W/cm² of mounting surface. If instrument components are primarily external to the spacecraft surface, then the instrument components need to be thermally isolated from the spacecraft and provide their own thermal control.

Any special thermal interface requirements shall be identified in the proposal. Instrument developers shall develop thermal models of their instrument components for integration into an integrated spacecraft thermal model. Preliminary models shall be developed in Phase A and refined during Phase B. The instrument thermal design shall comply with the General Environment and Verification Specification (GEVS) for STS and ELV Payloads, Subsystems and Components, Revision A (available through Appendix C).

5.4.3. Power and Power Switching Interfaces

The spacecraft will provide only unregulated primary power with at least one switched primary power service for operational power to each instrument. Each instrument shall interface to the spacecraft power system on a dedicated primary power interface connector that is isolated from secondary power signals and interfaces. The dedicated power interface may include operational power, survival power, and primary power pulse
commands. Instruments shall be capable of surviving, without damage, primary power voltages over a range of -2.0 VDC to +40.0 VDC.

Preplanned instrument power cycling may be required for extended eclipse periods. During anomalous conditions, operational power may be removed from the instruments without notice. Survival power will be supplied to the instruments when operational power is removed, and instruments should only require survival power when operational power is removed. Operational and survival power resources are listed in Table 5.2. The proposal should specify the number of switched power services required for each instrument. A limited number of primary power pulse command (nominally +28V pulse) interfaces are available for one-time activations (deployments) or occasional control functions for instruments and not for routine operational functions; requirements for this command interface should also be specified in the proposal.

5.4.4. **Attitude Control System**

Requirements for instruments to have accurate alignment knowledge relative to the spacecraft coordinate system must be identified in the proposal. Plans for using any special reference devices (such as optical cubes) and requirements for absolute co-alignment with respect to other instrument components or the spacecraft spin axis must be specified in the proposal.

5.4.5. **Command and Data Handling**

The spacecraft will have a minimal role in instrument command and telemetry operations. That is, communication services between the ground and instruments will consist of a "bent pipe," i.e., a relay of data to and from the instrument interface with no instrument data processing, formatting, or compression provided by the spacecraft. In normal operation, the spacecraft will not generate instrument commands. However, the spacecraft will support storage of preplanned command packets for distribution to instruments at a later time. The spacecraft will forward command packets to the instruments without processing based on the Consultative Committee for Space Data Systems (CCSDS) telecomm and packet header. Exceptions to this approach may be considered for instrument safety, thruster firings, coordinated science modes, or other maintenance operations that would impact ongoing science operations.

Each instrument shall generate science packets according to the Source Data Packet telemetry format document CCSDS 102.0-B-5, *Packet Telemetry* (available through Appendix C) including defining the format for the data portions of instrument command packets.

The science data collected from the instruments will be temporarily stored on the spacecraft Command and Data Handling (C&DH) data recorder. A subset of the data, suitable for space weather operations centers, will be telemetered in real time and will not be stored. Instrument providers should expect to iterate with the spacecraft developer/integrator and/or LWS-identified space weather operation centers during Phases A and B on the final data handling strategies.
The C&DH and operations will accommodate the payload packet telemetry rates identified in Table 5.2; the aggregate size of the memory available for stored commands for all instruments is approximately 100 Kbytes and includes both science and housekeeping data. Stored command packets may be individually time tagged with a nominal execution uncertainty of +/-1 second per packet or may be part of a packet sequence executed as a macro command.

The spacecraft will broadcast a time synchronization message at a rate of 1 Hz to the instruments. The instruments must annotate their instrument data with a broadcast time if they need to correlate the broadcast time with the spacecraft-provided UT (to an accuracy of +/-0.7 seconds) during their data analysis; correlation with UT will not be available in real-time coincident with data collection.

The spacecraft developer is responsible for implementing the command and data interfaces between the spacecraft and instruments. Options that are being considered are: (1) a MIL-STD-1553 redundant serial bus where the spacecraft acts as the 1553 bus controller and each instrument is a 1553 remote terminal; (2) a pair of synchronous serial data interfaces with gate and clock signals generated by the C&DH system implemented with differential signal lines; and (3) a pair of asynchronous serial data interface implemented with differential signal lines.

5.4.6. Contamination Control

The spacecraft and instruments will select materials and processes that conform to NASA Reference Publication 1124, "Outgassing Data for Selecting Spacecraft Materials," as a guide for materials selection (available through Appendix C). Instruments must be designed to be compatible with hydrazine and hydrazine propellant byproducts. Instrument providers must specify cleanliness requirements and state the measures to achieve their requirements during integration and testing (I&T), launch site processing, and on-orbit operations. They are responsible for providing any required doors and door mechanisms needed to minimize contamination onto sensitive surfaces. I&T is expected to take place in a Class 100,000 clean-room environment. If a prelaunch (T-0) purge connection is needed, it should be specified in the proposal; purge flow rates should not exceed 0.5 liters/min.

5.4.7. Electrostatic Controls

The spacecraft design and externally exposed instrument components shall minimize electrostatic disturbances in the vicinity of the spacecraft. Most external surfaces shall be electrically conducting and grounded to the spacecraft single-point ground (negative ground). The bias voltage of any external conducting surface shall not exceed 2 V. Instrument doors or other hinged or shafted devices shall provide a DC resistance to the spacecraft structure of less than 1.0 ohm. Instrument-specific electrostatic accommodation requirements should be described and if the proposed requirements exceed the planned levels, they should be scientifically justified in the proposal.
5.4.8. Electromagnetic Compatibility

At a minimum, each instrument will be required to comply with the Electromagnetic Interference (EMI)/Electromagnetic Compatibility (EMC) design requirements of the General Environment and Verification Specification (GEVS) for STS and ELV Payloads, Subsystems and Components (available through Appendix C). The spacecraft and instrument components shall be designed to minimize conducted and radiated emissions in the frequency range from 10 Hz to 10 KHz, and, in any case, those emissions shall not exceed the emissions requirements specified in General Environment and Verification Specification (GEVS) for STS and ELV Payloads, Subsystems and Components. Instrument-specific EMI/EMC requirements should be described and if the proposed requirements exceed the planned levels, they should be scientifically justified in the proposal. The final requirements will be established during Phase A.

5.4.9. Magnetic Cleanliness

The spacecraft and instrument components shall be designed to minimize the residual and induced magnetic fields. The integrated spacecraft and instrument shall not generate DC magnetic fields greater than 10 nT at a distance of 1 meter from any external surface or shall verify that residual magnetic fields are stable to less than 10 nT.

5.5. Mission Operations Concept and Ground System Architecture

The concept for mission operations assumes a single Mission Operations Center (MOC) to coordinate and perform mission operations activities. The MOC will be responsible for the control, commanding, telemetry download distribution, and health and safety monitoring of the spacecraft. The ground station will receive and process RBSP downlink telemetry and deliver the instrument telemetry to the appropriate locations for further processing. During contact with the ground, the RBSP spacecraft will downlink instrument data as well as spacecraft housekeeping data. The MOC will receive instrument commands and will manage the spacecraft and instrument uplink loads for transmission to the spacecraft. It will also transmit the unprocessed science data directly to the investigators' Science Operations Centers (SOC) and store 30 days of science data for retransmission to the SOCs.

Each PI must provide a science operations capability in the manner and location deemed best. The SOC, funded by the PI investigation, must be able to take data from the ground station, plan scientific observations, generate instrument command timelines, and perform science data analyses. The SOC is also solely responsible for the health and safety of the PI's instrument. PIs will provide training materials for the flight operations team and all required personnel, hardware, and software for instrument science operations. Proposers are reminded to include the cost of instrument health and safety oversight during the mission operations phase in their proposals. Details of the RBSP science operations will be defined by the selected science teams. Mission operation is subdivided into phases: launch and early operations, prime operations, and science data distribution.
5.5.1. Early Mission Operations

Early operations include establishing spacecraft orientation and drift velocity, deploying and checking out the spacecraft systems and science instruments, and commissioning the instruments and spacecraft for prime mission operations. Real-time operations of instruments nominally will only be available during this time period and during anomaly resolution during prime operations. This phase ends after the health and operations of the spacecraft and its instruments have been verified. Nominally, this phase is funded as part of Phase D and lasts for 30 days after launch.

The instruments will remain powered off and the spacecraft will continually spin during orbit insertion after launch. The launch time of year will be selected to minimize extended eclipse periods during the first year. The launch time of day will be selected to prove a near-solar orientation to the spin axis. The spacecraft spin rates prior to instrument deployment may significantly exceed the nominal operational spin rate of ~5 RPM.

5.5.2. Prime Mission Operations

After checkout and commissioning, the MOC may be staffed only a few hours per day for five days per week. Ground contact with the spacecraft for command uploads may be limited to as few as several contacts per week. Commanding will only occur during weekday operations when staff is present. This mission is being designed to implement autonomous operations, such as unattended spacecraft contacts and the use of automated paging to allow proper response to spacecraft anomalies. However, the MOC will be capable of supporting unscheduled contacts to mitigate spacecraft emergencies. The MOC will produce ancillary spacecraft housekeeping and navigation data for use by instrument investigations including time referenced correlation data, spacecraft attitude data, and navigation data as listed in Table 5.3.

<table>
<thead>
<tr>
<th>Data Product</th>
<th>Reference</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude Knowledge</td>
<td>Spacecraft Spin Axis Spin Phase</td>
<td>1.0 degrees (3 sigma) 2.0 degrees (3 sigma)</td>
</tr>
<tr>
<td>Time Offset &amp; Scale Factor</td>
<td>Universal Time</td>
<td>0.7 seconds (absolute)</td>
</tr>
<tr>
<td>Navigation</td>
<td>In-Track Cross Track Normal</td>
<td>10 km (3 sigma) 10 km (3 sigma) 10 km (3 sigma)</td>
</tr>
</tbody>
</table>
5.5.3. **Science Data Distribution**

All down-linked data will be maintained in the MOC data system for 30 days after receipt from the spacecraft in order to ensure that it is transmitted to, recovered, and processed by the instrument teams. The MOC will provide "after-the-fact" time-annotated spacecraft housekeeping data and ancillary data products for instrument investigations including attitude, ephemeris, and time reference correlation data.

Each instrument SOC must include a science data capability to ensure the availability of their data and metadata (calibrations, instrument and data descriptions, observation timelines, etc.) to the broader science community throughout the prime mission operations. At the conclusion of prime mission operations, the instrument data and metadata shall be archived in a deep archive that will be specified by NASA. Each investigator should provide 1 year of data analysis beyond prime mission operations at a funding level equal to a year of data analysis during the prime mission to complete the data analysis and complete the deep data archiving.

5.5.4. **Project Schedule**

For the purpose of this AO, the RBSP launch is planned for February, 2011. In the planning schedule (which may be revised during Phase A), instruments will begin I&T in January 2010. Proposals must clearly identify sufficient reserves (both schedule and financial) to ensure on time delivery of the instruments. The planning schedule for the RBSP mission is shown in Table 5.4 and should be the basis for the schedules proposed in the investigations.

**Table 5.4: Planning Schedule for the RBSP Mission**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>March 2006 – March 2007</td>
</tr>
<tr>
<td>Initial Confirmation Review</td>
<td>March 2007</td>
</tr>
<tr>
<td>Phase B</td>
<td>April 2007 – April 2008</td>
</tr>
<tr>
<td>Confirmation Review</td>
<td>April 2008</td>
</tr>
<tr>
<td>Phase C/D</td>
<td>May 2008 – February 2011</td>
</tr>
<tr>
<td>Flight Instrument Delivery &amp; Integration</td>
<td>January 2010 – December 2010</td>
</tr>
<tr>
<td>Launch</td>
<td>February 2011</td>
</tr>
<tr>
<td>Phase E</td>
<td>March 2011 – March 2013</td>
</tr>
</tbody>
</table>

5.6. **Management Requirements**

5.6.1. **General Policies**

Regardless of the number of instruments proposed, RBSP investigations must be led by a single Principal Investigator (PI) who is responsible for managing the selected investigation and interfacing with the RBSP Project Office through the Instrument Manager assigned to the investigation and through the RBSP Mission and Project Scientists. The PI may be from any category of U.S. or non-U.S. organization, including
educational institutions; industry or nonprofit institutions; or from one of the NASA Centers, the Jet Propulsion Laboratory (JPL), other Federally-funded research and development centers, or other U.S. Government agencies. Teams may be formed from any combination of these institutions. Note that the level of detail required in the proposal is the same regardless of what organizations are partners in the investigation team, including NASA centers.

The PI is in charge of the investigation with full responsibility for its scientific integrity and its implementation, from development of the proposal through all phases of the investigation, including the E/PO program. NASA intends to allow the PI team to use their own management processes, procedures, and methods to the fullest extent possible. Investigation teams shall define a management approach appropriate for their instrument or suite proposal and teaming arrangement. This approach must address the scope and complexity of the proposed instrument or suite to ensure the adequate control of development within the cost and schedule constraints. The investigation team may propose a Work Breakdown Structure (WBS) that best fits its organizational approach and design concept. The WBS must provide adequate insight into each individual instrument. The proposed WBS must conform to the standard WBS in Appendix J of the NPR 7120.5C NASA Program and Project Management Processes and Requirements (see Appendix C for access).

Each selected investigation must have a professional Project Manager (PM), selected by the PI, who will oversee the technical implementation of the investigation. The role, qualifications, and experience of the PM must be adequate to ensure that the technical and managerial needs of the investigation will be met.

Finally, the PI is accountable to NASA for the scientific success of the investigation. Therefore, the PI must be prepared to recommend termination of the investigation if the successful achievement of established science objectives, as defined in the proposal, is no longer likely within the committed cost and schedule reserves.

5.6.2. Risk Management and Quality Assurance

The proposer must define the risk management approach to be used to ensure successful achievement of the objectives within established resource, funding, and schedule constraints. Included in this discussion of risk management should be risk mitigation plans for any new technologies to achieve a Technical Readiness Level (TRL) of 5 or better by the end of Phase A and TRL 6 or better by the end of Phase B and the need for any long-lead items that need to be placed on a contract before the start of the Implementation phase, in order to ensure timely delivery (see the TRL Definition Chart available via Appendix C). In addition, any manufacturing, calibration, test, or other facilities needed to ensure successful completion of the proposed investigation should be identified. The proposer must describe the approach for managing risk that will mitigate loss of the investigation or serious degradation due to errors by human operators or errors or malfunctions in the mission data systems during the flight phase.

The Geospace Mission Assurance Requirements (MAR) document defines specific products and processes required during the design and development phases of the investigation; this document is available in the RBSP Library (see Appendix C).
Proposers shall describe a safety and mission assurance program adhering to the Geospace MAR requirements and appropriate to the investigation planned with cost proposals generated accordingly. The Geospace MAR will become part of the contractual requirements for only selected RBSP investigations.

