National Aeronautics and
Space Administration

April 13, 1998

AO-98-OES-01

ANNOUNCEMENT OF OPPORTUNITY

Earth System Science Pathfinder Missions (ESSP)

Notice of Intent due May 5, 1998
Proposals Due May 27, 1998

OMB Approval No. 2700-0087

EARTH SYSTEM SCIENCE PATHFINDER MISSIONS (ESSP)

NASA Announcement of Opportunity
Soliciting Proposals
for
Period Ending
May 27, 1998

AO-98-OES-01
Issued April 13, 1998

Office of Earth Science
National Aeronautics and Space Administration
Washington, DC 20546

Earth System Science Pathfinder AO-2

Table of Contents

		Page
1.0	Description of Opportunity	1
	1.1 Introduction	1
	1.2 Proposal and Evaluation Process	2
	1.2.1 Notice of Intent	2
	1.2.2 Preproposal Conference	4
	1.2.3 Two Step Proposal Process	5
	1.2.4 Notice to Offerors	6
	1.3 Proposal Opportunity Period and Schedule	6
2.0	Program Objectives	7
	2.1 Programmatic Objectives	7
	2.2 Scientific Objectives	7
	2.3 Announcement Objectives	11
3.0	ESSP Program Constraints, Guidelines and Requirements	12
	3.1 General Program Constraints	12
	3.1.1 Available Funding	12
	3.1.2 Mission Readiness	13
	3.1.3 Launch Services	13
	3.2 General Program Guidelines	14
	3.2.1 Mission Teaming	14
	3.2.2 Contributions	14
	3.2.3 Data Dissemination	15
	3.3 International Participation	16
	3.4 Science Requirements	17
	3.5 Technical Requirements	19
	3.6 Opportunity	19
	3.6.1 Educational and Public Outreach	19
	3.6.2 Participation of Small, Small Disadvantaged, and Women-owned Small Businesses, and Minority Institutions	20
	3.6.3 Commercialization	20
	3.7 Cost Requirements	20
	3.8 Management Requirements	22
4.0	Step-One Proposal Submission Guidelines	26
	4.1 General Overview	26
	4.1.1 Proposal Instructions	26
	4.1.2 Proposal Format	27

4.1.3 Technical and Scientific Inquiries 29
4.2 Step-One Proposal Content 29
4.2.1 Science 29
4.2.2 Science Instrumentation 30
4.2.3 Mission Implementation Approach 30
4.2.4 Cost Ranges 31
4.2.5 Management Approach 31
4.2.6 Schedule 31
4.3 International Participation 32
4.4 Submittal of Step-One Proposals 32
4.4.1 Certification 32
4.4.2 Quantity 32
4.4.3 Submittal Address 32
4.4.4 Submittal Deadline 33
4.4.5 Notification 33
4.4.6 Submittal of Proposals Involving International Participation 33

5.0 Step-Two Proposal Submission Guidelines 34
5.1 General Overview 34
5.1.1 Proposal Instructions 34
5.1.2 Proposal Format 35
5.1.3 Technical and Scientific Inquiries 39
5.2 Step-Two Proposal Content 39
5.2.1 Science 39
5.2.2 Technical 41
5.2.3 Management 45
5.2.4 Opportunity 51
5.2.5 Cost 51
5.3 International Participation 56
5.4 Submittal of Step-Two Proposals 56
5.4.1 Certification 56
5.4.2 Quantity 56
5.4.3 Submittal Address 57
5.4.4 Submittal Deadline 57
5.4.5 Notification 57
5.4.6 Submittal of Proposals Involving International Participation 57

6.0 Proposal Evaluation, Selection and Implementation 58
6.1 Evaluation Criteria 58
6.1.1 Step-One Proposal Evaluation 58
6.1.2 Step-Two Proposal Evaluation 59

6.1.2.1 Step-Two Evaluation Criteria 60
6.1.2.1.1 Science Evaluation Criteria 60
6.1.2.1.2 Technical Evaluation Criteria 60
6.1.2.1.3 Opportunity Evaluation Criteria 61
6.1.2.1.4 Cost Evaluation Criteria 61
6.1.2.1.5 Management Evaluation Criteria 62
6.2 Evaluation and Selection Process 62
6.3 Contract Administration and Funding 64

7.0 Conclusion 65

APPENDIX

Appendix A General Instructions and Provisions

Appendix B ESSP Launch Services Information

Appendix C EOSDIS Interfaces and standards
Appendix D Sample Mission Definition and Requirements Agreement

Appendix E Regulations Governing Procurement of Foreign Goods or Services

Appendix F Elements to be Included in Arrangements Between U.S. Principal Investigators and Cooperating Foreign Parties Under the ESSP Program

Appendix G Contents of the ESSP Program Library

Appendix H ESSP AO Acronyms

Appendix I Glossary of Terms

Appendix J Certification Regarding Debarment, Suspension and Other Responsibility Matters Primary Covered Transactions

Appendix K Certification Regarding Lobbying

Appendix L Services and Resources

Appendix M Charts and Templates

Appendix N ESSP Project Mission Assurance Guidelines and Requirements

Appendix O ESSP Project Safety Requirements

1.0 DESCRIPTION OF OPPORTUNITY

1.1 Introduction

The National Aeronautics and Space Administration (NASA) announces the opportunity to conduct Earth System Science investigations as part of the Earth System Science Pathfinder (ESSP) Program. The ESSP Program is intended to accomplish high quality, focused Earth System Science measurements utilizing innovative, streamlined management and implementation approaches designed to yield high value science. Competitively selected mission teams will have full responsibility and authority to accomplish their missions.

The ESSP Program will carry out Earth System Science investigations by means of spaceborne observations with low total cost per mission. Proposals to the ESSP Program will require a careful trade-off between science and cost, in order to produce missions with the highest possible science value to NASA, which will be a determining factor in selection. Total cost includes mission management; spacecraft and instrument definition and development; mission systems integration and test; launch services; on-orbit operations; in-situ measurements necessary to enable optimum science return, which may include non-satellite or ground measurements; mission science team support; algorithm development and data processing; calibration/validation; data product archiving and distribution; and publication of results in refereed science journals. All civil service or civil service support contractor resources must be proposed on a full cost basis.

NASA is interested in promoting a diversity of Earth System Science missions by means of frequent spaceborne missions within the ESSP Program, thereby providing maximum opportunities for the Earth Science community. In order to allow frequent missions within the ESSP budget profile, NASA will be seeking a balance between higher and lower cost investigations with the highest possible science value. Consistent with this strategy ESSP missions are encouraged to include resource sharing to reduce NASA mission costs. Opportunities for commercialization and private investment may reduce the cost to NASA in accomplishing mission science objectives by providing commercial opportunities for industry to address target markets. Non-commercial domestic agencies and institutions may also propose to contribute, from their own resources, all or a portion of the scientific instruments, spacecraft, launch services, mission science

support, mission operations, communications, data systems, or a combination of these. NASA also encourages PIs to include international partners on their mission teams. Non-U.S. participation will be conducted on a no-exchange-of-funds basis, as described in Section 3.3. In addition, non-U.S. PI's must make arrangements with a U.S. co-PI to fund U.S. participants on the mission team.
In order to meet the ESSP Program launch rate and cost goals, there are constraints limiting mission definition and development times. Missions are expected to be ready for launch after completing a definition and development period of no more than 3 years. The length of mission operations is dependent upon scientific objectives (i.e., required observation period) and cost.

NASA intends to solicit ESSP investigations every two years. This announcement will result in the selection of at least two missions, one to be launched in 2002 and the other in 2003. NASA reserves the right to select and approve additional missions through this AO, based on funding availability and science value. Any additional missions will be phased appropriately within programmatic and funding guidelines. ESSP proposals must be for complete missions from project initiation (Phase B) through delivery of calibrated/validated data to the science community (Phase E) and which are otherwise consistent with the criteria described herein. Innovative teaming arrangements which result in NASA Mission Costs (NMC) below the stated mission caps are encouraged.

The NASA Headquarters Office of Earth Science (OES) will be responsible for selecting ESSP missions, while the NASA Goddard Space Flight Center (GSFC), Greenbelt, MD, will manage programmatic activities associated with all implementation phases of ESSP missions.

1.2 Proposal and Evaluation Process

NASA is aware of the significant burdens placed upon the proposing community in responding with detailed proposals to open Announcements of Opportunity. In order to reduce the overall effort expended by the community in preparing full proposals, NASA plans to conduct a two-step proposal and evaluation process for this AO.

1.2.1 Notice of Intent

To assist NASA's planning of the proposal evaluation process, a written and signed Notice of Intent should be submitted by all prospective Step-One proposers on or before May 5, 1998 in one of the following three ways:

by mail to:

ESSP Announcement of Opportunity
Code Y
400 Virginia Avenue, S.W.
Suite 700
Washington, DC 20024

by E-mail to:

“dcardasc@hq.nasa.gov”, with subject designated as “ESSP NOI - (PI Name)”

or by Fax to:

ESSP Executive Secretary
Attention: Ms. Dawn Cardascia
(202) 554-2970

Principal Investigators whose investigation teams include non-U.S. institutions should send their Notice of Intent to the same address, but should also send a copy (hardcopy only) to the NASA Office of External Relations at the address specified in Section 4.4.6. In cases where investigators or team members from non-U.S. institutions are to participate, their names, addresses and affiliations must be included in the Notice of Intent, even if the details of their participation cannot be formalized by the deadline for receipt of the Notice of Intent.

The Notice of Intent must be typewritten in English, no longer than 2 pages and include the following information:

(a) Title of the proposed mission
(b) A brief description of the proposed mission goals and objectives
(c) A list of names, addresses, telephone numbers, fax numbers and electronic mail addresses of the following:

(1) Principal Investigator
(2) Co-Investigators
(3) Lead representatives from each organization included in the mission team

All Notices of Intent must be received on or before 4:00 p.m. Eastern Time on May 5, 1998. NASA will not notify proposers that their Notice of Intent has been received.

SPECIAL NOTICE: As a result of recent AO's for complete mission investigations such as this one, commercial aerospace and technology organizations have requested access to the names and addresses of those who submit NOI's in order to facilitate informing potential proposers of their services and/or products. As an experiment and at the option of the submitters of a NOI, NASA OES is willing to offer this service with the understanding that the Agency takes no responsibility for the use of such information. Therefore, all those submitting an NOI in response to this AO are requested to include the appropriately edited form of the following material:

> "By submitting this Notice of Intent to propose, I hereby do / do not authorize NASA to post my name and institutional address (but not the name of my intended proposal) on the World Wide Web starting approximately one week after the NOI due date. If I do authorize such a posting, I understand that such information will be in the public domain, and I will not hold NASA responsible for any use made by others for revealing this information."

1.2.2 Preproposal Conference

A preproposal conference will be held on April 28, 1998. The purpose of this conference will be to address questions about the ESSP Proposal process. The preproposal conference will address all those questions received by the ESSP Program Coordinator via fax, mail, or electronic mail at the address given in Section 4.1.3 on or before April 24, 1998. Additional questions submitted after this date, including those provided in writing at the preproposal conference, may be addressed at the conference as time permits. An "ESSP AO Preproposal Conference Transcript" will be prepared and mailed approximately two (2) weeks after the conference to the following individuals: (1) those attending the preproposal conference and (2) anyone submitting a request for this document to the ESSP Program Coordinator by fax or electronic mail. The conference will be held at the Crystal City Sheraton in Crystal City, Virginia from 8:30 am to 5:00 p.m. Additional information concerning the conference is available on the Internet at: http://www.hq.nasa.gov/office/ese/nra.html. Those without Internet access may request this information from the address shown below.

Individuals planning to attend the preproposal conference are requested to provide notice to the following address:

Code Y
400 Virginia Avenue S.W.
Suite 700
Washington, DC 20024
Phone: 202-554-2775
Fax Number: 202-554-2970
e-mail: (Internet) dcardasc@hq.nasa.gov

Please provide the number of persons attending and the names, addresses and organizational affiliations of the attendees. This information must be received by no later than April 20, 1998 to facilitate logistical planning of the conference.

1.2.3 Two Step Proposal Process

The ESSP proposal process is divided into two distinct steps. Proposers responding to this AO must first submit a 15 page Step-One Proposal with emphasis on the planned science investigation, measurement approach, instrumentation and technical maturity. The Step-One Proposal will be reviewed in accordance with the evaluation criteria in Section 6.1.1. Evaluation of the Step-One Proposal is intended to assess the in-depth scientific merits, justification and the maturity of the proposed mission in relation to the science priorities, goals and objectives of the ESSP Program and the Earth Science Enterprise. Ratings will be assigned to each Step-One Proposal and provided to the proposer. Based on the Step-One rating, NASA will recommend whether or not a full Step-Two Proposal should be submitted. Each proposer will be provided with an assessment of the scientific and technical merit of the proposed investigation and instrumentation, along with a high level risk assessment of the mission implementation approach, prior to submittal of a full Step-Two proposal. No debriefing will be provided until after final selection. NASA intends to recommend that only a limited number of highly rated investigations proceed to Step-Two. Missions not recommended to proceed to Step-Two are not prohibited from preparing Step-Two proposals, but should be aware that their proposed science investigation is unlikely to be selected.

Those proposers who choose to continue with the AO process will then be required to submit additional information in the form of a Step-Two Proposal. This proposal shall contain detailed science, technical, cost and management information. The Step-Two Proposal will be evaluated in accordance with the evaluation criteria in Section 6.1.2. NASA will make mission selections on the basis of the combined Step-One and Step-Two evaluations as described in Section 6.

Detailed information regarding the preparation and evaluation of the Step-One and Step-Two Proposals is provided in Sections 4 and 5 respectively.

1.2.4 Notice to Offerors

In the event that a Principal Investigator employed by NASA is selected under this Announcement of Opportunity (AO), NASA will award prime contracts to non-Government participants, including co-investigators, hardware fabricators, and service providers, who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. Refer to Section 5.1.2 Certifications of this AO for proposal information which the selecting official will review in determining whether to incorporate a non-Government participant in the selection decision. Each NASA contract with hardware fabrications and service providers selected in this manner will be supported by an appropriate justification for other than full and open competition, as necessary.

1.3 Proposal Opportunity Period and Schedule

All investigations proposed in response to this ESSP Mission AO must be sufficiently mature to proceed immediately to the Definition Study Phase (Phase B). The required schedule for investigations selected via this AO will be three years or less from the beginning of full Phase B funding to launch readiness. Proposers are encouraged to propose missions with shorter definition and development schedules. For the second mission selected under this AO, it is anticipated that full Definition Study Phase funding will be delayed by a year, during which a low level of funding will be available. Additional missions, if selected, would be phased appropriately with respect to the available funding profile. Investigators are not precluded from proposing investigations that begin with the Design and Development Phase (Phase C/D) and are compatible with the available funding profile.

The opportunity described here is for a two step proposal selection cycle, according to the nominal schedule shown below:

Date of AO release .....April 13, 1998
Preproposal Conference .....April 28, 1998
Notices of Intent due .....May 5, 1998
Step-One Proposals due .....May 27, 1998
Announcement of Step-One ratings .....July 13, 1998
Step-Two Proposals due .....September 21, 1998
Announcement of selections .....December 1998
Award of definition study contracts .....February 1999

2.0 PROGRAM OBJECTIVES

2.1 Programmatic Objectives

The overarching goal of the NASA Earth Science Enterprise is to advance scientific understanding of the entire Earth system by developing deeper comprehension of the components of the system and of the interactions among them. The Earth Observing System (EOS) is the primary vehicle for achieving these goals. The NASA initiated ESSP Program is intended to provide a flexible opportunity to stimulate new scientific observations of the global Earth system by encouraging innovation in instrumentation and strategies for acquiring and distributing new datasets. The program seeks to reward creativity in all aspects of mission development and to encourage increased participation and innovative ideas in studies of interactions of components of the Earth system and in measurements of additional key variables from space. The philosophy behind ESSP embraces cost-constrained Earth System Science where the scientific focus of the program will naturally evolve as the science strategy for Earth observations responds to the needs of the community. Thus, the strategy for the second ESSP AO is to solicit unique Earth Science missions that address one or more of the gaps in the existing/approved NASA flight program for Earth observations, due to new knowledge or changing priorities.

ESSP is a science-driven program intended to identify and develop low-cost, quick turnaround spaceborne missions. The National Academy of Sciences recommended that ESSP pursue scientific objectives that are not being directly addressed by current or approved programs. It is the goal of the ESSP Program to sustain a launch rate of at least one per year. As such, ESSP will provide periodic windows of opportunity to accommodate new scientific priorities and infuse new scientific participation into the Earth Science Enterprise. ESSP will conduct a series of focused, limited-duration missions to answer critical questions in Earth System Science not currently addressed within the Earth Science Enterprise. By conducting ESSP missions on a regular basis, NASA provides a mechanism to continuously enhance Earth Science Programs that are evolving on the basis of new knowledge and changing priorities.

2.2 Scientific Objectives

The ESSP Program resides within the NASA Office of Earth Science (OES), and as such is intended to be responsive to the emerging scientific drivers in the context of NASA's contribution to Earth System Science and the U.S. Global Change Research Program (USGCRP). As such, it is focused on fulfilling near-term requirements for global Earth measurement sets that address the five scientific themes articulated in the Science Research Plan for NASA's Earth Science Enterprise.

NASA's existing and approved flight program within the Office of Earth Science has recently evolved to embody a balanced approach for observing the global Earth System, and includes the EOS-AM1 platform, the Tropical Rainfall Mapping Mission (TRMM), the Landsat 7 system, as well as those small missions selected by means of the first ESSP Announcement of Opportunity, namely the Vegetation Canopy Lidar (VCL) and the Gravity Recovery And Climate Experiment (GRACE) missions. In addition, the New Millennium Program (NMP) is contributing to the growing body of Earth-related measurement sets with the EO-1 mission, and the flight of EO-2 on the Space Shuttle to validate orbital wind lidar instrumentation. Finally, the OES is making use of new strategies to acquire further global observational datasets via data purchase arrangements with SeaWIFS for ocean color monitoring, and by operating the Space Shuttle based Shuttle Radar Topography Mission (SRTM) for global land topography. Other elements of the OES flight program, including components of EOS beyond the AM1 platform, are summarized in the NASA Mission to Planet Earth Science Research Plan (1996) (see Appendix G).

The ESSP Program is designed to both complement and extend the existing OES flight program strategy. The NASA Headquarters Office of Earth Science has developed a science plan which outlines a strategic approach for addressing high priority and critical Earth System Science areas for which new space-based observations may be required over the next several years. Science priorities that have been identified include:

- <u>Land Cover Change and Global Productivity</u>
  - Document and understand the trends and pattern of changes in landcover, biodiversity, and global primary production
- <u>Seasonal-to-Interannual Climate Prediction</u>
  - Provide global observations and scientific understanding to improve forecasts of the timing and regional extent of transient climate anomalies
- <u>Long-term Climate Variability</u>
  - Provide global observations and scientific understanding of the mechanisms and factors which determine long-term climate variations and trends

- Atmospheric Chemistry and Ozone

  - Detection, causes and consequences of changes in stratospheric and tropospheric ozone and other chemically active atmospheric constituents

〈 Natural Hazards

  - Apply unique Earth Science Enterprise remote sensing science and technologies to disaster characterization and risk reduction from earthquakes, fires, floods, and droughts

These scientific themes encompass the traditional disciplines of atmospheric chemistry and physics, solid Earth, oceans and ice, ecosystems, and natural hazards, and are intended to impart a problem focus on the satellite observational activities conducted under the aegis of the Earth Science Enterprise.

The initial ESSP Announcement of Opportunity emphasized scientific investigations within all areas of Earth System Science, provided that complementarity with NASA's existing and/or approved flight program, largely embodied by the Earth Observing System (EOS), could be clearly demonstrated. Further, it was intended to encourage missions which could serve as either gap-fillers or which could provide new types of global "foundation" datasets. The five major themes in NASA's scientific strategy for Earth System Science were well represented in the competition that ensued after the release of the AO in July 1996. The VCL mission contributes naturally to the Land Cover Change and Global Productivity theme, while the GRACE mission, with its emphasis on global ocean circulation, best contributes to Seasonal to Interannual Climate Variability and Prediction as a sub-discipline.

Given the uncertainties that lie ahead in the implementation of the longer-term aspects of the Earth Observing System Program (i.e., beyond AM, PM, Jason, and ICESat), as well as the selections of VCL and GRACE, a sense of observational priorities is emerging. Thus, this second ESSP Announcement of Opportunity, while not precluding innovative proposals for missions that address critical issues in land cover, ocean dynamics, and other areas for which there are approved flight programs, seeks unique missions that demonstrate a scientific focus that is clearly beyond the scope of existing programs. It remains, however, up to the proposers to articulate the overall scientific benefit of any missions which seek to improve upon planned measurement sets.

NASA advisory committees have suggested that there may be gaps in the planned global measurement sets to be acquired over the next several years by NASA's approved satellite missions. New ESSP missions that seek to fill in these gaps are ideal, and it is left up to the Earth Science community to identify these niches and develop their proposals accordingly. ESSP missions are intended to be science-driven, and proposers are required to quantify how the proposed new observations will contribute to the state of knowledge in one or more chosen disciplines by means of a sensitivity analysis and traceability matrix.

The NASA Earth Science Enterprise integrates a broad suite of observational and monitoring objectives in the context of the USGCRP. Specific program elements are summarized in several key science documents (see Appendix G).

The following Internet World-Wide-Web Homepages (URL addresses) may provide additional information of interest:

NASA Earth Science Enterprise Homepage: http://www.hq.nasa.gov/office/mtpe

EOS Project Office Homepage: http://spso.gsfc.nasa.gov/spso_homepage.html

ESSP Project Homepage:
http://essp.gsfc.nasa.gov

In summary, the ESSP Program is designed to augment the global measurement objectives of the USGCRP as well as other strategic Earth Science objectives outlined by the National Academy of Sciences. As such, the ESSP Program seeks to:

- Provide space based measurements complementary to those directly supported by the EOS baseline (i.e., EOS observational data sets)

- Avoid duplicating observational objectives currently supported by means of existing NASA Earth Science Programs (i.e., VCL, GRACE, etc.)

- Avoid duplicating observational objectives supported by existing or approved international global Earth System Science Programs (i.e., ADEOS II, ENVISAT, METOP, etc.)

2.3 Announcement Objectives

This AO invites proposals for the next set of ESSP missions. Proposals are invited for complete investigations of significant Earth System Science questions which meet the objectives of the ESSP Program defined above. Only proposals to execute complete flight missions through delivery of data to the scientific community will be accepted. Proposals describing only portions of a mission or which do not address all phases from definition through operations and delivery of data will be deemed not responsive to the AO and will be returned to proposers prior to evaluation.

As a minimum, two primary missions will be selected and funded for definition. After successful completion of a Mission Confirmation Review (MCR) to be conducted by NASA during the Definition Study Phase, these missions will proceed into development for eventual flight. In addition, a mission will be selected as an alternate through this AO, but will not undergo definition unless one of the primary missions fails to reach development. In this event, the alternate would proceed through definition and, if successful, replace the terminated primary mission in the ESSP mission queue for development and eventual flight. Only those investigations approved for development will continue within ESSP after the end of the Definition Study Phase. Missions which are not approved will not receive additional funding and will not be considered for development or flight through this AO, but can be re-proposed to future opportunities.

3.0 ESSP PROGRAM CONSTRAINTS, GUIDELINES AND REQUIREMENTS

In the ESSP Program, the responsibility and authority to implement the mission rests with the mission team. The team will have a large degree of freedom in accomplishing mission objectives within the stated constraints and with limited NASA oversight. Once a mission has been selected, failure to maintain satisfactory progress on an agreed to schedule or failure to operate within the constraints outlined below will be cause for termination of the investigation by NASA.

Every aspect of an ESSP mission must reflect a commitment to mission success, while keeping total mission costs as low as possible. Each component of a proposed ESSP mission, from the mission design to the selection of the launch service, to the approach to mission operations, will be evaluated on that basis. Consequently, missions should be designed and scoped to emphasize mission success within cost and schedule constraints by incorporating sufficient margins, reserves, and content resiliency.

Only those missions whose scientific objectives are deemed of highest priority and whose proposed cost and definition/development schedules are within the constraints and guidelines identified herein will be considered as candidates for selection. Low cost missions which can demonstrate high science value are encouraged, in order to enable more frequent and diverse ESSP missions.

The following sections describe the constraints, guidelines and requirements of the ESSP Program and its missions. Specific directions and requirements for proposal preparation are included in Sections 4 and 5.

3.1 General Program Constraints

3.1.1 Available Funding

The ESSP Program represents an effort by NASA to develop and implement a program of small, frequent, high value Earth System Science missions. To this end, NASA will limit the NASA funding, or NASA Mission Cost (NMC), of ESSP missions selected under this AO. Contributions from sources other than NASA, while not required, are encouraged. The total available NASA funding (in real year $M) for the primary missions selected under this AO is anticipated to be:

FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	TOTAL
13.0	44.5	76.0	48.0	19.1	7.5	1.9	210.0

NASA funding of the primary missions selected under this AO is limited to $90 million for the first mission and $120 million for the second mission. NASA reserves the right to select more than two missions through this AO, provided they are of high science value and fit within the above AO funding/NMC profile. As a result, mission proposals below these caps are strongly encouraged.

3.1.2 Mission Readiness

The ESSP Program provides a mechanism to accomplish important scientific investigations within a short time frame. Therefore, all proposed ESSP missions, whether proposing for the first or second launch opportunity, must be of sufficient technical maturity to achieve launch readiness within 36 months of contract award. Although scientific and cost-based justification of the proposed mission duration must be provided, no absolute time constraint is placed upon the duration of mission operations.

3.1.3 Launch Services

NASA seeks to take advantage of all reasonable sources of commercial expendable launch vehicle (ELV) services, while assuring that NASA-funded payloads are not exposed to excessive risk. Accordingly, the launch vehicles that may be considered for ESSP missions pursuant to this AO must be acquired and managed consistent with NASA Policy Directive (NPD) 8610, “Launch Services Risk Mitigation Policy for NASA, NASA-Sponsored Payloads”. The demonstrated reliability of the proposed launch vehicle, the programmatic and technical risk associated with the proposed launch service, and the resultant probability of mission success will be evaluated in the Step-Two process. The following types of services may be proposed:

- Delta II (7900 Series) and Atlas/Atlas-Centaur launch vehicles have demonstrated reliability through numerous launches. Therefore, launch services involving these vehicles may be obtained directly by the mission team.

