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**National Aeronautics and Space Administration  
NASA Headquarters  
Exploration Systems Mission Directorate  
Advanced Capabilities Division  
300 E ST SW  
Washington, DC 20546-0001**

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## **Research Opportunities in Fluid Physics**

### **NASA Research Announcement Soliciting Proposals for the Period Ending September 8, 2008**

Catalog of Federal Domestic Assistance (CFDA) Number: 00.000

**NNH08ZTT002N NRA  
Issued: June 6, 2008  
Notices of Intent Due: July 7, 2008  
Proposals Due: September 8, 2008**

# NRA NNH08ZTT002N: Research Opportunities in Fluid Physics

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Proposals that do not conform to the standards outlined in this solicitation may be declared noncompliant and declined without review. You must read and understand this solicitation in its entirety to prepare a competitive proposal. Key requirements are identified here:

- You and your organization must be registered with NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). Your proposal must be submitted by an authorized representative of your organization. All team members listed on the proposal must be registered with NSPIRES (Section IV.B.1.a).
- Your hypothesis and specific aims must address the research emphases in this solicitation, and must be clearly outlined in the project description of your proposal (Section I.B).
- The length of the project description of the proposal cannot exceed 20 pages using standard (12 point) type (Section IV.B.1.c.2).
- If your proposal is a revised version of a previously submitted proposal, you must address prior review comments (2 pages maximum) in a section separate from the project description (Section IV.B.1.c.1).
- Your proposal must meet requirements of the Compliance Review section of this solicitation (Section V.A).

### I. Funding Opportunity Description

#### A. Introduction

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA) solicits hypothesis-driven research proposals to conduct investigations in multiphase flow and heat transfer including phase change in microgravity and reduced-gravity environments. This call is for ground-based research that may eventually lead to research on the International Space Station (ISS). The proposer must show a clear path from the proposed ground-based research to an experiment feasible to conduct on the ISS using facilities currently existing on ISS or planned for in the future, such as the Fluids Integrated Rack, Microgravity Science Glovebox, etc. For more information, please see <http://exploration.grc.nasa.gov/Advanced/ISSResearch/>. The ultimate goal of the research is to provide validated mechanistic models and predictive framework necessary for developing and implementing multiphase-based technologies for space and planetary applications. Proposers are encouraged to provide information on their planned or required use of NASA's ground-based low-gravity facilities such as the 2.2 Second Drop Tower, 5.2 Second Zero Gravity Facility and Low-gravity Aircraft <http://microgravity.grc.nasa.gov/ground/>.

NASA's physical sciences research activities have been guided by recommendations from the National Research Council (NRC). Since the President's major space policy address in 2004, multiphase flow and heat transfer issues in space technology operations,

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has been listed as a priority area of research by the NRC in the 2006 report: “Review of NASA Plans for the International Space Station”. Also, multiphase flow and heat transfer has been ranked as an area of high importance in prior NRC reports, “Space Engineering Board and Assessment of Directions in Microgravity and Physical Sciences Research at NASA” in 2003, and the “Microgravity Research in Support of Technologies for the Human Exploration and Development of Space and Planetary Bodies”, in 2000.

Proposals submitted in response to this NRA must address the research emphases defined in Section B and are expected to provide evidence of a firm justification for the need of a microgravity environment. Even though the solicitation is for ground-based research, it is recommended that the proposer provide information about the possible space flight experiment resulting from this work. This information should include the flight experiment concept, implementation of the experiment, and the level of development required for any important instrumentation. This will help NASA assess the maturity and feasibility of the proposed experiment concept. In order to avoid duplication of efforts please refer to the following websites to find the current ISS experiments:

<http://spaceflightsystems.grc.nasa.gov/Advanced/ISSResearch/>

[http://www.nasa.gov/mission\\_pages/station/science/experiments/Summary.html](http://www.nasa.gov/mission_pages/station/science/experiments/Summary.html)

<http://www.esa.int/esaCP/index.html>

[http://www.jaxa.jp/index\\_e.html](http://www.jaxa.jp/index_e.html)