5.6.3. **Required Project Reviews and Meetings**

The following is a high level list of technical and management reviews that proposers must include in their schedule development. Those reviews that are highlighted in bold do not require the investigator to attend and present, but may require inputs. Additional detail information pertaining to these reviews and other internal reviews expected by the Project of the proposer are described in the Geospace MAR located in the RBSP Library (see Appendix C). Additional reviews may be scheduled during the life of the project:

- Systems Requirements Review
- Initial Confirmation Review
- Preliminary Design Review
- Confirmation Review/Nonadvocate Review
- Critical Design Review
- Mission Operations Review
- PreEnvironmental Review
- PreShip Review
- Flight Operations Review
- Launch Readiness Review

5.6.4. **Science Working Group**

A LWS Geospace Science Working Group (SWG) will be established and will be composed of the Principal Investigators from the RBSP mission and other LWS Geospace missions. The SWG will be chaired by the LWS Geospace Project Scientist, who shall be an employee of the NASA Goddard Space Flight Center. If an investigation includes a suite of instruments, a Lead Scientist for each of the separate instruments may also participate in the SWG meetings, as may the Project Manager for the suite. However, in the case of any votes that may be taken, each investigation has only one vote, to be cast by the PI. Voting members of the SWG may also include several Interdisciplinary Scientists who will be competitively selected through a separate solicitation after the RBSP science investigations are known. The purpose of the SWG will be to maximize the scientific return of this mission within the existing resources. SWG meetings will be conducted at least twice a year. Proposers should include funding to cover travel for reviews and meetings.

5.6.5. **Co-Investigator Roles and Requirements**

A Co-Investigator is defined to be an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employing institution. If funded by NASA, costs must be accounted for in the NASA SMD Cost (see Section 5.8.3 below). If contributed, the costs must be accounted
for in the Total Cost and a letter of commitment from the proposed Co-Investigator's institution must be provided with the proposal (see Section 5.6.6). The role of each Co-Investigator must be described in the proposal. Other nonfunded members of the proposal team may be included in the proposal as collaborators but their roles must be justified. PIs must ensure that all individuals included in the proposal in any category have a specific and significant role in the proposal or proposed investigation. Individuals with a minor or honorary role should not be included in the proposal.

5.6.6. Letters of Endorsement

Letters of endorsement and commitment signed by an institutional official must be provided from (i) all organizations offering contributions of critical goods and/or services (including Co-Investigator services, both U.S. and non-U.S.) on a no-exchange-of-funds basis, (ii) all non-U.S. organizations providing hardware or software to the investigation, and (iii) all major or critical participants in the proposal. A letter of endorsement that contains a statement of financial commitment from each responsible organization contributing to the investigation must be submitted with the proposals, to assure NASA that all contributions will be provided as proposed. Any proposal failing to provide letters of endorsement from U.S. and non-U.S. partners with the submitted proposal at the time proposals are due may be judged noncompliant and returned.

For all U.S. components of proposals offering contributions, letters of commitment must be submitted with the proposal from both the organization providing any contributed property or service and from the organization providing any required funding. Letters of endorsement must provide evidence that the institution and/or appropriate Government officials are aware and supportive of the proposed investigation and will provide funding for the investigation if selected by NASA. They must be signed by institutional and/or Government officials authorized to commit their organizations to participation in the proposed investigation.

Letter(s) of endorsement and commitment are required for non-U.S. individuals and/or institutions participating as team members and/or as contributors. Requirements for letters of endorsement and commitment supporting non-U.S. participation and/or contributions may be found in Section 5.9.

Every Co-Investigator, U.S. or non-U.S., must submit a brief, signed statement of personal commitment that acknowledges his/her intended participation in the proposed effort. In the case of more than one Co-Investigator from the same institution, a single statement signed by all participants may be submitted. In any case, each statement must be addressed to the PI, may be a facsimile of an original statement or the copy of an E-mail (the latter must have sufficient information to unambiguously identify the sender), and is required even if the Co-Investigator is from the PI institution. An example of such a statement follows:

"I (we) acknowledge that I (we) am (are) identified by name as Co-Investigator(s) to the investigation, entitled <name of proposal>, that is submitted by <name of Principal Investigator> to the NASA Announcement of Opportunity <alpha-numeric identifier>, and that I (we) intend to carry out all responsibilities identified for me (us) in this proposal. I (we) understand that the extent and justification of my (our)
participation as stated in this proposal will be considered during peer review in
determining in part the merits of this proposal."

In addition, if that person or his/her institution will be providing or contributing
hardware, software, or other tangible services, a letter from that institution must also be
included that certifies the intended contribution.

5.7. Proposed Investigation and Minimum Science Investigation

Every investigation must specify a "Proposed" investigation and a "Minimum Science"
investigation defined as follows: The Proposed Investigation is the investigation that, if
fully implemented, will accomplish the entire set of scientific objectives proposed for the
investigation. Any alteration that results in a reduction of the investigation's ability to
accomplish the proposed set of scientific objectives as identified in the proposal will be
considered a descope of the investigation. The resulting reduced set of achievable
scientific objectives will be reviewed to ensure that the investigation remains at or above
the Minimum Science Investigation, which is defined as the minimum science return
below which the investigation will not be considered justified for the proposed cost. The
Minimum Science Investigation must be identified and documented for a proposed
investigation along with a plan for the prioritized descoping of capability from the
Proposed Investigation to the Minimum Science Investigation in the event of cost or
schedule growth, for risk mitigation, or for partial selection. Proposals must define
descope options in their proposals, decision dates for implementation, costs avoided, and
science impact associated with each descope option.

The differences between the Proposed Investigation and the Minimum Science
Investigation will be assessed to determine the investigation's resiliency in the event that
development problems lead to reductions in scope. In addition, each selected PI will be
required to negotiate a set of performance metrics during the definition phase for program
evaluation, including cost, schedule, and others as appropriate. Failure to maintain a
level of science return at or above the Minimum Science Investigation as determined by
NASA will be cause for termination of the investigation.

5.8. Cost Requirements

5.8.1. Full Cost Accounting

Where NASA-provided services are used, NASA Civil Service labor and supporting
NASA Center infrastructure must be costed on a full cost accounting basis. Guidelines
for applying full cost accounting principles are provided in NASA's "Full Cost
Accounting Implementation Guide." (See Appendix C for access). If any NASA costs
are to be considered as contributed costs, the funding sources must be identified.

Other Federal Government elements of proposals must follow their agency cost
accounting standards for full cost. If no standards are in effect, the proposers must then
follow the Managerial Cost Accounting Concepts and Standards as recommended by the
Federal Accounting Standards Advisory Board (see Appendix C).
5.8.2. *Goods and/or Services Offered on a No Exchange of Funds Basis*

Contributions of any kind, whether cash or noncash (property and services), are welcome to RBSP investigations by organizations other than the Science Mission Directorate. Values for all contributions of property and services shall be established in accordance with applicable cost principles. Such contributions may be applied to any part or parts of a mission. For all U.S. components of proposals, letters of commitment must be submitted with the proposal from both the organization providing any contributed property or service and the organization providing any required funding. See Section 5.6.6 above for further requirements on letters of commitment. For non-U.S. components of proposals, see Section 5.9.

The cost of contributed hardware or software must be estimated as either: (1) the cost associated with the development and production of the item, if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (2) the total of any recurring and mission-unique costs associated with reproduction and/or modification of the item if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category with the estimated cost calculated as that associated with the reproduction and modification alone.

The cost of contributed labor and services must be consistent with rates paid for similar work in the offeror's organization. The cost of these contributions does not need to include funding spent before the start of the investigation (before entering into a Phase A contract or grant with NASA). The value of contributed materials and supplies shall be reasonable and shall not exceed the fair market value of the property at the time of the contribution.

5.8.3. *NASA SMD Cost*

The NASA SMD Cost is the funding that NASA SMD would be expected to provide to the investigation team over the course of the investigation, beginning with selection and ending with the conclusion of Phase E. Examples of costs to be included are education and public outreach activities; subcontracting costs (including fees); science teams; all personnel required to conduct the investigation, analyze and publish results, and deliver data in archival format; insurance; ground data system including mission and data services provided by NASA; labor (contractor); noncontributed NASA civil servant costs; reserves; and contract fees. The specific total funding limits are specified in Section 1.2.

The NASA SMD Cost is a consideration in the selection of investigations and in the continuing assessment of ongoing missions. It is essential that projects budget an adequate level of reserves during development and that these reserves be included within the NASA SMD Cost.
5.8.4. Additional Cost Requirements

Proposers must estimate the total NASA SMD cost in the proposal, as well as the total investigation cost when contributions from any source are required for the proposed investigation. The specific cost information required for proposals is contained in Appendix B. Note that the cost of the host mission for a Mission of Opportunity does not need to be provided.

The PI must assume all risk for delays in the investigation and must, therefore, propose appropriate reserves. Funded schedule reserves, in addition to the cost reserve, commensurate with investigation complexity and risk are required to ensure on-time delivery. For purposes of this cost estimate, the proposer should assume delivery of any hardware in accordance with the Project Schedule shown in Table 5.4 of this AO (see Section 5.5.4 above).

Proposers are asked to break down the estimates to a level that allows the total costs associated with major subsystems of each instrument to be evaluated. Since cost details for Phase B/C/D/E are not anticipated until the conclusion of Phase A, cost estimates in the proposal may be generated with models or cost estimating relationships from analogous investigations.

Each investigation team selected through this AO will conduct a Phase A concept study, the cost of which must be part of the proposal and must be included in the NASA SMD cost estimate. See the Guidelines and Criteria for the Phase A Concept Study document available in the RBSP Program Library (Appendix C) for information on the concept study to be conducted by the investigation team.

Cost risk is an important criterion in the selection of the investigation. Therefore, a realistic schedule and budget for development are required, including the identification and proposed development of long-lead items. Investigators must recommend reserves for funding within the overall allocation based on the maturity of the proposed design and the technologies incorporated in the design approach.

NPR 7120.5C establishes a requirement for Cost Analysis Data Requirement (CADRe) that is applicable to the RBSP Project. The investigation selected by this AO shall provide cost analysis data to support the RBSP project to meet this requirement. The proposal must identify the estimated costs of cost analysis data collection and updates to support the RBSP Project CADRe requirement. Updates to the CADRe report will be made by the Project at System Readiness Review (SRR), Preliminary Design Review (PDR), Mission Confirmation Review (MCR), Critical Design Review (CDR), Launch Readiness Review (LRR), or annually at a minimum.
5.9. **Guidelines Applicable to Non-U.S. (Foreign) Proposals and Proposals Including Non-U.S. Participation.**

5.9.1. **Overview**

NASA welcomes proposals having participants from non-U.S. institutions provided that they are offered on a no-exchange-of-funds basis and also comply with current U.S. restrictions concerning the export of technology. In addition to meeting the requirements discussed elsewhere in this AO, including the Appendices, which apply to all proposers, foreign proposals and proposals including foreign participation must comply with the policies below.

Note that any proposed international participation in the RBSP Investigation must be described as the same level of detail as that of a U.S. proposed investigation, to the maximum extent possible. NASA will seek to validate contribution costs, schedule, and management data during evaluation of the proposals and in subsequent reviews. Failure to provide such information about proposed contributions, or failure to document the commitment of all team partners to those costs and schedules, may cause a proposal to be found unacceptable for selection through this AO.

5.9.2. **General Policies**

(1) Although NASA welcomes proposals from outside the U.S., foreign entities are generally not eligible for funding from NASA. Thus, such investigations and investigators must be proposed on a no-exchange-of-funds basis to NASA. In addition, proposals from foreign entities, and proposals from U.S. entities that include foreign participation, must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and, that funds have been reserved by the respective foreign government or funding/sponsoring institution in support of the undertaking of this proposed activity and, if the proposal is selected, that sufficient funds will be made available to the proposer for the activities included in the proposal. These Letters of Endorsement are required from all organizations sponsoring non-U.S. participants and must be received at the address given in Section 6.7 by the schedule given in Section 4.0. Also see Appendix B, Section H item 1.

(2) All foreign proposals must be typewritten in English and comply with all other submission requirements stated in this AO. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All foreign proposals must be received by the established closing date for proposals. Those received after the closing date will be treated in accordance with Appendix A, Section VII.

(3) Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of External Relations will coordinate arrangements with the foreign sponsor to facilitate the proposed participation on a no-exchange-of-funds basis, in which NASA and the foreign sponsor will each bear the cost of discharging their respective responsibilities.
Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

(i) An exchange of letters between NASA and the foreign sponsor; or
(ii) A formal Agency-to-Agency Memorandum of Understanding (MOU).

5.9.3. Export Control Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation

Foreign proposals and proposals including foreign participation must include a section discussing compliance with U.S. export laws and regulations, e.g., 22 Code of Federal Regulations (CFR) Parts 120-130; 15 CFR Parts 730-774; and 10 CFR 110 and 810, as applicable to the circumstances surrounding the particular foreign participation. The discussion must describe in detail the proposed foreign participation and is to include, but not be limited to, whether or not the foreign participation may require the prospective proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.pmdtc.org and at http://www.bis.doc.gov. Proposers are advised that, under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130 (see Appendix C).

5.10. Geospace-Related Missions of Opportunity

5.10.1. General Policies

A LWS Geospace-related Mission of Opportunity (MO) is defined as a proposal for a U.S. proposer to carry out a LWS Geospace-related investigation by participating in a mission not sponsored by the NASA Science Mission Directorate by providing a flight experiment that is planned or that has been approved by its sponsoring organization (this includes missions planned by program offices of NASA other than SMD). In such a case, the NASA LWS Geospace program may select and fund that MO investigation if it is clear that the investigation could be regarded as part of the LWS Geospace Program as defined in Section 3.3 of this AO. Also, a MO may be selected if it could significantly augment the LWS RBSP mission objectives as judged by peer review and the NASA LWS staff and that its support by NASA would be advantageous to the LWS Program.

5.10.2. MO Proposer and NASA Roles and Responsibilities

The participation in a Geospace-related MO could take many forms, for example, providing a complete science investigation, providing hardware components of a science
instrument, or providing expertise in critical areas of the mission. In any case, NASA will evaluate only the proposed MO investigation and not the sponsor's entire mission, which may have entirely different objectives. While the investigator is not required to document the entire mission of the sponsor, the U.S. investigator must fully document their complete Geospace-related investigation in the proposal. In addition, sufficient information about the candidate Mission of Opportunity and the host mission must be provided to enable NASA to assess the performance, schedule, and cost risk associated with the mission.