- For dedicated (i.e., single payload) launch services involving other domestic launch vehicles, there are two options:

    - If any NASA funding is requested for launch services, these services must be acquired and technically managed by NASA under the MLELV or SELV II programs as defined in Appendix B.

    - If the launch services are fully contributed by the mission team (i.e., no NASA funding), they may be obtained directly.

- For co-manifested (i.e., shared launch) or payload of opportunity (i.e., ESSP instrument on a commercial spacecraft) launch services involving any domestic launch vehicle, the proposer may acquire these launch services directly. Under this circumstance, the proposal must identify the payload(s) sharing the launch service, define the commitment made by the sharing payload(s) to support the proposed ESSP mission, and address the risk of the proposed launch services arrangement.

- Any launch service using a non-U.S. manufactured vehicle must be proposed on a no-exchange-of-funds basis.

3.2 General Program Guidelines

3.2.1 Mission Teaming

ESSP mission teams must be led by a single Principal Investigator who may be from any U.S. or non-U.S. organization including educational institutions, industry, nonprofit institutions, NASA Centers, Federally Funded Research and Development Centers (FFRDC's) and Government agencies. Teaming and partnering arrangements among these organizations are encouraged. Teams are encouraged to utilize U.S. commercial suppliers, commercial off-the-shelf technology, and other arrangements to support U.S. industry to the greatest extent practical. NASA field centers and the Jet Propulsion Laboratory (JPL) are welcome as ESSP mission team members.

NASA institutional services may be proposed on a full cost basis through teaming arrangements between the mission team and NASA centers. In such cases, it is the team’s responsibility to contact the appropriate NASA organization directly.

3.2.2 Contributions

Contributions to ESSP missions of any kind, whether cash or non-cash (property and services), are encouraged. Contributions are defined as any portion of a mission provided on a no-exchange-of-NASA-funds basis. Such contributions may be applied to any part, or parts, of a mission, and may be from U.S. companies, U.S. Government agencies, and/or international participants (see Section 3.3). NASA Center civil service or support contractor resources (manpower, facilities or hardware) may not be contributed, unless they are being separately funded for an effort complementary to the proposed investigation.

Values for all contributions of property and services shall be established in accordance with applicable cost principles and included in the proposed Total Mission Life Cycle Cost (TMLCC), which is the sum of the NMC and all contributions. The cost of contributed hardware should 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 cost associated with the reproduction and modification of the item (i.e., any recurring and mission-unique costs) 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 should be consistent with rates paid for similar work in the offeror's organization. The value of materials and supplies shall be reasonable and not exceed the fair market value of the property at the time of contribution.

Proposed contributions must be described in sufficient detail to allow an assessment of the adequacy of the contribution to fulfill the commitment made. This includes the provision of all requested cost, schedule, and management data in the proposal and subsequent reviews. Failure to document all cost and schedule data, management approaches and techniques, and the commitment of all contributing team partners may cause a proposal to be found non-responsive to this AO. If NASA selects a mission with domestic contribution arrangements, the appropriate agreements and/or contracts must be signed and copies delivered to NASA within 90 days of award of NASA mission contract.

3.2.3 Data Dissemination

U.S. Government information must be disseminated without restriction at no more than the cost of dissemination. Therefore, data from ESSP missions funded by the U.S. Government will be distributed in the same way as other NASA Earth Science Enterprise data (see Section 3.4). However, for data from missions in which there is significant U.S. private sector investment, NASA will consider innovative data management approaches that afford protection of commercial opportunities while still maximizing non-proprietary scientific return. In all cases, the mission science team approved by NASA must have immediate and complete access to the basic data and products defined and produced by the mission. NASA will consider proposals for non-traditional data distribution arrangements as long as the full data set is ultimately available for long-term archival and open distribution. As with any NASA program, higher level products (i.e., beyond level-2) developed from Government-provided data by users outside of NASA-funded investigations are not subject to Government data policies or controls.

3.3 International Participation

Recognizing the potential scientific, technical, and financial benefits offered to all partners by international participation, participation by non-U.S. individuals and organizations as PI's or team members in ESSP Program investigations is welcomed. Participation by international partners in ESSP missions may include the contribution of all, or a portion of, the scientific instruments, spacecraft, launch services, mission operations, mission science (i.e., science team), communications, data processing, etc., on a no-exchange-of-funds basis. Any proposed international participation must be described at the same level of detail as that of other partners. This includes the provision of all requested cost, schedule, and management data in the proposal and subsequent reviews. Since participation of a non-U.S. PI in ESSP will be on a no-exchange-of-funds basis, any non-U.S. PI must make arrangements with a U.S. co-PI to fund U.S. participants under the proposal.

Although NASA-provided dollars may not be used to fund non-U.S. PI's or mission team members, the direct purchase of goods and/or services from non-U.S. sources by U.S. team members is permitted, but with the following restriction: NASA funds may not be used to purchase a launch service from a non-U.S. source. Potential ESSP participants are advised that international purchases made using funds derived from NASA must meet NASA and Federal regulations and that these regulations will place an additional burden on investigation teams that should be explicitly included in discussions of the investigation's cost, schedule, and risk management. Information regarding regulations governing the procurement of foreign goods or services is provided in Appendix E.

Participation by non-U.S. individuals and/or institutions as team members or contributors to ESSP investigations must be endorsed by the institutions and, where non-U.S. government funding is provided, the governments involved. If NASA selects a mission with non-U.S. participation, signed agreements with all non-U.S. partners and, in the case of a non-U.S. PI, with the U.S. co-PI, must be submitted. Sponsoring organizations of non-U.S. participation should commit directly to the PI, not NASA, via these signed agreements. Model language for the preparation of these agreements is included in Appendix F. NASA recognizes that unique circumstances or arrangements may dictate an agreement between the non-U.S. sponsoring organization and NASA. For the purposes of this AO, it is NASA's preference that such agreements be implemented under U.S. law. Therefore, all proposers with potential non-U.S. participation should contact the Office of External Relations at NASA Headquarters at the address in Appendix L during the preparation of the Step-One Proposal to obtain information about U.S. Government law or policies (e.g., export control) relevant to the non-U.S. component of their ESSP mission.

Under any circumstance, all agreements with non-U.S. partners or U.S. co-PI's must be finalized and signed no later than the Mission Confirmation Review or one year after contract award, whichever comes first. Failure to provide such agreements in the time allotted may result in the deselection of the investigation.

3.4 Science Requirements

Proposals submitted in response to this AO must cover the entire mission, including definition, development, launch, mission operations, necessary in-situ measurements, data processing, migration of data into the public domain, and preparation of adequate documentation and ancillary data for analysis by scientists other than those participating in the prime mission phase. All ESSP missions must comply with the OES Data and Information Policy guidelines as outlined in the "MTPE/EOS Reference Handbook" (Asrar and Greenstone, 1995), in order to ensure timely community-wide access to reduced data products. As such, there will be no proprietary data rights allowed, except as discussed in Section 3.2.3. ESSP mission teams will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the scientific data prior to making it available to the scientific community and, ultimately, the general public. The ESSP mission evaluation process will reward those proposals which outline procedures for minimizing the time between data acquisition and data availability.

ESSP missions are required to make data and supporting metadata available to the broader science community. ESSP PI's shall provide links to the Earth Observing System Data and Information System (EOSDIS) Advertising Service to publish information on available data and data access services. To facilitate use of the data by the Earth Science community and to minimize the cost of migrating data to long term archives, it is recommended that PI's produce data in the HDF-EOS (hierarchical data format) standard data format and adhere to the intermediate level of the EOSDIS Core System (ECS) Metadata standard. If PI's propose to use other standards, technical and cost rationale for the alternative formats should be provided, and the cost to convert all data and metadata produced to these EOSDIS standards must be included in the proposal. EOSDIS Core System software to support these standard formats and software for science data archiving, production, distribution, and access will be available for reuse. Proposers can propose to use EOSDIS software and interfaces, which will be provided at no cost, to meet these interfaces. Proposers, however, must include the cost of required software licenses and hardware in their proposal. Further information on EOSDIS standards, interfaces, and software is found in Appendix C.

In addition to the funding profile in Section 3.1.1, NASA intends to allocate resources to fund a post-launch Science Data Analysis Program (SDAP) for broad scientific studies of the Earth using newly generated ESSP datasets. Proposals for investigations under the SDAP will be solicited periodically after launch of ESSP missions via NASA Research Announcements (NRA's).

ESSP mission science teams must succinctly define the scientific objective of the proposed mission and the scope of their efforts for the active data collection phase of their mission. It is anticipated that the PI and the science team will focus their efforts on data acquisition, calibration, validation, and initial scientific evaluation in support of their proposed research objective(s). The follow-on SDAP, which will be open to all parties interested in ESSP mission datasets, will focus upon additional interpretation and correlative analysis activities. While the science team is encouraged to analyze and publish interpretations of mission flight data as it becomes available during the course of the active mission, it should be understood that community-wide analysis of the reduced (i.e., validated and calibrated) datasets provided by each ESSP mission will be largely supported by the follow-on SDAP. Therefore, mission science team members should have clearly defined roles during the pre-flight development and flight mission data acquisition, calibration, validation, and initial scientific evaluation activities.

It should be noted that ESSP missions may require supporting aircraft remote sensing underflights and ground calibration activities. These are recognized as critical elements of overall ESSP missions and must be fully described and costed as necessary in proposals submitted in response to this AO.

Every ESSP mission proposed in response to this AO must identify both a "Baseline Science Mission" and a "Minimum Science Mission". The Baseline Science Mission refers to that mission which, if fully implemented, will accomplish the entire set of scientific measurement objectives identified for the mission at the initiation of the Definition Study Phase. The Minimum Science Mission is defined as the minimum science accomplishment (i.e. measurement set) below which the mission will not be considered justifiable for the proposed cost.

Any alteration of the mission which results in a reduction of the mission's ability to accomplish the Baseline Science Mission set of scientific objectives as identified at the beginning of definition will be considered a "descoping" of the mission. The resulting set of achievable scientific objectives will be reviewed by NASA and the PI to ensure that the mission remains at or above the Minimum Science Mission. The peer review and technical evaluation of Step-Two proposals will determine the science return of both the Baseline and Minimum Science Missions. The differences between the proposed Baseline and

Minimum Science Missions will be assessed in the Step-Two process to determine mission resiliency in the event that development problems require reductions in scope. If the proposed Baseline and Minimum Science Missions are equivalent, proposers must clearly articulate the rationale for this decision and identify other viable contingency options in the Step-Two proposal (i.e. additional reserves, etc.).

The Minimum Science Mission, even if identical to the Baseline Science Mission, must be identified and documented for each proposed ESSP mission along with specific plans for the prioritized descoping of mission capability from the Baseline Science Mission to the Minimum Science Mission in the event of cost or schedule growth. Failure to maintain a level of anticipated science return at or above the Minimum Science Mission, as determined by NASA, will be cause for termination of the investigation at any time.

3.5 Technical Requirements

ESSP proposals must include all technical aspects of the investigation from definition (Phase B) through delivery of calibrated/validated data to the science community (Phase E). Although not prescriptive, NASA Handbook (NHB) 7120.5 ("Management of Major System Programs and Projects") delineates activities, milestones, and products typically associated with each of these phases and may be used as a reference in defining a team's mission approach. The use of innovative processes, techniques, and activities as well as direct purchase of commercial off-the-shelf (COTS) technology to accomplish objectives is encouraged when cost, schedule, and technical improvements can be demonstrated.

NASA is committed to successfully infusing new technologies into its programs that will lower mission costs. However, the short definition and development time available for ESSP missions generally will not allow for significant technology development after mission selection. NASA expects that the technology-driven New Millennium Program (NMP) will serve as the primary technology "engine" for future Earth Science Enterprise missions. Any new technology, technology development or technology enhancement required for successful performance of an ESSP mission must be identified in the proposal, along with the risks involved and alternative approaches.

3.6 Opportunity

3.6.1 Educational and Public Outreach

It is NASA's desire that ESSP investigations enhance the level of understanding and awareness of Earth Science by the public. Public information programs that

will inform the public by mass media or other means, or other innovative ideas for bringing Earth Science to the public, are encouraged. Educational activities coordinated with primary and secondary educational institutions are also encouraged.

3.6.2 Participation of Small, Small Disadvantaged, and Women-owned Small Businesses, and Minority Institutions

The PI and team members shall agree to use their best efforts to assist NASA in achieving its goal for the participation of small disadvantaged businesses, women-owned small businesses, Historically Black Colleges and Universities, and other minority educational institutions in NASA procurements. Investment in these organizations reflects NASA's commitment to increase the participation of minority concerns in the aerospace community, and is to be viewed as an investment in our future. Offerors, other than small business concerns, are also advised that contracts resulting from this AO will be required to contain a subcontracting plan which includes goals for subcontracting with small, small disadvantaged, and women-owned small business concerns. (See Appendix A, Section XIII.)

3.6.3 Commercialization

NASA is committed to enabling the economic and technical competitiveness of the United States through innovative partnerships between public sector programs within its purview and the private sector. This solicitation encourages U.S. commercial sector participation in all areas of proposed ESSP missions including flight and ground segment development, new product or service development based on data derived from the mission, and the production of final scientific reports and public or educational outreach materials. Best available commercial processes, business practices, and technologies are encouraged to optimize the effectiveness of the project and return best value science to the primary investors, the U.S. taxpayers. Examples of commercial benefits to partnering companies include new products, refinement of current products and services, and new directions for research and development of commercial offerings.

Although the evaluation process will reward those proposals which include U.S. private sector commercialization as part of the overall mission, proposals which do not include commercial participation will not be penalized.

3.7 Cost Requirements

NASA funding of the missions proposed under this AO is limited by the funding profile in Section 3.1.1. Once established for a selected mission, the NMC

baseline must assure adequate funding to meet cost-to-complete requirements. Where appropriate, this includes identification of credible, phased reserves, which are proportional to the development risk. The proposed NMC baseline will be considered to be fixed and committed at selection. The ESSP Program does not maintain a reserve pool from which missions exceeding their cost commitments may draw.

The TMLCC for each ESSP mission, which includes NASA and non-NASA costs, must also be proposed. The TMLCC includes but is not limited to:

- Mission definition and development of all flight and ground hardware and software, acquisition of launch services, launch, and operations of a mission to observe and understand some aspect of Earth System Science;

- Accomplishment of any correlative measurements necessary to ensure optimum science return by calibrating or validating these observations;

- Obtaining any support needed by the mission from other efforts;

- Development, operation, refinement, maintenance, documentation, and publication of all required algorithms to accomplish the mission;

- Processing, archiving, distribution, maintenance, documentation, and information management of all mission derived data products consistent with interfaces required to permit community-wide access via appropriate existing mechanisms;

- Publication of results in the refereed science literature;

- Delivery to NASA, at the conclusion of the mission, of all data, supporting information, and available results to facilitate NASA-supported preservation and distribution.

The proposed NMC in Step-Two will be used to assess the science value of the mission. The Step-Two TMLCC will be evaluated to determine the adequacy of the total proposed resources to successfully carry out the mission. While the TMLCC does not enter into the science value assessment directly, the contributions which augment the NMC should increase the science return of the mission, and therefore, its science value.

Of the two primary investigations anticipated to be selected through this AO, one will proceed directly into mission definition. Full Definition Study Phase funding of the other primary investigation will be delayed by a year, during which a low level of funding will be available. After the first year, the second investigation will proceed into full mission definition. The investigation selected as an alternate will be provided with limited funding for 1 to 2 years to conduct preparatory studies and to maintain a nucleus of the investigation team. It is anticipated that the total funding available for the alternate mission will be no more than $540,000. If, during the course of definition, either of the primary investigations should prove, in NASA's judgment, to be technically or programmatically infeasible, then the alternate selection will proceed into mission definition.

3.8 Management Requirements

The short development schedule and low costs associated with ESSP demand innovative business and management practices. NASA's approach to ESSP missions encourages teaming arrangements among industrial, academic, government and international partners. Selected mission teams will have full responsibility and authority to accomplish the mission. This will permit them to utilize innovative approaches necessary to stay within the strict cost and schedule limits of the program. NASA oversight and reporting requirements will be limited to that which is essential to assure mission success and agreed-upon science return in compliance with committed cost, schedule, performance, quality, reliability, and safety requirements. Failure to meet negotiated cost and schedule milestones at any stage of the mission will be cause for termination.

Mission teams shall submit monthly and quarterly (533M and 533Q, or equivalent) financial management reports as described in NPG 9501.2C “Procedures For Contractor Reporting Of Correlated Cost And Performance Data” (23 April 1996). Mission financial management reports shall be prepared according to the WBS and cost element structure contained in the mission proposal. Mission financial management reports shall be required from prime contractors as well as first-tier subcontracts that meet the reporting requirements set forth in NASA FAR Supplement Section 18-42.7201 (b) (1). Mission teams shall also provide funding profiles and explain variances between projected and actual costs, as required during mission implementation. NASA intends to use existing mission team internal management reporting systems to the maximum extent feasible in satisfying mission financial reporting requirements.

ESSP missions shall have a product assurance program that meets the intent of the ISO 9000 series, American National Standard, “Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing”, ANSI/ASQC Q9001-1994 and the ESSP Project Mission Assurance Guidelines and Requirements in Appendix N. ESSP missions shall also have a mission safety program which complies with the ESSP Project Safety Requirements in Appendix O.

NASA will require four reviews for ESSP missions. The Preliminary Design Review (PDR) and the Mission Confirmation Review (MCR) will be held during the mission Definition Study Phase. The PDR will be conducted by the ESSP Mission Team, with participation by the ESSP Project Office. The purpose of the PDR is to assess the system design at the system and subsystem level as it relates to the mission requirements. The MCR, conducted by NASA, will follow the PDR, and combine the findings of the PDR with a programmatic and process review of the proposed mission implementation. The purpose of the MCR is to establish that the Mission Team has completed an acceptable mission Definition Study Phase and is prepared to complete flight and ground system development and mission operations within the identified mission cost cap. The MCR provides an independent assessment of mission readiness by identifying the technical, financial and management risks associated with development and operations. The MCR and a review of the mission cost plan will serve as a gate for the mission to proceed into development. The other required reviews are the Mission Readiness Review (MRR) and the Launch Readiness Review (LRR), both conducted by NASA. The MRR will verify that testing has been completed with no unacceptable open issues and to evaluate the readiness of the flight and ground segments. The LRR will take place at the launch site just prior to launch to certify flight readiness of all mission elements. Details concerning these required reviews are found in Appendix N.

In order to assess the progress of the mission and to provide NASA with necessary technical and programmatic insight, the mission team shall also develop and propose a schedule of internal reviews. Although not prescriptive, the proposer may refer to NASA NHB 7120.5 for guidance in this area. The purpose of these reviews is to assess the technical, management, cost and schedule progress of the mission to ensure that reasonable and sound engineering and management are being employed throughout the mission definition and development cycle. These reviews will provide the mission team with an assessment of the program, provide feedback through recommendations as necessary and indicate any potential problem areas.

The selected mission team will be totally responsible for the ESSP mission, including science integrity and mission implementation. In this "PI-Mode", the Principal Investigator and mission team will have full responsibility for all aspects of the mission, including instrument and spacecraft definition, development, integration, and test; launch services (if acquired by mission team) or mission launch interfaces (if launch service is NASA provided); ground system; science operations; mission operations; and data processing and distribution. Each mission team member should consider themselves responsible for mission

success (i.e., delivery of science data products), rather than solely for their portion of the mission. The PI may select partners from industry, academia, nonprofit institutions, NASA Centers, FFRDC's, other Government agencies, and international organizations to assist in carrying out the responsibility for implementing the mission.

It is the intent of NASA to give the PI and the mission team the ability to use their own processes, procedures, and methods to the fullest extent possible. ESSP mission teams should define the management and contractual approaches that are best suited for their particular teaming arrangement. These approaches should be commensurate with the investigation's implementation approach while retaining a simple and effective management structure necessary to assure the adequate control of development within the cost and schedule constraints. Contractual approaches are encouraged which incentivize team members toward successful delivery of science data products. Team member agreements and/or contracts must be signed and copies delivered to NASA within 90 days of award of NASA mission contract (see Section 3.3 for international agreements). The investigation team should develop and propose a Work Breakdown Structure (WBS) to manage mission implementation that best fits their organizational approach and mission design concept.

The PI is expected to be the central person in each ESSP mission, with full responsibility for the scientific integrity of the mission. The PI is responsible for assembling a team to propose and implement the mission. The PI must be accountable to NASA for the scientific success of the mission and must be prepared to recommend mission termination when, in the judgment of the PI, the successful achievement of the established Minimum Science Mission objectives is not likely within the committed cost and schedule reserves. Each selected mission team will propose and negotiate a set of performance metrics during the Definition Study Phase for program evaluation, including cost, schedule, and technical performance as appropriate. These metrics will be incorporated into the contract. Violation of the agreed upon metrics, as determined by NASA, may be cause for termination of the investigation at any time.

Each ESSP mission must have a Project Manager (PM) who will oversee the implementation of the mission. The role, qualifications and experience of the PM should be carefully considered to ensure that the programmatic and technical needs of the investigation will be met. Other key individuals, their roles, and the adequacy of their experience should be identified for each ESSP investigation.

Each ESSP mission must define the risk management approach it intends to use to ensure successful achievement of the mission objectives within established resource and schedule constraints. In addition, any manufacturing, test, or other

facilities needed to ensure successful completion of the mission's objectives should be identified.

4.0 STEP-ONE PROPOSAL SUBMISSION GUIDELINES

4.1 General Overview

A Step-One Proposal must first be submitted by each proposer. The following guidelines apply to the preparation of Step-One proposals by potential investigators in response to this ESSP AO. The material presented is not intended to be all encompassing. The proposer shall provide information relative to those items applicable or as otherwise required by the AO. The required proposal format, contents and instructions are summarized below. Failure to follow all proposal format, content and other instructions may result in reduced ratings during the evaluation process and could lead to rejection of the proposal.

4.1.1 Proposal Instructions

All documents must be typewritten in English, use the International System of units (SI), and be clearly legible. All cost estimates, including non-U.S. contributions, must be in U.S. dollars. Submission of proposal material by facsimile (fax), videotape, or Internet reference is not acceptable. All paper proposals and copies must be submitted on plain white paper only (e.g., no cardboard stock or plastic covers, no colored paper, etc.). Photographs and color figures are permitted if printed on recyclable white paper only. The original signed copy should be bound in a manner that makes it easy to disassemble for reproduction. Every side upon which printing appears will be counted against the page limits. In complying with page limits, no page should contain more than 50 lines of text and the type size should not be smaller than 12 points. Top, bottom and side margins of at least one inch should be used. Single or double column format is acceptable.

In addition to the bound paper volumes, the Step-One Proposal shall also be provided on diskettes. These diskettes will be used primarily to assist evaluators with searches for information within the proposal. The actual evaluation will be performed utilizing *all* portions of the proposal submitted on paper. Only the text portion plus table and figure titles need to be provided on the diskettes; tables, figures and any other material of an essentially graphic nature need not be included. INFORMATION NOT INCLUDED IN THE PAPER VOLUME OF THE PROPOSAL SHALL NOT BE INCLUDED ON THE PROPOSAL DISKETTES. If the diskettes are found to include information which differs from the paper volume or are found to be defective (e.g., non-readable) the diskettes will be returned to the proposer and the proposer shall promptly provide replacement diskettes. Replacement diskettes will not be considered a late proposal under NFS 1815.412, Late Proposals, Modifications and Withdrawal of Proposals. If necessary to segment the proposal on multiple diskette files either because of

diskette space or other limitations, the files should be as large as possible and have a logical relationship to the proposal structure.

All information shall be provided on DOS-compatible (version 5.0 or higher), high-density (1.44 megabytes), 3-1/2" diskettes. All text portions of the proposal shall be provided in Microsoft Word for Windows format (version 6.0 or earlier) and in ASCII (DOS) format on separate diskettes.

Three copies of each proposal diskette (all certified as virus-free) shall be provided. A brief description explaining the diskette file structure, naming conventions used and any other information that the proposer feels may be helpful to use these files effectively for the intended purpose shall be included. These pages do not count toward the proposal page limit.

4.1.2 Proposal Format

The Step-One Proposal is limited to 15 single-spaced typewritten pages, without reduction. Not included in the page count are the cover page, cost range page, signature page, fact sheet, fact sheet transparency, Instrumentation Technical Maturity Matrix, required certifications, list of peer-reviewed references and non-U.S. participation commitment letters (if applicable). The Step-One proposal shall include the following information, in order:

- A cover page signed by the Principal Investigator and an official by title of the investigator's organization and/or the organization(s) contracting directly with NASA who is authorized to commit the organization(s) that is directly responsible for the proposal and its contents. The cover page must include the title of the mission being proposed and the full names, affiliations, addresses with zip codes, telephone and fax numbers, and electronic mail addresses of the Principal Investigator and authorizing official(s).

- A separable page with the estimated NMC and TMLCC cost ranges for the mission in real year dollars. This is the only place where cost information shall appear.

- A signature page containing the endorsements of the implementing, funding and sponsoring organizations on the mission team must be forwarded with the proposal. For Step-One, the signatures signify commitments by the appropriate organizations to participate in the proposed mission. The signature page must include the title of the mission being proposed and the name of the Principal Investigator (PI), as well as the full names, signatures, titles, affiliations, and addresses of the Project Manager, all Co-Investigators (Co-I) and lead representatives from

every organization represented on the team (including contributing and non-U.S. members), as well as the authorizing official from each organization represented on the team who is authorized to commit that institution to the proposed investigation. Signatures of officials from institutions sponsoring only Co-Is are not required in Step-One proposals. In the case of non-U.S. participants, signatures from the institutional and/or government funding providers must be included. Details regarding commitments from non-U.S. participants can be found in Section 4.3. The Principal Investigator and authorizing official signatures, phone numbers, addresses, etc., included on the cover page need not be repeated on the signature page. Should it not be feasible to have all individuals sign the same sheet due to time or page constraints, more than one sheet may be used to enable concurrent signatures. Appendix M, Figure M-5 provides the format to be followed in preparing the signature page(s).