<http://www.roscosmos.ru/index.asp?Lang=ENG>

<http://www.cnsa.gov.cn/n615709/cindex.html>

<http://www.space.gc.ca/asc/eng/default.asp>

### **B. Research Emphases Specific to this Solicitation**

Advanced space technologies, such as advanced power, propulsion and life support systems, using liquid-vapor phase-change processes have the potential to significantly improve efficiency and reduce mass of space flight systems needed to support future human space exploration activities. NASA has avoided using such technologies because of a lack of understanding and validated predictive framework for multiphase and phase change processes. The technology required for these future systems cannot solely rely on Earth gravity based designs because multiphase fluid systems behave differently in space. For example, in microgravity, the safe upper limit for pool boiling changes and the pressure drop and heat transfer are altered in two-phase flow. Subsystems that will be affected include boilers, condensers, liquid-vapor separators, two-phase radiators, heat pipes, cryogenic storage tanks, etc. Microgravity research in multiphase flow and heat transfer is essential to provide a fundamental knowledge base in order to develop these future space systems.

Due to relatively large density differences between phases, gravity tends to exert a controlling influence on these processes. Therefore, microgravity behavior of such systems often differs widely from their terrestrial counterparts. This knowledge gap can only be filled by a combination of well devised long-duration microgravity experiments

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and mechanistic models of the fundamental processes and phenomena. It is also envisioned that microgravity data will help refine normal-gravity models by providing new insights into various competing mechanisms. NASA is, therefore, interested in supporting research in the following areas:

1. **Phase Separation:** The absence of buoyancy force in microgravity eliminates a common terrestrial means of phase separation. Both “active” and “passive” concepts for phase separation have been proposed and limited studies have been conducted as to their effectiveness. Additional research is needed for quantitative prediction of such devices and validation of their performance in microgravity environment.
2. **Forced Flow Boiling and Condensation:** Understanding of convective or forced flow boiling and condensation are crucial to developing many of the multiphase technologies ranging from fluid transfer of cryogenic propellants to thermal management and water purification techniques. Research is needed to predict transient and steady state heat transfer coefficients, the associated pressure drops, and the heat transfer regime transitions from sensible heating through nucleate boiling to dry out . Flow regimes, another key aspect of multiphase processes, is inherently intertwined in such research studies. Research should include quantitative prediction tools and microgravity experiments required to validate them.
3. **Multiphase Flow Dynamics/Instabilities:** Besides the expected transient behavior associated with system startup, shutdown and change of set-point, terrestrial multiphase flow systems have exhibited other flow instabilities that can have debilitating effect on system performance and safety. These instability mechanisms result in preferential phase accumulation within portions of the system and then the sudden depletion of that accumulation. This phase accumulation and depletion results in flow rate oscillations, water hammering, heater burnout etc. Research is needed to establish parameters necessary to ascertain stable performance of such systems in microgravity environment.

Due to budget and flight constraints, not all proposals of high scientific merit will be selected. Applicants are advised that proposals must be based on firmly established analytical procedures and published ground-based and/or flight research. A hypothesis must be clearly stated and the appropriate methods outlined for conducting the project using NASA’s ground-based low-gravity facilities and a clear pathway to utilizing the ISS. Also, proposers do not need to include any costs incurred by NASA in making the low-g facilities or ISS available but should include all costs to be incurred by the proposers in using such facilities.

Note: Several studies have examined proposed multiphase flow systems vs. the existing experimental databases and the available analytical models. These studies include:

- 1) **Microgravity Research in Support of Technologies for the Human Exploration and Development of Space and Planetary Bodies, Committee on Microgravity Research, National Academy Press, 2000.**

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- 2) McQuillen, J., Rame, E., Kassemi, M., Singh, B., and Motil, B., “Results of the Workshop on Two-Phase Flow, Fluid Stability and Dynamics: Issues in Power, Propulsion, and Advanced Life Support Systems, ” NASA TM-2003-21258, 2003.
- 3) Lahey, R. T., and Dhir, V., “Research in Support of the Use of Rankine Cycle Energy Conversion Systems for Space Power and Propulsion,” NASA/CR—2004-213142, 2004.

### **C. NASA Safety Policy**

Safety is NASA’s highest priority. Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA’s safety priority is to protect: (1) the public, (2) the NASA workforce (including astronauts, pilots and employees working under NASA instruments), and (3) high-value equipment and property. All research conducted under NASA shall conform to this philosophy.

### **D. Availability of NASA Funds for Award**

The Government’s obligation to make award(s) is contingent upon the availability of the appropriated funds from which payment can be made and the receipt of proposals that are determined acceptable for NASA award under this NRA.