Note that selection by NASA through this AO does not constitute selection of the investigation as part of the MO mission itself, which is necessarily a decision made by the sponsor of that mission. Instead, the selection of an MO through this AO is a commitment by NASA to fund only the U.S. portion of the investigation as part of the LWS Geospace program, although funding beyond basic studies does not begin until detailed design of the mission itself is underway. If a LWS Geospace MO investigation is selected both by NASA and by the mission sponsor, the PI will be responsible to NASA for the scientific integrity and the management of NASA's contribution to the mission.

5.10.3. MO Proposal Review, Selection, and Management

A Mission of Opportunity investigation that is submitted under this AO will be subject to the same selection and review process and will require the same commitment by the PI for the cost, schedule (subject to negotiations), and scientific performance as an investigation selected under the NASA-provided spacecraft option. In addition, in keeping with SMD policy, proposals for a MO to this AO must also support the LWS Geospace Education/Public Outreach program (see Section 5.12 and Appendix B Section G for details).

It is incumbent on the proposing investigator to provide evidence in their proposal that the sponsoring organization intends to fund the mission and state when the endorsement of NASA for U.S. participation is required. The operational phase of a MO must include a reasonable and meaningful overlap with planned LWS Geospace missions operation phase.

If selected, a LWS Geospace-related MO will be conducted on a no-exchange-of-funds basis between NASA SMD and the mission sponsor, including other parts of NASA. Like other investigations proposed to this AO, the NASA funding is subject to cancellation if there is a cost overrun charged to NASA for any reason, including a launch delay caused by the non-NASA SMD partner. The PI assumes all risk for delays in the mission and must propose appropriate reserves (see specific cost information required for proposals in Appendix B).

Confirmation Reviews for any selected MO(s) will be held prior to the start of Phase B and Phase C/D. Assuming a positive outcome, NASA will confirm the investigation to proceed to the next Phase. MO investigation teams may have data analysis responsibilities defined by the policies of the mission sponsor; nevertheless, as a condition for confirmation, NASA expects that the mission sponsor will enter into an agreement with NASA to assure that data returned from at least those aspects of the
mission in which NASA support is involved, if not the entire mission, will be made available to the U.S. scientific community in conformance with the RBSP data policies (see Section 5.11).

5.11. **RBSP Data Policy**

The LWS Program seeks to provide data to a broad community of users that will combine the different data sets from the RBSP mission and eventually other LWS missions to obtain a better understanding of Sun-Earth interactions. The data will be treated as a public resource and will be made available for public access as soon as is practical. With that in mind, the following principles will guide the development of the final RBSP data policy:

1. In accordance with the SMD requirement for open data and related software, starting after the initial check out and calibration period of approximately one month, research quality data and any specialized software required for its basic analysis will be made available by the investigators to the international community through a project-approved web site with no more than a two month delay from the time of its acquisition (in the case of data) or the completion and verification for its use (in the case of software). Once the calibrated RBSP data are deposited in an accessible data bank, NASA intends to provide support for extended data analysis through an appropriate Guest Investigator (GI) program.

2. RBSP near real-time space weather quality data products useful to space weather operation centers for forecasting and monitoring shall be identified in the proposals. The LWS Geospace SWG will finalize a coordinated list of products that the investigators will be responsible to make publicly available via the spacecraft real-time transmitter and, if deemed desirable, again within minutes after receipt of the full RBSP data stream by the PI teams.

3. During Phases A and B, NASA and the PI teams working in the context of the LWS Geospace SWG will decide on uniform format(s) for data and standards for analysis software. They will also decide on the location(s) of the data analysis and archiving center(s).

4. The RBSP MOC will retain downlinked raw data for only 30 days during Phase E. Each PI Team is responsible for collecting their raw data from the MOC, providing access to their calibrated data and required software during the mission and for maintaining a safe repository for the data until the data and required software are delivered to the end-of-mission archive.

Proposers must identify how they plan to satisfy these policies from the standpoint of hardware, software, personnel, and cost.
5.12. **Education, Public Outreach, and Small Disadvantaged Business Requirements**

5.12.1. **Education and Public Outreach (E/PO) Requirements**

The National Aeronautics and Space Administration's (NASA) Vision,
*To improve life here, to extend life to there, and to find life beyond,*
and its Mission,
*To understand and protect our home planet,*
*To explore the Universe and search for life,*
*To inspire the next generation of explorers*
... as only NASA can,

provide the context for the NASA Education program. The SMD has an essential role in NASA's mission to inspire the next generation of explorers by motivating the Nation's teachers and students, engaging and educating the public, advancing the scientific and technical capabilities of the nation, as well as helping to ensure the participation by underrepresented and underserved groups.

As part of its response to this mandate, SMD is committed to fostering the broad involvement of the space and Earth science research communities in Education and Public Outreach (E/PO) with the goal of enhancing the nation's formal education system and contributing to the broad public understanding of science, mathematics, and technology. Progress towards achieving this goal has become an important part of the broad justification for the public support of Earth and space science. In addition, an enhanced, coordinated Agency-level education program is now being undertaken through the NASA Office of Education. The SMD sponsors a broad spectrum of educational activities ranging from kindergarten to postgraduate levels via several vehicles of solicitation.

In accordance with established SMD policies, E/PO will be an integral element of the RBSP Program; 1 to 2 percent of the NASA SMD Cost for the mission (excluding launch vehicles) will be allocated to E/PO. Every proposal to this AO must contain an E/PO statement of commitment following the guidelines contained in Section G of Appendix B.

SMD strongly encourages members of the NASA research community to engage actively in Education and Public Outreach as an important component of their NASA-supported professional activities. The key documents that establish the basic policies and guidance for all SMD E/PO activities are *Partners in Education: A Strategy for Integrating Education and Public Outreach Into NASA’s Space Science Programs* (March 1995), *Implementing the Office of Space Science Education/Public Outreach Strategy* (October 1996), and the *Explanatory Guide to the NASA Office of Space Science Education and Public Outreach Evaluation Criteria* (March 2004). These documents are available in the RBSP Library. Additional information concerning NASA Education and Public Outreach may also be found in the *Education Enterprise Strategy* (October 2003) and the Earth and Space Science Enterprise strategies. These documents are also available in the RBSP library.
As a consequence of the plans and policies that have been established and implemented over the past several years, a significant national SMD E/PO program is now underway as described in the SMD E/PO Newsletters and the Annual Reports that may be accessed by opening the "Educators" link on the SMD homepage at http://science.hq.nasa.gov.

The RBSP mission, as a whole, must have an E/PO plan in place by the time of the Preliminary Confirmation Review and the plans for E/PO will play an explicit role in the confirmation of the mission for implementation leading to flight. However, E/PO will not be an evaluation factor in the selection process for the investigations solicited under this AO. Proposers are welcome to provide a brief discussion of any unique characteristics of the instrument that might provide unusual opportunities for E/PO. Also note that significant elements of this AO's goal for involvement of SDBs and minority institutions (Section 5.12.2) may be met through an appropriately planned E/PO program.

Questions and/or comments and suggestions about the SMD E/PO program are welcome; they may be directed to Dr. Larry P. Cooper (telephone: (202) 358-1531; E-mail: larry.p.cooper@nasa.gov).

5.12.2. Small Disadvantaged Businesses and Minority Institutions

Offerors other than small business concerns are advised that contracts resulting from this AO will be required to contain a subcontracting plan that includes goals for subcontracting with small, small disadvantaged, women-owned, and Historically Underutilized Business Zone, veteran-owned, and service-disabled veteran-owned small business concerns (see Section XIII of Appendix A). Investment in these organizations reflects NASA's commitment to increase the participation of minority concerns in the aerospace community and is viewed as an investment in the nation's future. Proposers to this AO are expected to use their best efforts to assist NASA in achieving its goal for the participation of all forms of small business in NASA procurements. Note that substantial involvement of minority colleges and universities in space science missions and research programs is also a key objective of the SMD E/PO program.

While only a preliminary subcontracting plan is required at the time the proposal to this AO is written, a detailed implementation plan will be developed by each selected investigation and delivered in conjunction with its Phase A contract as directed by the RBSP project office. Participation goals and the quality and level of work performed by small disadvantaged businesses and minority institutions will be examined in the confirmation review of investigations for development for flight.

5.13. Environmental Protection

Proposers are encouraged to make limited use of hazardous, toxic, ozone depleting, and nuclear materials to reduce the overall environmental risk of the mission and enable NASA to better fulfill its mission of understanding and protecting the Earth. Information about such materials will be required in order to assist in the environmental review of the mission. The contracting process will require demonstrated compliance to all known Federal, state, and local environmental, health, and safety laws.
6. PROPOSAL SUBMISSION INFORMATION

6.1. Resources for Additional Information

The RBSP Library provides reference documents and background information on the RBSP Mission, including science goals, technology and Education/Public Outreach strategies, and information on management aspects of flight programs. The contents of the RBSP Library are listed in Appendix C. The online version of the library is at http://rbsp.larc.nasa.gov/rbsplib.html.

All inquiries regarding this AO should be directed to the LWS Geospace Program Scientist, as designated below. Inquiries are preferred in writing and may be sent by fax or E-mail; the character string "LWS RBSP AO" (without quotes) should be included in the Subject line of all transmissions.

Dr. Barbara L. Giles  
Earth-Sun System Division  
Mail Suite 3Q39  
Science Mission Directorate  
300 E Street SW  
NASA Headquarters  
Washington, DC  20546-0001

Telephone:  (202) 358-1762  
Fax:  (202) 358-3987  
E-mail: barbara.giles@nasa.gov

Any updates to information during this AO solicitation process will be made available at the WWW location where this AO is posted. Answers to questions submitted by proposers to the Program Scientist will be posted at http://rbsp.larc.nasa.gov/rbspQA.html. The author(s) of such questions will not be identified.

6.2. Preproposal Activities

6.2.1. Preproposal Conference

A Preproposal Conference will be held in the Washington, DC metropolitan area in accordance with the schedule in Section 4. Further information, including logistics, will be available at the RBSP Acquisition website, http://rbsp.larc.nasa.gov/, prior to the Preproposal Conference. Note that all expenses and arrangements for attending this meeting are the responsibility of the attendee. Travel and associated costs of attendance are not allowable as a direct cost under another Federal Government award, i.e., contract, grant, or cooperative agreement. Government employees may attend and be authorized travel with associated costs as a matter of official business.

The purpose of the conference will be to address questions about the proposal process for this AO, including a discussion of the evaluation criteria, procurement approach, International Trade Regulations, and Education and Public Outreach plans. The
Preproposal Conference will also answer those questions that are received by NASA at least one week prior to the Preproposal Conference. Questions should be addressed to the LWS Geospace Program Scientist at the address in Section 6.1. Additional questions submitted after this date, including those provided in writing at the Conference, may be addressed at the Conference only as time permits. Anonymity of the authors of all questions will be preserved.

6.2.2. Notice of Intent to Propose

A Notice Of Intent (NOI) is submitted electronically by entering the requested information at http://nspires.nasaprs.com. Proposers who experience difficulty in using this site should contact the Help Desk by E-mail at NSPIRES-Help@nasaprs.com for assistance.

To the extent the following information is known by the NOI due date, the Website for NOIs will request the following information:

- Name, address, telephone number, fax number, E-mail address, and institutional affiliation of the PI.
- Full names and institutional affiliations of any Co-Is. All Co-Is must have substantial and well-defined roles in the investigation. If any Co-Is or other team members are from non-U.S. institutions, the organization that will provide support for these people should be identified in the "Comments" box on the NOI form.
- A brief statement (150 words or less) that includes all of the following:
  - the scientific objectives of the proposed investigation;
  - identification of proposed instrumentation;
  - identification of any new technologies that may be proposed as part of the investigation; and
  - any anticipated contributions and the approximate value and contributor.
- The name of the Lead Representative from each partner organization (industrial, academic, nonprofit, and/or Federal) included in the proposing team.
- Indication of proposal class; RBSP Investigation or Mission of Opportunity

Note that all information provided in an NOI is for NASA planning purposes only, is confidential, is not binding on the submitter, and is replaced by information in the final proposal.

6.3. Teaming Interest

Some organizations have requested a forum to inform other proposers of their contact information and their services and/or products. NASA SMD is willing to offer this service with the understanding that the Agency takes no responsibility for the use of such information. The organizations listed on the RBSP Teaming Interest web page (see link from the RBSP Acquisition website) have expressed an interest in teaming with other organizations on RBSP proposals. This is not necessarily a list of organizations that are capable of teaming but is simply a list of those organizations that have asked to be included in this list. Proposing organizations are not required to team with any organization on this list. NASA does not endorse any of these organizations and does not accept responsibility for their capabilities or actions.
6.4. **Format of Proposals**

Appendix B provides detailed information concerning the contents and format of proposals submitted in response to the AO.

6.5. **Signature Authorizations**

Proposers are required to register key data concerning their intended submission with NASA's master proposal database system located at the Web site [http://nspires.nasaprs.com](http://nspires.nasaprs.com). Note that this database system is new. The new system is the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). Potential proposers are urged to access this site well in advance of the proposal due date to familiarize themselves with its structure and enter the requested identifier information. It is especially important to note that every individual named on the proposal's Cover Page must be registered in this NASA proposal data system and that such individuals must perform this registration themselves; that is, no one may register a second party, even the PI of a proposal in which that person is committed to participate. This data site is secure and all information entered is strictly for NASA's use. It is also important to note that the proposal's Cover Page must be submitted electronically by one of the officials at the PI's organization who is authorized to make such a submission. Every organization that intends to submit a proposal to NASA in response to this NRA must be registered in this NASA proposal data system. Such registration must be performed by an organization's business point-of-contact (EBPOC) in the Central Contractor Registry (CCR).

All proposals must have a Cover Page that includes a Proposal Summary that is to be submitted electronically through the designated Web site following the instructions given in Appendix B. Once this form is submitted, it must be printed and signed by an official of the PI's institution who is authorized to certify institutional support and sponsorship of the investigation, including the management and the financial parts of the proposal. Note that the authorizing institutional signature on the printout of the electronically submitted Cover Page also certifies that the proposing institution understands and complies with the required certifications supplied with the model contracts in the RBSP Library (Appendix C); therefore, it is not necessary to submit certifications separately with the proposal.

6.6. **Required Certifications**

All proposals requesting NASA funding must demonstrate compliance with the policies set forth in the model contracts in the RBSP Library (Appendix C). Note that this information is only for reference; the authorizing institutional signature on the Cover Page form (see Appendix B) certifies that the submitting institution has read and is in compliance with these policies.
6.7. Submittal Address

The signed original plus 50 copies of proposals must be received at the following address by the schedule in Section 4. NASA's policy concerning late delivery of proposals is given in Appendix A, Section VII.