〈 A separable one-page, single-sided "fact sheet" which contains, in order, the mission name; the names of the PI and all Co-Is (including their institutions); mission team member organizations, including their respective roles; a brief mission statement; a brief statement of science objectives; a brief description of proposed science data sets; a brief description of proposed instrumentation; a brief list of instrument and spacecraft heritage (if any); the proposed launch service; a brief description of the Minimum Science Mission; and major milestones, including proposed launch date and mission lifetime. No cost data should appear on the fact sheet. In addition, one transparency (viewgraph) of the fact sheet must be included.

〈 A justification of the planned scientific investigation to be conducted.

〈 A description of the proposed science instrumentation.

〈 A separable, one page self-assessed Instrumentation Technical Maturity Matrix for proposed instrument(s) and other relevant science hardware.

〈 A description of the mission implementation approach, including spacecraft, instrument accommodations, launch service, orbital parameters, ground systems, etc.

〈 A brief description of the management approach including roles, responsibilities, contributions, and experience of team members.

〈 A master schedule with major milestones for the proposed mission.

〈 A list of the scientific references from literature cited in the proposal.

4.1.3 Technical and Scientific Inquiries

Inquiries of a technical or programmatic nature should be directed to the ESSP Program Coordinator and inquiries of a scientific nature should be directed to the ESSP Program Scientist at the address below:

ESSP Announcement of Opportunity
Ref.: AO-98-OES-01
Code Y
400 Virginia Avenue S.W.
Suite 700
Washington, DC 20024
Phone: 202-554-2775
Fax Number: 202-554-2970
e-mail: (Internet) dcardasc@hq.nasa.gov

4.2 Step-One Proposal Content

The following sections describe in detail the content requirements of Step-One proposals.

4.2.1 Science

This section shall provide a detailed discussion of the planned scientific investigation to be conducted. This includes identifying the science problem to be addressed; the measurement approach and objectives; the underlying physics of the proposed measurements; scientific problem relevance to the Earth Science Enterprise and complementarity to EOS and other OES approved flight programs; science measurement requirements (lifetime, orbit, resolution, accuracy, etc.); Baseline Science Mission and Minimum Science Mission; science team members and their experience and area of expertise relative to the science measurement objectives; science validation and correlative measurement plan; algorithm development plan; and data processing and distribution plan.

An explicit scientific justification of the proposed investigation shall be provided. This includes defining the role of the proposed investigation in addressing key scientific question(s) and its applicability to current environmental issues, as well as how it differs from or complements existing or approved spaceflight missions; documentation of the existing state of knowledge with respect to the problem to be addressed, including existing models and observations; articulation of how the proposed mission addresses the stated problem or questions in terms of measurement characteristics and instrumentation, including the requisite in-situ/correlative measurements necessary to provide an integrated observation

strategy; and defining the mission characteristics, including specifics of the spatial and temporal sampling, precision and accuracy of the measurements, in the context of the proposed science objectives specifically, and Earth Science Enterprise objectives in general. In addition, a detailed Sensitivity Analysis must be provided which describes how the proposed measurement set extends the state of Earth System Science knowledge in the problem area defined with respect to existing physical models, observational dataset(s), and/or observational trends. All references cited should be available from literature (i.e. commonly available journals and books) or easily accessible as preprints (i.e. accepted for publication). The impact of degradation of mission characteristics on the scientific objectives of the investigation shall also be described.

4.2.2 Science Instrumentation

A description of the proposed science instrumentation shall be provided, including, but not limited to, the sensor type, number of channels, mass, power, volume, data rate and performance requirements. The linkage between the required physical measurements and the proposed instrumentation shall be described in sufficient detail. In addition, an assessment of the technical maturity of all proposed instrumentation shall be provided. This Instrumentation Technical Maturity Matrix shall include the name of each major element, a description of the item, an assessment of its maturity level (according to the definitions in Appendix M, Figure M-1) and rationale for each maturity assessment given, including examples of heritage, if any. The format of the Instrumentation Technical Maturity Matrix shall be as shown in Appendix M, Figure M-8.

In order to quantitatively document how the proposed instrumentation permits key scientific problems to be addressed, a traceability analysis is required. The details of the mapping between scientific objectives and the measurements required to fulfill these objectives must be provided, as well as the mapping between functional requirements and top-level engineering requirements. This analysis shall be presented as the Science Traceability Matrix, with individual scientific requirements mapping into functional requirements, which themselves map into higher order engineering requirements. The matrix format shown in Appendix M, Figure M-7 shall be used.

4.2.3 Mission Implementation Approach

A description of the mission implementation concept shall be provided, including, but not limited to, the spacecraft, instrument accommodations, launch services, orbital parameters, and ground systems. The linkage between the required physical measurements and the proposed mission approach shall be described

in sufficient detail. In particular, any mission “drivers” shall be described and the driving scientific requirement identified.

4.2.4 Cost Ranges

The estimated NASA Mission Cost (NMC) and Total Mission Life Cycle Cost (TMLCC) in real year dollars should be provided on a separable page by identifying the appropriate cost range:

NMC	TMLCC
$0-30M	$0-30M
31-45M	31-45M
46-60M	46-60M
61-90M	61-90M
91-120M	91-120M
	> 120M

These cost ranges will be used for planning purposes only, in order to assess the range of missions proposed. As such, this information will not be provided to the evaluators. Proposals will not be categorized by cost ranges for evaluation purposes.

4.2.5 Management Approach

The management approach including roles, responsibilities, contributions, and experience of major team members shall be described. A mission management organization chart, including all team members, shall be provided.

4.2.6 Schedule

A master schedule for the proposed mission shall be provided, which includes but is not limited to major milestones such as proposed project reviews; instrument development; spacecraft development; instrument to spacecraft integration and test; launch vehicle integration; launch; mission operations; and algorithm development and data processing.

4.3 International Participation

Participation of non-U.S. mission team members is allowed under the guidelines discussed in Section 3.3. Principal Investigators with non-U.S. participation are urged to contact NASA's Office of External Relations (see Appendix L) for guidance. All Step-One proposals for missions with non-U.S. participants shall include a Letter of Commitment from each non-U.S. organization. The Letter of Commitment must clearly identify the intended role of the organization in the proposed mission and the resource(s) being provided, and must clearly commit identified resources to the mission upon selection as an ESSP mission. The Letter of Commitment must be signed by an official with the authority to commit his/her organization's resources. Letters of Commitment do not count as part of the page limit for Step-One proposals. Non-U.S. institutions providing only Co-Investigators are exempt from the Letter of Commitment requirement.

4.4 Submittal of Step-One Proposals

4.4.1 Certification

The original copy of all proposals shall include the signature page(s). Additional certifications identified in Appendices J and K are required by law and must also be included. These certifications do not count toward the page limit.

4.4.2 Quantity

All proposers must provide 35 copies of their bound paper proposal, including the original signed proposal, on or before the proposal deadline. The proposals must be numbered sequentially from 1 to 35 in the upper right-hand corner of the cover page; the original signed proposal should be number 1. The requirements for submittal of diskette copies of the proposal are defined in Section 4.1.1.

4.4.3 Submittal Address

All proposals shall be mailed to the following address:

ESSP Executive Secretary
Code Y
400 Virginia Avenue, S.W.
Suite 700
Washington, DC 20024
Phone: 202-554-2775

4.4.4 Submittal Deadline

All Step-One proposals must be received no later than 4:00 p.m. Eastern Time on May 27, 1998. Proposals received after the established closing date and time will be treated in accordance with NASA's provisions for late proposals (NASA FAR Supplement 1815.412, Late Proposals, Modifications and Withdrawal of Proposals).

4.4.5 Notification

NASA will notify proposers in writing that their proposals have been received. Proposers not receiving this confirmation within two weeks after submittal of their proposal should contact NASA at the address given in Section 4.1.3.

4.4.6 Submittal of Proposals Involving International Participation

The procedures for submission of proposals with non-U.S. participants are the same as those for strictly U.S. proposals, as previously outlined in this section. Additionally, one copy (over and above the 35 copies identified in Section 4.4.2) of any proposal that includes non-U.S. participants shall be sent to:

William W. Turner
Office of External Relations
Mail Code IY
Ref.: AO-98-OES-01
National Aeronautics and Space Administration
Washington, DC. 20546 USA
Phone: 202-358-0793

5.0 STEP-TWO PROPOSAL SUBMISSION GUIDELINES

5.1 General Overview

The following guidelines apply to the preparation of Step-Two proposals by potential investigators in response to this Earth System Science Pathfinder (ESSP) Missions AO. The material presented is not intended to be all encompassing. The proposer shall provide information relative to those items applicable or as otherwise required by the AO. The required proposal format, contents and instructions are summarized below. Failure to follow all proposal format, content and other instructions may result in reduced ratings during the evaluation process and could lead to rejection of the proposal.

5.1.1 Proposal Instructions

All documents must be typewritten in English, use the International System of units (SI), and be clearly legible. All cost estimates, including non-U.S. contributions, must be in U.S. dollars. Submission of proposal material by facsimile (fax), videotape, etc., is not acceptable. All paper proposals and copies must be submitted on plain white paper only (e.g., no cardboard stock or plastic covers, no colored paper, etc.). Photographs and color figures are permitted if printed on recyclable white paper only. The original signed copy should be bound in a manner that makes it easy to disassemble for reproduction. Each copy of the Step-Two Proposal shall be provided in a 3-ring loose leaf binder. If necessary, the Cost section (text and spreadsheets) may be provided in a separate binder. Two-sided copies are preferred. Every side upon which printing appears will be counted against the page limits. In complying with page limits, no page should contain more than 50 lines of text and the type size should not be smaller than 12 points. Top, bottom and side margins of at least one inch should be used. Single or double column format is acceptable.

In addition to the bound paper volumes, the Step-Two Proposal shall also be provided on diskettes. These diskettes will be used primarily to assist evaluators with searches for information within the proposal. The actual evaluation will be performed utilizing *all* portions of the proposal submitted on paper. With the exception of the Cost section, only the text portion, plus table and figure titles, need to be provided on the diskettes; tables, figures and any other material of an essentially graphic nature need not be included. The entire Cost section shall be provided on a separate diskette. INFORMATION NOT INCLUDED IN THE PAPER VOLUMES OF THE PROPOSAL SHALL NOT BE INCLUDED ON THE PROPOSAL DISKETTES. If the diskettes are found to include information which differs from the paper volumes or are found to be defective (e.g., non-readable) the diskettes will be returned to the proposer and the proposer shall promptly provide replacement diskettes. Replacement diskettes will not be considered a

late proposal under NFS 1815.412, Late Proposals, Modifications and Withdrawal of Proposals. If necessary to segment the proposal on multiple diskette files either because of diskette space or other limitations, the files should be as large as possible and have a logical relationship to the proposal structure.

All information shall be provided on DOS-compatible (version 5.0 or higher), high-density (1.44 megabytes), 3-1/2" diskettes. All text portions of the proposal shall be provided in Microsoft Word for Windows format (version 6.0 or earlier) and in ASCII (DOS) format on separate diskettes. The proposer shall submit the Cost section spreadsheets in the designated layouts properly formatted for use by Excel for Windows software version 5.0 on a separate diskette.

Three copies of each proposal diskette (all certified as virus-free) shall be provided. A brief description explaining the diskette file structure, naming conventions used and any other information that the proposer feels may be helpful to use these files effectively for the intended purpose shall be included. These pages do not count toward the proposal page limit.

5.1.2 Proposal Format

The following requirements pertain to proposal format. The cover page, signature page(s), table of contents, reference list, curriculum vitae, Executive Summary, certifications, fact sheet, fact sheet transparency, non-U.S. participant MOUs, Mission Definition Requirements Agreement, Statement of Work, cost spreadsheets and all other required contract documentation will not be counted against the page limits.

〈 Cover Page

The cover page must be signed by the Principal Investigator and an official by title of the investigator's organization and/or the organization(s) contracting directly with NASA who is authorized to commit the organization(s) that is directly responsible for the proposal and its contents. The cover page must include the title of the mission being proposed; the full names, affiliations, addresses with zip codes, telephone and fax numbers, and electronic mail addresses of the Principal Investigator and the authorizing official(s); and annual funding requirements for the mission in real year dollars by Government fiscal year, clearly identifying the amount requested from NASA and the amount to be contributed by partners. This cover page should be attached to the front of the proposal.

〈 Signature Page

A signature page containing the endorsements of the implementing, funding and sponsoring organizations on the mission team must be forwarded with the proposal, immediately following the cover page. For Step-Two, the signatures shall serve as endorsements of the proposed mission cost, schedule and implementation as defined by the Step-Two Proposal, and commit each institution to carry out its proposed responsibilities for the resources proposed. The signature page must include the title of the mission being proposed and the name of the Principal Investigator (PI), as well as the full names, signatures, titles, affiliations, and addresses of the Project Manager, all Co-Investigators (Co-I) and lead representatives from every organization represented on the team (including contributing and non-U.S. members), as well as the authorizing official from each organization represented on the team who is authorized to commit that institution to the proposed investigation. In the case of non-U.S. participants, signatures from the institutional and/or government funding providers must be included. The Principal Investigator and authorizing official signatures, phone numbers, addresses, etc., included on the cover page need not be repeated on the signature page. Should it not be feasible to have all individuals sign the same sheet due to time or page constraints, more than one sheet may be used to enable concurrent signatures. Appendix, Figure M-5 provides the format to be followed in preparing the signature page(s).

〈 Table of Contents

The table of contents should parallel the outline provided below to the greatest extent possible.

〈 Executive Summary

The Executive Summary should provide an overview of all aspects of the investigation. This summary should be presented in five parts reflecting the major sections of the proposal (Science, Technical, Opportunity, Cost, and Management). It is recommended that the Executive Summary be constructed by writing abstracts of each of the five major sections and should serve as the Introduction and Summary for the proposal. The Executive Summary is limited to a maximum of 5 single-spaced typewritten pages, without reduction. No foldout pages are allowed.

〈 Fact Sheet

A separate "Fact Sheet" that provides a brief summary of the proposed investigation shall be included with the Executive Summary, but is not included in the 5-page limit. The information conveyed on this fact sheet shall include the following in order: the mission name; the name of the PI and his/her institution; mission team member organizations; a brief mission statement; a brief statement of science objectives; a brief description of proposed science datasets; a brief description of proposed instrumentation; a brief list of instrument and spacecraft heritage (if any); the proposed launch service; a brief description of the Minimum Science Mission; cost; schedule; and mission cost and schedule reserves. Other relevant information, including figures or drawings, may be included at the proposer's discretion. This fact sheet is restricted to one (1) side of one page of paper. There are no restrictions on the type of paper upon which the fact sheet is printed (i.e., glossy paper is permitted). In addition, one transparency (viewgraph) of the fact sheet must be included.

〈 Proposal Body

The Step-Two Proposal body shall consist of five sections in order: "Science", "Technical", "Opportunity", "Cost" and "Management".

The Science, Technical and Opportunity sections together are limited to a maximum of 75 single-spaced typewritten pages, without reduction, including illustrations and tables, and may contain no more than 5 foldout pages (28 x 43 cm) (i.e., 11 x 17 inches).

The Cost and Management sections together are limited to a maximum of 35 single-spaced typewritten pages, without reduction, including figures, tables, and charts. The proposed Statements of Work (SOW), Mission Definition and Requirements Agreement (MDRA), contract list of deliverables, exceptions and/or changes to contract clauses, and the requested cost spreadsheets in the designated layouts will not be counted against the page limit.

The Science, Technical and Opportunity sections must provide a clear statement of the scientific objectives of the mission, identifying any science descopes from the Step-One Proposal, and a description of the approach to be used in attaining those objectives, as well as the educational and/or social benefits and any commercial opportunities offered by the mission. These sections should contain enough background information to be

meaningful to a reviewer who, although not necessarily a specialist, is generally familiar with the field.

The Cost and Management sections must provide a clear statement of all costs associated with the mission, along with the management approach to be used in attaining the mission objectives.

〈 Curriculum Vitae

A two-page maximum length curriculum vitae is required for all key personnel and should be appended to the proposal.

〈 Certifications

Certifications required by Federal law are included as Appendices J and K to this AO and should be appended to the proposal.

Proposals submitted by NASA employees as Principal Investigators should contain the following information concerning the process by which non-Government participants were included in the proposal. The proposal should (i) indicate that the supplies or services of the proposed non-Government participant(s) are available under an existing NASA contract; (ii) make it clear that the capabilities, products, or services of these participant(s) are sufficiently unique to justify a sole source acquisition; or (iii) describe the open process that was used for selecting proposed team members. While a formal solicitation is not required, the process cited in (iii) above should include at least 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. The proposal should address how the selection of the proposed team members followed the objective criteria and is reasonable from both a technical and cost standpoint. The proposal should also include a representation that the Principal Investigator has examined his/her financial interests in or concerning the proposed team members and has determined that no personal conflict of interest exists. The proposal must provide a certification by a NASA official superior to the Principal Investigator verifying the process for selecting contractors as proposed team members, including the absence of conflicts of interest. This information should be provided under separate cover and is not included against the page limit for Step-Two proposals.

5.1.3 Technical and Scientific Inquiries

Inquiries of a technical or programmatic nature should be directed to the ESSP Program Coordinator and inquiries of a scientific nature should be directed to the ESSP Program Scientist at the address below:

ESSP Announcement of Opportunity
Ref.: AO-98-OES-01
Code Y
400 Virginia Avenue S.W.
Suite 700
Washington, DC 20024
Phone: 202-554-2775
Fax Number: 202-554-2970
e-mail: (Internet) dcardasc@hq.nasa.gov

5.2 Step-Two Proposal Content

The following sections describe in detail the content requirements of Step-Two proposals.

5.2.1 Science

The science section shall contain all pertinent information allowing for an evaluation of the scientific merit of the investigation (i.e. independent of the Step-One proposal), and must identify any descoping of the investigation from the Baseline Science Mission defined in the Step-One Proposal. The scientific objectives and methodologies must be consistent with those proposed in Step-One. In addition, this section must include the required Science Traceability Matrix, Sensitivity Analysis, and Instrumentation Technical Maturity Matrix as previously defined in Section 4. All of this information is counted as part of the proposal page limit.

> SCIENTIFIC GOALS AND OBJECTIVES - This section shall provide a definition of the goals and objectives of the investigation, their value to Earth System Science and the Office of Earth Science priorities in general, and their relationships to past, current, and future investigations and missions (i.e., complementarity to EOS and approved OES flight programs). It shall describe the history and basis for the proposed mission and discuss the need for such an investigation.
>
> NATURE OF INVESTIGATION - This section shall provide an end-to-end overview of the mission. A more detailed description of the mission approach shall be included in the Technical section.

MEASUREMENT OBJECTIVES AND ANTICIPATED DATA RETURN - This section shall fully describe the measurements to be acquired during the course of the mission, the scientific data to be returned, and the approach that will be utilized in analyzing the observational data to achieve the scientific objectives of the investigation. This description shall identify the type of experiments to be performed (imaging, spectroscopy, sounding, ranging, etc.), the quality of the data to be returned (spatial and temporal resolution, coverage, pointing accuracy, measurement precision, etc.), and the quantity of data to be returned (number of bits, images, etc.). The relationship between the data products generated and the scientific objectives shall be explicitly described, as shall the expected results. It is assumed that the above information will constitute the Baseline Science Mission.

This section shall also identify a minimum acceptable data and scientific return for the mission (the Minimum Science Mission), below which the mission would not be justifiable at the proposed cost. Options for descoping the mission from the Baseline Science Mission to the Minimum Science Mission shall also be included. Proposals shall include no more than one Baseline Science Mission and one Minimum Science Mission.

Finally, this section shall describe the plan for processing and distributing the data. The procedures for ESSP mission data quality assessment (i.e., calibration, validation and evaluation), data product generation in geophysical data record format, and external data product dissemination shall be explicitly described. The anticipated format of the final data products shall be described, as well as the time required for calibration, validation and quality check evaluation.

INSTRUMENTATION - This section shall fully describe the proposed instrumentation and the criteria used for its selection. A description of the operational scenario/modes and an overall functional description and block diagram for all instrumentation shall be provided. The state of maturity of the instrumentation shall be described, including design heritage and existing instruments, breadboards, brassboards, and prototypes. Instrumentation concept, feasibility or definition studies already performed shall be summarized. Instrumentation performance requirements (resolution, sensitivity, and accuracy) shall be related to the proposed science measurement objectives for both the Baseline and Minimum Science Missions described above. A description of the technology/development risks and the plan to address them shall be included. A preliminary schedule for instrument development shall be provided. The following preliminary information shall be provided:

- Size
- Mass with margins
- Power with margins (nominal, peak, duty cycle, standby)
- Data rate with margins
- Mechanical, electrical, and thermal layouts
- Optical layout including field of view (if appropriate)
- Ground and on-orbit calibration scheme
- Pointing requirements (knowledge, control, and stability)
- Command and control requirements
- Flight software development plan (use of existing or commercial off the shelf software shall be identified)

REFERENCES - This section shall list all cited references which appear in the Science section of the Step-Two proposal. Cited references are encouraged to be from the extant literature (i.e. widely available journals, books, etc.), or available as preprints.

SCIENCE TEAM - This section shall identify the mission science team, and the activities of that team shall be described in detail. The capabilities and experience of all members of the proposed science team shall be described. In addition, the role of each science team member in the investigation shall be explicitly defined. Resumes or vitae of team members shall be included as attachments to the proposal. Any plans for producing an initial analysis of early mission data should be described.

5.2.2 Technical

The Technical section shall detail the method and procedures for investigation definition, design, development, integration, ground operations, and flight operations. This section must also detail the expected products and end items associated with each phase. Mission teams have the freedom to use their own processes, procedures, and methods. The use of innovative processes, techniques, and activities in accomplishing mission objectives is encouraged when cost, schedule, and technical improvements can be demonstrated. The experience and qualifications of performing organizations shall be discussed.

This section must be complete in itself without the need to request additional data.

MISSION DESIGN - This section shall fully describe the design, development, launch and operation of the mission. Mission design and development, including systems engineering and requirements flowdown and allocation, shall be described. Information on the proposed launch service, orbital parameters and a preliminary mission timeline indicating

periods of data acquisition, data downlink, etc. shall be included. The mission description shall also define the type and source of communications network interface required.

The rationale that justifies both the cost effectiveness and technical effectiveness of the mission design shall be described. A "Mission Traceability Matrix" showing how the proposed mission design is derived from the stated objectives, requirements, and constraints of the proposed investigation shall be included. The format of the Mission Traceability Matrix shall be as shown in Appendix M, Figure M-9. The rationale for the selection of launch vehicle must be provided. If not NASA-provided, the prior demonstrated flight record and qualification history of the launch vehicle shall be provided. The proposal shall identify any innovative features of the mission design that minimize total mission costs, including the use of commercial off-the-shelf technology.

SPACECRAFT - This section shall describe the spacecraft design approach, particularly as it relates to new versus existing hardware and redundant versus single-string hardware. It shall fully identify the spacecraft and describe its characteristics and requirements. A preliminary description of the spacecraft design with a block diagram showing the spacecraft subsystems and their interfaces shall be included, along with a description of the flight software and a summary of the estimated performance of the spacecraft. The flight heritage and/or rationale used to select the spacecraft and its subsystems, major assemblies, and interfaces shall be described. In addition, an assessment of the technical maturity of each subsystem and critical component shall be provided. This “Spacecraft Technical Maturity Matrix” shall define the technology readiness level (as defined in Appendix M, Figure M-1) of each item, along with a rationale for the assigned rating. The Spacecraft Technical Maturity Matrix is separate from the previously requested Instrumentation Technical Maturity Matrix and is counted as part of the proposal page limit. The format of the Spacecraft Technical Maturity Matrix shall be as shown in Appendix M, Figure M-8.

Subsystem characteristics and requirements shall be described to the greatest extent possible. Such characteristics include: mass, volume, and power requirements; pointing knowledge and accuracy; new developments needed; spaceflight qualification plan; and logistics support. Any design features incorporated to effect cost savings shall be identified. A summary of the resource elements of the spacecraft design concept, including key margins, shall be provided. The rationale for margin allocation shall also be provided. Those design margins that are driving costs shall be identified.

Plans for all phases of software development, including the use of existing (including "commercial off-the-shelf") software, shall be described. The method planned for development and validation of flight software shall be addressed.

The method for resolving any major open spacecraft issues, major systems trades, and technology development planned to be addressed in Phase B shall be addressed. A preliminary schedule for the spacecraft development must be included.

PAYLOAD INTEGRATION - This section shall characterize the interface between the science instrumentation and the spacecraft. The planned process for physically and analytically integrating the science payload with the spacecraft shall be described. Along with a description of the payload layout and configuration, the accommodation of the science instruments by the spacecraft shall be addressed as follows:

- Instrument location constraints
- Mechanical/structural interface
- Field of view, alignment and pointing
- Baffling or other protection
- Thermal environment/temperature limits
- Data collection and storage
- Data processing (onboard and on the ground)
- Telemetry
- Commands
- Timing (clocks)
- Environmental sensitivities (electrical cleanliness, magnetic fields, contamination, etc.)

MANUFACTURING, INTEGRATION, AND TEST - This section shall describe the manufacturing strategy to produce and verify the hardware/software necessary to accomplish the mission. It shall include a description of the main processes/procedures planned in the fabrication of flight hardware and software development; use of production personnel resources; incorporation of new technology/materials; and the preliminary test and verification program.

The approach, techniques, and facilities planned for manufacturing, integration, test and verification, and launch operations phases, consistent with the proposed schedule and cost, shall be described. A preliminary schedule for manufacturing, integration, and test activities shall be included. A description of the planned end items, including engineering

and qualification hardware, shall be included. The use of any existing test facilities and processes shall be described.

GROUND AND DATA SYSTEMS - This section shall discuss the ground operations support required for the proposed investigation. The approach to the development of the ground data system (GDS), including the use, if any, of existing facilities shall be described. Any mission-unique facilities must be adequately described. Include a block diagram of the GDS showing the end-to-end concept (acquisition through archiving) for operations and data flow to the subsystem level. Describe the use of standards, such as Consultative Committee for Space Data Systems (CCSDS) recommendations or commercial standards, on the space/ground communications link. Describe all communications, tracking, and ground support requirements, including space/ground link spectrum requirements and licensing approach. Describe the software development approach and its relationship to the flight system software development.