### **E. Additional Funding Restrictions**

The construction of facilities is not an allowed activity unless specifically stated so in the program description. For further information on the allowable costs, refer to the cost principles cited in the *NASA Federal Acquisition Regulations (FAR) Supplement Provision* and the *Guidebook for Proposers*.

Travel, including foreign travel, is allowed as may be necessary for the meaningful completion of the proposed investigation, as well as for presenting results at an appropriate professional meeting. See Section VI, Part D for required travel information.

Profit for commercial organizations is allowed under contract awards only.

Regardless of whether functioning as a PI or as a team member, personnel from NASA Centers must propose budgets based on Full Cost Accounting (FCA). Non-NASA U.S. Government organizations should propose based on FCA unless no such standards are in effect; in that case such proposers should follow the Managerial Cost Accounting Standards for the Federal Government, as recommended by the Federal Accounting Standards Advisory Board. For further information, see <http://www.hq.nasa.gov/fullcost/>.

## **II. Award Information**

The selected proposal(s) are expected to be funded for activities lasting three years. The mechanism for funding each successful proposal will be a single grant, with funding allocations to participating investigators based on the submitted budget, available funds and overall project review. The funding duration will depend on proposal requirements, peer review panel recommendations, and continuing progress of the activity. Proposals will be evaluated as described in Section V. Proposals to continue or supplement existing grants, if selected, will result in a new grant.

Depending on available funding, the total award for each selected proposal will average \$300,000. It is anticipated that up to six investigations will be selected. Successful proposals will be funded with fiscal year 2008 funds for activities lasting up to three years. NASA does not provide separate funding for direct and indirect costs; thus, the amount of the award requested is the total of all costs submitted in the proposed budget. Selection of proposals will be announced in November 2008, and the grant will be awarded in a reasonable timeframe thereafter.

## **III. Eligibility Information**

### **A. Eligibility of Applicants**

All categories of U.S. institutions are eligible to submit proposals in response to this NRA. PI's may collaborate with universities, Federal Government laboratories, the private sector, and state and local government laboratories. In all such arrangements, the applying entity is expected to be responsible for administering the project according to the management approach presented in the proposal. The applying entity must have in place a documented base of ongoing high quality research in science and technology, or in those areas of science and engineering clearly relevant to the specific programmatic objectives and research emphases indicated in this NRA. Present or prior NASA support of research or training in any institution or for any investigator is not a prerequisite to submission of a proposal.

### **B. Guidelines for International Participation**

NASA welcomes proposals from outside the U.S. However, foreign entities are generally not eligible for funding from NASA. Therefore, unless otherwise noted in the NRA, proposals from foreign entities should not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and if the proposal is selected, sufficient

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funds will be made available to undertake the activity as proposed. All foreign proposals must be typewritten in English and comply with all other submission requirements stated in the NRA. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with: Appendix A, paragraph (G). Sponsoring foreign government agencies or funding institutions may, in exceptional situations, forward a proposal without endorsement if endorsement is not possible before the announced closing date. In such cases, the NASA sponsoring office should be advised when a decision on endorsement can be expected. Successful and unsuccessful foreign entities will be contacted directly by the NASA sponsoring office. Copies of these letters will be sent to the foreign sponsor. Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of External Relations (OER) will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding institution will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

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

NASA's policy is to conduct research with non-U.S. organizations on a cooperative, no exchange-of-funds basis. Although Co-Investigators or collaborators employed by non-U.S. organizations may be identified as part of a proposal submitted by a U.S. organization, NASA funding through this NRA may not be used to support research efforts by non-U.S. organizations at any level; however, the direct purchase of supplies and/or services that do not constitute research from non-U.S. sources by U.S. award recipients is permitted. See NASA FAR Supplement Part 1835.016-70 for additional information on international participation, which can be referenced at [http://www.hq.nasa.gov/office/procurement/regs/1835.htm#35\\_016-70](http://www.hq.nasa.gov/office/procurement/regs/1835.htm#35_016-70). Also see NASA Policy Directive 1360.2 Initiation and Development of International Cooperation in Space and Aeronautics Programs, which is located at [http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal\\_ID=N\\_PD\\_1360\\_002A\\_&page\\_name=main](http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PD_1360_002A_&page_name=main)

### **C. Export Control Guidelines Applicable to Proposals Including Foreign Participation**

Proposals, including foreign participation, must include a section discussing compliance with U.S. export laws and regulations, *e.g.*, 22 CFR Parts 120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular foreign participation. The discussion must describe in detail the proposed foreign participation and is to include, but not be limited to, whether or not the foreign participation may require the prospective investigator to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export

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license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at <http://www.pmdtc.org/> and <http://www.bis.doc.gov/>.