LWS RBSP AO
Science Mission Directorate
NASA Research and Education Support Services (NRESS)
Suite 200
500 E Street, SW
Washington, DC  20024
Tel: 202-479-9030

In addition to the paper copies, one searchable PDF-formatted Compact Disc-Read Only Memory (CD-ROM) per paper copy must be provided. Details on the contents of the CD-ROM are provided in Appendix B. In addition, 25 copies of the Fact Sheet must also be provided.

NASA will notify the proposers in writing or E-mail that their proposals have been received. Proposers not receiving this confirmation within ten days after submittal of their proposals should contact the LWS Geospace Program Scientist at the address given in Section 6.1.
7. PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

7.1. Evaluation, Selection, and Debriefing Processes

All proposals submitted in response to this AO will be subjected to a screening to determine their compliance to the constraints, requirements, and guidelines of the AO. Failure to comply with the requirements, constraints, and guidelines of this AO may result in the proposal being returned to the proposer without further review.

Proposals in compliance with this AO will be evaluated against the criteria given in Section 7.2 by panels of individuals who are scientific and technical peers of the proposers. These panels may be augmented through the solicitation of mail-in reviews as well, which the panels have the right to accept, in whole or in part, or reject. The LWS Program Office will participate in technical and accommodation studies of proposals and may involve the mission prime contractor in such studies (Section 7.4). NASA will use a non-Government organization to provide assistance in organizing and documenting this panel review process. These evaluations will be expressed in terms of the perceived strengths and weaknesses of each proposal. These Peer Review panels will not directly compare proposals.

The issues of conflict of interest and confidentiality are of critical importance to the peer review process. Appropriate safeguards, including organizational firewalls, will be implemented during the evaluation process to mitigate actual and apparent conflicts of interest and to maintain confidentiality about all activities involved in the review process. It is NASA policy that NASA civil Service personnel will be in charge of and direct all aspects of the review and selection processes.

All proposals in which the Phase A costs are expected to exceed $500,000 and the proposers are organizations other than small business concerns need to submit a Small Business Subcontracting Plan (see Appendix A, Section XIII). The subcontracting plan will be evaluated on the participation goals and quality and level of work performed by small business concerns, HBCUs, and other minority educational institutions. The review will be conducted as part of the panel review of management.

In the case of investigations that propose to provide suites of instruments, the scientific merit; the scientific implementation merit; including technical merit; and the technical, management, and cost (TMC) of each instrument will be evaluated in addition to the overall suite. Therefore, proposers of instrument suites must indicate the scientific return and cost of each instrument and the cost of the entire suite.

Proposers should be aware that during the evaluation process NASA may request clarification of a specific point or points in a proposal. Such a request and the proposer's response shall be in writing.

An Ad Hoc Categorization Subcommittee of the AO Steering Committee (see below), composed wholly of Civil Servants, will convene to consider the peer review results. This Committee will categorize the proposals in accordance with procedures required by
NASA FAR Supplement (NFS) Part 1872 (see Appendix C). Note that composite suites, as well as their individual instruments, will be categorized separately in order to give NASA the greatest flexibility in assembling the most scientifically and technically satisfactory and cost effective payload possible. These Categories are defined as follows:

**Category I.** Well conceived and scientifically and technically sound investigations pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and that data can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

**Category II.** Well-conceived and scientifically or technically sound investigations that are recommended for acceptance, but at a lower priority than Category I.

**Category III.** Scientifically or technically sound investigations which require further development. Category III investigations may be funded for development and may be reconsidered at a later time for the same or other opportunities.

**Category IV.** Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

After categorization, the Program Scientist may request a payload accommodation assessment of the highly ranked proposals to aid in developing a recommendation for selection of an integrated science payload that addresses the AO objectives (Section 2). The accommodation study will be led by the LWS Program Office and may involve the participation of the mission prime contractor (Section 7.4). The accommodation assessment may include Category I, II, and III investigations.

The selection process is a NASA Headquarters function (Section 7.3). The results of the evaluations and categorizations and the recommendation for selection of investigations will then be presented by the LWS Geospace Program Scientist to the AO Steering Committee, which is composed wholly of NASA Civil Servants and appointed by the Deputy Associate Administrator for the Science Mission Directorate. The AO Steering Committee will conduct an independent assessment of the evaluation and categorization processes regarding both their compliance to established policies and practices, as well as the completeness, self-consistency, and adequacy of all materials related thereto. After this review, the final evaluation and categorization results will be forwarded to the Deputy Associate Administrator for the Science Mission Directorate who is the Selection Official for this solicitation. Note that some proposals may be classified as Category III due to technical issues. A Category III proposal may be selected and funded for further development if the selection official determines it is in the best interest of NASA.

NASA reserves the right to select only a portion of a proposer's investigation and/or to invite his/her participation with other investigators in a joint investigation. In that case, all affected proposers will be given the opportunity to accept or decline such a partial acceptance and/or participation with other investigators (see Appendix A, Section II).
Selected proposers will be notified immediately by phone and by letter and provided with instructions for initiating their Phase A concept study. Proposers not selected will be notified by letter and will be offered a debriefing. Such debriefings may be in person at NASA Headquarters or, if the investigation team prefers, by telephone. In the former case, SMD research funds may not be used to defray travel costs by the proposer for a debriefing. In either case, along with the proposing Principal Investigator, a senior representative from the key institution(s) of a proposal may also participate in such debriefings.

7.2. Evaluation Criteria

7.2.1. Overview

The fundamental aim of this NASA acquisition process is to identify scientific ideas and unique instrumental capabilities that together optimally address the overall scientific objectives of the RBSP mission in the context of the LWS program as described in this AO. The evaluation criteria below will be used to evaluate and categorize proposals as described in Section 7.1. For a Mission of Opportunity, only the proposed investigation for this AO will be evaluated, not the entire mission. The evaluation criteria (which are defined more fully in the sections below) are as follows:

- Scientific merit;
- Scientific implementation merit, including technical merit; and
- Technical, Management, and Cost (TMC) feasibility, including cost risk.

The proposal categorizations, discussed in Section 7.1 above, will be based on these criteria. The first criterion is approximately 40% of the total weight, and the second and third criteria are approximately 30% of the total weight each.

7.2.2. Scientific Merit (40%)

To evaluate the intrinsic scientific merit, the goals and objectives of the proposed investigation will be assessed to determine the potential of the investigation to achieve one or more of the RBSP specific science objectives and the potential to impact characterization and predictability of the space weather effects as identified in Section 2 of this AO. The relevance of the proposed investigation, as it applies to the specific opportunity described in this AO, will be assessed along with its perceived scientific value considering the investigation resources required and mission resources available. A major element in this assessment will be whether the data that are proposed to be gathered will be sufficient to complete the proposed investigation and are suitable for integration into the LWS Targeted Research and Modeling Program efforts for the purpose of supporting science understanding studies, characterization studies of the near-space environments, and the prediction of potential hazardous space weather effects.

The scientific value of the Minimum Science Investigation will also be assessed as part of the determination of the overall scientific merit of the investigation.
7.2.3.  Scientific Implementation Merit, Including Technical Merit (30%)

Each proposed investigation will be evaluated for its scientific implementation and technical merits as a measure of the probability of success of the proposed hardware to supply the data needed to successfully achieve the goals of the proposed investigation and to contribute to the success of the RBSP mission. This evaluation will consider the relationship between the proposed scientific objectives, the data to be returned, and scientific implementation to be used in carrying out the investigation. Scientific implementation merit will be evaluated by assessing the degree to which the proposed instrument(s) will support the accomplishment of the proposed investigation and the degree to which the proposed instrument(s) can provide the necessary data using the proposed technologies, as well as the degree to which the mission will support the accomplishment of acquisition of the required data. Areas requiring critical technology development of the instrument for flight readiness shall be identified. Should a new technology that represents an untested advance in the state of the art be proposed for use, an assessment will be made of the likelihood of its scientific success. Other major elements of this criterion include the proposed data analysis and archiving plan and the proposed plan for the timely release of the data to the public domain. The probability of success will be evaluated by assessing science team roles, experience, expertise, and the organizational structure of the science team and the technical merit associated with the overall investigation design and/or instrument set. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation.

7.2.4.  Technical, Management, and Cost (TMC) (30%)

The soundness of the technical and management implementation approach, schedule, and cost realism and reasonableness will be the primary factors considered in determining the Technical, Management, and Cost (TMC) Risk. Each investigation will be evaluated to assess the likelihood that it can be implemented as proposed, including an assessment of the risk of completion within the proposed costs. The evaluation will consider implementation factors such as the technical approach to design, develop, integrate, and test the proposed instrumentation hardware and software to meet the investigation requirements within the mission's constraints defined in the AO; the adequacy and robustness of the proposed resources (technical, management, and cost); the management approach and the adequacy of the proposed organizational structure; the competence and relevant experience and past performance of the proposed technical and management team; the relevant experience and past performance of the proposing organizations; the soundness of plans and commitments of partners and contributors; the team's understanding of the scope of work (covering all elements of the investigation, including contributions). The relationship of the work to the project schedule, the project element interdependencies, and associated schedule margins will also be evaluated to ensure that the investigation can be successfully completed and delivered within budget and meet the project schedule milestones. The investigations use of new technology will be assessed. Investigations proposing new technology, i.e., technologies having a Technology Readiness Level (TRL) less than 6 will be assessed a higher risk rating if adequate backup plans to ensure success of the investigation are not described. The proposal must discuss the methods and rationale (cost models, cost estimating relationships of analogous investigations, etc.) used to develop the estimated cost, and must include a
discuss discussion of cost risks. The proposal must also demonstrate the capability and plan to adhere to sound business practices. Cost realism and cost reasonableness will be used to determine an overall cost risk (uncertainty) associated with the investigation.

The commitment of every partner, U.S. or non-U.S., offering a contribution must be documented in letters of endorsement. For proposals offering contributions that are critical to the success of the proposed investigation, the evaluated risk will increase if the proposals: 1) do not have clear and simple technical and management interfaces in the proposed cooperative arrangements, 2) do not provide evidence in the proposal that the contribution is within the scientific and technical capability of the partner, and 3) do not have the required endorsement or a firm commitment to provide the offered contribution. Adequate contingency plans for coping with the failure of a proposed cooperative arrangement may help to reduce the evaluated risk.

7.3. Selection Factors

As described in Section 7.1, the scientific and technical evaluations determine the categorization and, in turn, which proposals are eligible for selection. The results of the proposal evaluations and categorizations for selectable proposals will be considered in the selection process along with a variety of other programmatic factors. These include, but are not limited to, the most current Administration policies and budgets, as well as the evolving scientific priorities identified by the scientific community. The overriding consideration for the final selection of proposals submitted in response to this AO will be to maximize the scientific return of the entire mission within the available budget. Depending on the availability of proposals of appropriate merit, this objective may be achieved by a combination of investigations from Category I, II, or III to form a complete mission payload within the cost ceiling for this AO. For selection, the proposed cost to NASA SMD will be invoked to help discriminate between closely competing proposals (based on their scientific and technical merits) in this final stage of the selection process.

Note that NASA reserves the right to select only a portion of a proposer's investigation and/or to invite his/her participation with other investigators in a joint investigation. In that case, all affected proposers will be given the opportunity to accept or decline such a partial acceptance and/or participation with other investigators (see Appendix A, Section II).

Critical contributions to a proposed investigation, including contributions from non-U.S. partners, represent a risk to a project that is beyond the PI's control. Particular attention will be paid to these risk considerations during the evaluation and selection process, including the prior performance of proposed partners in projects involving NASA and other agencies.

Regarding the final selections, proposers should recognize that NASA will use a wide range of planning and policy considerations when selecting among top-rated proposals. The SMD program is an activity that ultimately depends upon the most current Administration policies and budgets, as well as the evolving scientific priorities identified by the scientific community. NASA reserves the right not to make a selection, regardless of the categorization results, or cancel this AO at any time.
7.4. Implementation Activities

The LWS Program Office is located at, and managed by, NASA's Goddard Space Flight Center for NASA's Science Mission Directorate. It is anticipated that the Johns Hopkins University/Applied Physics Laboratory (JHU/APL) will be the mission prime contractor for the RBSP Project and will provide mission implementation services. Science investigations will be contracted either from NASA directly or as subcontracts through JHU/APL. Throughout the lifetime of the project, science formulation and selection remains a NASA responsibility.

Contracts will be awarded for Phase A concept studies with an option for a Bridge Phase to continue on to Phases B/C/D and E. The Bridge phase may be exercised upon successful completion of Phase A activities and is intended to cover the first three months of Phase B in order to provide program continuity while the Phase B/C/D/E negotiations are completed. A model contract can be found in the RBSP Library (Appendix C).

The deliverables of Phase A will be implementation plans that detail the technical, cost, schedule, and technology readiness levels (TRL) required to complete definition, implementation, and mission operation activities. The RBSP Library contains definitions of each TRL. A TRL of at least 5 is required for transition from Phase A to B. NASA may request presentations and/or site visits to review the Phase A implementation plans with the investigation teams.

The PIs of selected investigations will be required to participate in the mission science and operations planning for the mission. PIs are required to support mission confirmation reviews and other mission milestones as defined in Table 5.4.

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be confirmed for implementation, NASA's Office of External Relations will arrange with the sponsoring non-U.S. agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal agency-to-agency Memorandum of Understanding (MOU).
CONCLUSION

The Geospace RBSP mission represents an exciting and important step in accomplishing the goals of NASA's Living With a Star program that is expected to significantly advance our knowledge of how the acceleration, global distribution, and variability of energetic electrons and ions in the inner magnetosphere are changed in response to the variable inputs of energy from the sun. This level of physical understanding will lead to improved characterizations of planetary space environments and the prediction of potentially hazardous space weather effects. In addition, this program is expected to generate excellent opportunities to enhance K-12 education opportunities and engage the public in the excitement of space scientific research. NASA invites both the U.S. and international space science communities to submit proposals in compliance with the provisions of this Announcement of Opportunity.

[signature on original copy]

Mary Cleave
Director, Earth-Sun System Division
Science Mission Directorate

[signature on original copy]

Ghassem R. Asrar
Deputy Associate Administrator for
Science Mission Directorate
I. **INSTRUMENTATION AND/OR GROUND EQUIPMENT**

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation, or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use of Government instrumentation or property that subsequently becomes available, with or without modification, that meets the investigative objectives.

II. **TENTATIVE SELECTIONS, PHASED DEVELOPMENT, PARTIAL SELECTIONS, AND PARTICIPATION WITH OTHERS**

By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment and to discontinue the investigative effort at the completion of any phase. NASA may desire to select only a portion of the proposed investigation and/or that the individual participates with other investigators in a joint investigation. In this case, the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its leader or contact point. NASA reserves the right not to make an award or cancel this AO at any time.

