

A.26 INSTRUMENT INCUBATOR

**Amended July 24, 2007**

**This final version of Appendix A.26: Instrument Incubator replaces in its entirety the placeholder version that was released with the ROSES-2007 NASA Research Announcement. The due date for Notices of Intent to propose (NOIs) is October 12, 2007. The due date for proposals is December 12, 2007.**

1. Scope of Program

1.1 Introduction

NASA's Earth Science Technology Office (ESTO) manages the development of advanced technologies and applications that are needed for future Earth science missions. ESTO pursues promising scientific and engineering concepts and ensures that the program maintains an effective balance of investments in order to advance technology development across all relevant areas.

The Instrument Incubator Program (IIP) seeks proposals for technology development activities leading to new system and subsystem level airborne and space-based measurement techniques to be developed in support of the Science Mission Directorate (SMD) Earth science research and applications. The objectives of the IIP are to identify, develop and, where appropriate demonstrate new measurement technologies which:

- Reduce the risk, cost, and development time of Earth observing instruments, and
- Enable new Earth observation measurements.

The IIP is designed to reduce the risk of new, innovative instrument systems so that they can be successfully used in future science solicitations in a fast track (3 year) acquisition environment. Figure A.26-1 shows the idealized relationship between the IIP and development of future missions.

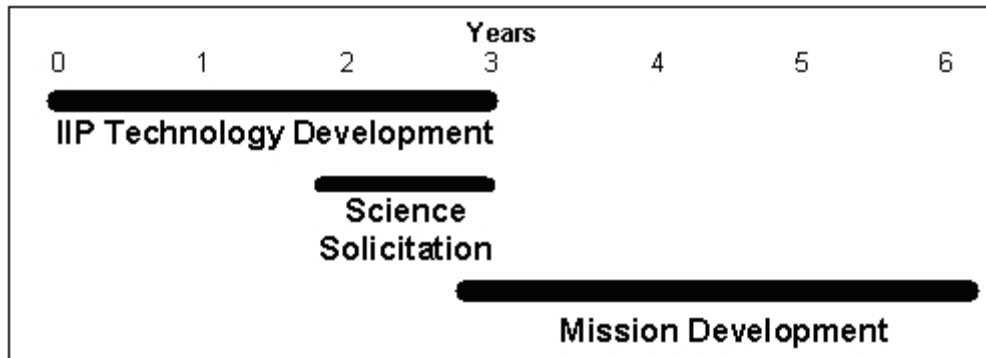


Figure A.26-1. Idealized Relationship between IIP and Future Flight Missions

Critical to this design is the relationship between the various technology development programs that the SMD has available to enable missions. For technology infusion into NASA science missions to take place in a timely and efficient manner, appropriate funding must be applied at each stage or readiness level associated with the development of key and enabling technologies. Technology development activities are planned and initiated so that major technological risk is retired prior to a science solicitation via an Announcement of Opportunity (AO) or Request for Proposal (RFP). A focused, science-driven approach with direct traceability to planned measurements can effectively harness advanced instrument technology capabilities and leverage developments in technology programs funded by NASA, other Government agencies, private organizations, and academic institutions. Within this development environment, the IIP can rely upon the NASA Advanced Component Technology (ACT) Program for advanced instrument components and subsystems and other NASA programs for space flight validation.

Technology Readiness Level (TRL) is a systematic metric/measurement system that supports assessments of the maturity of a particular technology and the consistent comparison of maturity between different types of technology (see section 2.1.2.2, Table A.26-1 for TRL definitions). Figure A.26-2 shows the Technology Readiness Levels for these programs and future science missions.