MISSION OPERATIONS - This section shall describe the planned approach for managing mission operations and all flight operations support, including mission planning. A description of the operational phase of the mission shall be included. Operational constraints, viewing requirements, and pointing requirements shall also be identified. Describe any special communications, computer security, tracking, or near real-time ground support requirements, and indicate any special equipment or skills required of ground personnel.

The acquisition of data and the processing of that data both onboard the spacecraft and on the ground shall be described. The plan for processing the data after it has been delivered to the ground shall be discussed, including the method and format of the data reduction, data validation, and preliminary analysis. The process by which data will be prepared for archiving shall be discussed and the plan must include a detailed schedule for the submission of data to the public domain in the proper formats, media, etc. Delivery of the data to the public domain shall take place in the shortest time possible.

Specific features incorporated into the flight and ground system design that lead to low-cost operation shall be identified. The use of any existing mission operations facilities and processes shall be described, as well as any new facilities required to meet mission objectives.

PHASE B TECHNICAL DEFINITION PLAN - This section shall describe the means by which the Definition Study Phase (Phase B) will be

performed. The key trade-offs and options to be investigated during Phase B, as well as the issues and technologies critical to mission success, shall be identified. The products of Phase B and the schedule for their delivery shall be defined.

5.2.3 Management

The Management section shall summarize the management approach and the facilities and equipment required. This section sets forth the investigator's approach for managing the work, the recognition of essential management functions, and the overall integration of these functions. This section shall specifically discuss the decision-making process to be used by the team, focusing particularly on the roles, responsibilities and authority of the Principal Investigator (PI) and Project Manager (PM) in that process. The Management section shall provide insight into the organizations proposed for the work, including the internal operations and lines of authority, together with internal interfaces and relationships with NASA, team members, major subcontractors, and associated investigators. It also identifies the institutional commitment of all team members, and the institutional roles and responsibilities. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged when cost, schedule, and technical improvements can be demonstrated.

MANAGEMENT PROCESSES AND PLANS, SCHEDULE AND PROCUREMENT STRATEGY - This section shall describe the management processes and plans, schedules, and procurement strategy necessary for the logical and timely pursuit of the work, accompanied by a description of the work plan. This section shall also describe the proposed methods of hardware and software acquisition. Specifically, it shall include the following, as applicable:

- Capabilities that each member organization brings to the team, as well as previous experience with similar systems and equipment.

- Management processes which the mission team proposes to:

  - develop and maintain the hardware and software requirements and specifications;

  - manage and control development progress;

  - manage and conduct technology development;

  - manage and conduct design;

- manage, review, and control changes to hardware/software, documentation, etc.;
- manage and conduct mission systems engineering and integration;
- manage and conduct procurement, including make or buy decisions, subcontract management, etc.;
- manage, control, and allocate resources, including reserves;
- manage and conduct the testing and verification programs, including final checkout and calibration;
- manage and conduct launch and mission operations;
- manage and conduct data reduction and distribution;
- coordinate with team members and document agreements;
- provide NASA with insight; and
- report progress to NASA.

- The specific decision-making process regarding all aspects of the mission, including mission descoping and distribution of reserves, and the individual with ultimate decision-making authority in such cases.
- Availability of proposed personnel on the team to successfully administer the mission contract and subcontracts and technically monitor the implementation.
- A document tree which describes key proposed documentation, including development schedule and current status of each document.

The mission schedule and work flow should be clearly laid out, including critical path, schedule margins, deliveries of end items and major interdependencies. The method for internal review, control, and direction shall be discussed, including whether or not a form of performance measurement system will be used.

ROLES, RESPONSIBILITIES, AND EXPERIENCE OF TEAM MEMBERS - The roles, responsibilities, time commitment, and experience of all key personnel must be described in this section, with particular emphasis placed on the responsibilities assigned to the PI, the Project Manager and other key personnel. In addition, information shall be provided which indicates what percentage of time will be devoted to the mission, the duration of service, and how changes in personnel will be accomplished. (Note: The experience of the PI and science team members does not need to be included in this section since it would have been addressed in the Science section.)

- PRINCIPAL INVESTIGATOR - The role(s), responsibilities, and time commitment of the Principal Investigator shall be discussed. Provide a reference point of contact including address and phone number.

- PROJECT MANAGER - The role, responsibilities, time commitment, and experience of the Project Manager shall be discussed. Provide a reference point of contact including address and phone number.

- OTHER KEY PERSONNEL - The roles, responsibilities, time commitments, and experience of the Co-Investigators and other key personnel in the investigation shall be described.

The management organizational structure of the investigation team must be described in the proposal. The proposal must identify the teaming approach to be used and describe the responsibilities of each team member and their contributions to the investigation. The work of these individuals and institutions must be accounted for in the cost elements breakdowns provided in the Cost section.

Of special interest is the organizational approach and plan for efficient and effective management of the multi-organizational interfaces between cooperating partners and team members. Particular emphasis shall be placed on the organizational relationship between the PI and the PM. The capability of the team to respond quickly and effectively to problems and inter-organizational conflicts must be demonstrated. Proposed lines of communication and authority must be demonstrated.

The contractual/financial responsibilities and relationships of all team partners, including contributions, must be described. The mechanisms (contracts, subcontracts, cooperative agreements, memoranda of agreement, etc.) by which organizations commit to participate as partners

on a proposing team must be clearly identified. Include a description of incentives and fee strategy, where appropriate, and their rationale. The proposal signature page must include the signature of an official from each organization represented on the team or contributing to the investigation who is authorized to commit that organization to the proposed investigation. Failure to include any such authorization may be grounds for rejection of the proposal. Non-U.S. organizations and funding sources participating as team partners must also meet this requirement. Information on procurement of long lead items and proposed major and critical subcontracts, including procurement activities of all team partners, must be provided. The information shall consist of, at a minimum, name of the item, scope of the work to be performed, name and location of supplier or subcontractor, proposed award schedule, deliverable items and delivery schedule, proposed performance assurance requirements, and contingency plans if a supplier or subcontractor fails to perform. Describe the relationships and controls you will exercise over suppliers and subcontractors from both cost and schedule standpoints.

The experience (successes *and* failures) of team partners in managing projects of similar scope, including cost and schedule performance within the last ten years shall be discussed.

COST MANAGEMENT - The specific means by which costs will be tracked, managed and reported to the Government shall be defined. A Work Breakdown Structure (WBS) and WBS dictionary, consistent with the plans set forth elsewhere in the proposal, shall be included Specific reserves and the timing of their application, if needed, shall be described within the proposal. This shall include the strategy for maintaining reserves as a function of cost-to-completion. All funded schedule margins must be identified. The relationship between the use of such reserves, margins and potential descope options, and their effect on cost, schedule and performance, shall be fully discussed.

RISK MANAGEMENT AND DESCOPE OPTIONS - This section shall describe the approach to, and plans for, risk management to be taken by the team, both in the overall mission design and in the individual systems and subsystems. Particular emphasis shall be placed on describing how the various elements of risk will be managed to ensure successful accomplishment of the mission within cost and schedule constraints. In the event risks cannot be managed successfully and mission objectives must be revised toward the Minimum Science Mission, this section shall describe the descope options available to the team, their phasing, and their effect on mission performance relative to the previously defined

Baseline Science Mission. If the proposed Baseline and Minimum Science Missions are equivalent, proposers must clearly articulate the rationale for this decision and identify viable contingency options (i.e. additional reserves, etc.). This section shall identify the latest possible dates at which descope options may be implemented and the procedure by which they would be accomplished.

MISSION ASSURANCE - This section shall describe the process by which mission success is assured and achieved. This section shall describe mission assurance plans, including specific plans for reviews, problem/failure resolution, inspections, quality assurance, reliability, parts selection and control, and software validation activities compatible with industry best practices, ISO 9000 quality standards, and the ESSP Program Mission Assurance Guidelines in Appendix N. A table similar to that shown in Appendix M, Figure M-6 shall be used to illustrate compatibility of the proposer's own mission assurance processes with the ESSP Project Mission Assurance Guidelines and Requirements.

SAFETY - This section shall describe the process by which safety standards are met and hazards mitigated. The mission team member responsible for implementing the system safety program for the proposed mission shall be identified. Past experiences of this mission team member in implementing system safety program from previous missions shall be described. This section shall also describe all safety plans and practices to be used in mission development. These plans and practices shall be compliant with the ESSP Project Safety Requirements in Appendix O. This section shall also address the mission's compliance with NASA Safety Standard (NSS) 1740.14, "Guidelines and Assessment Procedures for Limiting Orbital Debris", which can be found in the ESSP Project Library (see Appendix G).

REVIEWS, AUDITS AND INSIGHT - Propose a schedule of mission reviews (both NASA and internal), including reviews of technical and programmatic status and any other informal reviews intended to report status and accomplishments, discuss problems, and provide technical and programmatic information to NASA. Include review description, content, planned schedule and duration, planned documentation and schedule for document delivery. The proposed implementation of mechanisms which will provide NASA insight into the mission shall be described.

The approach to interfacing with the Government for the purpose of conducting audits shall be described. Describe the audit process from contract award through performance and contract close-out.

FACILITIES AND EQUIPMENT - All major facilities, laboratory equipment, and ground-support equipment (GSE) (including those of the team's proposed contractors and those of NASA and other U.S. Government agencies) essential to the mission in terms of its system and subsystems are to be indicated, distinguishing insofar as possible between those already in existence and those that will be developed in order to execute the investigation. The outline of new facilities and equipment shall also indicate the lead time involved and the planned schedule for construction, modification, and/or acquisition of the facilities.

STATEMENTS OF WORK (SOW) - Provide Statements of Work/Task Plans for Phase B and Phase C/D/E covering all aspects of the mission. These documents shall cover all phases and include, as a minimum, Scope of Work, Deliverables (with emphasis on science data products), and Government Responsibilities (as applicable). Example SOWs and Task Plans are available in the ESSP Project Library (see Appendix G).

MISSION DEFINITION AND REQUIREMENTS AGREEMENT (MDRA) - A draft Mission Definition and Requirements Agreement shall be provided. The MDRA shall define the mission science objectives, deliverable science data products, mission cost and schedule requirements, partnering arrangements and responsibilities, contract and subcontract incentives, and NASA responsibilities. The MDRA will become a contract attachment. An example is provided in Appendix D. An additional sample MDRA is available in the ESSP Project Library (see Appendix G).

CONTRACTUAL REQUIREMENTS - In order to expedite mission contract awards, proposers are required to propose mission contract terms, conditions and deliverables as defined below.

Each proposer shall submit a list of contract deliverables for both Phase B and the Phase C/D/E option. Example contracts, including deliverable lists (Section B.1 of the contract), for current ESSP missions VCL and GRACE are available in the ESSP Project Library (see Appendix G). Submitted contract deliverable lists shall be consistent with the format of these referenced examples.

Proposers shall review the generic contract terms and conditions for educational institutions or commercial organizations (whichever is appropriate) in the ESSP Project Library (see Appendix G). Proposers shall specifically identify any exceptions and/or proposed changes to the contract terms and conditions (i.e., clauses) contained within the appropriate contract document. If no exceptions are taken, a statement to that effect must be included.

All proposed contractual documentation, if accepted by NASA, shall be considered executable upon selection. If no exceptions are taken, the sample generic contractual documents will be used as the basis for selected mission contract formulation. NASA reserves the right to negotiate all contract terms and conditions following mission selection.

5.2.4 Opportunity

This section shall describe the benefits offered by the mission beyond the scientific benefits brought by obtaining and distributing the desired data. These benefits may be educational and/or social.

EDUCATIONAL AND PUBLIC OUTREACH - This section shall discuss the degree to which this investigation will generate educational opportunities and contribute to the Nation's educational initiatives. The involvement of teachers and/or students in the investigation shall be documented here, as will any educational activities to be implemented. Coordination and collaboration with educational institutions shall be discussed. Activities to enhance the level of understanding and awareness of Earth Science by the public shall be described.

SMALL DISADVANTAGED BUSINESSES, WOMEN-OWNED SMALL BUSINESSES, HISTORICALLY BLACK COLLEGES AND UNIVERSITIES, AND OTHER MINORITY EDUCATIONAL INSTITUTIONS - This section shall describe the opportunities offered by the mission for small disadvantaged and women-owned small businesses, Historically Black Colleges and Universities, and other minority educational institutions. This section shall describe the type and percentage of work, expressed as a percentage of the proposed total contract price/cost, to be performed by these entities.

COMMERCIALIZATION - For those proposals involving a private sector partner(s), this section shall provide sufficient detail to describe the nature of the commercial opportunity(ies) including a description of the U.S. company(ies) involved, the nature of the commercial involvement (for example, launch services, instrument, other product or service), and the market to be addressed. If the commercial opportunity involves use of data that will be acquired by the mission, any data rights required by the private sector partner must also be defined (see section 3.2.3).

5.2.5 Cost

Proposals submitted in response to this AO must be of sufficient cost detail to enable NASA to make a fair and reasonable assessment of the NASA Mission

Cost (NMC) and the Total Mission Life Cycle Cost (TMLCC) of the proposed Baseline Science Mission. The term “cost” is defined as dollars actually expended for accomplishment of the mission during a given time period. Cost differs from “funding”, which is defined in the Funding Profile section below. The NMC represents the NASA-funded portion of the mission. The TMLCC is the total amount of resources used to produce the mission; that is, the NMC plus all non-NASA funded contributions. This includes direct and indirect costs that contribute to the mission, regardless of funding sources. The NMC for an ESSP mission must include the full cost of all civil service support to the mission, including science co-investigators, technical advisors, facilities, etc., unless contributed by their agency. If contributed, these resources must be included in the TMLCC.

Direct costs that can be specifically identified with an ESSP mission include: (a) salaries and other benefits for employees who work directly on the mission, (b) materials and supplies used directly in support of the mission; (c) various costs associated with office space, equipment, facilities, and utilities that are used exclusively to produce the mission; and (d) costs of goods or services received from other segments or entities that are used to produce the ESSP mission.

Indirect costs include resources that are jointly or commonly used to produce two or more types of products but are not specifically identifiable with any of the products. Typical examples include labor overheads, material handling, cost of money (COM), general administration, general research and technical support, security, rent, employee health and recreation facilities, operating and maintenance costs for buildings, equipment, and utilities.

Cost estimating procedures shall be based upon generally accepted cost accounting principles and practices and must be in accordance with the proposer's approved accounting system. Additional information on cost principles, procedures and definitions are found in the Federal Acquisition Regulations (FAR) in parts 30 and 31.

The methods by which the cost estimates are derived shall be described. If an estimate is based on heritage, the performance and cost parameters that the proposed system has in common with the previous or existing system shall be provided. An analysis of the impact of the referenced heritage on the risk of the proposed mission and on the proposed mission cost estimate shall also be provided. If cost models are used, a description of the model and the assumptions used to derive the cost estimates shall be documented. Identify any “discounts” assumed in the cost estimates for business practice initiatives or streamlined technical approaches. Describe how these have been incorporated in the cost estimate.

Copies of applicable forward pricing rate agreements shall be provided. Costing of Federal Government elements of proposals must follow the agency cost accounting standards for full cost. If no standards are in effect for the agency, the proposers must then follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board. NASA Centers may submit full cost proposals based on the instructions in the NASA Financial Management Manual, Section 9091-5, Cost Principles for Reimbursable Agreements.

All costs, including non-U.S. contributions, must be in U.S. Government real year dollars. Real year dollars are current fiscal year (FY) dollars adjusted to account for inflation in future years. The inflation rate index provided in Appendix M, Figure M-2 shall be used to calculate all real year dollar amounts unless an industry forward pricing rate is used and documented. Where cost phasing is requested, the cost plan shall provide data by U.S. Government fiscal year (October 1 - September 30) for Phases C/D and E and by Government fiscal quarter for Phase B. Requests for cost by "Phase" refer to Phases B, C/D, and E as defined in NASA Handbook (NHB) 7120.5. Costs shall be broken down to the system or subsystem level, as requested, in accordance with the proposer's Work Breakdown Structure (WBS), which shall be included for reference.

Separate Summaries of Elements of Cost by mission phase and Government fiscal year (fiscal quarter for Phase B) shall be provided at the appropriate WBS level for each major mission organization (i.e., the PI, each NASA-funded team member, each contributor, and each subcontract exceeding $1,000,000) as defined below. In addition, a roll-up Summary of Elements of Cost shall be provided for each organization. Appendix M, Figure M-3 is provided as a template for these costs. This format can be expanded to show additional phases and fiscal years. Major categories of cost shall be provided at the subsystem level for the flight system and at least the system level for all other items. The value of reserves shall be included and separately identified by WBS at the system level. A mission level Summary of Elements of Cost for the total NMC and the total TMLCC, which represents the total of all separate Summaries, shall also be provided, but need not be broken down by skill categories, overhead centers, etc.

The Summaries of Elements of Cost shall contain the following direct and indirect elements:

- DIRECT LABOR HOURS - Show productive hours by individual skill categories for Phases B, C/D and E.

- DIRECT LABOR COSTS - The labor costs shall be itemized by skill categories for Phases B, C/D and E.

- LABOR OVERHEAD - Overhead shall be itemized by cost centers (engineering, manufacturing, etc.) for Phase B and as totals by fiscal year for Phases C/D and E. Rates shall be documented for Phases B, C/D and E.

- SUBCONTRACTS - Supporting information shall be provided for all subcontracts exceeding $500,000 for phases B, C/D and E. This detail shall include name/address, cost, fee/profit, type of contract, number of quotes solicited/received, basis of selection, affiliation with the Prime, type of business, type of cost and price analysis accomplished, concise basis of estimate, and basis of selection.

- MATERIALS - Supporting detail for major vendors (exceeding $500,000) in Phases B, C/D and E shall include WBS element, fiscal year or quarter, description, vendor name/address, quantity, and current/proposed unit prices. Material burden rates shall be documented for Phases B, C/D and E.

- TRAVEL - Travel shall be summarized as totals for Phases B, C/D and E.

- OTHER DIRECT COSTS - Other direct costs shall be summarized as totals for Phases B, C/D and E.

- 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 shall be itemized by cost pool for Phase B and summarized as totals for Phases C/D and E. Rates shall be documented for Phases B, C/D and E.

- COST OF MONEY (COM) - COM represents interest on borrowed funds invested in facilities. COM shall be itemized by indirect pools and overhead centers for Phase B and summarized as totals by fiscal year for Phases C/D and E. Rates shall be documented for Phases B, C/D and E.

- PROFIT/FEE - Document the basis, rate, and amount of fee for Phases B, C/D and E.

- ESCALATION FACTORS - Document the escalation factors used to determine real year dollars for Phases B, C/D and E.

In addition to the Summaries of Elements of Cost, the proposer shall provide the following mission level information:

- Total costs will always equal total funding at program completion.

- SUMMARY OF COST RESERVES - A time phased summary of cost reserves shall be presented by Phase for all WBS elements that contain reserve. The proposed cost by element, the amount of reserve for each element, and the reserve as a percentage of the TMLCC for each element shall be provided. A rolled up summary of cost reserves, which represents a total of reserves for all WBS elements, shall also be provided.

- TOTAL MISSION LIFE CYCLE COST PHASING - Appendix M, Figure M-4 is provided as a template for the TMLCC phasing by fiscal year. Resources provided as contributions by international or other partners shall be included and clearly identified as separate line items. This is the only chart where NASA-funded costs and contributions by other partners are presented together.

- DESCOPE OPTIONS - The cost savings associated with all descope options presented in the Management section shall be time-phased and provided for all mission phases.

- FUNDING PROFILE - Provide a profile of required NASA-funding by fiscal year. The funding profile is derived from the cost profile which is the basis of the proposal. The funding for a given fiscal year is determined from the estimated costs in that year, less the funding carried over from the previous fiscal year, plus the forward funding needed to cover the costs of the first month in the following fiscal year, plus the forward funding required for “unfilled orders”. Unfilled orders refers to long lead items for which funding and costing takes place in different Government fiscal years. Because of forward funding, costs will not equal funding in any given fiscal year. Total costs shall equal total funding at program completion.

A complete cost plan as defined above is required. In addition, a Contract Proposal Cover Sheet, with level of information equivalent to an SF1448 (see Appendix G), shall be provided for NASA funding of (1) the total mission, (2) Phase B, and (3) Phases C/D/E combined.

5.3 International Participation

Participation of non-U.S. mission team members is allowed under the guidelines discussed in Section 3.3. All Step-Two proposals for missions with non-U.S. participants shall include a draft Memorandum of Understanding (MOU) between the Principal Investigator and each non-U.S. organization. Principal Investigators are urged to contact NASA's Office of External Relations (see Appendix L) for guidance with international affairs. The draft MOU is not required to be signed at the time of the Step-Two proposal, but should be representative of the terms and conditions under which mission team members would operate. The MOU must clearly identify the role of the two parties in the proposed mission and the resource(s) being provided, and must clearly commit and make available all identified resources to the mission by an identified time which is compatible with the mission's proposed milestones. All MOUs must be finalized and signed as defined in Section 3.3. Model MOU language can be found in Appendix F. MOUs do not count as part of the page limit for Step-Two proposals.

Non-U.S. institutions providing only Co-Investigators are not required to submit an MOU, but should submit a commitment letter. The Letter of Commitment must clearly identify the intended role of the organization in the proposed mission and the resource(s) being provided, and must clearly commit identified resources to the mission upon selection as an ESSP mission. The Letter of Commitment must be signed by an official with the authority to commit his/her organization's resources. Letters of Commitment do not count as part of the page limit for Step-Two proposals.

5.4 Submittal of Step-Two Proposals

5.4.1 Certification

The original copy of all proposals shall include a signature page(s) signed by an institutional official from each organization represented on the team authorized to certify institutional support and sponsorship of the investigation as well as concurrence in the management and financial parts of the proposal. This requirement includes all non-U.S. organizations. Additional certifications identified in Appendices J and K are required by law and must also be included.

5.4.2 Quantity

All proposers must provide 35 copies of their bound paper proposal, including the original signed proposal, on or before the proposal deadline. The proposals must be numbered sequentially from 1 to 35 in the upper right-hand corner of the cover page; the original signed proposal should be number 1. In addition to the

35 requested proposal copies, all proposers must provide 15 copies of all fold-out pages and color diagrams. The requirements for submittal of diskette copies of the proposal are defined in Section 5.1.1.

5.4.3 Submittal Address

All proposals shall be mailed to the following address:

ESSP Executive Secretary
Code Y
400 Virginia Avenue, S.W.
Suite 700
Washington, DC 20024
Phone: 202-554-2775

5.4.4 Submittal Deadline

All Step-Two proposals must be received on or before 4:00 p.m. Eastern Time on September 21, 1998. Proposals received after the established closing date and time will be treated in accordance with NASA's provisions for late proposals (NASA FAR Supplement 1815.412, Late Proposals, Modifications and Withdrawal of Proposals).

5.4.5 Notification

NASA will notify proposers in writing that their proposals have been received. Proposers not receiving this confirmation within two weeks after submittal of their proposals should contact NASA at the address given in Section 5.1.3.

5.4.6 Proposals Involving International Participation

The procedures for submission of proposals with non-U.S. participants are the same as those for strictly U.S. proposals, as previously outlined in this section. Additionally, one copy (over and above the 35 copies identified in Section 5.4.2) of any proposal that includes non-U.S. participants shall be sent to:

William W. Turner
Office of External Relations
Mail Code IY
Ref.: AO-98-OES-01
National Aeronautics and Space Administration
Washington, DC. 20546 USA
Phone: 202-358-0793

6.0 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Evaluation Criteria

The selection of investigations that best meet the scientific and programmatic objectives stated in the AO is the fundamental aim of the proposal evaluation process. The evaluation approach is designed to determine the missions with the best science value to NASA, adjusted for the probability that the science investigations can be achieved within established limits of cost and schedule. The information requested in Sections 4 and 5 will enable the evaluation panel to determine how well each mission team understands the complexity of the proposed mission, its technical risks, and any challenges which require specific action during Phase B. This information will also enable the evaluation panel to rank the proposed investigations, and will provide the necessary discriminators to permit the selection of those proposals which best meet all guidelines and constraints, and which address all elements viewed necessary for mission success.

6.1.1 Step-One Proposal Evaluation

Evaluation of the Step-One Proposal is intended to assess the in-depth scientific merits, justification and maturity of the proposed investigation in relation to the science priorities, as well as the goals and objectives of the ESSP Program and the overall Earth Science Enterprise. As such, the Step-One evaluation will consider the proposed scientific justification and Science Traceability Matrix (see Section 4.2.2) as the basis from which overall scientific merit and ESSP/OES Program relevance are assessed. The Instrumentation Technical Maturity Matrix and any instrumentation heritage and/or precursors will be assessed to determine the maturity level of the proposed instrumentation. The proposed instrumentation will be evaluated for its applicability to the required physical measurements. Proposed missions which seek to address a broad variety of scientific issues at various disparate levels without attempting to resolve a particular issue will be scored lower than focused missions which articulate a well-defined scientific justification by means of the Sensitivity Analysis and Science Traceability Matrix.

The following are the primary criteria for evaluation of the Step-One Proposal and are of equal importance:

〈 The overall scientific merit of the proposed investigation, including the Minimum Science Mission, as measured by:

- The scientific justification of the proposed investigation; and
- The coherence of the traceability between the proposed scientific

objectives and the measurements required to fulfill these objectives (i.e., instrument functional requirements), as well as the traceability between the instrument functional requirements and the instrument/mission engineering requirements.

- The degree to which the proposed mission addresses the science priorities, goals and objectives of the ESSP Program and is complementary to EOS and other OES approved flight programs.

- Relevance of the proposed investigation to the Earth Science Enterprise and its science priorities.

- The feasibility of the proposed instrumentation.

- The expertise and experience of the science team in relation to the proposed science measurement objectives.

The criteria above will combine with the Step-Two Proposal evaluation criteria as a basis for mission selection.

The following criteria are of equal weight, but of less importance than the above.

- The adequacy of the correlative measurement and validation activities.