III. **SELECTION WITHOUT DISCUSSION**

The Government intends to evaluate proposals and award contracts without discussions with offerors. Therefore, each initial offer should contain the offeror's best terms from a cost or price and technical standpoint. However, the Government reserves the right to conduct discussions, if later determined by the Contracting Officer to be necessary.

IV. **NONDOMESTIC PROPOSALS**

The guidelines for proposals originating outside of the United States are the same as those for proposals originating within the United States, except that the additional conditions described in Sections 5.9 and Appendix B section H shall also apply.

V. **TREATMENT OF PROPOSAL DATA**

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other
information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal or quotation and specify the information, subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

RESTRICTION ON USE AND DISCLOSURE OF PROPOSAL AND QUOTATION INFORMATION (DATA)

The information (data) contained in (insert page numbers or other identification) of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data), if obtained from another source without restriction.

VI. STATUS OF COST PROPOSALS

The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that, following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit or execute all certifications and representations required by law and regulation.

VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the selecting official deems it to offer NASA a significant technical advantage or cost reduction. (See NFS 18-15.208.)

VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate investigations for space missions can come from many sources. These sources include those selected through the AO, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.

IX. DISCLOSURE OF PROPOSALS OUTSIDE THE GOVERNMENT

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal, the investigator and institution
agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desires to preclude NASA from using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. **EQUAL OPPORTUNITY**

For any NASA contract resulting from this solicitation, the clause at FAR 52.222-26, "Equal Opportunity," shall apply.

XI. **PATENT RIGHTS**

A. For any NASA contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 18-52.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at NFS 18-52.227-71, Requests for Waiver of Rights to Inventions.

B. For any NASA contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, Patent Rights -- Retention by the Contractor (Short Form), (as modified by NFS 18-52.227-11) shall apply.

XII. **RIGHTS IN DATA**

Any contract resulting from this solicitation will contain the Rights in Data - General clause: FAR 52.227-14.

XIII. **SMALL AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING**

A. Offerors are advised that, in keeping with Congressionally mandated goals, NASA seeks to place a fair portion of its contract dollars, where feasible, with small, small disadvantaged, women-owned small business concerns, and Historically Black Colleges and Universities (HBCUs), and other minority educational institutions, as these entities are defined in FAR 52.219-8 and 52.226-2.

B. Section 8(d) of the Small Business Act requires insertion of the clause at FAR 52.219-9, Small Business Subcontracting Plan, in NASA contracts that offer subcontracting possibilities, exceed $500,000, and are with organizations other than small Business Concerns. Offerors seeking Phase A contracts that meet these criteria must include subcontracting plans as part of their proposals for this phase. The subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns, HBCUs, and other minority educational institutions. Offerors will also be evaluated on proposed participation targets of small business concerns (SDBs) in the applicable North American Industry Classification System (NAICS) Subsector as determined by the Department of Commerce (see FAR 19.201(b)).

C. Offerors that are selected for Phase A contracts will be required to submit new subcontracting plans in conjunction with their continuation into Phase B/C/D. These plans will
reflect subcontracting opportunities anticipated as part of the Implementation Phase contracts. The subcontracting plans and the participation of SDBs in the performance of this phase of the contract will be evaluated in the manner described in Paragraph B above as part of the process of selecting the Implementation Phase contractor.

XIV. WITHDRAWAL OF PROPOSALS

Proposals may be withdrawn by the proposer at any time before award. Proposers are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances that dictate termination of evaluation.
INTRODUCTION

The following guidelines apply to the preparation of proposals in response to this Radiation Belt Storm Probes Investigations and Mission of Opportunity Announcement of Opportunity (AO). The material presented is a guide for the prospective proposer and is not intended to be all encompassing. The proposer must, however, provide information relative to those items applicable, as well as other items required by the AO. In the event of an apparent conflict between the guidelines in this appendix and those contained within the body of the AO, those within the AO shall take precedence.

GENERAL GUIDELINES

All documents must be typewritten in English, use metric and standard astronomical units, and be clearly legible. Submission of proposal material by facsimile (fax), electronic media, videotape, or floppy disk is not acceptable except as specifically requested. No proposal may reference a website for any data or material needed for adequate review of the proposal.

The proposal must consist of only one volume, with readily identified sections corresponding to Sections A through H given below. In order to allow for recycling of proposals after the review process, all proposals and copies must be submitted on plain white paper only (e.g., no cardboard stock or plastic covers, no colored paper, etc.). Proposers are not to use three-ring binders. Photographs and color figures are permitted only if printed on recyclable white paper. The original signed copy must be bound in a manner that makes it easy to disassemble for reproduction. Except for the original, two-sided copies are preferred. Every side upon which printing appears will be counted against the page limits.

Proposers must provide 50 copies of their proposal, plus the signed original, by the proposal deadline given in Section 4 of the AO. It is required that the original and each paper copy of the proposal be accompanied by a compact disk (CD) containing an electronic version of the entire proposal in a single, searchable file in the Portable Document Format (PDF) that has bookmarks. This file and the hard copies need to be identical. In addition, proposers must also submit the Fact Sheet (see Section B in Appendix B) as a separate PDF file on the CD.

Proposers must also submit the data in Tables B.4 or B.6, as appropriate, and Table B.5 and B.7 as separate files. Each of these cost tables in Appendix B, including the headings for the rows and columns, must be in a tab-delimited text file. Optionally, versions of these files in Excel format can be included in addition to the required tab-delimited file. Each CD that will accompany the original or a copy of the proposal must include the required files. These CDs and the files in them must be compatible with both the PC and Macintosh platforms.

Proposals must contain no more pages than given in Table B.1 below, including no more than two fold out pages (28 x 43 cm; i.e., 11 x 17 inches). A fold out page counts as one page. All
pages other than fold out pages shall be 8.5 x 11 inches or A4 European standard. The cover, table of contents, required cost table(s) and appendices will not be counted against the page limit.

Single- or double-column format is acceptable. In complying with the page limit, no page may contain more than 55 lines of text and the type font must not be smaller than 12 point (i.e., less than or equal to 15 characters per inch). Figure captions must not be smaller than 12 point. Within figures and tables the font must not be smaller than 10 point.

The following Table B.1 provides restrictions and guidance on page count within the proposal:

Table B.1. Proposal Page Guideline

<table>
<thead>
<tr>
<th>Section</th>
<th>Page Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphic cover page (optional)</td>
<td>Single page, does not count against page limit</td>
</tr>
<tr>
<td>A.   Cover Page and Proposal Summary</td>
<td>Printout of electronic submission</td>
</tr>
<tr>
<td>B.   Fact Sheet</td>
<td>2 pages</td>
</tr>
<tr>
<td>C.   Table of Contents</td>
<td>1 page</td>
</tr>
<tr>
<td>D.   Science Investigation</td>
<td>25, plus 8 p for each additional instrument if a suite of instruments is proposed</td>
</tr>
<tr>
<td>E.   Management and Schedule</td>
<td>15, plus 3 for each additional instrument</td>
</tr>
<tr>
<td>F.   Cost Estimating Methodology and Cost</td>
<td>No page limit</td>
</tr>
<tr>
<td>G.   E/PO and Small Disadvantaged Business/Minority Educational Institutions Plans</td>
<td>E/PO: 1 page text SDB/MEI: 1 page</td>
</tr>
<tr>
<td>H.   Appendices: (no others permitted)</td>
<td>No page limit, but small size encouraged</td>
</tr>
<tr>
<td>1.   Letters of Endorsement</td>
<td></td>
</tr>
<tr>
<td>2.   Co-I Statement(s) of Commitment</td>
<td></td>
</tr>
<tr>
<td>3.   Statement(s) of Work (SOW)</td>
<td></td>
</tr>
<tr>
<td>4.   Resumes (2 pages PI and PM, 1 page for others)</td>
<td></td>
</tr>
<tr>
<td>5.   Draft International Participation Plan - Discussion on Compliance with U.S. Export Laws and Regulations</td>
<td></td>
</tr>
<tr>
<td>6.   Outline of Technical Responsibilities between U.S. and International Partners</td>
<td></td>
</tr>
<tr>
<td>7.   NASA PI Hardware Selection Process (as appropriate)</td>
<td></td>
</tr>
<tr>
<td>8.   Abbreviations and Acronyms</td>
<td></td>
</tr>
<tr>
<td>9.   References (optional)</td>
<td></td>
</tr>
<tr>
<td>10.  Relevant Experience and Past Performance</td>
<td></td>
</tr>
<tr>
<td>11.  Summary of Proposed Cooperative Contributions</td>
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</tr>
</tbody>
</table>
A. COVER PAGE AND PROPOSAL SUMMARY

A Cover Page and Proposal Summary must be a part of the proposal, but will not be counted against the page limit. It must be signed by an official by title of the investigator's organization who is authorized to commit the organization. This authorizing signature also certifies that the proposing institution has read and is in compliance with the required certifications supplied with the model contracts in the RBSP Library (Appendix C); therefore, certifications do not need to be submitted separately.

The full names of the Principal Investigator and the authorizing official, their addresses with zip code, telephone and fax numbers, and electronic mail addresses, shall be included on the Cover Page. Additional information, including the names, institutions, and E-mail addresses of all participants, the type of investigation proposed, the total NASA SMD Cost, and a 200 word Proposal Summary shall also be provided.

The Cover Page and Proposal Summary must be submitted electronically at http://nspires.nasaprs.com. The electronic submission must be performed by an authorized official of the proposing organization. Categories of participants (e.g., collaborator, Co-I) must match the choices available in the electronic submittal system. The Cover Page has four blocks for two types of cost so each can be given in FY 2005 dollars and real year dollars: NASA SMD Cost, that is, the cost paid by SMD; and Total Cost, which is the NASA SMD Cost plus any contributions. The short title requested in this form is the science investigation's acronym, if any. The foreign participation block requests a statement of contributions to development or operations (but not science) including the foreign partner, the foreign funding agency, and the approximate value of the non-U.S. contributions, if any.

After electronic submission, a hard copy version of this Cover Page must be printed in time to acquire signatures and include with the original hard copies of the proposal for delivery according to the schedule provided in Section 4 in this AO. Proposers are advised that they must not reformat this Cover after it is printed, as important NASA-required documentation may be lost. Proposers without access to the Internet or who experience difficulty in using this site may contact the NASA Research and Education Support Service Help Desk at NSPIRES-Help@nasaprs.com The Help Desk phone number is (202) 479-9376 (8:00 a.m. to 6:00 p.m. Eastern Time, Monday through Friday). Note that submission of the electronic Cover Page does not satisfy the deadline for proposal submission.

It is NASA's intent to enter the Proposal Summaries of all selected investigations for its various programs into a publicly accessible database. Therefore, the Summary should not contain any proprietary or confidential information that the submitter wishes to protect from public disclosure.

It is permitted but optional to include a graphic cover page (color or otherwise) in front of the hard copy of the electronically submitted Cover Page and Proposal Summary. It will not count against the page limit so long as it does not contain any technical information not found within the body of the proposal. If this graphic cover page is included, proposers are requested to include the NSPIRES-generated proposal number at the top right corner.
B. FACT SHEET

A Fact Sheet that provides a brief summary of the proposed investigation must be included in the proposal. Include 25 copies of the Fact Sheet with the proposals. The information conveyed on the Fact Sheet must include the following:

- science objectives (including the importance of the science to the NASA science themes),
- investigation overview,
- key instrumentation,
- characteristics,
- investigation management (including teaming arrangement as known),
- schedule and cost estimate (NASA SMD Cost and Total Mission Cost in real year dollars), and
- other relevant information, including figures or drawings, may be included at the proposer's discretion.

The Fact Sheet is restricted to two pages (preferably a double-sided single sheet).

C. TABLE OF CONTENTS

The proposal shall contain a table of contents that parallels the outlines provided below in Sections D through I. Figures and tables shall also be included.

D. SCIENCE INVESTIGATION

1. Scientific Goals and Objectives. This section must discuss the scientific goals and objectives of the proposed investigation, including their value to the specific Radiation Belt Storm Probes objectives described in this AO and to the general NASA Living With a Star Program objectives. The proposal should describe the history and basis for the proposal and should discuss any relationships to past, current, and future investigations and missions. This section must discuss the need for such an investigation. The practical applications of the investigation, in relation to enabling space weather forecasting, must also be outlined. This section must directly address the evaluation criteria for scientific merit described in the AO.

2. Science Requirements. This section must describe the observations and/or data required to meet the scientific objectives. The scientific requirements for the investigation must be explicitly described and these must be linked to the scientific objectives of the mission. The requirements that these objectives and observations impose on the instrumentation design elements must be discussed. The required "science objectives-to-measurements-to-mission traceability" may be provided either in narrative or tabular form. Examples of Science
Traceability and Mission Traceability Matrices are given in Tables B.2 and B.3, along with examples for elements in such matrixes.

The measurements to be taken in the course of the mission, the data to be returned, and the approach that will be taken in analyzing the data to achieve the scientific objectives of the investigation must be discussed. This description must link the investigation to be performed with the quality of the data to be returned (resolution, coverage, measurement precision, etc.) and the quantity of data to be returned (bits, images, etc.). The RBSP data downlink must support all of the instruments; consequently, proposers must justify their telemetry requirements in terms of the overall mission objectives. The relationship between the data products generated and the scientific objectives must be explicitly described, as well as the expected results. The improvement over current knowledge that the results of the investigation are expected to provide must be clearly stated.

Table B.2. Science Traceability Matrix

<table>
<thead>
<tr>
<th>Investigation Objectives</th>
<th>Approach</th>
<th>Technique</th>
<th>Measurement Parameters</th>
<th>Instrument Functional Requirements</th>
<th>Mission Functional Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table B.3. Mission Traceability Matrix

<table>
<thead>
<tr>
<th>Instrument Element or sensor</th>
<th>Requirements on Spacecraft/Host</th>
<th>Requirements on Ground System</th>
<th>Requirements on Operations</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

The Science Traceability Matrix is meant to clearly indicate which Measurement Parameters are to be supplied through the present proposal which are assumed available from RBSP instrumentation to be supplied by other investigations, and which are assumed available from other data or modeling sources. The Mission Traceability Matrix is required only for instrumentation to be supplied through the present proposal. The kinds of information to be addressed in the Tables B.2 and B.3 include the following examples:

*Instrument Functional Requirements*

- Parameter range and resolution
- Accuracy, sensitivity
- Data rate
- Number of sensors, Field of view
**Mission Functional Requirements**
- Orbit information (type, altitude range, inclination range)
- Launch date and launch date flexibility
- Mission duration
- Number of satellites

**Requirements on Spacecraft/Host**
- Control method (3-axis stabilized, spinner, etc.)
- Mounting requirement (ram facing, nadir facing, clearances, etc.)
- Accommodation of investigation-supplied booms, plates, armatures, etc.
- Pointing control, knowledge, and jitter
- Data storage
- Thermal requirements
- Power required by instruments
- Radiation sensitivity
- Electrostatic and magnetic cleanliness (indicate spatial range required)

**Requirements on Communications and Ground Data System**
- Data Volume (Mbytes per day)
- Number of data dumps per day
- Real time requirements

**Requirements on Mission Operations**
- Commanding and monitoring
- Special calibration operations
- Maneuvering, including constraints on maneuvering
- Impact of thruster firings on instrument operation

3. **Science Data and Other Scientific Products.** A discussion of the scientific products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) and how the science products and data obtained will be used to fulfill the scientific objectives must be provided. A discussion of how the science data will be obtained, including a plan for delivery of the products, and the individuals responsible for the data delivery must also be provided. Proposers should describe how they will coordinate their investigations with other Geospace investigations and how their data will collectively contribute to achievement of broader LWS goals.