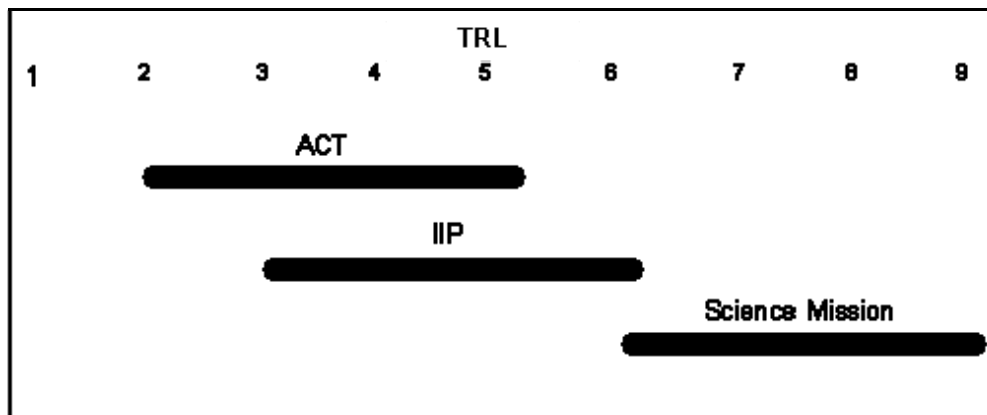


Figure A.26-2. TRL Ranges for Technology Development Programs and Science Missions

## 1.2 Background and Solicitation Justification

A series of future Earth Science mission concepts have been recommended by the National Research Council (NRC) in response to a request in 2004 from NASA’s Office of Earth Science, the National Oceanic and Atmospheric Administration (NOAA) National Environment Satellite Data and Information Services, and the U.S. Geological Society (USGS) Geography Division. The full NRC report entitled, “Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond” may be accessed on the web at <http://www.nap.edu/catalog/11820.html>. This report is referred to below as the “decadal survey.”

The decadal survey's recommended observational strategy consists of:

- 14 missions for implementation by NASA,
- 2 missions for implementation by NOAA
- 1 mission (CLARREO), which has separate components for implementations by NASA and NOAA

NASA's Earth Science Division has a significant challenge ahead of it to determine how to incorporate the NRC recommendations into future mission planning. New technology will play a key role in enabling many future recommended measurements and will help to reduce the cost of others. This IIP solicitation will facilitate the implementation of the recommended measurements by carefully choosing where to invest in future instrumentation to get the most benefit from NASA's technology development funds.

### 1.3 Proposal Research Topics

#### 1.3.1 Goals of the Instrument Incubator Program

This solicitation covers instrument design, breadboard, prototype, and engineering model construction, lab demonstrations, and field demonstrations for innovative measurement techniques that have the highest potential to meet the objectives of the IIP and the measurement capability requirements for NASA Earth science research.

The IIP is envisioned to be flexible enough to accept instrument and measurement concepts at various stages of maturity (see Figure A.26-3), and through appropriate risk reduction activities advance the system's technology readiness level to that necessary to compete successfully in future science solicitations or space flight demonstrations. The proposer must define the starting point for the instrument or measurement technique and the exit or success criteria for the proposed activity.