- The adequacy of the data processing and distribution plan, including arrangements for the timely release of the processed data to the public domain.

- The feasibility of the proposed mission implementation and management approaches to meet the scientific and programmatic objectives of the ESSP Program.

6.1.2 Step-Two Proposal Evaluation

The Step-Two Proposal will be evaluated in a manner that provides emphasis on the science value of the mission, which will be assessed by integrating the science and cost evaluations of the mission.

Science value will be rated at approximately the same weight as the combination of Technical and Opportunity. Technical will be approximately equal in importance to Management and will be weighted significantly greater than Opportunity.

A general description of evaluation criteria for each of the five proposal sections follows. The degree to which a proposed ESSP investigation meets the various criteria will be determined by the evaluators and ratings assigned.

6.1.2.1 Step-Two Evaluation Criteria

6.1.2.1.1 Science Evaluation Criteria

Each mission will be evaluated for its scientific return, feasibility, resiliency and the probability of success. Evaluation of scientific return will be based on the Step-One rating, adjusted as necessary on the basis of any new information submitted. In addition, the timeliness of dissemination of mission data product(s) to the broad user community and the methods to be employed will be considered. Feasibility will be determined by evaluating the degree to which the mission will address the stated scientific goals and objectives; the degree to which the instrument set can provide the necessary data; the maturity of scientific understanding for retrieving the information content of the observations (i.e., algorithm development); the adequacy of any proposed correlative measurements to calibrate and/or validate the observations; and the approach to data quality assessment, production of science data products in geophysical data record format, and external data product dissemination. The proposed instrumentation will be evaluated for soundness, achievability, and the feasibility of making the required measurements. The differences between the Baseline Science Mission and the Minimum Science Mission, if any, will be assessed in order to determine the mission's scientific resiliency in the event that development problems lead to reductions in scope. Risk mitigation plans will also be considered. Finally, the probability of success will be determined by considering the experience, expertise, and organization of the science team, incorporating the Step-One evaluation; the overall risk associated with the science objectives; and the maturity of the proposed instrumentation, including the Instrumentation Technical Maturity Matrix.

6.1.2.1.2 Technical Evaluation Criteria

The Technical evaluation will consider the proposer's understanding of the processes, products, and activities required to accomplish development of all mission elements (e.g., flight segment, ground and data systems, mission operations etc.) required to execute the mission, as well as the adequacy of the proposed approach. The Mission Traceability Matrix will be evaluated to assess the derivation of the proposed mission design from the stated objectives, requirements, and constraints of the proposed investigation. The technical approach will be examined in its entirety to ensure that: (1) all elements and processes are addressed; (2) weaknesses and design issues are understood and plans for resolution have been identified; (3) fundamental design trades

have been identified and studies planned; and (4) primary performance parameters have been identified and minimum thresholds established. The overall approach (including schedule), the specific design concepts, and the known hardware/software will be evaluated for soundness, achievability, and maturity. The evaluation will consider proposed technologies, including commercial off-the-shelf technology, their benefit to the mission and potential risk. Resiliency and margins will be a consideration in the evaluation. The probability of success will be determined by evaluating the experience and expertise of the technical organizations and the programmatic and technical risk associated with the mission design, including the launch service. The Spacecraft Technical Maturity Matrix will be evaluated to determine the maturity level of the proposed spacecraft design. In addition, innovative, cost-effective features, processes, or approaches will be rewarded if shown to be sound.

6.1.2.1.3 Opportunity Evaluation Criteria

The information provided in the Opportunity section will demonstrate the proposer's plans for educational and public outreach programs, opportunities for small disadvantaged and women-owned small businesses and minority educational institutions, and commercial opportunities for private sector partners. Educational program activities will be evaluated on their potential impact for different educational levels, and public information programs will be evaluated for their potential to excite and involve the public. The extent of participation at the prime or subcontract level of small disadvantaged businesses, women-owned small businesses, Historically Black Colleges and Universities, and other minority educational institutions will be evaluated. Commercial opportunities will be evaluated on the potential for business success of the proposed opportunity, as demonstrated in the market description; the level of investment by the private sector as an indicator of shared mission risk; and any other benefits to the mission as a result of commercial involvement. Relevance to the current NASA and National strategies will also be evaluated, as well as the plans for monitoring and assessing progress in these areas.

6.1.2.1.4 Cost Evaluation Criteria

The information provided in the Cost section will be used to evaluate the adequacy and realism of the total proposed cost within the constraints established in this AO for ESSP missions. The intent of the cost evaluation process will be to appraise the total mission cost and determine the overall risk associated with the cost elements. The basis, heritage and quality of the cost estimates and the probability that the mission can be achieved within the proposed schedule for the proposed resources (including NASA funding and contributions) will be assessed. The same evaluation standards will be applied to NASA-provided and contributed resources. Given the risks associated with

full-up end-to-end missions, the adequacy of cost measures to decrease the risk to mission success will be evaluated. The clarity of the relationship between identifiable technical and schedule risks and the planning, identification, tracking, and application of reserves will be assessed. Past cost performance by the PI and major partners on similar missions will be reviewed in terms of the probability of mission success.

6.1.2.1.5 Management Evaluation Criteria

The information provided in the Management section will demonstrate the proposer's plans, processes, organization and personnel for managing and controlling the development and operation of the mission and will be evaluated on the soundness, completeness and specificity of the approach and the probability that the management team can assure mission success. The soundness and completeness of the approach will be determined by reviewing the organizational structure (including roles, responsibilities, accountability, and decision making process), the key personnel, and the processes, plans, and strategies the team will use to manage the various mission elements (including contributions) and provide NASA insight. Criteria will include clear lines of authority; clean interfaces; prudent scheduling and cost control mechanisms and review processes; demonstrated awareness of all necessary management processes, etc. The probability of mission success will consider, for both NASA-funded and contributing organizations, the experience, expertise, and commitment of key personnel, as well as the organizations to which they are attached; the proposed contractual arrangement between NASA and the mission team as well as between team members, including contractual performance and incentives; the adequacy of facilities and equipment proposed for the mission; the adequacy of proposed mission assurance and safety plans, including compatibility the ESSP Project Mission Assurance Guidelines and Requirements and compliance with the ESSP Project Safety Requirements; the adequacy of the team's approach to risk management, including descoping options; and the adequacy of the management and control mechanisms. The quality and specificity of the proposed Statements of Work, Mission Definition and Requirements Agreement and other required contractual documentation will be evaluated to assess the maturity of the mission management approach. Innovative management processes and plans which are expected to improve performance and reduce costs will be rewarded.

6.2 Evaluation and Selection Process

Proposals received in response to this AO will be reviewed and selected in accordance with the procedures stated in NASA FAR Supplement 1872.4 as modified by this section. All non-U.S. proposals will go through the same evaluation, selection, and approval process as proposals originating in the U.S.

Evaluation panels, using scientific, technical, management and administrative peers and experts, will assess the strengths and weaknesses of each proposal and will provide the NASA Headquarters Office of Earth Science with a summary report.

The Step-One Proposals received will be peer reviewed by a scientific and technical peer panel and evaluated according to the evaluation criteria in Section 6.1.1. Evaluation of the Step-One Proposal is intended to assess the in-depth scientific merits, justification and maturity of the proposed mission in relation to the science priorities, goals and objectives of the ESSP Program and the overall Earth Science Enterprise. Each proposer will be provided with an early determination of the scientific and technical merit of the proposed investigation and instrumentation, along with a high level risk assessment of the mission implementation approach. Based on this evaluation, each proposal will be assigned an adjectival science rating and a risk assessment. On the basis of the science ratings, which include feasibility of the proposed instrumentation, NASA will select the missions to be recommended to proceed to Step-Two, and notify each proposer accordingly. NASA intends to recommend only a limited number of highly rated investigations for continuation to Step-Two.

Those proposers choosing to continue with the AO process will then be required to submit Step-Two Proposals. NASA will consider only those proposals whose objectives or methodologies have been evaluated in Step-One. Any proposal whose objectives or methodologies have not been evaluated, including proposals whose objectives or methodologies have changed from Step-One, will not be considered in Step-Two. The scientific and technical aspects of each compliant Step-Two Proposal will be assessed in accordance with the evaluation criteria in Section 6.1.2 by individuals who are scientific peers of the proposers and technical experts. Concurrently, the implementation aspects (management, cost, and opportunity) will be evaluated by management, cost and technical experts. After the individual evaluations, the Science, Technical, Management, Cost and Opportunity panels will meet to consider the total quantitative and qualitative aspects of the evaluations in order to integrate the findings of the individual reviewers. The evaluation panels may also prepare questions requesting clarification, which will be transmitted to the appropriate proposers for prompt response. After these evaluations, the panels will meet in plenary in order to integrate the separate panel results. Panel evaluation reports will represent the final product of the combined evaluation team.

The ESSP Evaluation Executive Committee, consisting of the Evaluation Chairperson and the chairs of the individual evaluation panels will, upon consideration of the reports of the evaluation panels, integrate the science return and cost evaluations of each mission to provide an assessment of science value. The committee will then categorize all proposals in accordance with the category

definitions contained in NASA FAR Supplement 1872.4. On the basis of these categorizations and review and recommendation of the Earth Science Systems Program Office, the Associate Administrator for Earth Science will select the proposals to be supported as the primary investigations for definition as well as the alternate mission. Contract award will be dependent on approval of the various implementation documents (e.g., Mission Definition and Requirements Agreement, Statements of Work, etc.) and other proposed contract documents.

NOTICE TO ALL OFFERORS: In the event that a Principal Investigator employed by NASA is selected under this Announcement of Opportunity (AO), NASA will award prime contracts to non-Government participants, including co-investigators, hardware fabricators, and service providers, who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. Each NASA contract with hardware fabrications and service providers selected in this manner will be supported by an appropriate justification for other than full and open competition, as necessary.

Certain key provisions concerning selections are also given in Appendix A.

6.3 Contract Administration and Funding

Different mission management approaches and organizational arrangements will require different contract administration and funding arrangements. The PI is expected to recommend, as part of the teaming arrangement, the organizations and contract mechanisms NASA should use in awarding work to the team. Participation by international partners will be on a no-exchange-of-funds basis. Therefore, any non-U.S. PI must make arrangements with a U.S. co-PI to fund U.S. participants under the proposal.

For missions selected as a result of this AO, it is anticipated that cost-reimbursement contracts will be awarded for the Definition Study Phase, with an option for the design, development, mission operations and data processing and distribution phases. The proposed NMC will be considered to be fixed and committed at selection. A post-selection survey may be conducted by the ESSP Project Office to ensure that commitments of equipment, technical resources, facilities, and letters of agreement between affiliated mission team members reflect the written proposal, the Mission Definition and Requirements Agreement, Statements of Work, and other proposed contract documents.

In order to expedite contract award after selection, all proposed contractual documentation, if accepted by NASA, will be considered executable upon selection. However, NASA reserves the right to negotiate all contract terms and conditions following mission selection.

7.0 CONCLUSION

The ESSP Program represents a challenging and innovative approach for NASA to accomplish important scientific investigation of the Earth system. It provides an opportunity for frequent flights to execute science investigations at the forefront of Earth System Science, as well as offering commercial partnering and investment opportunities. NASA invites both the U.S. and international science communities to participate in proposals for ESSP missions to be carried out as a result of this Announcement.

Dr. Ghassem Asrar
Associate Administrator
Office of Earth Science
NASA Headquarters

APPENDIX A

GENERAL INSTRUCTIONS AND PROVISIONS

I. INSTRUMENTATION AND/OR GROUND EQUIPMENT

By submitting a proposal, the investigator and institution agree that the National Aeronautics and Space Administration (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.

III. SELECTION WITHOUT DISCUSSION

The Government intends to evaluate proposals and make selections without discussions with offerors (except for communications conducted for the purpose of minor clarification). Therefore, the Step-Two Proposal 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. NON-U.S. 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 Section 3.3 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 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 cost information in accordance with FAR 15.8.

VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated, should such action be in the interest of the Government.

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 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

By submitting a proposal, the investigator and institution agree to accept the following clause in any resulting contract:

During the performance of this contract, the Contractor agrees as follows:
(a) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
(b) The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (1) employment, (2) upgrading, (3) demotion, (4) transfer, (5) recruitment or recruitment advertising, (6) layoff or termination, (7) rates of pay or other forms of compensation, and (8) selection for training, including apprenticeship.
(c) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.
(d) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(e) The contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding the notice to be provided by the Contracting Officer, advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.
(f) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.
(g) The Contractor shall furnish the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within 30 days following the award, unless filed within 12 months preceding the date of award.
(h) The Contractor shall permit access to its books, records, and accounts by the contracting agency or the Office of Federal Contract Compliance Programs (OFCCP) for the purposes of investigation to ascertain the Contractor's compliance with the applicable rules, regulations, and orders.
(i) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, the contract may be canceled, terminated, or suspended in whole or in part, and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.
(j) The Contractor shall include the terms and conditions of subparagraph (a) through (I) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.
(k) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as means of enforcing these terms and conditions, including sanctions for non-compliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

XI. PATENT RIGHTS

1. 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 contract, request waiver of rights as set forth in the provision at NFS 18-52.227-71, "Requests for Waiver of Rights to Inventions".

2. 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. DATA RIGHTS

For any NASA contract resulting from this solicitation, the clause at FAR 52.227-14, "Rights in Data - General" (as modified by NFS 18-52.227-14) shall apply.

XIII. PARTICIPATION OF SMALL, SMALL DISADVANTAGED, AND WOMEN-OWNED SMALL BUSINESSES, AND MINORITY INSTITUTIONS

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 disadvantaged business concerns, women-owned small business concerns, Historically Black Colleges and Universities, and minority educational institutions, as these entities are defined in 52.219-8 of the FAR and 1852.219-76 of the NASA FAR Supplement. For this Announcement of Opportunity, NASA has established a goal of 8 percent for the participation of these entities at the prime or subcontractor level. This goal is stated as a percentage of the total contract value.

NASA encourages all offerors to propose to meet or exceed this goal to the maximum extent practicable and to encourage the development of minority businesses and institutions throughout the contract period. Offerors will be evaluated on the proposed goal for participation of the entities listed above in comparison with the 8 percent goal and on the methods for achieving the proposed goal.

B. Offerors are advised that for NASA contracts resulting from this solicitation which offer subcontracting possibilities, exceed $500,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 shall apply. Offerors who are selected under this AO will be required to negotiate subcontracting plans which include subcontracting goals for small, small disadvantaged, and women-owned small business concerns. Note that these specific subcontracting goals differ from the 8 percent goal described in paragraph A above, and need not be submitted with the proposal. Failure to submit and negotiate a subcontracting plan after selection shall make the offeror ineligible for award of a contract.

APPENDIX B

ESSP LAUNCH SERVICES INFORMATION

NASA seeks to take advantage of all reasonable sources of commercial expendable launch vehicle (ELV) services while assuring that NASA-funded payloads are not exposed to excessive risk. Accordingly, the launch vehicles available to launch ESSP missions pursuant to this AO must be acquired/managed consistent with NASA Policy Directive (NPD) 8610. The available launch service options for ESSP missions are described in Section 3.1.3. This appendix provides performance, interface and cost information for NASA-provided expendable launch services under this AO.

A SELVS II launch services contract is in work with contract award targeted for calendar year 1998. The MLELV (Med-Lite) launch services include launch on the Delta 732X (three strap-on Solid Rocket Motor's (SRM's)) and the Delta 742X (four strap-on SRM's).

Figures B-1 through B-3 illustrate the launch vehicle performance currently available for the various launch services noted above. The range of performance anticipated as available under the SELVS II launch services contract(s) is also noted. Delta performance is shown for the two available fairings (9.5 foot fairing and 10 foot diameter). Spacecraft mass capability is shown for circular orbits of 28.5 degrees inclination in Figure B-1, 50.0 degrees inclination in Figure B-2 and Sun-Synchronous inclination in Figure B-3.

The fairing envelopes available for the various vehicles are shown in Figures B-4 through B-6. Figures B-4 and B-5 show the 9.5-foot and 10-foot diameter fairings available on the Delta launch vehicles. Figure B-6 shows the minimum SELV II fairing volumes required by the SELV II Request For Proposal RFP10-98-0016.

NASA's launch services contracts include the provision of spacecraft/launch vehicle integration, analysis, and post-flight mission data evaluation. NASA also provides spacecraft processing at the launch site and technical oversight of the launch vehicles and coordinates mission-specific integration activities. Figure B-7 shows integration activities for a typical mission.

Table B-1 provides the funding required for each launch service, including annual phasing by fiscal year, which should be used for proposal purposes. Funding estimates assume a fiscal year 2002 launch and are given in real year dollars. The cost estimate for launches in years later than 2002 may be calculated by applying the inflation indices in Appendix M, Figure M-2. The funding profiles provide for advanced mission integration and analysis support, launch services, typical mission unique launch vehicle modifications, mission integration, launch site payload processing, as well as a the full-cost accounting for NASA contract administration, technical and mission support and launch service contract oversight. Costs associated with payload

caused launch delay penalties are the responsibility of the mission team and are not included in this estimate.

Users guides for the Med-Lite launch vehicles are provided in the ESSP Program Library (see Appendix G). Requisite information for SELV-II launch services is contained in this Appendix. No User's Guides are currently available for SELV II launch services For purposes of NASA provided launch services, additional information (including, but not limited to, performance quotes and mission integration inquiries) and official response to questions from prospective proposers may only be obtained from the GSFC Orbital Launch Services Project via facsimile (301/286-1696) or e-mail at Hobart.Swartwood@gsfc.nasa.gov. Mr. Swartwood is the authorized launch services contact for this AO. Information obtained from any source other than Mr. Swartwood shall not be considered acceptable for response to this AO.

Hobie Swartwood
Orbital Launch Services Project
GSFC / Code 470
Greenbelt, MD 20771

Phone: (301) 286 - 0431

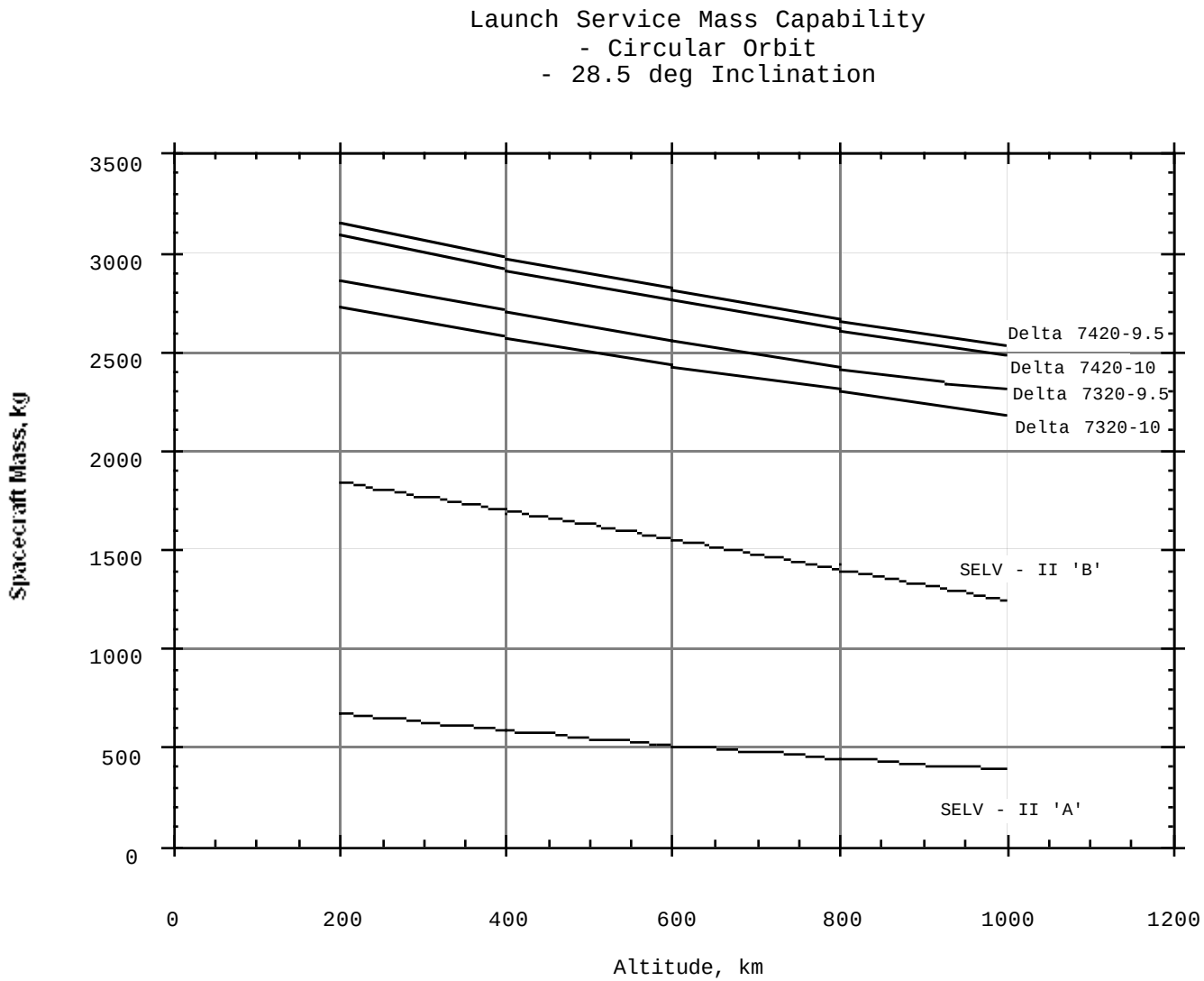


Figure B-1 Launch Service Capability for Circular Orbits, Inclination 28.5 degrees

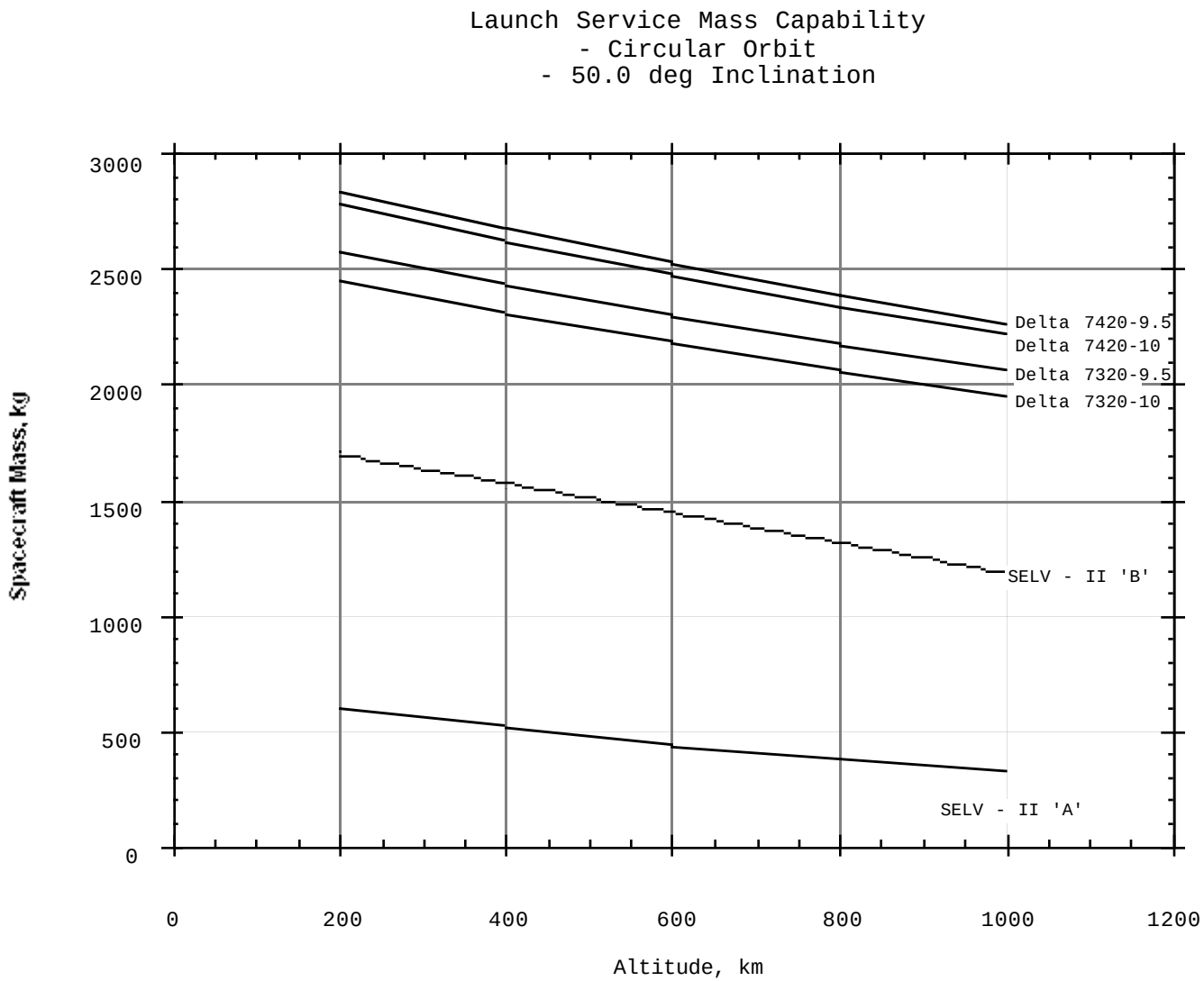


Figure B-2 Launch Service Capability for Circular Orbits, Inclination 50.0 degrees