4. **Minimum Science Investigation.** This section must identify a minimum acceptable data and scientific return for the investigation (the Minimum Science Investigation), below which the investigation would not be worth pursuing. The value of the Minimum Science Investigation must be discussed. A description of the descope options available, their phasing, their effect on meeting the scientific objectives of the investigation, and their value during development (e.g., savings in cost, schedule, or risk), as the investigation is descope from the Proposed Investigation to the Minimum Science Investigation must be discussed. Proposals must include only one Minimum Science Investigation.
5. **Science Implementation**

a. **Instrumentation.** This section must describe the proposed instrumentation and the criteria used for its selection. While it is not expected that full details of instrument design will be available until completion of further studies, the information requested is needed for proposal review and, thus, must be provided to the extent known. This section must identify the individual components (including any mechanisms supplied by the proposer) and instrument systems, including their characteristics and requirements. It must identify individual sensor and sensor systems, including their characteristics and requirements, and indicate items that require development, as well as any existing components or design/flight heritage. The heritage of various parts of the instrumentation, supporting systems, and software must be described. For any level of heritage claimed, cost information about the referenced sources of heritage will be required in the section on cost estimating methodology.

The proposal must describe all parameters of the instrument that are pertinent to the accommodation of the instrument within the spacecraft resources and configuration advertised in this AO (and as may be updated at the WWW location where this AO is posted; see Section 6.1) plus any special requirements necessary for successful implementation. This information must be given in sufficient detail to permit an evaluation of both the concept and the practical feasibility of the hardware. These resources include, but are not limited to: volumetric envelope, mass, power, and thermal requirements (including preferred thermal limits); telemetry and command requirements; environmental sensitivities (e.g., to electrical cleanliness, magnetic fields, and contamination); any special spacecraft or launch vehicle integration requirements or constraints; field-of-view clearances; pointing requirements; and on-board data processing. Mass, power, and data processing budgets must be provided. The power discussion must outline average, cruise, and peak power use and a time profile of power needs. All enabling technologies must be identified and the TRL level defined. All enabling technologies are required to be at TRL level 5 or higher before a project may enter Phase B and at TRL level 6 or higher by the end of Phase B. A plan to meet the required TRL levels for each phase must be discussed.

The design heritage and maturity of each instrument(s) shall be addressed. Use tables where possible to provide the following:

- **The design basis:**
  - Describe the closest heritage system, including recent applications(s) dates of use, and developer institution;
  - Indicate whether the individuals who participated in the heritage basis are available to the team;
  - State whether heritage is flight-proven, ground application, or other status;
  - Describe existing instruments, breadboards, and prototypes, if any;

- **Difference between the basis and the proposed design:**
  - Justify the new design or design modifications required;
  - Specify exactly what will be modified;
  - Characterize the difference in relevant terms: mass, power, cost, etc.;
• Development challenges:
  • Describe any circumstances that might adversely impact the ability to incorporate the planned design heritage or to deliver the new technology item. If necessary, describe the steps planned to ensure the claimed design heritage is captured, and describe remedial action plan should the expected heritage prove unattainable within resources.

A preliminary description of each instrument design with a block diagram showing the instrument systems and their interfaces must be included, along with a description of the estimated performance of the instrument. In the case of a new or not-yet-space-qualified design, the instrument must, to the extent possible, be compared on the basis of performance, complexity, and cost to existing instruments. Since the locations of the interfaces are not finalized, proposers must identify possible locations for the electrical, mechanical, and data interfaces based on information provided in this AO (and updated at the WWW location where this AO is posted; see Section 6.1). In addition, the preferred location of the instrument itself on the spacecraft must be described. Where more than one choice is available, proposers must identify and justify their preference.

Instrument assembly, testing, and calibration (both pre- and during flight) must be described. The proposal shall include a flow diagram indicating the order of assembly, tests, and calibration. In addition, the PI shall submit a verification matrix that describes the tests and calibrations that are to be performed on components, development units, and subassemblies.

In the case of proposals for multiple instruments, both individual instruments and package parameters must be detailed to the extent possible. Proposals for multiple instruments are expected to justify each instrument. Multiple-instrument proposals are expected to provide technical and cost information for each instrument sufficient to allow separate evaluation. The instrument suite component level reserves and margin for resources such as mass, telemetry, and power must be identified. Also, for each instrument in the suite, identify all hardware components necessary to support each single instrument as if it were the only instrument selected from the suite. The mass, telemetry, and power and reserves and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see below for definitions of contingency and margin). Discuss the allocation of reserves and margin to the instrument and/or suite.

<table>
<thead>
<tr>
<th>Contingency (or reserve)</th>
<th>When added to a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the maximum expected value of the resource less the contingency.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td>Is the difference between the maximum possible value of a resource and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.</td>
</tr>
</tbody>
</table>

B-8
Example: A suite has a maximum expected value of 40 kg, which includes 5 kg of reserve. The percent reserve is 14%. The maximum possible value of the resource is 44 kg so the percent margin is 10%.

Using the term contingency equivalently to the term reserve, and acknowledging that the maximum expected resource value is equal to the maximum proposed resource value (including contingency), the above technical terms can be expressed in equation form as:

\[
\text{Contingency} = \text{Max Expected Resource Value} - \text{Proposed Resource Value}
\]

\[
\% \text{ Contingency} = \frac{\text{Contingency}}{\text{Max Expected Resource Value} - \text{Contingency}} \times 100
\]

\[
\text{Margin} = \text{Max Possible Resource Value} - \text{Max Expected Resource Value}
\]

\[
\% \text{ Margin} = \frac{\text{Margin}}{\text{Max Expected Resource Value}} \times 100
\]

The proposer may identify variations of proposed instruments or suites of instruments that reduce the impact of the instrument/suite on spacecraft resources and saves cost. The reduction in spacecraft resources (mass, power, telemetry) and cost should be clearly defined and the impact of the instrument or suite change on the science capability of the instrument must be described and related to the science objectives in section 2 of the AO.

b. Investigation Concept. Proposals must include a discussion of the purpose of the instrument and how its capabilities, data rates (peak and average), fields of view, resolution, sensitivity, pointing accuracy, etc. contribute to fulfillment of the science objectives. The observing strategy, within the framework of the expected spacecraft performance, required for obtaining the necessary data with the proposed instrumentation must be described. Operational constraints and spacecraft pointing requirements must be identified. The concept and the expected requirements for supporting mission operations must be given. Requirements for pre- or postlaunch ground operations support must be identified. Proposers who require Mission Operations Center support beyond what is currently planned must include the cost for the additional MOC support under Phase E in Table B.4. The planned support for mission operations is described in Section 5.5 of this AO.

c. Data Collection, Analysis, Dissemination, and Archiving. For both RBSP investigations and investigations funded as LWS Geospace Missions of Opportunity, the data reduction, dissemination, and analysis plan, following delivery of the data to the ground, must be discussed, including the method and format of the data reduction, data validation, dissemination to the science community, and preliminary analysis. The process by which data will be prepared for archiving must be discussed, including a list of the specific data products and the individual team members responsible for the data products. The plan must include a detailed schedule for the submission of raw and reduced data to the appropriate data archive in the proper formats, media, etc. Delivery of the data to the data archive must take place in the shortest time possible as specified by the NASA policy on open data access and Section 5.11 of this AO.
The proposal must describe how the data that are to be obtained with the proposed hardware may be related to other RBSP investigations and to the broader goals of the RBSP mission. Specific approaches being proposed to maximize the effective use of these data for the study of outstanding problems in the context of LWS must be identified together with the proposer's plans for data processing and management.

d. **Science Team.** This section must identify each necessary individual of the investigation science team and his or her roles and responsibilities. NASA strongly encourages proposers to identify only the most critically important personnel to aid in the execution of their proposals. The inclusion of Co-Is who are judged by peer review to have either insignificant or unjustified roles in a proposed program of research will be considered a weakness for purposes of the evaluation of the proposal. The capabilities and experience of all members of the proposed science team must be described. Resumes or curriculum vitae of team members must be included as attachments to the proposal (see Section I, below). The role of each Co-I must be explicitly defined and justified, and the funding source (NASA or contributed) for the Principal Investigator and each Co-I named. A letter of endorsement is required from each Co-I's institution if the Co-I's services are contributed (see Section 5.6.6). Other nonfunded members of the proposal team may be included in the proposal as collaborators.

e. **Radiation Environment effects.** This section must address how the instrument design and planned instrument operations addresses the expected radiation environment. The proposal must discuss the expected operation of the instrument in the radiation environment. The proposal must address planned mitigation of the radiation environment effects and describe how the science goals will be achieved in the expected environment.

### E. MANAGEMENT AND SCHEDULE

This part of the proposal sets forth the investigator's approach for implementing the investigation. It should, in particular, provide a discussion with regards to managing the work, the recognition of essential management functions, and the overall integration of these functions in order to meet the established review and delivery dates while controlling costs. When necessary or to avoid duplication, references can be made to other parts, sections, and/or charts in the proposal.

This section must summarize the investigator's proposed management approach. The management organization (including an organization chart) and decision-making process must be described, and the teaming arrangement (as known) must be discussed. The responsibilities of team members, including contributors, and institutional commitments must be discussed. Unique capabilities that each team member organization brings to the team, as well as previous experience (including cost and schedule performance) with similar systems and equipment, must be addressed.

The proposer shall identify any deficiencies in experience and past performance for themselves or a partner that is not equivalent to, or better than, the requirements for the proposed mission. The proposer shall explain how confidence can be gained that the mission can be accomplished within cost and schedule through a plan of training, oversight, and/or whatever means is necessary to obtain the required expertise.
The specific roles and responsibilities of the Principal Investigator and Project Manager must be described. Risk management and risk mitigation plans must be described. This discussion must include the top three to five risks, descoping strategies, if relevant, and management strategies for control, allocation, and release of technical, cost, and schedule reserves and margins. When contracts are required, the acquisition strategy, including any incentive strategy, must be described.

A Work Breakdown Structure (WBS) shall be defined in this part of the proposal that clearly links the investigation organization with the cost information in the cost plan.

Mission of Opportunity proposals must specifically address how the investigation team will interrelate with the sponsoring organization, organizationally and managerially, and describe;

- the status of the commitment from the host mission's sponsoring organization to fly the proposed instrument or conduct the proposed investigation;
- if and how the proposed investigation relates to the sponsor's overall mission objectives;
- the investigation development plan and how it fits in the development plan of the sponsor's mission; and
- how the operations plan for the proposed investigation fits within those for the mission of the sponsoring organization.

A project schedule covering all phases of the investigation must be proposed. The schedule must include, as a minimum, proposed major project review dates, instrument development and delivery, supporting structure development and delivery (if applicable), instrument-to-spacecraft/host integration and test, any launch vehicle integration issues, and mission operations and data analysis (MO&DA). For purposes of this schedule, the proposer should assume delivery of any hardware in accordance with the Project Schedule shown in Table 5.4 of the AO (see Section 5.5.4). Schedule critical path and funded schedule reserve must be clearly identified. A Partner Mission of Opportunity schedule shall also include the major milestones of the mission sponsor/host and show how the investigation fits in the development plan for the sponsor's mission.

In areas of management and schedule where the required depth of information is not available at this stage, for whatever reason, the proposal must (i) describe the current management approach and schedule, (ii) justify that the development of that aspect of the project is not required at this stage and that it is acceptable to develop details later, and (iii) explain why the lack of information at this stage should not translate into a risk to the proposer's ability to implement the mission as proposed. The schedule and process for developing the required depth of information must be explicitly included among the plans for future activity. In the case where an investigation is proposed at or near the cost cap, but depth of detail is deferred, the proposal must justify the adequacy of the proposed cost reserves since the proposed cost is not allowed to increase during Phase A (or at any later time).
F. COST ESTIMATING METHODOLOGY AND COSTS

This section shall include an estimated cost of the investigation that encompasses all proposed activities, including all applicable mission phases, fee, and contributions. spacecraft operations costs will be covered by the project, thus proposers need only include costs for science operations and data analysis in their Phase E estimates. Costs for E/PO will also be covered by the project, although it is expected that a portion of the E/PO budget will be allocated to mission investigators to support their role in the LWS Geospace E/PO Plan. These costs shall be consistent with the available resources and program requirements described in Section 1.2 and Section 5, as applicable, of this AO. Since the available funding must support the entire science payload, proposers must justify their costs in terms of the overall mission objectives.

The Cost Plan must have two parts: detailed total cost for Phase A and the Bridge Phase and an estimated cost plan for Phases B, C, D, and E. Each contract resulting from this selection for Phase A studies will contain a priced option for a Bridge Phase, as well as an advance agreement to add Phases B/C/D/ and E. If the investigation is approved to continue, terms and conditions for these phases will be negotiated based on the concept study report submitted for Phase A. A supplemental agreement shall be executed and shall represent an equitable adjustment to the estimated cost, deliverable items, and delivery schedules, and other affected terms of the contract for inclusion of Phases B through E. Proposals are to include a priced Bridge Phase option to be exercised upon investigations selected to proceed into phase B/C/D/E. The Bridge Phase is intended to cover a three-month period of Phase B effort to provide program continuity while the Phase B/C/D and E negotiations are completed and these three phases are added to the contract.

Proposers must estimate the Total NASA Cost in the proposal and, if selected through this AO, in much more detail in the Phase A implementation plans. Contributions by foreign partners or others are not considered to be part of the Total NASA Cost. However, cost estimates for these contributions must be included to allow a full assessment of the Total Investigation Cost (Defined as the Total NASA Cost plus all contributions).