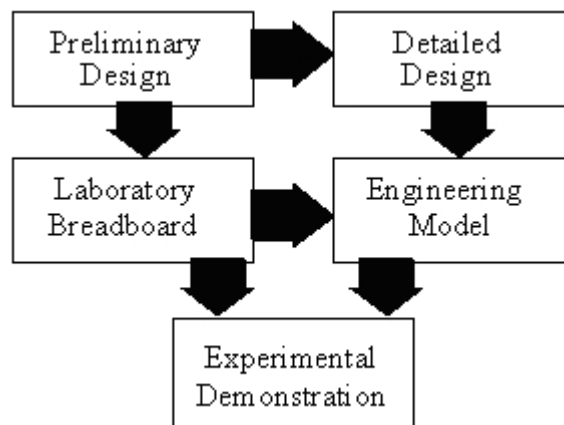


Figure A.26-3. Entry and exit points defined by proposer

### 1.3.2 Proposal Research Topics

The NRC decadal survey recommends an integrated strategy for Earth science and applications from space. This solicitation focuses on the instrumentation to make the science measurements that are described by the decadal survey. The measurements called out in the decadal survey mission concepts include such things as radiation balance; soil moisture; ice sheet height; surface deformation; vegetation structure; land surface composition; carbon dioxide column integrals; ocean, lake, and river water levels; atmospheric gas columns; ocean color; aerosol and cloud profiles; land surface topography, temperature and humidity sounding; gravity fields; snow accumulation; ozone and trace gas amount; and tropospheric winds. This list is illustrative only – proposers should refer to the decadal survey itself for clarification of the exact measurements desired.

The measurements called for in the decadal survey have been assembled into a series of mission concepts divided into three timeframes covering the period from 2010 to 2020. Proposers should carefully consider these timeframes in deciding what types of technology to propose for a given measurement. It may be more appropriate to propose more mature technologies for the earlier mission concepts and more challenging, lower TRL technologies for the later mission concepts. However, note that technology development must be included in the proposal, even for earlier missions, since the IIP is a technology development program.

Priority for selection will be given to those proposals that most clearly demonstrate the potential for making significant contributions to the technology readiness of the Earth science measurements recommended by the decadal survey.

## 2. Programmatic Information

This solicitation provides additional details governing the proposed activities that supersede the general guidelines announced in the *NASA Guidebook for Proposers Responding to a NASA Research Announcement - 2007*. The most recent edition of this Guidebook may be accessed on the web at <http://www.hq.nasa.gov/office/procurement/nraguidebook/>.

### 2.1 Proposal Content and Submission

#### 2.1.1 Notice of Intent to Propose

A Notice of Intent (NOI) to propose is encouraged, but not required, for the submission of proposals to this solicitation. The information contained in the NOI is used to help expedite the proposal review activities and, therefore, is of considerable value to both NASA and the proposer. NOIs shall be submitted electronically via NSPIRES by the due date given in Section 2.5. Since NOIs submitted after the deadline may still be useful to NASA, late NOIs may be submitted by E-mail to the point of contact concerning this solicitation (see Section 2.5).

## 2.1.2 Proposal Content

### 2.1.2.1 Proposal Summary

Each proposal shall include a proposal summary, or abstract, that describes the proposal in no more than 300 words. The proposal summary shall include: (a) objectives and benefits; (b) an outline of the proposed work and methodology; (c) the period of performance; and (d) entry and planned exit TRL.

### 2.1.2.2 Scientific/Technical/Management Section

This section completely replaces Section 2.3.5 of the *Guidebook for Proposers*.

This section must include the following content information in subsections that use the same titles. Failure to provide any of this material may be a cause for the proposal being judged as noncompliant and returned without further review. The Project Description shall be limited to 15 nonreduced, single-spaced typewritten pages. Standard proposal style formats shall be in accordance with Section 2.2 of the *Guidebook for Proposers*. Proposals that exceed the 15-page limit will be truncated at 15 pages.

1. Applicability to Earth Science Measurements in the NRC Decadal Survey – Describe the benefits to future Earth science missions that utilize the proposed technology. Proposers shall include a one-page relevancy scenario showing how the proposed technology contributes to an Earth science decadal survey measurement of their choosing. Involvement of Earth science researchers in advancing these concepts is strongly encouraged. Proposals that fail to include a relevancy scenario will be considered noncompliant and will be returned without review.
2. Description of Proposed Technology – Provide a description of the proposed new technology for an instrument system or subsystem. Describe the technical approach and include an operational concept for the proposed technology that addresses Earth science needs. Discuss any possible commercial benefits.
3. Comparative Technology Assessment – Describe the anticipated advantages of this technology compared to those currently in use - e.g., reduction of size, mass, power, volume or cost, improved performance, or enabling of a new capability not previously possible. Review the current state of the art and relate it to the proposed work.
4. TRL Assessment – Provide the current TRL assessment of the technology and the anticipated progression of TRL levels throughout the proposed effort. The TRL shall advance by at least one during the period of performance of the

activity. If the proposed activity duration is for multiple years, advancement of one TRL per year is desirable.