### D. Cost Sharing or Matching

If an institution of higher education, hospital, or other non-profit organization wants to receive a grant from NASA, cost sharing is not required. However, NASA can accept cost sharing if it is voluntarily offered. If a commercial organization wants to receive a grant, cost sharing is required unless the commercial organization can demonstrate that they are unlikely to receive substantial compensating benefits for performance of the work. If no substantial compensating benefits are likely to be received, then cost sharing is not required but can be accepted. Acceptable forms of cost sharing are located at [http://www.hq.nasa.gov/office/procurement/regs/1816.doc#OLE\\_LINK3](http://www.hq.nasa.gov/office/procurement/regs/1816.doc#OLE_LINK3).

## IV. Proposal and Submission Information

### A. Source of Application Materials

Except where specifically stated otherwise in this NRA, applicants must prepare proposals in accordance with the “Instructions for Responding to NASA Research Announcements” NASA Federal Acquisition Regulations (FAR) Supplement (NFS), Part 1852.235-72 ([http://www.hq.nasa.gov/office/procurement/regs/5228-41.htm#52\\_235-72](http://www.hq.nasa.gov/office/procurement/regs/5228-41.htm#52_235-72)). These instructions hereafter referred to as the *NASA FAR Supplement Provision*, can be referenced in its entirety in Appendix A of this document.

All information needed to submit an electronic proposal in response to this solicitation is contained in this NRA and in the 2008 version of the companion document entitled “Guidebook for Proposers Responding to a NASA Research Announcement (NRA)” (hereafter referred to as the *Guidebook for Proposers*) that is located at <http://www.hq.nasa.gov/office/procurement/nraguidebook/>.

**At NASA’s discretion, proposals that do not conform to these standards and directions given in this NRA may be declared noncompliant and declined without review.**

Proposal submission questions will be answered and published in a Frequently Asked Questions (FAQ) document. This FAQ will be posted on the NSPIRES solicitation download site alongside this NRA, and will be updated periodically between submission release and the proposal due date.

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### B. Content and Form of NOI and Proposal Submission

#### 1. NASA Proposal Data System

##### a) NSPIRES Registration

This NRA requires that the proposer register key data concerning their intended submission with the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) located at <http://nspires.nasaprs.com>. Potential applicants are urged to access this site well in advance of the NOI and proposal due dates to familiarize themselves with its structure and enter the requested identifier information. **It is especially important to note that every individual named on the proposal's Cover Page (see further below) must be registered in NSPIRES and that such individuals must perform this registration themselves; that is, no one may register a second party, even the PI of a proposal.** This data site is secure and all information entered is strictly for NASA use only.

Every organization that intends to submit a proposal in response to this NRA, including educational institutions, industry, nonprofit institutions, NASA Centers, the Jet Propulsion Laboratory, and other U.S. Government agencies, **must be registered in NSPIRES**, regardless of the electronic system used to submit proposals. Such registration must be performed by an organization's electronic business point-of-contact (EBPOC) in the Central Contractor Registry (CCR).

##### b) Notice of Intent Submission

To facilitate planning for the review process, applicants are strongly encouraged to submit a NOI through NSPIRES by following the online instructions. **Notices of Intent must be electronically submitted by July 7, 2008**, through the NSPIRES website (<http://nspires.nasaprs.com>).

To initiate a NOI:

- Log in using your NSPIRES user name and password.
- Access Proposals in the NSPIRES Options Page
- Click on the "Create NOI" button in the upper right hand corner of the screen.
- Select the "Research Opportunities for Fluid Physics" (NNH08ZTT002N) solicitation.
- Follow the step-by-step instructions provided in NSPIRES to complete your Step-1 proposal.

**Please refer to the NSPIRES tutorials at <http://nspires.nasaprs.com/tutorials/index.html>** for on-line help. All information entered will remain private until the electronic submission is completed. Please note that Notices of Intent are strongly encouraged, but are not required for submission of a proposal. Failure to submit a Notice of Intent will not impact the selection process.