The amount required in each U.S. Government fiscal year (October 1 – September 30) in real-year (RY) K dollars must be identified. Use Tables B.4 and B.5 for RBSP investigations and Table B.6 for Missions of Opportunity. For an individual instrument proposal, one Table B.4 and one Table B.5 are required. For proposals with more than one instrument, one Table B.4 and one Table B.5 are required that shows the total cost for all instruments. In addition, a separate Table B.4 is required for each instrument in the suite. For example, if three instruments are proposed, then there must be four versions of Table B.4 of which one will show the total cost if all instruments are selected as proposed. The other three tables must address the cost of each instrument as if it were selected separately. An explanation should be provided with each Table B.4, for an individual instrument in a suite, noting whether there are any performance changes or design changes if only the single instrument is selected. Also, if a variation of an instrument has been discussed in order to save spacecraft resources or cost, a separate Table B.4 should be submitted.

The top portion of Tables B.4, B.5, and B.6 requests cost data relative to the NASA SMD Cost. The lower portion addresses both domestic and non-U.S. contributions. The rows in Table B.4, B.5, and B.6 are to be modified as appropriate for the proposal although the cost of Data Analysis must be shown separately from Science Operations costs. Provide the data requested in
Table B.7 for the NASA SMD Cost by mission phase. The columns in all tables must be labeled with the appropriate fiscal years. Tables B.3, B.4, B.5, B.6, and B.7 will not be counted against the page limit. Table B.8 gives the NASA inflation index. These rates should be used to calculate real-year dollars unless an industry forward pricing rate is used and documented.

The Cost Plan must provide an estimate of the total lifecycle cost to NASA of the investigation, along with sufficient technical information to allow the reliability of the figures to be judged. The methodology used to estimate the cost, for example, the specific cost model, past performance, and/or cost estimating relationships from analogous missions, must be discussed. The method used for determining the value of any foreign contributions must be described. Budget reserve strategy, including budget reserve levels as a function of mission phase, must be discussed. Provide assumptions used in developing cost estimates to help facilitate reviewer understanding of proposed cost estimates, particularly with regard to any requested Government furnished equipment and services. Provide rationale that describes why NASA should feel confident that the proposed costs are reasonable and will remain within the cost cap.

An investigation may be required to descope to meet cost or other resource constraints; therefore, the proposer shall identify a prioritized Risk Management Plan for the removal of requirements. The E/PO program element may not be considered a descope option. The decision points for achieving effective reductions in cost and schedule must be identified. The hardware and project costs associated with the investigation at each level of descoping must be estimated and any resulting schedule savings must be outlined.

G. EDUCATION/PUBLIC OUTREACH AND SMALL BUSINESS PLANS

Within the page limit for the text (see Table B.1 in this Appendix) and consistent with the guidance given in Section 5.12.1 and 5.12.2 of the AO and below, discuss the plans and commitments for the following subject:

Education/Public Outreach. The proposer should provide a statement that she/he understands NASA SMD requirements for Education and Public Outreach (E/PO) and is committed to contributing to and supporting a mission level E/PO program that meets the goals described in Section 5.12.1 of the AO. The proposer may also provide an overview with a brief discussion of any unique characteristics of the proposed investigation that might provide unusual opportunities for E/PO. The proposer must declare any intention to include any experiment on the spacecraft that will be led by students, particularly pre-college students. Because of the length of the Formulation and Implementation phases of missions, a student–led experiment should be proposed only if there are compelling circumstances to justify its inclusion. Detailed plans for implementing the E/PO activities, including identification of and formal commitment from E/PO partner institutions, is not required from individual investigations, but will be handled at the mission level and will be evaluated as part of the confirmation process (see Section 7.3 of this AO).

Small Business Plans. Within the page limit (see Table B.1 in this Appendix) and consistent with the specific guidance given in Sections 5.12.2 of this AO and Paragraph XIII of Appendix A, respectively, discuss the proposed Small Business Plan.
H. APPENDICES

The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit. NO OTHER APPENDICES ARE PERMITTED.

1. **Letters of Endorsement.** Letters of endorsement must be provided from all non-SMD organizations (including foreign participants) offering goods and/or services (including the support of members of the science team) for the proposed investigation. Proposals lacking such letters, or including letters judged inadequate by NASA, may be rejected without further review. Proposals from foreign entities and proposals from U.S. organizations that include foreign participation must be on a no-exchange-of-funds basis and must be endorsed by the respective Government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such letters of endorsement must be signed by institutional and/or Government officials authorized to commit their organizations to participation in the proposed investigation. All letters of endorsement are to be included in and submitted with the proposal. Copies of faxed letters from non-U.S. participants may be used in the submitted proposals as long as original signed letters are received within a week of the due date for proposals. Requirements for letters of endorsement may be found in Section 5.6.6 and Section 5.9.2 of this AO.

2. **Co-I Statement(s) of Commitment.** See section 5.6.6 of this AO.

3. **Statement(s) of Work (SOW).** For investigations managed from non-Government institutions, provide a SOW. For investigations managed from Government institutions, provide a SOW as if the institution were non-Government. This SOW must include the requirement for a Phase A concept study report that is described in the Guidelines and Criteria for the Phase A Concept Study document available through the RBSP Program Library. The SOW must include general task statements for Phases B/C/D and for Phase E. All SOWs must include Scope of Work and Government Responsibilities (as applicable). SOWs need not be more than a page in length. If more than one contractual arrangement between NASA and the proposing team is required for Phase A or the Bridge Phase, information must be provided that identifies how funds are to be allocated among the organizations.

4. **Resumes.** Provide resumes or curriculum vitae for the PI, Project Manager (PM) and all Co-Investigators identified in the science section and for any key project personnel. These resumes must clearly show experience related to the job the individual will perform on the proposed investigation. If the PI or PM have project management experience, it must be included in their resume. Resumes or curriculum vitae should be no longer than two pages for the PI and PM and no longer than one page for each additional participant. The resume may contain the signed statement of participation from Co-Investigators (see Section 5.6.6).

5. **Draft International Participation Plan - Discussion on Compliance with U.S. Export Laws and Regulations.** Investigations that include international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities must include a section discussing compliance with U.S. export laws and regulations, e.g., 22 CFR 120-130, *et seq.* and 15 CFR 730-774, *et seq.*, as applicable to the scenario surrounding the particular
international participation. The discussion must describe in detail the proposed international participation and is to include, but not be limited to, the following items: (i) complexity and risk, (ii) management of international contributions (including flowchart showing flow of hardware, information, and management authority), (iii) risk mitigation should contributions not materialize, and (iv) whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.pmdtc.org/ and http://www.bis.doc.gov/. Proposers are advised 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 this AO, are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, et seq. See Sections 5.9.1 and 5.9.2, 5.9.3 for additional requirements.

6. Outline of Technical Responsibilities between U.S. and International Partners. These outlines will be used by NASA at selection as the starting point for formalizing the agency-to-agency agreements that will be required if the investigation is implemented. There is a Letter of Agreement (LOA) Template in the RBSP Program Library.

7. Compliance with Procurement Regulations by NASA PI Proposals.

a) NASA solicits, accepts, and evaluates proposals submitted by NASA Centers in response to an AO. A NASA investigator may team with one or more non-Government co-investigators. A NASA investigator may also need to acquire supplies, including instruments and other hardware, and non-research services in support of the proposed investigation. If a proposal submitted by a NASA Center is selected, formal assembly of the team and acquisition of hardware and support services must be accomplished through the award of new Government contracts, unless existing Government contracts are available. The award of new Government contracts must comply with procurement laws and regulations.

(b) In addition to complying with proposal preparation instructions contained in the AO, proposals submitted by NASA Centers should address the following matters.

(1) Non-Government co-investigators.

(i) The proposal should describe the open and competitive process that was used for selecting proposed team members. While a formal solicitation is not required, the process should include the following competitive aspects: notice of the opportunity to participate to potential sources, submissions from and/or discussions with potential sources, and objective criteria for selecting team members among interested sources. If proposed team members are selected without using an open and competitive process, the proposal should contain a full justification consistent with the requirements of FAR Subpart 6.3.

(ii) The proposal should also include a representation that the NASA investigator has examined his/her financial interests and has determined that no personal conflict of interest exists.
(2) Supplies and support services.
   (i) The proposal should indicate that the supplies or services are available under an existing Government contract; or
   (ii) The proposal should state that the supplies or services will be acquired under a full and open competition; or
   (iii) The proposal should explain the basis of a justification for acquiring the supplies or services noncompetitively (see FAR Subpart 6.3).
(c) A selection decision approving the non-Government team members as selected co-investigators satisfies legal and regulatory requirements without further competition or justification (see 1872.702).
(d) For the acquisition of supplies, including hardware, and support services by non-Government co-investigators, see 1872.502(a)(4).

8. Abbreviations and Acronyms.

9. References. In addition to the above items, a References List may be provided that identifies reference documents and materials that were fundamentally important in generating the proposal. Proposers are allowed to include a URL for those documents available through the Internet. Note that the proposal itself must be self-contained; that is, any information intended as part of the proposal must be included in the proposal. If documents and materials themselves are submitted as a part of the proposal, they must be included within the prescribed page count.

10. Relevant Experience and Past Performance. Relevant experience and past performance (successes and failures) of the major team partners in meeting cost and schedule constraints in similar projects within the last ten years must be discussed with a particular emphasis on the incorporation of lessons learned from previous projects and any mitigating circumstances. The discussion of relevant experience and past performance must include a description of each project; its relevance to the investigation proposed to this AO; the proposed performance and the actual performance; the proposed cost and actual cost; the proposed schedule and actual schedule; an explanation of any differences between proposed performance, cost, and schedule and what was actually achieved; and points of contact for the past project's customer, including address and phone number. If the customer for the past project was the United States Government, then the contract number must be included along with current technical point(s) of contact, phone number(s), and address. For projects that are not yet complete, the current projected performance, cost, and schedule must be used in place of actual values.

In evaluating the proposal, NASA will consider the past performance of the major partner organizations. The evaluation of past performance will not be arithmetic; instead, the information deemed to be most relevant and significant will receive the greatest consideration. Relevant experience will be viewed as the demonstrated accomplishment of work that is comparable or related to the investigation proposed to this AO. In conducting the evaluation, NASA reserves the right to use all information available.

The team is cautioned that omissions or an inaccurate or inadequate response to this evaluation item will have a negative effect on the overall evaluation, and, while NASA may
consider data from other sources, the burden of providing relevant references that NASA can readily contact rests with the proposer.

The following requirement for additional information applies equally to Missions of Opportunity proposed in response to this AO.

As provided in section 7.2.4 of the AO, each proposal will be evaluated for feasibility of the proposed approach for implementation, including cost risk (see also section 5.8.4). Per these provisions, proposals that include cooperative contributions to the proposed investigation, whether foreign or domestic, may be attributed additional risk if (i) the approach does not have clear and simple technical and management interfaces, (ii) the proposal does not provide evidence that the contribution is within the scientific and technical capability of the contributing partner, and/or (iii) the proposal does not include a firm, demonstrable commitment for each contribution. Cooperative contributions are defined to be those that are to be provided to the proposed investigation from a domestic or international partner on a no-exchange-of-funds basis.

Therefore, in order to aid NASA in conducting an equitable assessment of risks from cooperative contributions, each proposer must provide, in addition to the commitment letter from funding sponsors of all cooperative contributions, two additional items as an appendix to the proposal:

1. An "exploded diagram" of the investigation (see Figure B.1) that provides a clear visual representation of cooperative contributions incorporated in the proposed implementation approach.
   All cooperative contributions, including those that will require an international agreement or interagency memorandum of agreement, must be shown in this diagram. Each contribution shown must display a unique name for the contribution as well as the identity of the contributing entity. However, arrangements that need not be shown are:
   i. Scientific collaborations such as joint data analysis that do not involve contribution of flight hardware or other items critical to the investigation, and
   ii. Foreign or domestic goods and services obtained by contract (i.e., purchased) using NASA funds.

2. A supporting table with more information that elaborates each cooperative contribution shown in the exploded diagram.
The table must include, for each contribution, the following information:
   i. Unique name identifying the contribution (must match the name on the exploded diagram);
   ii. The full, formal name of the providing entity;
   iii. For foreign contributions, the identification of the funding sponsor if different from the entity identified in item (ii) above; and
   iv. The approximate value of the contribution, in U.S. dollars (i.e., what would be the cost to NASA to replace the contribution if it were not provided as planned).
FIGURE B.1. Sample “Exploded Management Diagram.”
Table B.4. Total Investigation Cost Funding Profile  
(FY costs’ in Real Year Dollars; Totals in Real Year and FY 2005 Dollars)

<table>
<thead>
<tr>
<th>Cost Element</th>
<th>FY1</th>
<th>FY2</th>
<th>FY3</th>
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Total NASA SMD Cost: $          $          $          $          $          $          $          $          $          $

Contributions

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<th>FY1</th>
<th>FY2</th>
<th>FY3</th>
<th>FY4</th>
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<th>Total FY2005</th>
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Total Investigation Cost: $
Table B.5. Summary of Elements of Costs

INSTRUMENT: ____________________________________________________________

CHECK ONE: ___________________________ PHASE A ___________________________ BRIDGE PHASE ___________________________

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<tr>
<th></th>
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<th>Cost</th>
<th>Hours</th>
<th>Rate</th>
<th>Cost</th>
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<th>Cost</th>
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<td>Labor Hrs/ Costs: (by skill categories)</td>
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<tr>
<td>Overhead (by cost centers)</td>
<td>%</td>
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<td>%</td>
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<td>%</td>
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<td>Other Direct Costs</td>
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<td>Subcontracts</td>
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<tr>
<td>G&amp;A Expense (by cost pools)</td>
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<tr>
<td>Cost of Money (by direct pools &amp; overhead centers)</td>
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<tr>
<td>Profit/Fee</td>
<td>%</td>
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<td><strong>Total Cost Plus Fee</strong></td>
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</table>

The Summary of Elements of Cost and Basis of Estimate for Phase A and the Bridge Phase should contain the following direct and indirect elements, as applicable:

**DIRECT LABOR HOURS** – Show productive hours by individual skill categories.

**DIRECT LABOR COSTS** – The labor costs should be itemized by skill categories. The basis for the rates should be described.

**LABOR OVERHEAD** – Overhead should be itemized by overhead cost centers (engineering, manufacturing, etc.) as well as associated rates.

**SUBCONTRACTS** – Supporting information, such as name/address, cost, fee/profit, basis of estimate, etc., should be provided for each of the major subcontracts.

**MATERIALS** – Provide supporting details for major vendors. Burden rates must be identified.

**TRAVEL** – Provide supporting details for destination, purpose, number of people per trip, transportation costs, per diem costs, and miscellaneous costs.

**OTHER DIRECT COSTS** – Identify cost and purpose.

**GENERAL AND ADMINISTRATIVE (G&A) EXPENSE** – G&A expense represents the institution's general and executive offices and other miscellaneous expenses related to business. G&A expense should be itemized by cost pool, and rates should be documented.