For this solicitation, the entry TRL shall be between 3 and 5. Table A.26-1 provides high-level definitions for instrument system technology TRLs. More detailed TRL definitions can be found at <http://esto.nasa.gov/files/TRL.doc>. The proposer shall identify the entry TRL, the planned exit TRL, and success criteria in their proposal. Past and ongoing work on the research activity should determine the entry TRL; the proposer shall substantiate the entry TRL in the proposal. Proposals that fail to include and substantiate the entry TRL will be considered noncompliant and will be returned without review.

Table A.26-1. High-Level TRL Definitions

TRL	Definition
1	Basic principles observed and reported
2	Technology concept and/or application formulated
3	Analytical and experimental critical function and/or characteristic
4	Component and/or breadboard validation in laboratory environment
5	Component and/or breadboard validation in relevant environment
6	System/subsystem model or prototyping demonstration in a relevant environment (ground or space)
7	System prototyping demonstration in a space environment
8	Actual system completed and "flight qualified" through test and demonstration (ground or space)
9	Actual system "flight proven" through successful mission operations

5. Research Management Plan – Provide a statement of work that concisely describes each task or milestone to be accomplished in the course of the research and development. Define the success criteria associated with each task or milestone. Also include a schedule chart that identifies critical milestones. At least two milestones per twelve-month period must be defined.

Subcontracting portions of the research project is acceptable and is the responsibility of the proposing organization.

6. Personnel – Include a list of key personnel and identify experience related to the proposed activity. Proposers should be sure to demonstrate science, technology development, and instrument development skills on the team. The key personnel list is included in the overall page count and must include, as a minimum, the Principal Investigator (PI). Optionally, one-page resumes for

Key Personnel may be supplied; these resumes are not included in the overall page count.

7. Facilities and Equipment – Describe significant facilities and equipment required to complete the work. Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative.
8. Special Matters – Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal.

### 2.1.3 Proposal Submission

Proposals shall be submitted electronically via NASA’s master proposal database system, NSPIRES, as described in the *Guidebook for Proposers* (see Chapter 3 for details).

## 2.2 Award Information

### 2.2.1 Funding

Funds are not currently available for awards under this solicitation. The Government’s obligation to make award(s) is contingent upon the availability of appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this solicitation. No additional funds beyond the negotiated award value will be available.

Proposers are encouraged to offer cost sharing. If a cost sharing arrangement is proposed, appropriate data rights that recognize the proposer’s contributions as well as the Government’s rights to access will be negotiated prior to award.

The funding available for this solicitation will limit the number and magnitude of the proposals awarded. The ESTO expects that a total of 15 to 20 proposals will be selected and awards issued with values in the approximate range of \$500K to \$1.2M per year per award.

### 2.2.2 Period of Performance

The minimum period of performance is 12 months. The total proposed period of performance must not exceed 36 months. Grants may be awarded for up to a three-year performance period. Annual reviews will be held according to the criteria specified in the *NASA Grants and Cooperative Agreement Handbook* (14 CFR 1260). Proposals must define clear, measurable milestones to be achieved for each year of performance in order to warrant continuation in the second and third years.

### 2.2.3 Type of Award

All selected proposals will result in the award of grants, cooperative agreements, or intra- or inter-Government transfers, as appropriate. Contracts are specifically excluded as an award vehicle for this solicitation. Grants and cooperative agreements will be subject to the provisions of the *NASA Grants and Cooperative Agreement Handbook*. If a commercial organization wants to receive a grant or cooperative agreement, cost sharing is required unless the commercial organization can demonstrate that it does not expect to receive substantial compensating benefits for performance of the work. If this demonstration is made, cost sharing is not required but may be offered voluntarily (see also Section D, Provision 1274.204, of the *Grants Handbook*).