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### c. Proposal submission

As with the NOI, the NSPIRES system will guide proposers through submission of all required proposal information. Please note that previously submitted NOI information will be automatically transferred to the proposal when using NSPIRES. Please refer to the on-line NSPIRES tutorials at <http://nspires.nasaprs.com/tutorials/index.html> for help.

Proposals must be submitted electronically. Proposers intending to submit proposals can use either Grants.gov (<http://www.grants.gov/>) or NSPIRES (<http://nspires.nasaprs.com>) for proposal submission. Instructions for submitting proposals via Grants.gov may be found on the Grants.gov portal at <http://www.grants.gov/>.

**Proposals must be submitted electronically by one of the officials at the PI's organization who is authorized to make such a submission. It is strongly recommended that the PI work closely with his/her organization official to ensure the proposal is submitted by the due date and time listed in this solicitation. Proposals will not be accepted after the listed due date and time.**

NSPIRES accepts electronic proposals through a combination of data-based information (e.g., the electronic *Cover Page* and its associated forms) and an uploaded PDF file that contains the body of the proposal. The web site will provide a list of all elements that make up an electronic proposal, and the system will conduct an element check to identify any item(s) that is (are) apparently missing or incomplete. Note that a failed element check will not preclude submission but rather it will serve as a warning that a proposal may be incomplete. Proposers are particularly encouraged to begin their submission process early.

Requests for assistance in accessing and/or using the NSPIRES website should be submitted by E-mail to [nspires-help@nasaprs.com](mailto:nspires-help@nasaprs.com) or by telephone to (202) 479-9376 Monday through Friday, 8:00 AM – 6:00 PM Eastern Time. FAQs may be accessed through the Proposal Online Help site at <http://nspires.nasaprs.com/external/help.do>. Tutorials of NSPIRES are available at <http://nspires.nasaprs.com/tutorials/index.html>.

**Proposals are due September 8, 2008.** All proposals must meet the requirements for responding to an NRA as outlined in the *NASA FAR Supplement Provision* (Appendix A). Chapter 2 of the *Guidebook for Proposers* provides detailed discussions of the content and organization of proposals for electronic submission.

The NSPIRES system will guide proposers through submission of all required proposal information. Select the NOI button on the Create Proposal screen on NSPIRES to create a proposal from a previously submitted NOI. Information from your NOI will be automatically transferred to your proposal. Please note that the Proposal Summary, Business Data, Budget, and Proposal Team are required Cover Page Elements. The proposal summary should be between 100-300 words and understandable by the layman reader.

NSPIRES allows for the upload of several proposal components as individual documents.

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However, to ensure proper proposal transmission, please provide only **one** PDF attachment upload ordered as follows:

1. *Response to prior review, if applicable (see IV.B.1.c.1)*
2. *Scientific / Technical Project Description (see section IV.B.1.c.2)*
3. *References and Citations*
4. *Management Approach (see Guidebook for Proposers & Appendix A)*
5. *Personnel CVs (see Guidebook for Proposers & Appendix A)*
6. *Facilities and Equipment (see Guidebook for Proposers & Appendix A)*
7. *Budget Justification (see Guidebook for Proposers & Appendix A)*
8. *Letters of Collaboration / Support (see Guidebook for Proposers & Appendix A)*
9. *Reprints and Appendices (see IV.B.1.c.3)*

The PDF upload must not be password protected or locked in any way. As a courtesy, the NSPIRES system performs a “check” of the proposal components upon submission. NSPIRES is used by multiple programs for proposal submission and only the components outlined in this solicitation are required for compliance. Checks referring to proposal components not mentioned above or requesting proposal components be uploaded separately (such as budget justification) can be ignored.

Proposals are prepared by the PI or a designated representative of the PI but are submitted by an official of the PI’s organization after the PI has released the prepared proposal to the institution official. It is strongly recommended that the PI work closely with his/her organization official to ensure the proposal is submitted by the due date and time listed in this solicitation. Proposals will not be accepted after the listed due date.