**COST OF MONEY (COM)** – COM represents interest on borrowed funds invested in facilities. COM should be itemized by indirect pools and overhead centers. Rates should be documented.

**PROFIT/FEE** – Document the basis, rate, and amount of fee.

**ESCALATION FACTORS** – Document the escalation factors used to determine real year dollars.
Table B.6. NASA Cost Funding Profile for Missions of Opportunity
(FY costs in Real Year Dollars, Totals in Real Year and FY 2005 Dollars)

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<thead>
<tr>
<th>Cost Element</th>
<th>FY1</th>
<th>FY2</th>
<th>FY3</th>
<th>FY4</th>
<th>FY5</th>
<th>...</th>
<th>FYn</th>
<th>Total (Real Yr.)</th>
<th>Total (FY 2005)</th>
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<td>Pre-Launch GDS/MOS(^2)</td>
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<td>Total Phase E</td>
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</table>

Rows should be modified to suit the proposal
* Specify each one in separate row
1 Costs must include all costs including overhead, G&A, and fees
2 PM/SE - Project Management/Systems Engineering including Mission Analysis and Mission Assurance
3 IAT - Integration, Assembly and Test
4 GDS/MOS - Ground Data System/Mission Operations Services
5 MO&DA - Mission Operations and Data Analysis
6 Include Bridge Phase in Phase B
### Table B.7. Mission Phase Summary for NASA SMD Cost
**(FY costs\(^1\) in Real Year Dollars, Totals in Real Year and FY 2005 Dollars)**

<table>
<thead>
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<th>Mission Phase</th>
<th>FY1</th>
<th>FY2</th>
<th>FY3</th>
<th>FY4</th>
<th>FY5</th>
<th>...</th>
<th>FYn</th>
<th>Total (Real Yr.)</th>
<th>Total (FY 2005)</th>
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<tbody>
<tr>
<td>Phase A</td>
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<tr>
<td>NASA SMD Cost, FY Totals</td>
<td>$</td>
<td>$</td>
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</tbody>
</table>

\(^1\) Costs must include all costs including overhead, G&A, and fees

### Table B.8. NASA NEW START INFLATION INDEX

<table>
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<th>Fiscal Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2010</th>
<th>2011</th>
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<td>2.0%</td>
<td>2.1%</td>
<td>2.1%</td>
<td>2.0%</td>
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<tr>
<td>Cumulative Inflation Index</td>
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<td>1.020</td>
<td>1.041</td>
<td>1.063</td>
<td>1.085</td>
<td>1.107</td>
</tr>
</tbody>
</table>

Use an inflation rate of 2.0% for years beyond 2011.
APPENDIX C

CONTENTS OF THE RBSP PROGRAM LIBRARY

The LWS Geospace Library includes documents available electronically via the Internet. Proposers are requested to access the documents electronically. Please note that not all documents are available via the RBSP Library, but access information is provided. The list below may not be inclusive. The online library will have the latest documents.

*It is incumbent upon the proposer to ensure that the documents used in proposal preparation are of the date and revision listed in the Announcement of Opportunity or this Appendix.*


---

NATIONAL SPACE SCIENCE DOCUMENTS AND REPORTS


National Research Council report of the Solar and Space Physics Survey Committee. A study undertaken by the Space Studies Board and the Board on Physics and Astronomy of both solar and space physics recommends priorities for new initiatives in the decade 2003 to 2013.


National Research Council report of the Task Group on Astronomy and Astrophysics. A study undertaken by the Space Science Board to determine the principal scientific issues that the discipline of space science would face during the period 1995-2015.


National Research Council report of the Committee on Solar and Space Physics and the Committee on Solar-Terrestrial Research. A study undertaken by the Space Studies Board recommends the major directions for scientific research in space physics for the coming decade.

*National Space Weather Program Implementation Plan* (July 2000)

National Space Weather Program report which identifies specific objectives and recommended activities necessary for improving space weather predictive capabilities.

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NASA STRATEGIES AND POLICIES


The Education Enterprise Strategy (2003)
Contains additional information on the NASA approach to education, and the relationship of the OSS E/PO program to larger agency efforts.

SCIENCE MISSION DIRECTORATE (SMD) STRATEGIES AND POLICIES

The Space Science Enterprise Strategy (October 2003)
A concise statement of the goals and outlook of NASA's Space Science Enterprise. It is a compilation of the major ideas described in more detail in the context of the overall NASA Strategic Plan.

Partners in Education: A Strategy for Integrating Education and Public Outreach into NASA’s Space Science Programs (March 1995)
Describes the overall strategy for integrating education and public outreach (E/PO) into NASA's space science programs.

Implementing the Office of Space Science (OSS) Education/Public Outreach Strategy (October 1996)
Describes OSS's overall approach to implementing its E/PO strategy.

Provides answers to frequently asked questions and an elaboration of each of the OSS E/PO criteria. The document is intended to give a flavor of what an exemplary E/PO program can be.

Summarizes the OSS E/PO programs conducted in FY2003.

The Space Science Enterprise Integrated Technology Strategy (October 1998)
Describes efforts to manage technology infusion into future OSS missions and to promote technology transfer to the private sector.

SCIENCE MISSION DIRECTORATE ROADMAP

The science themes of the NASA Science Mission Directorate (SMD) through its Advisory Committee, subcommittees, and the NASA Advanced Planning and Integration Office (APIO) have developed Roadmaps. These planning documents prioritize the SMD science goals for NASA for the years 2005-2035. The following Roadmap applies to the LWS Geospace project:

Sun-Solar Connection Science and Technology Roadmap 2005-2035 (June 2005)
Describes the Sun-Solar System Connection Theme Roadmap.
LIVING WITH A STAR SUPPORTING DOCUMENTS

Living With a Star Science Architecture Team, report to SECAS (August 30 2001)


Final report of the LWS Geospace Mission Definition Team (GMDT) and is the primary document describing the recommended science objectives and implementation strategies.

Solar Dynamics Observatory, Report of the Science Definition Team

Geospace Mission Assurance Requirements (MAR)

Draft Concept Study Report Guidelines for Phase A

Concept RBSP Payload Resources

GENERAL GUIDELINE AND REQUIREMENTS DOCUMENTS

Phase A Statement of Work (SOW) Example SDO HMI

Model Contract

Letter of Agreement (LOA) Template

Sample of a study phase international letter of agreement.

NPR 7120.5C – Program and Project Management Processes and Requirements (March 22, 2005)

Provides a reference for typical activities, milestones, and products in the development and execution of NASA missions.

NASA Independent Assessment Team (NIAT) Report


General Environmental Verification Specification (GEVS) for STS and ELV Payloads, Subsystems, and Components, Revision A
PROCUREMENT-RELATED INFORMATION

Federal Acquisition Regulations (FAR)  
(URL: http://www.arnet.gov/far/)

NASA FAR Supplement (NFS)  
(URL: http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm)

(URL: http://www.hq.nasa.gov/fmm/)

NPR 5800.1E -- Grant and Cooperative Agreement Handbook  
(URL: http://ec.msfc.nasa.gov/hq/grcover.htm)

NASA Full Cost Initiative  
(URL: http://www.hq.nasa.gov/fullcost/)

NASA's Full Cost Accounting Implementation Guide (February 1999)

Procurement Notice 97-34: Implementing Foreign Proposals to NASA Research Announcements on a No-Exchange-of-Funds Basis  
(URL: http://www.hq.nasa.gov/office/procurement/regs/pn97-34.html)

Federal Accounting Standards Advisory Board (FASAB)  
(URL: http://www.fasab.gov/)

OTHER

NASA Science Mission Directorate  
(URL: http://science.hq.nasa.gov/)

NASA Lessons Learned Database  
(URL: http://llis.nasa.gov/)

NASA Online Directives Information System (NODIS) Library  
(URL: http://nodis.hq.nasa.gov/)

NASA Technology Inventory Database  
A subset of the NASA Technology Inventory is available for proposer’s reference. Proposers may use it to find out about the technologies that NASA is already developing. Proposers may query the database by technology disciple and/or linkages to NASA needs, or may be searched by keyword. You may apply for a username/password for accessing the subset (labeled "Contractor") by accessing the following URL: http://nti-accounts.gsfc.nasa.gov/request/. Provide your name, e-mail address, and other contact information. Select "Space Science" as the Enterprise. In the Request Description, type "access for RBSP AO". A username and password, and the URL for access to the database will be provided by email.
Technology Readiness Level (TRL) Definitions
(URL: http://www.asc.nasa.gov/aboutus/trl-introduction.html)

NASA Export Control Program
(URL: http://www.hq.nasa.gov/office/oer/nasaecp/)

Office of Defense Trade Controls, U.S. Department of State
Includes links to the International Traffic in Arms Regulations (ITAR)
(URL: http://www.pmdtc.org/)

Bureau of Industry and Security, U.S. Department of Commerce
Includes links to the Export Administration Regulations (EAR)
(URL: http://www.bis.doc.gov/)

NASA Safety and Mission Assurance Requirements document tree
(URL: http://www.hq.nasa.gov/office/codeq/doctree/qdoc.htm)

NPR 8000.4 – Risk Management Procedures and Guidelines
(URL: http://www.hq.nasa.gov/office/codeq/doctree/80004.htm)

NPD 8730.4 – Software Independent Verification and Validation (IV&V) Policy
(URL: http://www.hq.nasa.gov/office/codeq/doctree/87304.htm)

NASA IV&V Facility On-Line Self Assessment Process
A starting point for Pre-Phase A proposal teams to understand the risk and specific software development characteristics of their investigation. For Phase A teams, this is the discussion starting point used by the NASA IV&V Facility to understand the risk and specific software development characteristics of the mission.
(URL: http://ivveriteria.ivv.nasa.gov/)

CCSDS 102.0-B-5, Packet Telemetry
(URL: http://www.ccsds.org/CCSDS/recommandreports.html)

NASA Reference Publication 1124 Outgassing Data for Selecting Spacecraft Materials
(URL: http://outgassing.nasa.gov/)
APPENDIX D

PROPOSAL CHECKLIST

The following proposal checklist will be used by NASA to perform a compliance check on all proposals received in response to this AO.

<table>
<thead>
<tr>
<th>Administrative Compliance</th>
<th></th>
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<tbody>
<tr>
<td>1. Delivered on time</td>
<td>§4.0</td>
</tr>
<tr>
<td>2. Includes printed copy of electronically-submitted Cover Page and Proposal Summary</td>
<td>Appendix B</td>
</tr>
<tr>
<td>3. Includes original authorizing official signature</td>
<td>§6.5</td>
</tr>
<tr>
<td>4. Correct number of copies delivered</td>
<td>§6.7</td>
</tr>
<tr>
<td>5. Proposal meets page limits</td>
<td>Appendix B</td>
</tr>
<tr>
<td>6. Each proposal accompanied by a CD copy</td>
<td>§6.7</td>
</tr>
<tr>
<td>7. Meets general guidelines (one volume original easy to disassemble not smaller than 12 pt font)</td>
<td>Appendix B</td>
</tr>
<tr>
<td>8. Includes only required appendices</td>
<td>Appendix B</td>
</tr>
<tr>
<td>9. Budgets submitted in required formats</td>
<td>Appendix B</td>
</tr>
<tr>
<td>10. Includes letters of endorsement from all organizations contributing critical goods and services, including those for Co-Is, from all major participants, and from any required funding organizations</td>
<td>§5.6.6, Appendix B</td>
</tr>
<tr>
<td>11. Includes letters of endorsement from participating non-U.S. institutions</td>
<td>§5.8.2, §5.9, §4.0, Appendix B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Programmatic Compliance</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>12. Addresses goals and objectives of the solicited mission</td>
<td>§1.1, §1.3, §2.0</td>
</tr>
<tr>
<td>13. Responsive to the data policy</td>
<td>§5.11</td>
</tr>
<tr>
<td>14. Proposes an investigation versus just an instrument or technology</td>
<td>§1.1</td>
</tr>
<tr>
<td>Technical Compliance</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>15. Complete investigation (Phases A-E) proposed</td>
<td>§1.1</td>
</tr>
<tr>
<td>16. Team led by a single PI</td>
<td>§5.6.1</td>
</tr>
<tr>
<td>17. Proposed budget within cost constraints</td>
<td>§1.2</td>
</tr>
<tr>
<td>18. Phase A costs within cost limits</td>
<td>§1.2</td>
</tr>
<tr>
<td>19. Includes Contract Start required information</td>
<td>Appendix B</td>
</tr>
<tr>
<td>20. Includes E/PO and SDB commitments</td>
<td>§5.12, Appendix B</td>
</tr>
</tbody>
</table>
APPENDIX E

ACRONYMS AND ABBREVIATIONS

AO
Announcement of Opportunity
ATLO
Assembly, Test, and Launch Operations
CBE
Current Best Estimate
CDR
Critical Design Review
CD-ROM
Compact Disk- Read Only Memory
Co-I
Co-Investigator
CR
Confirmation Review
EEE
Electrical, Electronic, and Electromechanical
ELV
Expendable Launch Vehicle
EM
Engineering Model
E/PO
Education and Public Outreach
ERD
Environmental Requirements Document
FAR
Federal Acquisition Regulation
FM
Flight Model
FMECA
Failure Modes, Effects, and Criticality Analysis
FTE
Full Time Equivalent
FY
Fiscal Year
GDS
Ground Data System
GFE
Government Furnished Equipment
GSE
Ground Support Equipment
HBCU
Historically Black Colleges and Universities
LOA
Letter of Agreement
LOE
Letter of Endorsement
MEI
Minority Educational Institution
MO
Missions of Opportunity
NASA
National Aeronautics and Space Administration
NFS
NASA FAR Supplement
NOAA
National Oceanic and Atmospheric Administration
NOI
Notice of Intent
NPD
NASA Policy Directive
NPG
NASA Procedures and Guidelines
NPR
NASA Procedures and Requirements
NRC
National Research Council
PDR
Preliminary Design Review
PDF
Portable Document Format
PI
Principal Investigator
PM
Project Manager
RY
Real Year
S/C
Spacecraft
SDB
Small Disadvantage Business
SIC
Standard Industrial Groups
SMD
Science Mission Directorate
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
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<tbody>
<tr>
<td>SOW</td>
<td>Statement of Work</td>
</tr>
<tr>
<td>TBR</td>
<td>To Be Resolved</td>
</tr>
<tr>
<td>TRL</td>
<td>Technology Readiness Level</td>
</tr>
<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
</tr>
<tr>
<td>WBS</td>
<td>Work Breakdown Structure</td>
</tr>
<tr>
<td>WOSB</td>
<td>Woman-Owned Small Business</td>
</tr>
</tbody>
</table>