### 2.3 Evaluation Criteria

The first criterion, relevance to NASA's objectives, includes the applicability of the proposed investigation to decadal survey science measurements and technology needs (40% of total evaluation weight) and specifically includes the following factors:

1. The proposal's relevance and potential contribution to NASA's scientific and technical areas of emphasis, including the potential to make measurements which are part of the decadal survey mission concepts.
2. The potential for the sensor or instrument technology development to reduce the risk, cost, size, and development time of Earth science instruments or to enable new Earth science measurements. Potential cost reductions should be clearly stated and substantiated to the extent possible, with supporting analysis that indicates scalability.
3. The potential of the sensor or instrument technology to be integrated, once matured, into future NASA missions.
4. The potential for the sensor or instrument technology development to have commercial benefits.

The second criterion, intrinsic merit, includes the technical merit of the proposed investigation (30% of total evaluation weight) and specifically includes the following factors:

1. Feasibility and merit of the proposed technical approach to achieve the technology development and science measurement objectives.
2. Degree of innovation of the proposed technology development concepts and approach.
3. Substantiated justification and appropriateness of the entry and exit technology readiness level (TRL).
4. Feasibility of obtaining the potential reduction in risk, cost, size, and development time, or making the newly enabled measurement, with the proposed sensor or instrument; and feasibility of making a demonstrable TRL increase. The TRL must advance by at least one (1) level during the performance period of the project.



The third criterion, cost and programmatic realism (30% of total evaluation weight) specifically includes the following factors:

1. Adequacy and realism of proposed milestones and associated success criteria.
2. Realism and reasonableness of the proposed cost and comparison of costs to available funds.
3. Adherence to sound and consistent management practices appropriate to the TRL level of the proposed task.
4. Past performance and related experience in the proposed area of technology development.
5. Qualifications of key personnel and adequacy of facilities, staff, and equipment to support the proposed activity. This factor includes evaluation to ensure that the team has strong science, technology development, and instrument development skills.
6. Commitment of the organization's management to the proposed technology development (evidenced by cost and resource sharing, prior teaming arrangements, etc.). Proposers should identify any previous investment by the organization/program and provide supporting documentation.

## 2.4 Technical Reporting Requirements

All status information, presentation material, and report deliverables applicable to this IIP solicitation shall be submitted to the web-based ESTO IIP-07 Award Administration e-Book located at <http://esto.reisys.com/esto/>. A user account on the ESTO e-Book will be provided to the PI upon award. All submissions shall be made in PDF (preferred), Microsoft Word, Microsoft Excel, or Microsoft PowerPoint.

The following deliverables shall be required of awarded proposals. In cases where subcontract arrangements exist, consolidated project reports are the responsibility of the PI. The proposed budget should provide for these reporting requirements. In this context, "Annual" refers to a twelve-month task effort that commences at award.

### 2.4.1 Initial Plans and Reports

Within 15 days of award, the PI shall prepare a Project Plan, initial Quad Chart and initial TRL assessment. The project plan, initial (entry) Quad Chart, and initial TRL assessment (and supporting data) shall be uploaded to the appropriate locations in the ESTO e-Book for this solicitation.

The project plan shall identify plans for all technical, schedule, and resource activities for the proposed life of the project.

The Quad Chart shall contain the following information:

- First Quadrant: A visual, graphic, or other pertinent information
- Second Quadrant: "Description and Objectives"

- Third Quadrant: “Approach” and “Co-Is/Partners”
- Fourth Quadrant: “Milestone Schedule” and “Entry TRL.”

The Quad Chart shall be updated at least annually, more often if appropriate. A template is available in the ESTO e-Book under “Information” and “File Templates.”