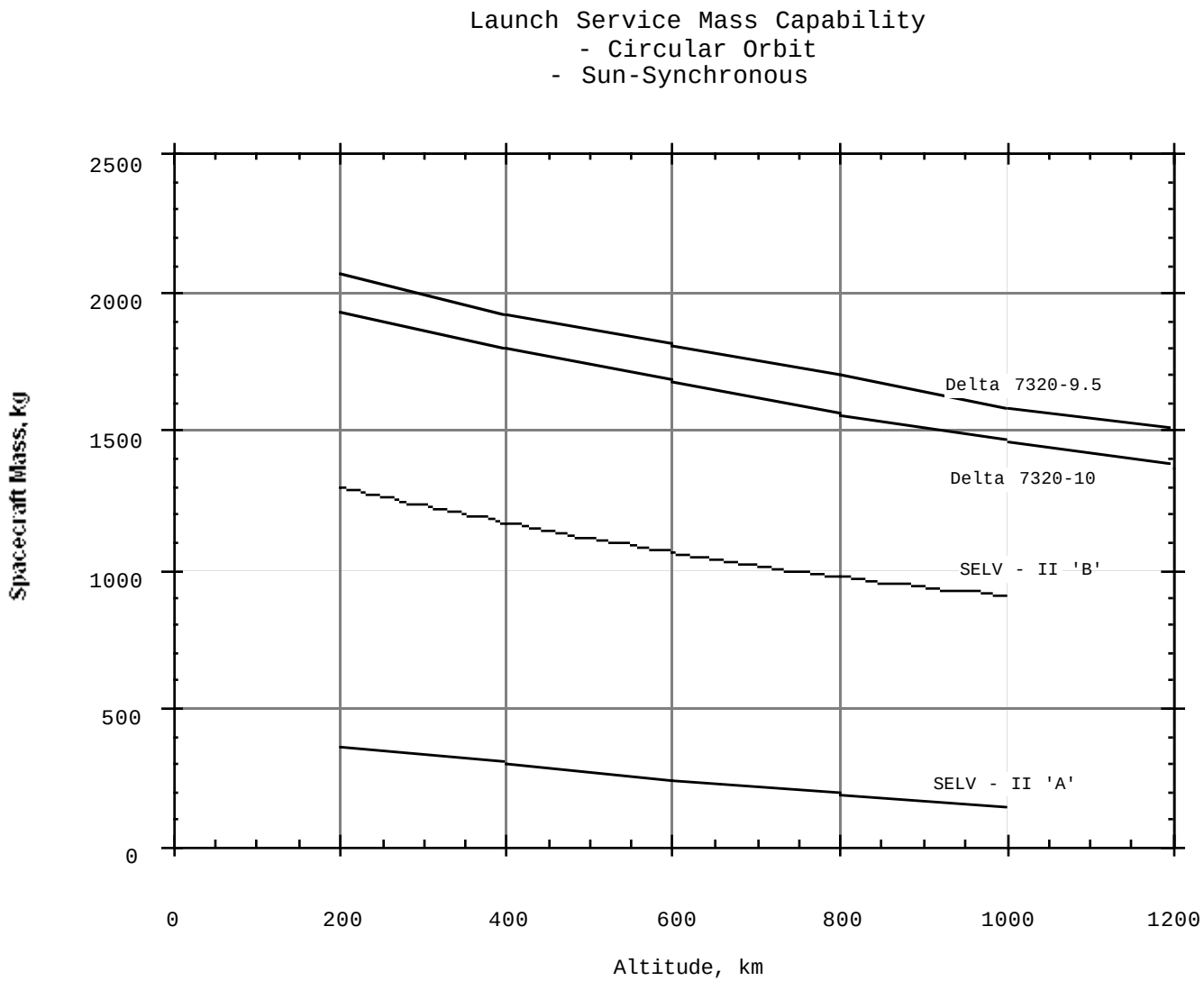


Figure B-3 Launch Service Mass Capability for Circular Sun-Synchronous Orbits

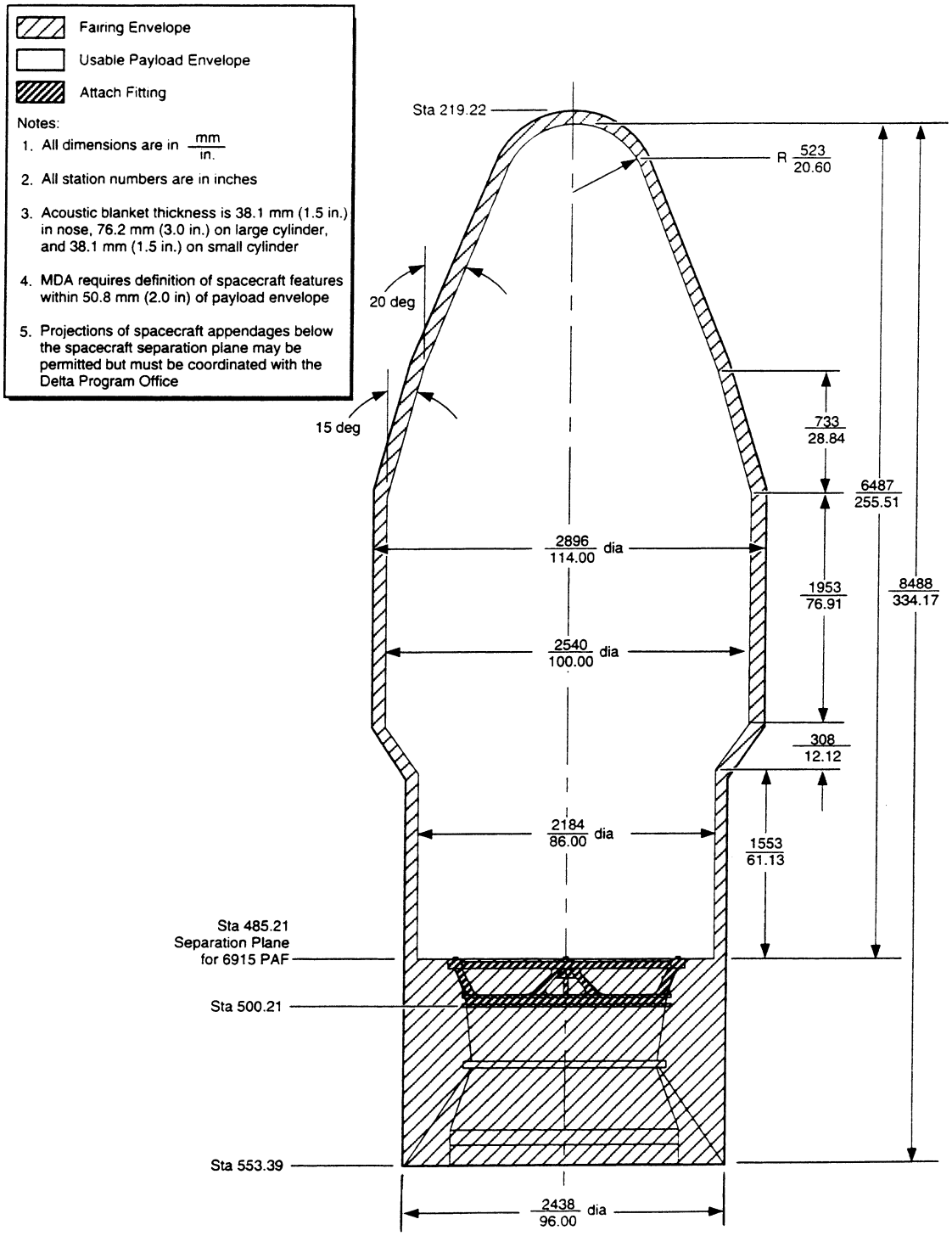


Figure B-4 Spacecraft Envelope, 2.9m (9.5 ft) Diameter Fairing, Two-Stage Configuration (6915 PAF)

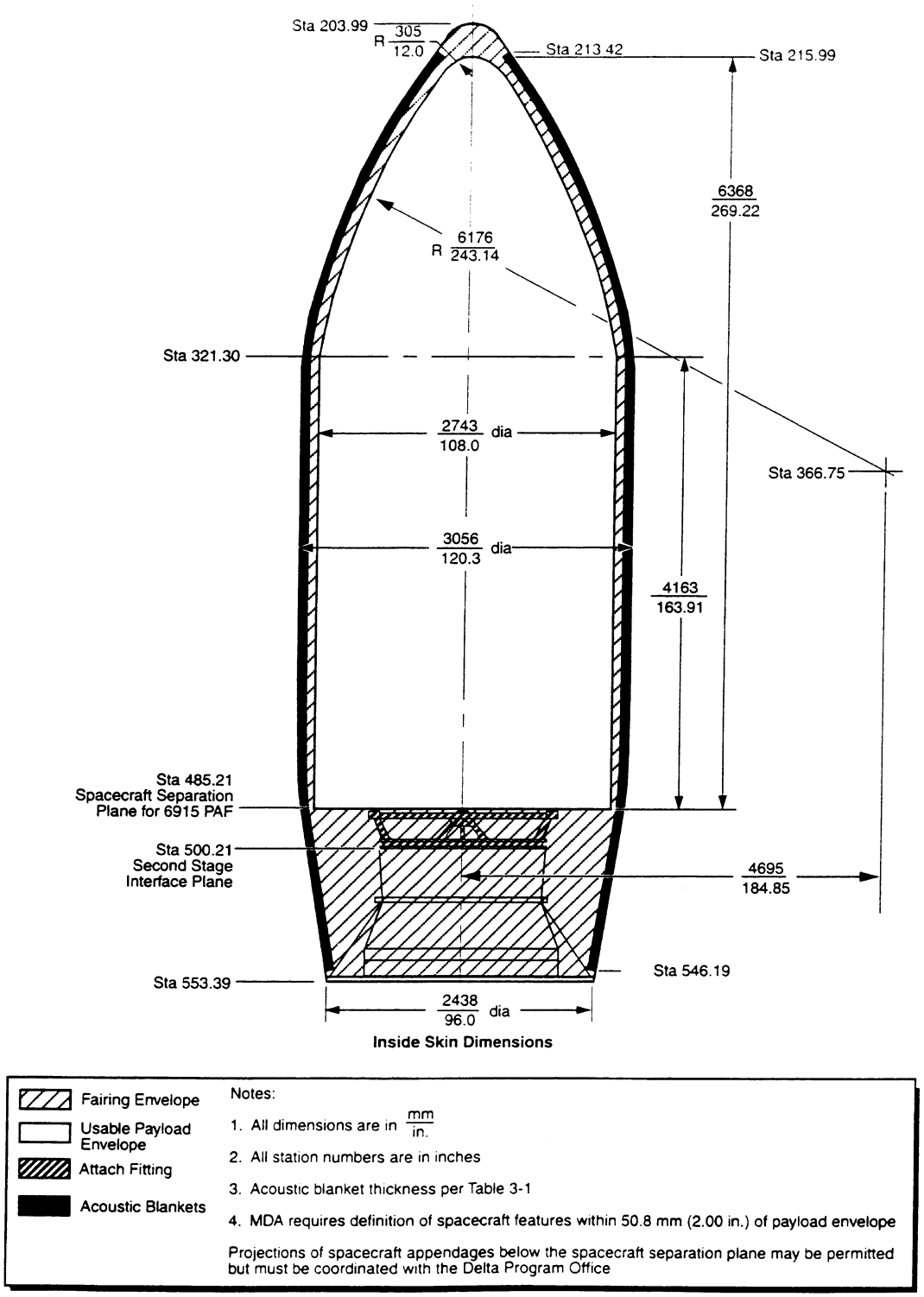
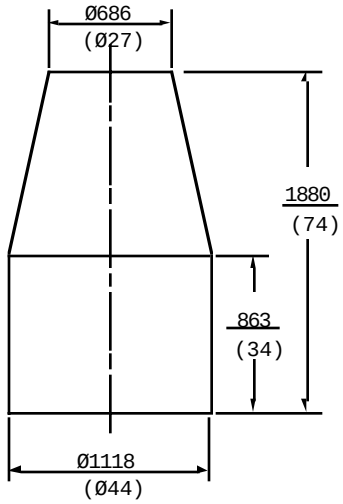


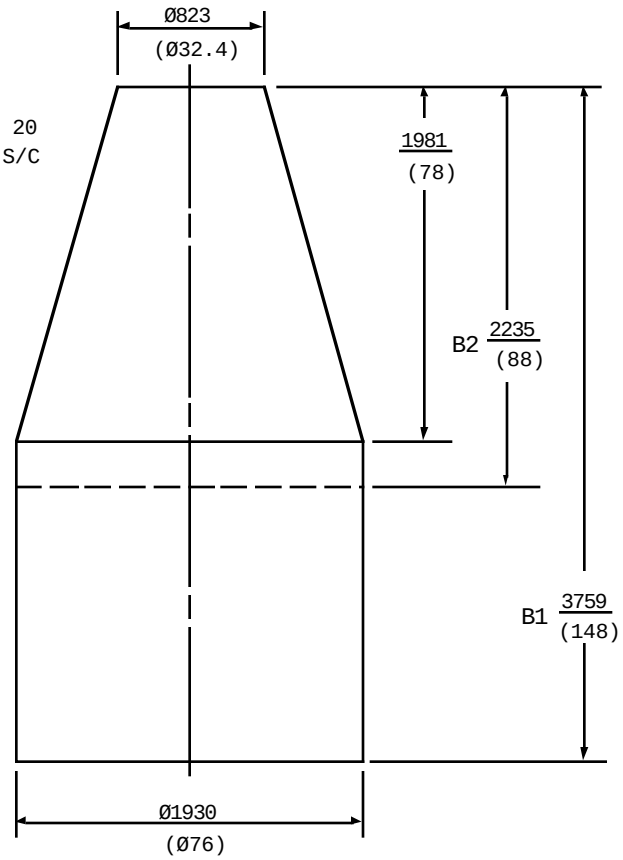
Figure B-5 Spacecraft Envelope, 3m (10ft) Diameter Fairing, Two-Stage Configuration (6915 PAF)

Notes:

(1)Dimensions are millimeters (inches)

(2)Payload static envelopes assume minimum payload lateral frequency of 20 Hz when rigidly supported at PAF-to-S/C interface.





Payload Static Envelope A Payload Static Envelopes B1 & B2

Figure B-6 Spacecraft Envelope, SELV II A and B Fairings

Figure B-7: Typical Mission Integration Activities

Agency	Milestones	Weeks 100 90 80 70 60 50 40 30 20 10 0
Spacecraft	Spacecraft Questionnaire	L-104 Launch
Spacecraft	Spacecraft Dynamics Mathematical Model	L-90 Initial L-48 Final
Spacecraft	Spacecraft Environ. Test Document	L-84
Launch Vehicle	Mission Specification	L-84 Initial
Spacecraft	Spacecraft Drawings	L-78 Initial L-44 Final
Launch Vehicle	Coupled Dynamic Loads Analysis	L-68 Initial L-26 Final
Spacecraft	Spacecraft Missile Systems Pre-Launch Safety Package	L-58
Spacecraft	Mission Analysis Inputs	L-54 Prelim L-38 Final
Spacecraft	S/C Program Requirements Doc.	L-52
Launch Vehicle	Mission Analysis Report	L-44(PMA) L-28(FMA)
Spacecraft	Spacecraft Launch Site Procedures	L-18

Table B-1: Launch Service Costs Summary ($ in Millions)

LAUNCH SERVICE	FY'99	FY'00	FY'01	FY'02	TOTAL COST
SELV II 'A'	-	15.0	8.6	1.4	25.0
SELV II 'B'	-	21.0	11.5	2.5	35.0
MED-LITE Delta 7320-9.5	7.5	16.0	16.5	5.0	45.0
MED-LITE Delta 7420-9.5	8.0	16.4	16.6	5.0	46.0
MED-LITE Delta 7326-9.5 (w/Upper Stage)	8.4	17.0	17.0	5.6	48.0

NOTE: Assumes a Fiscal Year 2002 launch, in real year dollars.

APPENDIX C

EOSDIS INTERFACES AND STANDARDS

EOSDIS Required Interface

ESSP PI's are required to make their products and data services available to the broader Earth Science community via the EOSDIS Core System (ECS) Advertising Service. The Advertising Service will enable users to locate data, information, and services both internal and external to EOSDIS. PI's will populate the ECS Advertising Service with appropriate information on their instrument and data products, and provide pointers to their World Wide Web (WWW) page or other client interface for search and access. Documentation on "advertising" data and services via ECS is provided in the ECS technical paper, "442 TP-001-001 External Data Provider Options", at http://edhs1.gsfc.nasa.gov.

Data Archival

ESSP PI's are required to archive their data at one of the EOSDIS Distributed Active Archival Centers (DAAC) for use of the science community. These Centers are described in the web site at : http://ecsinfo.hitc.com/sec4.sec4.html.

Data and Metadata Standards

To facilitate access to ESSP data by the Earth Science community, it is recommended that ESSP missions produce data products in the HDF-EOS (hierarchical data format) standard data format and that they generate and store metadata describing their data products that conforms to the intermediate level of the ECS Metadata Standard. Information on HDF-EOS and the ECS Metadata Standard is provided below. If a PI proposes to use other methods or standards for data products and metadata, then cost savings and rationale should be provided, and the conversion of data from the chosen format(s) to HDF (for transition to long term archives) must be included in the cost proposal.

The production of data in the HDF-EOS standard data format will provide the capability to use public domain and commercial data analysis and data management tools and provide the highest level of service (e.g., subsetting, subsampling) for data sets when they are migrated to EOSDIS. The HDF-EOS Primer, HDF-EOS Specification, and HDF-EOS Application Program Interfaces may be located via the WWW at http://eos.nasa.gov/esdis/InfoArch. Software for producing HDF-EOS data, serving HDF-EOS data on the WWW, and visualizing HDF-EOS data is also referenced at this Web page.

Adherence to the intermediate level of the ECS Metadata standard will result in the creation of directory, inventory and guide level information compatible with EOSDIS Version 0 data standards and facilitate future interoperability with EOSDIS Version 0 and future ECS-based versions. In addition, population of the ESSP metadata with this information will facilitate migration of data into ECS. The ECS "DID 311, SDPS Database Design and Database Schema Specifications for the ECS, Appendix B, Mandatory Metadata" may be located via the WWW at http://eos.nasa.gov/esdis/InfoArch. Software supporting this standard is also described at this site.

Systems and Software Available for ESSP Missions

In addition to software which supports the standards described in the preceding paragraphs, EOSDIS Core System software for science data archiving, production, distribution, and access will be available for reuse.

A white paper describing the available systems and software, titled "ECS Support for Federated Systems", is available via the WWW at http://edhs1.gsfc.nasa.gov. References on External Data Provider interfaces to ECS are documented in "819-RD-001-001, ECS Application Programming Interface (API) Interface Definition Document (IDD)", which is available via the WWW at http://edhs1.gsfc.nasa.gov.

Proposers can propose to use EOSDIS software and interfaces, which will be provided at no cost, to meet these interfaces. Proposers, however, must include the cost of required software licenses and hardware in their proposal.

APPENDIX D

SAMPLE MISSION DEFINITION AND REQUIREMENTS AGREEMENT

MISSION DEFINITION AND REQUIREMENTS AGREEMENT

for the

GRAVITY RECOVERY AND CLIMATE EXPERIMENT (GRACE) MISSION

UNIVERSITY OF TEXAS
CENTER FOR SPACE RESEARCH

July 31,1997

1.0 MISSION OVERVIEW

The primary goal of the GRACE mission is to obtain accurate global and high resolution models for both the static and the time variable components of the Earth's gravity field. This goal will be achieved by making accurate measurements of the inter-satellite range and range rate between two co-planar, low altitude polar orbiting satellites, using a micro-wave tracking system. In addition, each satellite will carry geodetic quality Global Positioning System (GPS) receivers and high accuracy accelerometers to enable accurate orbit determination, spatial registration of gravity data and the estimation of gravity field models.

The gravity field estimates obtained from data gathered by the GRACE mission will provide, with unprecedented accuracy, integral constraints on the global mass distribution and its temporal variations. In the oceanographic community, the knowledge of the static geoid, in conjunction with satellite altimeter data, will allow significant advances in the studies of oceanic heat flux, long term sea level change, upper oceanic heat content, and the absolute surface geostrophic ocean currents. Further, the estimates of time variations in the geoid obtained from GRACE, in conjunction with other in-situ data and geophysical models, will help the science community unravel complex processes in oceanography (e.g. deep ocean current changes and sea level rise), hydrology (e.g. large scale evapo-transpiration and soil moisture changes), glaciology (e.g. polar and Greenland ice sheet changes), and the solid Earth Sciences.

This mission will be relevant to the goals of both MTPE EOS and the USGCRP. Implementation of the mission will be efficient and cost effective due to international collaboration. The GRACE Principal Investigator (PI), Dr. Byron Tapley of the University of Texas, Austin Center for Space Research (UTCSR), has established teaming arrangements with a Co-Principal Investigator, Prof. Dr. Christoph Reigber of the GeoForschungZentrum (GFZ), Germany; the Jet Propulsion Laboratory (JPL), Space Systems Loral (SS/L), the Dornier SatellitenSysteme, GmbH, the Applied Physics Laboratory (APL) at Johns Hopkins University, ONERA and the Langley Research Center (LaRC) to implement the GRACE mission. The PI will have overall responsibility for the total mission, including the instrument, spacecraft, ground system, mission planning and operations, data processing and analysis, and data distribution. Dr. Tapley will be supported by experienced management and engineering teams, which have established close and efficient working relationships. The Deutsche Forschungsanstalt fur Luft and Raumfahrt (DLR) and GFZ will work under an International Memorandum of Understanding (IMOU) between NASA and DARA (Germany). JPL and LaRC will perform under task orders from the Goddard Space Flight Center (GSFC) ESSP Project Office. SS/L, Dornier, APL and ONERA will perform under contract with JPL.

2.0 SCIENCE OBJECTIVES

2.1 Baseline Science Mission

Primary Objective:

The primary objective of the GRACE mission is to provide gravity models with accuracies that better existing global and high spatial resolution models of the Earth's gravity field by at least an order of magnitude, on a monthly basis, for a period of up to 5 years. The temporal sequence of gravity field estimates provide the mean (or static) gravity field, as well as a time history of its temporal variability. The scientific data products to be generated by GRACE including the line of sight inter-satellite tracking, GPS and accelerometer measurements, along with the ancillary data will be made available to the science community via the PODAAC at JPL in an EOS compatible format, shortly after validation for the entire life of the mission.

Secondary Objectives:

The secondary objectives are related to demonstrating the ability of the gravity measurements to discriminate time varying changes in the mass of the Earth's dynamic system, and to provide additional data to support investigation of the Earth's atmosphere. Specifically, these secondary objectives are:

- To demonstrate the ability to monitor the time varying effects due to sea level rise, water storage, ice change, and other geophysical phenomena, from a temporal sequence of gravity measurements.

- To advance atmospheric model studies by collecting several hundred globally distributed profiles of the ionosphere and the atmosphere every 24 hours, using GPS limb-sounding.

Baseline Science Objectives Summary

Accurate and high resolution estimates of the mean and time variable parts of the Earth gravity field will be obtained from satellite-to-satellite tracking data gathered from the GRACE mission. The mean value and time variations of the spherical harmonic coefficients of the Earth gravity field will be estimated using 12 to 24 day batches or cycles of these data. The accuracy of the estimated spherical harmonic coefficients can be expressed as the global root mean square (rms) error in the resulting area mean geoid height over a disk of a specified radius (or spatial resolution). Using 90 days of data, the nominal GRACE mission scenario will yield geoid height accuracies of better than 0.01 mm for spatial resolutions larger than 3000 km, increasing to 0.02 mm at 1000 km, 0.05 mm at 500 km and 5 mm at 100 km spatial resolutions.

These nominal GRACE gravity field estimation errors can be further specified in terms of the primary science applications, as detailed in the original proposal. Table 1 presents the spatial and, where appropriate, temporal scales for the associated geoid accuracy requirements to support each scientific applications

Table 1 Baseline science objectives summary

APPLICATION	SPATIAL RESOLUTION	TIME SCALE	ACCURACY	COMMENTS
STATIC GRAVITY FIELD				
Oceanic Heat Flux	> 1000 km		> 40 percent improvements	
Ocean Currents	> 1000 km		< 1 mm geoid error	Improves to <0.1 mm for longest scales
Solid Earth Sciences	200 km		approx. 1 cm geoid error	
TIME VARIABLE GRAVITY FIELD				
Ocean Bottom Pressure	> 500 km	Seasonal	0.05 mBar pressure	90 day estimate
Deep Ocean Currents	> 500 km	Seasonal	1 cm/sec current velocity	90 day estimate
Sea Level Rise	> 700 km	Secular	0.1 mm/yr. water level	5 year estimate
Evapo - Transpiration	> 300 km	Seasonal	< 1 cm water equivalent	30 day estimate
Aquifer Depletion	> 300 km	Secular	1 - 2 mm/year water equivalent	5 year estimate
Greenland / Antarctic Ice		Secular	0.4 - 0.8 mm/yr. ice thickness	5 year estimate
- do -		Seasonal	3 - 10 mm ice thickness	1 year estimate

2.2 Minimum Science Mission

As a minimum goal for a successful mission, the GRACE measurements should support the requirement for at least an order of magnitude improvement in the marine geoid. This improvement will enhance dramatically the recovery of the general ocean circulation and ocean heat flux from satellite altimetry. This improvement is a current requirement of both the MTPE EOS and the World Ocean Circulation Experiment. To achieve minimum objectives of the GRACE mission, a static gravity field with a cumulative error of 5 mm root mean square over wavelengths 800 km and longer should be obtained. This will require separating the static and time varying signals during the observation interval. This goal should be readily attainable on the basis of one year of calibrated and validated data from GRACE's dual satellite microwave tracking system.

2.3 Science Data Products

2.3.1 Science Data Rights

There will be no proprietary science data rights for the mission. Science data will be made available to the public and the science community in an EOS compatible format after the appropriate science calibration and validation. The data and the associated higher level products will be made available in batches or cycles of 14 to 30 days each.

The Level-1 data products include the calibrated and verified satellite-to-satellite line of sight biased range and range rate, along with the GPS tracking data and precise ephemerides for the GRACE satellites. These data will be made available to the scientific community within 30 days of the last observation in each cycle.

The Level-2 data products include validated solutions for cycle averages of the Earth gravity field, in the form of coefficients of a spherical harmonic expansion and their time variations. These data products will be provided along with the equivalent 1x1 degree area mean geoid height and gravity anomalies on a global and regional basis. In addition, the one year average Earth gravity field model in the form of spherical harmonic coefficients as well as geoid height and gravity anomaly maps will be provided. The Level-2 products will be made available within 90 days of the last observation in each cycle.