An initial TRL assessment, and the basis for that assessment, shall be provided for the critical technology developments of the activity. The TRL assessment shall be updated at least annually, more often if appropriate.

#### 2.4.2 Bimonthly Technical Reports

The bimonthly technical report shall focus on the preceding two month’s efforts. Each report shall address:

1. Technical status: The PI shall summarize accomplishments for the preceding two months, including technical accomplishments (trade study results, requirements analysis, design, etc.), technology development results, and results of tests and/or demonstrations.
2. Schedule status: The PI shall address the status of major tasks and the variance from planned versus actual schedule, including tasks completed, tasks in process, tasks expected to complete later than planned, and tasks that are delayed in starting, with rationale for each and recovery plans as appropriate.

Bimonthly Technical Reports shall be uploaded to the appropriate location in the ESTO e-Book at two-month intervals, starting on the second-month anniversary date of the signing of the award vehicle. Reports shall be submitted in PDF, Microsoft Word ,or Microsoft PowerPoint compatible formats by the required due date, or by close of business of the first workday following the due date if the due date falls on a weekend or a holiday. A teleconference or brief meeting may be conducted between the ESTO and the PI to review and discuss each report.

#### 2.4.3 Interim Reviews

The PI shall provide an Interim Review at the end of the first six-month calendar period, commencing from the date of award, and at twelve-month intervals thereafter. Interim Reviews are required annually. The PI must provide a presentation summarizing the work accomplished and results leading up to this Interim Review and must:

1. Describe the primary findings, technology development results, and technical status, e.g., status of design, construction of breadboards or prototype implementations, results of tests and/or proof-of-concept demonstrations, etc.

2. Describe the work planned for the remainder of the project and critical issues that need to be resolved to successfully complete the remaining planned work.
3. Summarize the cost and schedule status of the project, including any schedule slippage/acceleration. A schedule milestone chart of all major task activities shall be created and maintained and shown at all reviews. A cost data sheet shall be created and maintained, showing total project costs committed, obligated, and costed, along with a graphical representation of the project cost run outs.
4. At the second and subsequent Interim Reviews, address the comments and recommendations prepared by the Independent Reviewer participating in the most recent Annual Review.

The ESTO will conduct the Interim Review via teleconference. The presentation shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. Following the review, the presentation, updated in accordance with comments and discussion resulting from the review, will constitute the Interim Report and shall be uploaded to the appropriate location in the ESTO e-Book within ten days after the review.

#### 2.4.4 Annual or Final Review

The PI shall provide an Annual Review at the end of each twelve-month calendar period, commencing from the date of award, and a Final Review at the completion of the activity. The PI shall provide a review summarizing the work accomplished and anticipated results at the end of the task. Each review must include:

1. A description of the work accomplished and the results leading up to this review.
2. A summary of the primary findings, technology development results, and technical status, e.g., status of elements, construction of breadboards or prototyping implementations, results of tests and/or demonstrations, etc. The PI may provide a laboratory demonstration, if appropriate, to show technical results and status.
3. A summary of the cost and schedule status of the project since inception.
4. The Final Review must provide conclusions of the work performed and make recommendations for follow-on activities that should be pursued, with estimates of the cost and schedule to achieve TRL 7.
5. Report any educational and outreach components of the project, e.g., graduate degrees, educational activities; technology infusion or patents applied for or granted; journal or conference publications; presentations at professional

conference, seminars and symposia; demonstrations; media exposure; and, other activities that contributed to the overall success of the research project.

The ESTO will conduct the review at the PI's facility, or a mutually agreed to location, with length of presentation tailored as appropriate, depending on the amount of work to be discussed. The Annual or Final Review should be comprehensive, and should include a discussion of the planned content of the written report. The review package shall be uploaded to the appropriate location in the ESTO e-Book at least two (2) working days prior to the review. Hardcopy handouts shall be provided by the PI at the review. The presentation, updated in accordance with comments and discussion resulting from the review, together with the separate Annual Report, shall constitute the Annual Report deliverable, and shall be uploaded to the appropriate location in the ESTO e-Book within ten days after the review.