The Level-3 data products contain higher level solutions targeted for geophysical quantities of interest. These include apparent changes in the 500 km disk averaged ocean bottom pressure as well as continental water storage over each

cycle or averaging interval, as well as their longer term (annual and secular) variations. The Level-3 data products will be funded through a separate GRACE Mission Science Data Analysis Program and will be available on a schedule that is consistent with the selected investigation objectives.

2.3.2 Measurement Requirements

The Level 1 science measurement requirements are contained in Table 2. These requirements are consistent with successful accomplishment of the science objectives listed in paragraph 2.1 above.

Table 2 Level 1 Science Requirements

Science Investigation	Instrumentation	S/C	Ground Ops	Mission Design	Mission Ops.	Comments
Earth Gravity Field	m-wave SST link, GPS Rcvr, Accelero-meter	2	Data Rate: 20 Mb/day	Inc 83°-90° Alt 450 km Life 5 yrs Sep 200 km	Orbit Maneuver Every 12 to 60 days	< 1m/s SST < 1 nm/s^2 Accelero-meter
Atm Occult	GPS Rcvr.	1	Data Rate: 20-40 Mb/d			

2.3.3 Descope Options

A cascade of options for descoping the implementation and operations efforts (i.e. a Descope Plan) will be developed during Phase B. The Descope Plan will provide clarity in terms of how the primary scientific applications will be affected as each descope option is implemented. As a minimum, the Descope Plan will address any reductions in technical accuracy, mission lifetime and science data products. The descope options leading to the minimum science requirements described in Section 2.2 will be defined during the Phase B effort.

3.0 MISSION AND PROJECT REQUIREMENTS

3.1 Mission Cost and Budgetary Requirements

The GRACE mission will be undertaken on a "design-to-cost" basis. As proposed, the mission shall be accomplished with a cost to NASA of no more than $X. Failure to keep the estimated cost to complete the mission at any stage of the development of the mission may be cause for termination. Annual funding will be reflected in contracting vehicles between NASA GSFC and the implementing organizations. Adjustments within the overall "design-to-cost" funding level will be made between years through the normal contracting process. Approval will be sought from NASA for reductions in funding for “opportunity” activities.

3.2 Schedule

The Level-1 schedule milestones are listed below:

Project Requirements Review:	Apr 1998
Mission Design & Cost Review:	Dec 1998 (or sooner)
Critical Design Review	Mar 1999
Pre-Ship Review	Mar 2001
Internal Progress Reviews	(bi-annual)
Deliver Spacecraft to Launch Site	Jun 2001
Launch	Jul 2001
End of Mission	Jul 2006

3.3 Management System

The mission will establish an effective and efficient management system which will assure that the science objectives can be accomplished within the schedule and cost limitations. As a minimum the following management requirements will be met:

- The GRACE mission will be undertaken on a "design-to-cost" basis;
- All hardware and software will be verified through robust testing;
- Quality assurance program will be consistent, or exceed, standards set in ISO 9000;

- The Principal Investigator (PI) will exercise overall responsibility for the mission implementation and the leadership of the US Science Team;
- The PI will form and chair a Project Management Team (PMT) which will coordinate all program elements between organizations in both countries;
- The Co-PI will serve as a member of the PMT, lead the European Science Team, and provide management oversight of all German operations in support of this project;
- The Project Manager (PM), acting through JPL, will lead the satellite and system implementation effort, and be responsible for the mission and systems engineering team;
- DLR will be the lead agency for the mission operations effort of this project;
- GFZ will be the lead agency for the launch vehicle of this project

Any requisite modifications to these requirements for Phase C, D and E will be defined during Phase B.

3.3.1 Scheduling

A fully integrated scheduling system will be established and implemented during Phase B to manage all project elements. This system will include the development of network schedules and critical paths. A Level-1 baseline schedule will be developed during Phase B and approved by NASA.

3.3.2 Performance Metrics

A system to measure mission progress will be established and implemented during Phase B which is compatible with the scheduling and cost control systems.

3.3.3 Key Personnel

Changes in the key personnel, defined as the Principal Investigator and the Project Manager, will be subject to NASA approval. The key DARA and DLR personnel will be approved by the respective organizations.

3.3.4 Contract Deliverables

Major contracts which are developed as part of the mission will reflect the science nature of the investigation. As appropriate, deliverables will focus on the science products, and incentive plans will reflect the science deliveries. For this mission, primary emphasis is placed on cost and schedule.

3.3.5 Incentive Fee Plans

Implementation contracts will provide incentives to the contractor for both adherence to cost commitments and technical performance. Subcontracts from JPL for the GRACE Mission are currently in negotiations. Subcontractors include the Johns Hopkins Applied Physics Laboratory, Dornier SattelitenSysteme, Space Systems Loral and ONERA. Upon completion of contract negotiations, a discussion of fee pools and incentive plans will be added to this section.

3.4 Legal Requirements

The Project will abide by all necessary U.S. federal (including NASA), state and local laws and regulations.

3.5 New Facilities

There are no new project specific major facilities required for this mission

3.6 Descope Plan

The PI is responsible, directly and indirectly, through recommendations to the GSFC Mission Manager, for implementing the Descope Plan when it appears that the mission cannot meet its baseline science requirements. If a descope is necessary, the Descope Plan will describe how the Mission will meet the minimum science, budget and schedule requirements.

4.0 MISSION RESPONSIBILITIES

4.1 Principal Investigator and Science Team

The Principal Investigator (PI) will be responsible to NASA for achieving the objectives of the mission. The PI will establish and chair the Project Management Team (PMT) in order to coordinate the elements of the mission being executed by all the participants. The PI shall approve the designation of a single individual as Project Manager at JPL, and shall delegate to this individual the requisite responsibility and authority to manage and administer the effort to implement the GRACE mission. Decisions dealing with mission objectives will be made by the PI, in consultation with the PMT. The PI will also lead the scientific analysis team responsible for data analysis and distribution.

The Co-Principal Investigator (Co-PI), Prof. Dr. Christoph Reigber of GFZ, will be responsible to the PI for oversight of launch and on-orbit operations in fulfilling the mission requirements. He will also provide leadership of the European Science Team.

The Project Manager (PM) shall have delegated to him the requisite responsibility and authority to manage and administer the effort to implement the GRACE mission. This individual shall be the focal point of contact for GSFC. The PM shall ensure that all the objectives associated with the implementation effort are accomplished within schedule and cost constraints, and provide timely reporting of overall progress.

The tasks of the PMT, which consists of the PI, Co-PI, PM and other designated individuals, are to ensure that the program is guided in a responsive manner to maximize the science gains for the mission cost consistent with the constraints of ESSP.

The Science Team will be as described in the Science Requirements sub-section (Section 2.9) of the original proposal. The PI may change the composition of the science team to meet the objectives of the Mission, with notification of such changes to the ESSP Project Office. International participation will be consistent with the NASA/DARA Memorandum of Understanding.

4.2 Industrial Partners

Space System/Loral (SS/L) will perform the satellite system engineering, assembly, integration, and verification testing (AIVT).

The Dornier Satelliten Systeme, GmbH, an affiliate of Daimler-Benz Aerospace (DASA) will initiate the satellite system engineering process in an manner that optimizes the inheritance from Germany's CHAMP Mission, and is responsible for development of the thermal, structural and power systems of the satellites, and will also support launch integration on the COSMOS and launch operations.

4.3 Other Pre-selected Subcontractors

The Applied Physics Lab (APL) at Johns Hopkins University will develop the ultra stable oscillators (USO) to be used for the frequency standards in the SST tracking systems.

ONERA (France) will provide the accelerometers for the two satellites.

5.0 NASA RESPONSIBILITIES

The NASA HQ Code IY will provide support in the development of a Memorandum of Understanding (MOU) with the international partners on the GRACE mission. The GSFC ESSP Project Office will provide mission funding, contract administration and programmatic oversight for the GRACE mission. To implement the GRACE Mission, the ESSP Project Office will provide funds

directly to three members of the GRACE Team - UTCSR, JPL and LaRC, as requested by the PI. Furthermore, the ESSP Project Office may provide other mission unique support, only as may be requested by the PI in writing and agreed upon by the ESSP Project Manager. In the event such support is requested, a portion of the PI's Mission Funds would be retained by the ESSP Project Resources Office, to be disbursed as requested by the PI.

6.0 REPORTING AND NASA REVIEWS

Reporting requirements and NASA reviews will be kept to a minimum while ensuring that NASA maintains an effective understanding of the progress of the development and execution of the mission. To this end, reports and supporting materials will be based on internal Project products and processes to the maximum extent practical. The details will be developed during Phase B between the PI, the Project Manager and the NASA Mission Manager.

NASA reviews will be conducted annually typically in conjunction with major project reviews by a team appointed by the ESSP Project Office to assess the progress of the mission and its readiness to proceed to the next phase. These reviews will assess technical, cost and schedule progress to verify that the project can be completed in accordance with the Level-1 requirements within the cost and schedule commitments. The results of these reviews will be reported to the Earth Science Systems Program Office, (ESSPO), to confirm that the mission should be continued.

APPENDIX E

REGULATIONS GOVERNING PROCUREMENT OF FOREIGN GOODS OR SERVICES

The following Federal Acquisition Regulation (FAR) clauses cover the purchase of foreign goods and services and may be included in contracts resulting from this Announcement of Opportunity:

52.225-3 Buy American Act -- Supplies (January 1994)

52.225-1 Certificate

52.225-7 Balance of Payments Program (April 1984)

52.225-8 Certification of Supplies or Services for use Outside the U.S.

52.225-9 Buy American Act -- Trade Agreements -- Balance of Payments Program (January 1994)

52.225-10 Duty-Free Entry (April 1984)

52.225-11 Restrictions on Certain Foreign Purchases (Oct 1996)

52.225-18 European Community Sanction for End Products (Jan 1996)

52.225-19 European Community Sanction for Services (Jan 1996)

52.225-21 Buy American Act -- North American Free Trade Agreement Implementation Act -- Balance of Payments Program (January1997)

The proposer is directed to the Federal Acquisition Regulation for further information on these regulations.

APPENDIX F

ELEMENTS TO BE INCLUDED IN ARRANGEMENTS BETWEEN U.S. PRINCIPAL INVESTIGATORS AND COOPERATING FOREIGN PARTIES UNDER THE ESSP PROGRAM

The following elements should be included in arrangements between approved Principal Investigators and foreign parties contributing to or cooperating in activities under the ESSP Announcement of Opportunity.

SCIENCE DATA RIGHTS

Unless otherwise agreed between NASA and the Principal Investigator, all data resulting from this cooperative activity will be made available to all users without restriction at no more than the cost of dissemination, through appropriate data archives in the United States and [foreign country]. In the event that reports or publications based upon this data are copyrighted, the Parties and NASA shall have a right under the copyright to reproduce, prepare derivative works from, perform, display, and distribute copies of such copyrighted work for their own purposes royalty-free.

EXCHANGE OF TECHNICAL DATA AND GOODS

The parties are obligated to transfer only those technical data and goods necessary to fulfill the responsibilities under this Agreement, in accordance with the following provisions:

1. Interface, integration, and safety data (excluding detailed design, development, production and manufacturing data, and associated software) shall be exchanged by the Parties without restrictions as to use or disclosure, except as specifically required by national laws and regulations.
2. In the event a Party finds it necessary to transfer technical data or goods other than that specified in paragraph 1 above, in carrying out its responsibilities under this Agreement, the provisions of this paragraph shall apply. In transferring data and goods which are proprietary or subject to export controls, and for which protection is to be maintained, such technical data shall be marked with a notice and such goods shall be specifically identified that they shall be used and disclosed by the receiving Party, institutions acting on its behalf, and its contractors and subcontractors only for the purposes of fulfilling the receiving Party's responsibilities under this Agreement, and that the technical data and identified goods shall not be disclosed or retransferred to any other entity without prior written permission of the furnishing Party. The receiving Party agrees to abide by the terms of the notice, and to protect any such

marked technical data or identified goods from unauthorized use,

retransfer, and disclosure. Nothing in this article requires the Parties to transfer technical data or goods contrary to national laws and regulations relating to export control or control of classified data.

3. The Parties are under no obligation to protect any unmarked technical data and goods transferred under this Agreement shall be used exclusively for the purposes of fulfilling the Parties' responsibilities under this Agreement.

LIABILITY

1. With regard to the activities undertaken pursuant to this Agreement, neither party shall make any claim against the other or the other's related entities (contractors, subcontractors, other providers, collaborating organizations, and contractors, subcontractors of these parties, or employees of the other or of the other's related entities) with respect to injury or death of its own employees or employees of its related entities, or with respect to damage of any kind to or loss of its own property or property of its related entities, whether such injury, death, damage or loss arises through negligence or otherwise, except in the case of willful misconduct. This cross-waiver of liability shall apply only if the person, entity or property causing the damage is involved in activities under this Agreement, and the person, entity or property damage is damage by virtue of its involvement in activities under this Agreement. For purposes of this Agreement, the National Aeronautics and Space Administration is a related entity of [U.S. PI or co-PI].

2. The parties further agree to extend this cross-waiver of liability to their respective related entities by requiring them, by contract or otherwise, to agree to waive all such claims, against the other Party and its related entities for injury, death, damage or loss arising from the activities undertaken pursuant to this Agreement.

3. This cross-waiver of liability shall not be applicable to:
   - claims between a Party and its related entity or between its own related entities;
   - intellectual property claims;
   - claims made by a natural person, his/her estate, survivors, or subrogees for injury or death of such a natural persons, except where a subrogee is one of the Parties; and
   - claims for damage based upon a failure of the Parties or their related entities to flow down the cross-waiver.

[Note: This liability arrangement may be superseded by the liability provisions of a launch license issued under the Commercial Space Launch Act.]

APPENDIX G

CONTENTS OF THE ESSP PROJECT LIBRARY

The ESSP Project Library includes documents available from a number of internet web sites as well as paper copies. Where the same document is available as paper copy and electronically, proposers are requested to access the document electronically unless internet access is unavailable. Only limited paper copies of documents will be available. Note that not all documents are available in the ESSP Project Library, but access information is provided.

The ESSP Project Library is accessible on the World Wide Web at the URL address:

http://essp.gsfc.nasa.gov/essplib/

Requests for paper copies must be submitted in writing to:
ESSP AO
Code Y
400 Virginia Avenue, SW
Suite 700
Washington, DC 20024
or fax request to: 202-554-3024

EARTH SCIENCES REFERENCES:

NASA:

Harriss, R. et al, (1996), NASA Mission to Planet Earth Science Research Plan, NASA Headquarters, Washington, DC 20546
(URL: http://www.hq.nasa.gov/office/ese/draftsciplan/mtpe-srp.htm)

Mission to Planet Earth/Earth Observing System Reference Handbook,
(URL: http://espso.gsfc.nasa.gov/eos_reference/TOC.html)

Science Strategy for the Earth Observing System
(URL: http://espso.gsfc.nasa.gov/sci_strategy/contents.html)

Science Plan for Earth Observing System
(URL: http://eospso.gsfc.nasa.gov/sci_plan/chapters.html

NASA Earth Sciences Enterprise (Mission to Planet Earth)
general information,
(URL: http://www.hq.nasa.gov/office/mtpe)

NASA Earth Science Systems Program Office general information:
(URL: http://mtpe.gsfc.nasa.gov)

Earth System Science Pathfinder Project general information:
(URL: http://essp.gsfc.nasa.gov)

EXTERNAL:

National Academy of Sciences (1995) A Review of the U.S. Global Change Research Program and NASA's Mission to Planet Earth/Earth Observing System
(URL: http://www.gcrio.org/online.html)

Committee on Environment and National Resources (CENR) Research of the National Science and Technology Council (1996) Our Changing Planet: the FY 98 U.S. Global Change Research Program, A Supplement to the President's Fiscal Year 1998 Budget
(URL: http://www.gcrio.org/ocp98/toc.html)

ESSP PROJECT DOCUMENTATION:

GRACE Mission Definition and Requirements Agreement (MDRA)

VCL Mission Definition and Requirements Agreement (MDRA)

GRACE Phase B Statement of Work (SOW)

GRACE Phase C/D/E Statement of Work (SOW)

VCL Phase B Statement of Work (SOW)

VCL Phase C/D/E Statement of Work (SOW)

GRACE Contract between UTCSR and NASA

VCL Contract between UMCP and NASA

GRACE Task Plans between JPL and NASA

Generic Contract Terms and Conditions for ESSP Missions (Educational Institution)

Generic Contract Terms and Conditions for ESSP Missions (Commercial Organization)

The VCL Science & Mission Requirements Document

ESSP Mission Confirmation Plan

LAUNCH SERVICES:

NPD 8610 Launch Services Risk Mitigation Policy for NASA, NASA-Sponsored Payloads

Delta II Med-Lite Payload Planners Guide

FEDERAL ACQUISITION REGULATIONS (FAR) ELECTRONIC VERSIONS ONLY:

Federal Acquisition Regulations (FAR) General Services Administration (URL: http://www.gsa.gov/far/)

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

NASA Financial Management Manual (URL: http://www.hq.nasa.gov/fmm/)

GENERAL REFERENCE INFORMATION:

Management of Major System Programs and Projects (NHB 7120.5)

Earth Science Systems Program Office Library (MTPE Library) (URL: http://envnet.gsfc.nasa.gov/MTPELibrary**)**

EOSDIS Information (URL: http://edhs1.gsfc.nasa.gov/)

Standard Form SF1448 Proposal Cover Sheet (URL: http://www.gsa.gov/forms/one.htm)

NASA's Mission Operations and Communication Services (SOMO)

RELIABILITY AND QUALITY ASSURANCE, MATERIALS AND EEE PARTS:

Office of Flight Assurance, GSFC
(URL: http://arioch.gsfc.nasa.gov/)

NASA Technical Standard NASA-STD-8739.3, Soldered Electrical Connections

NASA Technical Standard NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring.

NAS 5300.4(3J-1), Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies

NASA Technical Standard NASA-STD-8739.7, Electrostatic Discharge Control (Excluding Electrically Initiated Explosive Devices)

NHS 5300.4 (3M), Workmanship Standard for Surface Mount Technology.

ANSI/IPC-D-275, Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies, Class 3

IPC 6011 and IPC 6012, Class 3 as the basic specification requirements with GSFC S-312-P-003B, Procurement Specification for Rigid Printed Wiring Boards for Space Applications and other High Reliability Uses as a supplement.

NASA Technical Standard NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation

SAFETY

NSTS 1700.7B, "Safety Policy and Requirements for Payloads Using the Space Transportation System".

45 SPW S-100/KHB 1700.7B, "Space Shuttle Payload Ground Safety Handbook"

EWR 127-1, "Eastern and Western Range Safety Requirements"

RSM-93, “Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)”

(SSD TD-0005) (currently Rev B). "Pegasus Design Safety Requirements Document"

(SSD TD-0018) (currently Rev A) "Pegasus Safety Requirements Document for Ground Operations"

NPD 8710.3 NASA Policy for Limiting Orbital Debris Generation
(URL: http://arioch.gsfc.nasa.gov/302)

NSS 1740.13 Guidelines and Assessment Procedures for Limiting Orbital Debris

OTHER WEB PAGES

The following internet World-Wide-Web Homepages (URL addresses) may provide additional information of interest:

NASA Office of Earth Science Homepage:
(URL: http://www.hq.nasa.gov/office/mtpe)

ESSPO Homepage:
(URL: http://mtpe.gsfc.nasa.gov)

ESSP Project Homepage:
(URL: http:/essp.gsfc.nasa.gov)

APPENDIX H

ESSP AO ACRONYMS

AO	Announcement of Opportunity
API	Application Programming Interface
CAS	Cost Accounting Standards
CCSDS	Consultative Committee for Space Data Systems
CENR	Committee on Environment and National Resources
CDR	Critical Design Review
Co-I	Co-Investigator
COM	Cost of Money
COTS	Commercial Off the Shelf
CVCM	Collected Volatile Condensable Mass
DAAC	EOSDIS Distributed Active Archival Centers
DPA	Destructive Physical Analysis
ECS	EOSDIS Core System
EEO	Equal Employment Opportunity
ELV	Expendable Launch Vehicle
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ESE	Earth Sciences Enterprise
ESSPO	Earth Science Systems Program Office
ESSP	Earth System Science Pathfinder
ETR	Eastern Test Range
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center
FMEA	Failure Modes and Effects Analysis
FRR	Flight Readiness Review
G&A	General and Administrative
GDS	Ground Data System
GIDEP	Government Industry Data Exchange Program
GRACE	Gravity Recovery and Climate Experiment Mission
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HDF	Hierarchical Data Format
IDD	Interface Definition Document
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
LRR	Launch Readiness Review
MCR	Mission Confirmation Review
MDRA	Mission Definition and Requirements Agreement
MLELV	Medium Lite Expendable Launch Vehicle
MOU	Memorandum of Understanding
MRR	Mission Readiness Review

MTPE	Mission to Planet Earth (now known as Earth Science Enterprise)
NASA	National Aeronautics and Space Administration
NHB	NASA Handbook
NMC	NASA Mission Cost
NMP	New Millennium Program
NPD	NASA Policy Directive
NOI	Notice of Intent
NRA	NASA Research Announcement
NSS	NASA Safety Standard
OES	Office of Earth Science
OLS	Orbital Launch Services
PAF	Payload Attach Fitting
PDR	Preliminary Design Review
PER	Pre-Environmental Review
PI	Principal Investigator
PM	Project Manager
PRR	Preliminary Readiness Review
RSDO	Rapid Spacecraft Development Office
SB	Small Business
SDAP	Science Data Analysis Program
SDB	Small Disadvantaged Business
SELV	Small Expendable Launch Vehicle
SF	Standard Form
SI	International System of Units
SOMO	Space Operations and Management Office
SOW	Statement of Work
SRR	System Requirements Review
SRTM	Shuttle Radar Topography Mission
STS	Space Transportation System
TDRSS	Tracking and Data Relay Satellite System
TML	Total Mass Loss
TMLCC	Total Mission Life Cycle Cost
TRL	Technology Readiness Level
TRMM	Tropical Rainfall Measurement Mission
UESP	University Earth Science Program
USGCRP	U.S. Global Change Research Program
VCL	Vegetation Canopy Lidar Mission
WBS	Work Breakdown Structure
WFF	Wallops Flight Facility
WTR	Western Test Range
WWW	World Wide Web

APPENDIX I

GLOSSARY OF TERMS

CO-MANIFESTED LAUNCH

Launch of an ESSP spacecraft as the primary payload on the same launch vehicle with another payload.

DEDICATED LAUNCH

Launch of an ESSP spacecraft as the only payload aboard a launch vehicle.

NASA MISSION COST

That portion of the proposed mission cost to be funded by NASA, including full costing of non-contributed civil service resources.

PAYLOAD OF OPPORTUNITY

Launch of an ESSP instrument payload aboard a commercial spacecraft.

PHASE B

Early program Definition and Design Phase leading to Phase C/D development, integration and test. Phase B will terminate in a Mission Confirmation Review (MCR).

PHASE C/D

Program Design and Development Phase leading to Mission Launch.

Phase E

Program Operations Phase including mission operations, data collection and dissemination.

PI-MODE

A mission implementation mode whereby a Principal Investigator assembles a mission team to propose an investigation and, if selected, to assume full responsibility for all aspects of the mission. This mode contrasts with the more traditional approach whereby NASA has “brokered” the mission by contracting individually for the various mission components.

SCIENCE RETURN

The combination of the proposed mission’s relevance to the science priorities, goals and objectives of the Earth Science Enterprise and ESSP Program; complementary to EOS; overall scientific merit; and quality, quantity, relevance and timeliness of deliverable science data products.

SCIENCE VALUE

An assessment of the relationship between science return and the proposed NASA Mission Cost.

TOTAL MISSION LIFE CYCLE COST

The total proposed mission cost, which is the sum of the NASA Mission Cost and all contributions from mission team partners.

APPENDIX J

CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
PRIMARY COVERED TRANSACTIONS

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
(b) Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification;
(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lowered Tier Covered Transactions (Subgrants or Subcontracts)

(a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.
(b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name	AO or NRA Number and Title
Printed Name and Title of Authorized Representative	
Signature	Date
Printed Principal Investigator Name	Proposal Title

APPENDIX K

CERTIFICATION REGARDING LOBBYING

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant or cooperative agreement over $100,000, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Organization Name AO or NRA Number and Title

Printed Name and Title of Authorized Representative

Signature Date

Printed Principal Investigator Name Proposal Title

APPENDIX L

SERVICES AND RESOURCES

SERVICES AVAILABLE FROM CODE IY

The NASA Office of External Relations (HQ Code IY) may be contacted for assistance and information relative to international participation in ESSP missions.

The contact is:

William W. Turner
Office of External Relations
Mail Code IY
Ref.: AO-98-OES-01
National Aeronautics and Space Administration
Washington, DC. 20546 USA
Phone: 202-358-0793
Fax Number: 202-358-2798

SERVICES AVAILABLE FROM THE GODDARD SPACE FLIGHT CENTER

Consistent with its mission and subject to the availability of resources, the Goddard Space Flight Center will assist Principal Investigators (PIs) in any or all aspects of mission development, from systems engineering and mission management through on-orbit satellite operation. Upon request, GSFC is prepared to provide access to the Center's institutional capabilities, including facilities, equipment, and expertise in science, engineering, technology, and project management to support and enhance the abilities of the scientific and supporting technical communities to conduct scientific investigations.

These services include:

1) Consultation:

A minimum number of technical and programmatic consulting hours can be provided to answer questions and provide guidance during the proposal preparation phase.

2) Mission Support Services:

Services of a scientific, technical or programmatic nature that commits Center resources to assist, team or partner with Principal Investigators (PI's) in any or all aspects of mission development, and/or provide mission hardware, software or services, are available. GSFC will work with the Principal Investigator to plan and coordinate agreed upon services. These services are made available on a "full cost basis".

The single point-of-contact to coordinate any and all aspects of the use of GSFC resources in response to this Announcement of Opportunity(AO) is:

New Business Office
System Technology and Advanced Concepts Directorate
NASA GSFC
Mail Code 740.1
Greenbelt MD 20771
Phone: (301) 286-6076
Fax: (301) 286-1763

APPENDIX M

CHARTS and TEMPLATES

TECHNOLOGY READINESS LEVEL DEFINITIONS

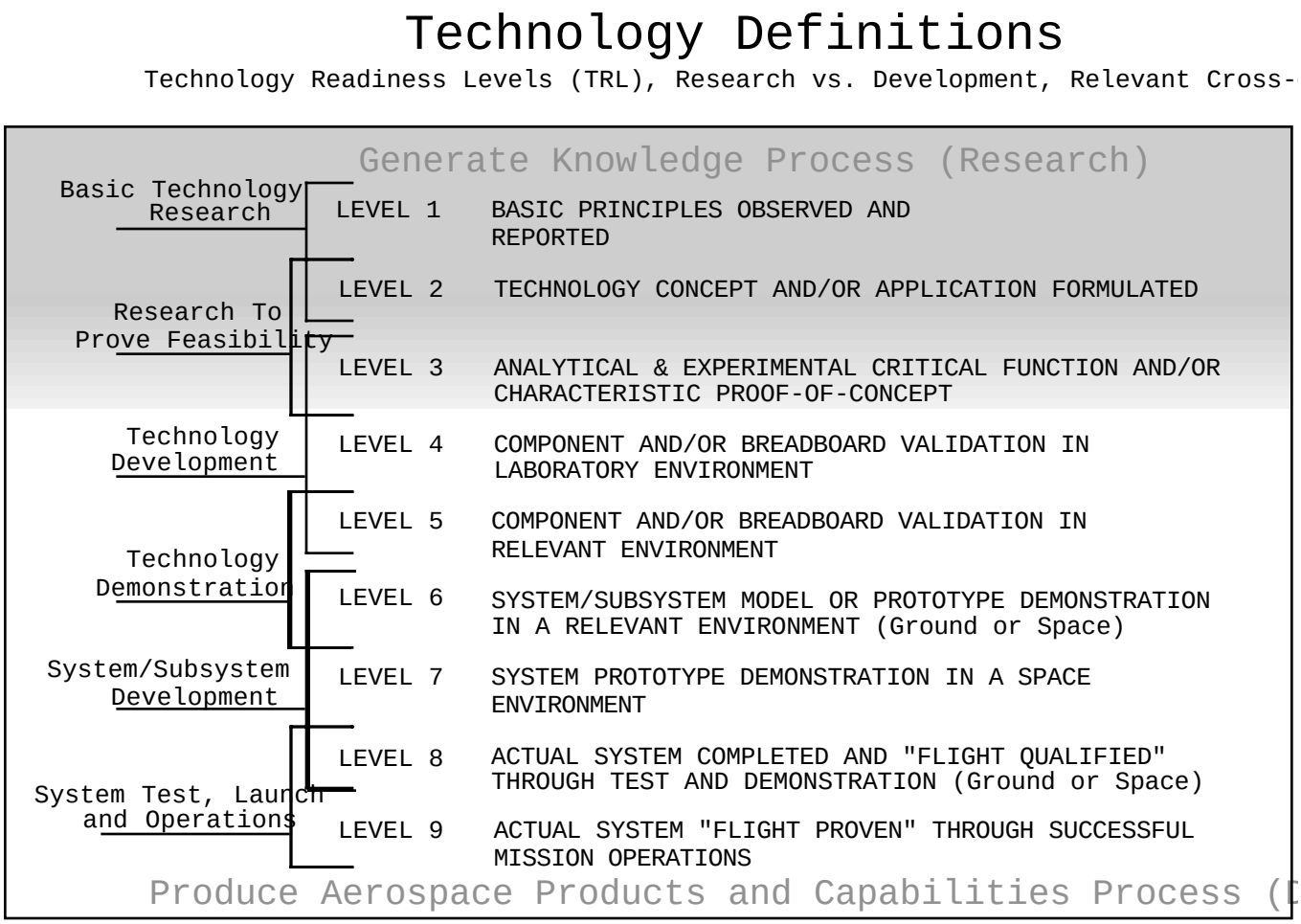


Figure M-1

NASA INFLATION INDEX

FISCAL YEAR	INFLATION RATE
FY 1999	3.8%
FY 2000	4.1%
FY 2001	3.9%
FY 2002	3.9%
FY 2003	3.9%
FY 2004	3.9%
FY 2005	3.9%
FY 2006 and Outyears	3.9%

Figure M-2

SUMMARY OF ELEMENTS OF COST
(BY PHASE, FISCAL YEAR AND WBS LEVEL)

	PHASE		
	FY/Quarter	FY/Quarter	Total
	Base Rate Cost	Base Rate Cost	Cost
Direct Labor			
Labor Hours: (by skill categories)			
TOTAL HOURS			
Labor Costs ($): (by skill categories)			
TOTAL DIRECT LABOR COSTS			
Overhead (%, $) (by cost centers)			
Subcontracts			
Materials			
Material Burdens (%, $)			
Travel			
Other Direct Costs			
SUBTOTAL			
G&A Expense (%, $) (by cost pools)			
SUBTOTAL			
Cost of Money (%, $) (by indirect pools & overhead centers)			
Profit/Fee (%, $)			
TOTAL COST PLUS FEE			

* This exhibit can be used for all Phases and WBS levels.

Figure M-3

TOTAL MISSION LIFE CYCLE COST PHASING (Figure M-4)

Item	FY1	FY2	FY3	FY4	FY5	.....	FYn	Total Real Yr $
Phase B	$	$						$
Phase C/D	$	$	$	$	$		$	$
Phase E	$	$	$	$	$		$	$
Launch Services	$	$	$	$	$		$	$
Ground System	$	$	$	$	$		$	$
Other (specify)	$	$	$	$	$		$	$
Other	$	$	$	$	$		$	$
Reserves	$	$	$	$	$		$	$
Total Cost to NASA	$	$	$	$	$		$	$
Additional Contributions by Organization (U.S. or non-U.S.) to:								
Total Phase B	$	$	$	$	$		$	$
- Organization A								
- Organization B								
Total Phase C/D	$	$	$	$	$		$	$
- Organization A								
- Organization B								
Total Phase E	$	$	$	$	$		$	$
- Organization A								
- Organization B								
Launch Services Costs	$	$	$	$	$		$	$
- Organization A								
Ground System	$	$	$	$	$		$	$
- Organization A								
- Organization B								
Other	$	$	$	$	$		$	$
Contributed Costs Total	$	$	$	$	$		$	$
					Mission Totals			$

SAMPLE SIGNATURE PAGE

Mission
Title:_____
Principal Investigator:_____

Project Manager:_____(signature)_____ _____
Name Date
Title, Affiliation, Address
Co-Investigator "A":_____(signature)_____ _____
Name Date
Title, Affiliation "A", Address

Authorizing Official "A" :_____(signature)_____ _____
Name Date
Title, Affiliation "A", Address
Co-Investigator "B":_____(signature)_____ _____
Name Date
Title, Affiliation "B", Address

Authorizing Official "B" : _____(signature)_____ _____
Name Date
Title, Affiliation "B", Address
Co-Investigator "C":_____(signature)_____ _____
Name Date
Title, Affiliation "C", Address
Authorizing Official "C" :_____(signature)_____ _____
Name Date
Title, Affiliation "C", Address
Lead Representative "D":_____(signature)_____ _____
Name Date
Title, Affiliation "D", Address
Authorizing Official "D" :_____(signature)_____ _____
Name Date
Title, Affiliation "D", Address
Lead Representative "E":_____(signature)_____ _____
Name Date
Title, Affiliation "E", Address
Authorizing Official "E" :_____(signature)_____ _____
Name Date
Title, Affiliation "E", Address

Figure M-5

MISSION ASSURANCE COMPATIBILITY TABLE

Mission Assurance Element	Check all that apply	Name of Applicable Plan, Document, Review or Program
System meets intent of ISO 9001		
Failure Reporting: Flight Equipment		
Failure Reporting: Ground Support Equipment		
Parts Program		
Failure Analysis		
Destructive Parts Analysis Procedure		
Materials and Processes Program		
Reliability Program		
Failure Modes and Effects Analysis Program		
Software Development Program		
Verification Program		
Contamination Control Program		
Printed Wiring Board Coupon Program		
System Requirements Review		
Preliminary Design Review		
Mission Confirmation Review		
Critical Design Review		
Pre-Environmental Review		
Mission Readiness Review		
Launch Readiness Review		
Soldering of Electrical Connections Standard		
Cabling and Harnessing Standard		
Crimping Standard		
Conformal Coating Standard		
ESD Control Standard		
Surface Mount Technology Standard		
Printed Wiring Board Design Standard		
Printed Wiring Board Procurement Standard		
Fiber Optic Standard		

Figure M-6

SCIENCE TRACEABILITY MATRIX

Science Objectives	**Scientific Measurement Requirements**	**Instrument Functional Requirements**	**Mission Functional Requirements (top-level)**

Figure M-7

TECHNICAL MATURITY MATRIX

Name of Hardware Item	**Item Description**	**Maturity Level**	**Rational for Maturity Assessment**

Figure M-8

MISSION TRACEABILITY MATRIX

Science Measurement Requirement	Mission Requirement	Instrument Requirement	Spacecraft Requirement	Ground System Requirement	Operations Requirement

Figure M-9

APPENDIX N

ESSP PROJECT MISSION ASSURANCE GUIDELINES AND REQUIREMENTS

PREFACE

The purpose of this document is to serve as a guideline to the Mission Team in preparing an appropriate mission assurance program and implementation. Each section of this document contains high-level requirements and a series of guidelines for implementing these requirements. These guidelines can be tailored to meet the specific needs of each mission, but must meet the intent of each requirement. Each ESSP mission is required to be implemented in accordance with the best aerospace industry mission assurance practices, as applicable to that particular mission.

All of the documents referenced herein are available in the ESSP Project Library (Appendix G). In addition, all NASA Technical Standards referenced in Section 2.2 herein can be found on the World Wide Web at URL address http://www/hq.nasa.gov/office/codeq/qdoc.pdf.

1.0 OVERVIEW

The Mission Team shall develop and implement an appropriate mission assurance program for flight hardware, software, ground support equipment and operations. The Mission Team, together with the Earth System Science Pathfinder (ESSP) Project and the Office of Systems Safety and Mission Assurance at the GSFC, will continually review and verify the proper implementation of this mission assurance program.

2.0 MISSION ASSURANCE

2.1 Quality System

The Mission Team shall define and implement a quality system based on ANSI/ASQC Q9001-1994 that meets the intent of ISO 9001. The Mission Team's quality system shall encompass all ESSP flight hardware, flight software and ground support equipment development, as well as mission operations.

2.2 Workmanship

The Mission Team shall impose workmanship standards which help assure that the required mission lifetime and performance are met. The following commercial or NASA workmanship standards are given as guidelines and may be considered for use:

Soldering of Electrical Connections: NASA Technical Standard NASA-STD-8739.3, Soldered Electrical Connections

Cabling, Harnessing, and Crimping: NASA Technical Standard NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring. Note: MIL-STD-1130B, Connections, Electrical, Solderless Wrapped can be used if the missions are planning to use wire wrap for flight hardware or mission critical ground support equipment.

Conformal Coating and Staking: NAS 5300.4(3J-1), Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies

ESD Control: NASA Technical Standard NASA-STD-8739.7, Electrostatic Discharge Control (Excluding Electrically Initiated Explosive Devices)

Surface Mount Technology (SMT): NHS 5300.4 (3M), Workmanship Standard for Surface Mount Technology.

Note: SMT processes must be qualified to the mission profile and life expectancy of the mission.

Printed Wiring Board Design: ANSI/IPC-D-275, Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies, Class 3

Printed Wiring Board Procurement: IPC 6011 and IPC 6012, Class 3 as the basic specification requirements with GSFC S-312-P-003B, Procurement Specification for Rigid Printed Wiring Boards for Space Applications and other High Reliability Uses as a supplement.

The Mission Team and their subcontractors shall provide printed wiring board coupons to GSFC, or to a GSFC approved laboratory, for test, analysis and review.

Fiber Optic: NASA Technical Standard NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation

2.3 Failure Reporting

A documented Failure Reporting System shall be implemented. A problem/failure report should be written for any departure from design, performance, testing, or handling requirement that affects the function of flight equipment, or ground support equipment that interfaces with flight equipment, or that could compromise mission objectives.

Reporting of failures to the ESSP Project should begin with the first power application at the box, instrument, or spacecraft levels. This reporting should continue through formal acceptance of the hardware. For software problems, failure reporting should begin with the first test use of the software item with the hardware item. All failure reporting records should be submitted to the ESSP System Assurance Manager for information. Either paper or electronic format is acceptable. The Mission Team can use any failure report format they deem acceptable, as long as the ESSP Project has concurred with their format. The Mission Team should maintain failure reporting records of problems encountered at the lower levels of assembly for information.

3.0 REVIEWS

The implementation of the mission shall be periodically reviewed by a competent and independent assessment team or teams, to assure that satisfactory progress is being made toward meeting mission requirements.

There are four required reviews that will be conducted by, or involve participation from the GSFC. These reviews will concentrate on the critical system and end-to-end technical and programmatic aspects of the mission.

Additional reviews at the subsystem level and at the system levels that are not covered by the required four GSFC reviews, should be conducted by the Mission Team. The review philosophy should be to provide and focus resources early and throughout the mission on engineering working level reviews, in order to identify and resolve potential problems before they reach formal, high-level system reviews. If requested to do so through the ESSP Project, the GSFC could provide technical expertise for participation in these additional reviews. The GSFC is required to assess the thoroughness, competence and independence of the total review process and shall be invited to attend all technical reviews.

3.1 Required Mission Reviews

The four required reviews for ESSP missions are the Preliminary Design Review (PDR), the Mission Confirmation Review (MCR), the Mission Readiness Review (MRR) and the Launch Readiness Review (LRR). The review chairman, in concert with the ESSP Project and other directorates, appoints independent key technical experts as review team members. Every effort will be made to maintain continuity of the chairman and the key technical experts for the duration of the mission. Other experts will be added and/or deleted from the review team, according to the technical needs and phases of the mission. The scope and function of these required reviews is as follows:

Preliminary Design Review (PDR): The PDR shall occur during the mission Definition Study Phase, but after final definition of the mission science and technical requirements. The purpose of the PDR is to examine preliminary designs of all mission subsystem and system components for technical feasibility with respect to the mission requirements and to assess the mission design at the subsystem and system levels as it relates to the mission requirements.

The Mission Team, with participation from the ESSP Project, will conduct the PDR. The GSFC Systems Review Office, Code 301, along with other independent technical experts from the GSFC are also available to participate in the PDR. The benefit of these additional reviewers will be to provide experienced expertise and to maintain review team continuity and familiarity through the other required reviews, as well as for the duration of the mission.

Mission Confirmation Review (MCR): The MCR will be held during the mission Definition Study Phase and shall follow the PDR. It combines the technical findings of the PDR with a programmatic and process review of the proposed mission implementation. The purpose of this review is to confirm:

- final design, fabrication and test plans for each subsystem
- final interface control documents

- mission integration and verification plans
- complete programmatic plan through launch
- requirements flow-down traceability
- risk identification and mitigation plans, including descopes
- comprehensive cost, schedule and resource plans
- complete ground system architecture
- comprehensive system engineering plan
- final definition of mission science requirements
- thoroughly defined roles and responsibilities of all mission team members

The GSFC Systems Review Office, Code 301 and an appointee of the Earth System Science Program Office will co-chair the MCR.

Mission Readiness Review (MRR): The MRR is conducted at the end of the Development Phase. The MRR shall verify that all system elements meet the requirements of the mission and are ready to proceed into final launch preparations. The MRR shall verify that testing has been completed with no unacceptable open issues and to validate the readiness of the flight hardware and software. The MRR should also cover:

- determination of completion of testing flight hardware and software
- verification of system requirements
- verification and documentation of hardware and software configuration
- identification of outstanding safety risks
- disposition of waivers, deviations, open issues
- compatibility of spacecraft and ground support equipment
- end-to-end system level testing verification
- orbital operations plans
- mission operations, ground system and data processing system readiness
- evaluation of the acceptance data packages

The MRR will be chaired or co-chaired by the GSFC Systems Review Office, Code 301.

Launch Readiness Review (LRR): The LRR shall take place at the launch site just prior to launch. This review is to certify final flight readiness of all mission elements. All open issues from the MRR must be resolved before the LRR.

The GSFC Systems Review Office, Code 301, will chair the LRR.

3.2 Recommended Additional Mission Reviews

Additional Mission Reviews are recommended as a supplement to the required reviews and shall be conducted by independent and competent outside consultants, peers or Mission Team personnel. For these reviews, technical support may be requested from the ESSP Project.

System Requirements Review (SRR): The SRR should be the first major mission review during the Definition Study Phase. The purpose of this review is to finalize mission science, operations and technical requirements. Traceability among these requirements should be demonstrated.

Critical Design Review (CDR): The CDR should occur after the design has been completed, but prior to the start of flight hardware manufacturing or coding of the flight software. It will emphasize implementations of design approaches, mission operations planning, as well as test planning for all flight systems. In the case of long lead procurements, manufacturing may be initiated prior to CDR as required to meet schedule.

Pre-Environmental Review (PER): The PER should assess the readiness of the flight hardware, software and required environmental test facilities to begin acceptance testing. The PER will also cover:

- design changes since CDR
- status of nonconformances
- test documentation (plans, procedures, waivers) and facilities readiness
- hardware and software configuration
- mission operations status

The PER should be held prior to the full system integration and functional test in preparation for environmental testing.

3.3 Peer Reviews

Engineering peer reviews typically occur during all phases of the project life cycle. These reviews are expected to be the most detailed of the technical reviews. It is the intent of the peer reviews that participants generate a detailed understanding of the component and subsystem design's ability to meet higher level system and mission requirements. Effective peer reviews will enable significant streamlining of the content of higher level formal reviews described in sections 3.1 and 3.2. To promote continuity of the whole review program, the Systems Review Office and other technical experts can be requested to attend any peer review session by the Mission Team. The ESSP Project shall be invited to attend all peer reviews. Some of the topics which should be addressed in the peer reviews are as follows:

- interface control design verification
- parts and materials review
- analysis and studies
- safety issues
- risk assessment, resolution and contingency plans

- procurements

- confirmation of technology items
- hardware and software configuration management
- detailed cost, schedule and resource availability
- manufacturability and testability
- integration and test planning, including test anomalies and resolution

4.0 DESIGN ASSURANCE

4.1 Parts

The Mission Team shall implement a parts program that assures mission reliability and performance requirements are met. A Failure Analysis shall be performed on all parts/components that fail after the final assembly of flight components and subsystems has been started. GSFC 311-INST-001, entitled Instructions for EEE Parts Selection, Screening, and Qualification for Grade 3 quality level may be used as a guide in selecting and processing parts. The Mission Team should control the management, selection, application, evaluation, and acceptance of all parts through a parts control board, or another similar documented parts control system. Board members should be responsible for the review and approval of all parts for conformance to the GSFC 311-INST-001, Grade 3 quality level. The Mission Team should maintain an EEE Parts Identification List prior to and during the Mission Team's hardware built. This as-built list should be updated and submitted as part of the Mission Readiness Review.

The Mission Team should have access to and maintain knowledge of parts problems as reported in the Government Industry Data Exchange Program (GIDEP).

Destructive Physical Analysis (DPA) are not required as a screening for general parts usage, unless specific issues such as part failure history, GIDEP Alerts and Problem Advisories, new/unknown technology, or other similar concerns warrant it. The Parts Control Board (or system) participants should be responsible for determining which parts, if any, require DPA. DPA performance, when required, should be in accordance with GSFC S-311-M-70 or the Mission Team's DPA procedure.

All Electrical, Electronic, and Electro-mechanical (EEE) parts should be derated in accordance with the guidelines specified in GSFC PPL-21, Appendix B. The Mission Team should be responsible for the implementation and verification of the derating guidelines.

All EEE parts should be selected and design implemented to meet the maximum predicted mission ionizing radiation level requirements and to minimize Single Event Upsets (SEU) and be latch up immune.

4.2 Materials and Processes

The Mission Team shall implement a Materials and Processes program. NASA Reference Publication 1124 entitled "Outgassing Data for Selecting Spacecraft Materials" should be used as a guide for materials selection on this program. Materials that have a total mass loss (TML) <1.00% and a collected volatile condensable mass (CVCM) <0.10% should be used on this program. Technical guidance in this area can be provided by the ESSP Project. The Mission Team should develop a single list which is all inclusive of the polymeric materials, inorganic materials, composites, lubricant usage, and the material process utilization. This list should be presented at the major reviews discussed in Section 3 of this Appendix.

Each Mission Team should maintain a list of materials, processes, and appropriate usage records prior to and during the hardware development. This as-built list should be updated and submitted as part of the Mission Readiness Review.

4.3 Reliability

The Mission Team shall plan and implement a reliability program that interacts with other mission disciplines including systems engineering, hardware design, parts selection, and systems safety. This program should be conceived and organized to effectively, efficiently, and responsively perform tasks that enhance the expected mission life-time. The Mission Team should develop and implement a program plan that addresses mission objectives, assigns responsibilities, and schedules tasks relative to program milestones. The reliability program should at least respond to the following objectives:

I. <u>Design</u>

a) Graceful degradation is a design objective.
b) Reduce series complexity by eliminating unnecessary parts and components.
c) Promote failure workarounds that allow continued successful but degraded operation.
d) By design, wherever practicable, failures shall allow continued successful, albeit degraded operation.
e) Isolate failure impact so that effects do not propagate to other functions.
f) Failure of non-critical functions shall not affect critical functions.
g) Show that electrical stress applied to parts and devices meets derating requirements over the extremes of operating temperature range, voltage temperature range, and current variations.

h) Parts meet total dose and single event effects radiation requirements. Verification that a consistent reliability process is flowed down to subcontractor(s) and suppliers.

II. Manufacture

a) An in-process inspection program that verifies hardware is assembled as designed.
b) A verification program that assures specified manufacturing processes are followed.

III. Test

a) A test program that verifies finished product meets specification.
b) A test program that verifies finished product functions as designed.

A Failure Modes and Effects Analysis (FMEA) should be performed early in the design process to identify problem areas that do not meet these objectives. Corrective action may be recommended. The FMEA should be updated as the design matures. GSFC Procedure No. S-302-89-01 entitled "Procedures for Performing a Failure Modes and Effects Analysis" and/or MIL-STD-1629A, "Procedures for Performing a Failure Mode, Effects and Critical Analysis" can be used as guides. The FMEA should be available for review by the ESSP Project. Procedures for performing a FMEA are available on the World Wide Web at URL address (http://arioch.gsfc.nasa.gov/302/ssromisc.htm).

4.4 Software

The Mission Team shall employ a structured program for the development of software. The program shall address appropriate development life cycle phases such as: requirements analysis, design, code and unit test, integration and build test, performance verification, and maintenance. Code produced shall be structured, error-free, and maintainable.

During the preliminary design process, the Mission Team shall establish and document software requirements and any appropriate external interface specifications and user guides.

The Mission Team shall participate in a program of internal and external software reviews to validate software requirements, design, operating characteristics, and external interface requirements.

The Mission Team should employ a software configuration management process to manage requirements, code, documentation, and data, and to track and report on the status of changes to them. The process should include a means to record, track and disposition identified discrepancies in the product (i.e., non-conformance control).

5.0 VERIFICATION

Each Mission Team shall conduct a verification program to ensure that the flight hardware meets the specified mission requirements. The program should consist of functional demonstrations, analytical investigations, physical measurements and tests that simulate all expected environments. Each Mission Team should provide adequate verification documentation including a verification plan and matrix, environmental test matrix, and verification procedures.

Guidelines for developing a Verification program are available on the World Wide Web at URL address (http://arioch.gsfc.nasa.gov/302/verifhp.htm).

6.0 CONTAMINATION

The Mission Team shall identify contamination requirements and establish and maintain a contamination control program consistent with mission requirements.

APPENDIX O

ESSP PROJECT FLIGHT AND GROUND SAFETY REQUIREMENTS

PREFACE

The purpose of this document is to serve as a resource to the Mission Team of each proposal for complying with necessary NASA safety requirements. All of the documents referenced herein are available in the ESSP Project Library (Appendix G).

GENERAL

Flight hardware and software systems developers shall implement a system safety program in accordance with the requirements imposed by the appropriate launch range and the launch vehicle manufacturer or launch service provider. The requirements are mandatory and are not negotiable, but may be tailored to the extent that not all requirements apply to every mission. The tailoring of the requirements to the specific mission is done with the applicable launch range safety organization.

Each mission shall comply with the “NASA Policy For Limiting Debris Generation” (NPD 8710.3) and the NASA Safety Standard “Guidelines and Assessment Procedure for Limiting Orbital Debris” (NSS 1740.14), which can be found either in the ESSP Project Library or on the World Wide Web at URL address (http://arioch.gsfc.nasa.gov/302/ssromisc.htm). The PI and his Mission Team shall be responsible for performance of the required orbital debris assessment.

The following are mandatory compliance requirements for hardware and software intended to be launched on any of the various launch vehicles/launch services. The PI ensures compliance with the requirements and certifies to the launch range, in the form of the Safety Data Package, that all of the requirements have been met.

The following documents describe the complete safety program implementation and deliverables required to safely launch space hardware. The documents reference other requirements that the flight system developer must also meet to gain access to the launch site and subsequent launch.

TOP LEVEL SAFETY REQUIREMENTS DOCUMENTS:

Any payload (ELV or Shuttle) using Kennedy Space Center (KSC) facilities for testing, integration, etc. (including those at Eastern Test Range (ETR) and Western Test Range (WTR) where KSC has jurisdiction for reviewing procedures and facilities) shall comply with KHB 1710.2C, "Kennedy Space Center Safety Practices Handbook".

For Shuttle missions:

1) NSTS 1700.7B, "Safety Policy and Requirements for Payloads Using the Space Transportation System".

2) 45 SPW S-100/KHB 1700.7B, "Space Shuttle Payload Ground Safety Handbook"

For ELV missions at ETR or WTR:

EWR 127-1, "Eastern and Western Range Safety Requirements".

For Wallops Flight Facility (WFF) Missions:

RSM-93, "Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)".

For payloads flying on the Pegasus launch vehicle:

1) "Pegasus Design Safety Requirements Document" (SSD TD-0005) (currently Rev B).

2) "Pegasus Safety Requirements Document for Ground Operations" (SSD TD-0018) (currently Rev A).