#### 2.4.5 Final Report

The written Final Report shall include the following:

1. Background of the project including the science rationale for conducting this technology development.
2. Results of all analyses, element, subsystem, or system designs, breadboards and/or prototyping implementations and designs.
3. Performance analysis results of tests and/or demonstrations; estimation of reduction(s) in size, mass, power, volume and/or cost; improved performance; description of newly enabled capability; and documentation of technology dependencies.
4. Tables, graphs, diagrams, curves, sketches, photographs and drawings in sufficient detail to comprehensively explain the results achieved.
5. An updated TRL assessment, including a rough order of magnitude cost and a description and estimate of the duration of the follow-on activities necessary to achieve TRL 7.
6. Updated Quad Chart.
7. At the end of the period of performance, the PI shall provide a final Accomplishments Chart which contains the following information (a template is available in the e-Book):
  - Upper Right: A visual, graphic, or other pertinent information
  - Upper Left: "Description and Objectives"
  - Middle: "Accomplishments"
  - Bottom: "Co-Is" (name and affiliation), "Entry TRL" and "Exit TRL."

The Final Report, updated Quad Chart or Accomplishments Quad Chart, and updated TRL assessment shall be uploaded with the updated Final Review presentation to the appropriate locations in the ESTO e-Book within ten days of the review.

2.4.6 Earth Science Technology Conference and Workshops

The awardee is encouraged to participate in the annual Earth Science Technology Conference (ESTC). The ESTC is an opportunity for NASA planners, managers, technologists and scientists to review the research funded by the ESTO. It is also an opportunity for researchers from NASA, academia and industry to meet with their peers and to better understand NASA Earth science requirements.

Travel expenses will be provided for non-Government awardees selected to participate in the ESTC. A travel charge number will be provided to NASA awardees selected to participate; an invitational travel order will be issued to other (non-NASA) Government awardees selected to participate. Therefore, no travel costs for participation in ESTC should be included in the proposal. If selected for participation in the ESTC, the awardee should be prepared to make a presentation, provide a paper, or create a poster providing a description of the project, the objectives, approach, technical status, and schedule information.

2.5 Summary of Key Information

Expected total program budget for new awards	~ \$500K – 1.2 M per year per award
Number of new awards pending adequate proposals of merit	~ 15-20
Maximum duration of awards	Minimum 1-year / Maximum 3-year awards
Due Date for Notice of Intent to Propose	October 12, 2007
Due date for delivery of proposals	December 12, 2007
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcomes(s) from Table 1 in the <i>Summary of Solicitation</i> of this NRA. See also Sections I(a) and IV(e).
General information and overview of this solicitation	See <i>Summary of Solicitation</i> of this NRA.
Detailed instructions for the preparation and submission of proposals	<i>Guidebook for Proposers Responding to NASA Research Announcement – 2007</i> at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a> .

Page length for the central Science-Technical-Management section of proposal	15 pp; see also Chapter 2 of the <i>NASA Guidebook for Proposers</i>
Submission medium	Electronic proposal submission is required; no hard copy is required. See also Section IV in the <i>Summary of Solicitation</i> of this NRA and Chapter 3 of the <i>NASA Guideline for Proposers</i>
Web site for submission of proposal Cover Page:	<a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)
Funding opportunity number for downloading an application package from Grants.gov	NNH07ZDA001N-IIP
NASA point of contact concerning this program	Ms. Janice L. Buckner Earth Science Technology Office Code 407 NASA Goddard Space Flight Center Greenbelt, MD 20771 Telephone: (301) 286-0171 E-mail: <a href="mailto:Janice.L.Buckner@nasa.gov">Janice.L.Buckner@nasa.gov</a>