**The following supersedes the information provided in the *Guidebook for Proposers* and is required in addition to the *NASA FAR Supplement Provision (Appendix A)*:**

### ***1) Revised Proposals***

Proposals that are revised versions of proposals previously submitted within two years must be clearly designated as such and must contain an explanation of how the revised proposal has addressed criticisms from previous review. This explanation should be presented preceding the research description as part of the main proposal upload and is limited to two pages. Related changes to the research plan should be highlighted in the body of the project description. Proposal reviewers will be provided with the evaluations of prior submissions. **Revised proposals not identified as such will be returned to the submitter without panel review and not considered for funding.**

### ***2) Scientific/Technical/Management Section (Project Description)***

The length of the project description of the proposal cannot exceed 20 pages using standard (12 point) type. Text should have the following margins: left = 1.5”; Right, top, bottom = 1.0”. Referenced figures must be included in the 20 pages of the project description; however figure captions can use a 10 point font. The proposal should contain sufficient detail to enable reviewers to make informed judgments about the overall merit of the proposed research and about the probability that the proposers will be able to accomplish their stated objectives with current resources and the resources

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requested. The hypotheses and specific aims of the proposed research must be clearly stated. **Proposals that exceed the 20-page limit for the project description will be declined without review. Cited literature and other proposal sections are not considered part of the 20-page project description.** Reviewers are not required to consider information presented as appendices or to view and/or consider Web links in their evaluation of the proposal. Additional information can be referenced in Appendix A, Section (c)(4).

### *3) Reprints and Appendices*

Reprints and Appendices, if any, do not count toward the project description page limit, and are to be included following all other sections of the proposal (**reviewers are not required to consider information presented in appendices**).

### **2. Submission of Proposals via Grants.gov**

In furtherance of the President's Management Agenda, NASA offers proposers the option to utilize Grants.gov to prepare and submit proposals. Grants.gov provides a single Government-wide portal for finding and applying for Federal grants online. Instructions for submitting proposals via Grants.gov may be found on the Grants.gov portal at <http://www.grants.gov/>.

**All proposers, team members, and agency officials must be registered with NSPIRES before proposal submission, as described under section IV.B.1, regardless of the electronic submission system used.**

## **C. Submission Dates**

For Solicitation announcement identifier NRA **NNH08ZTT002N**:

Notices of Intent are due July 7, 2008, 11:59 PM Eastern Time

Proposals are due September 8, 2008, 11:59 PM Eastern Time.

The estimated selection announcement date is November 2008. The NASA Selecting Official is the Director of Advanced Capabilities Division, Exploration Systems Mission Directorate at NASA Headquarters (Washington, D.C.).

## **V. Proposal Evaluation Process**

The overall evaluation process for proposals submitted in response to this NRA will include a Compliance Matrix Review and an Intrinsic Scientific or Technical Merit Review. Proposals most highly rated in the merit review process will undergo a programmatic balance and cost review.

### **A. Compliance Review**

All proposals must comply with the general requirements of the NRA as described in this

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solicitation, the *Guidebook for Proposers*, and the *NASA FAR Supplement Provision*. Upon receipt, proposals will be reviewed for compliance with these requirements including:

- 1) The proposal project description must be no more than 20 pages in length.
- 2) Submission of appropriate Institutional Review Board (IRB) or Animal Care and Use Committee (ACUC) certification for all proposals using human or animal test subjects in accordance with Section IV.B.3.a., if applicable
- 3) Submission of an appropriate and justified budget for a funding period not exceeding that described in the NRA.
- 4) Proposals that are revised versions of proposals previously submitted must be clearly designated as such and must contain an explanation of how the revised proposal has addressed criticisms from previous review. This explanation should be presented in a separate form of no more than two pages. Related changes to the research plan should be highlighted in the body of the project description.
- 5) Submission of all other appropriate information as required by this NRA.

At NASA's discretion, non-compliant proposals may be withdrawn from the review process and declined without further review. Compliant proposals submitted in response to this NRA will undergo an intrinsic scientific or technical merit review.

### **B. Intrinsic Scientific or Technical Merit Review and Evaluation Criteria**

Compliant proposals will undergo a merit peer review by a panel of scientific or technical subject matter experts. This panel of experts may include non-NASA and or non-Government personnel. The number and diversity of experts required will be determined by the response to this NRA and by the variety of disciplines represented in the proposals relevant to the research emphases described in this NRA. The merit review panel will assign *a score from 0-100* based upon the intrinsic scientific or technical merit of the proposal. This score will reflect the consensus of the panel.

The score assigned by this panel will not be affected by the cost of the proposed work, nor will it reflect the programmatic relevance of the proposed work to NASA. However, the panel will be asked to include in their critique of each proposal any comments they may have concerning the proposal's budget.

To be responsive to this research solicitation, proposed studies should be hypothesis-driven and lead to new knowledge within accepted scientific standards. Purely phenomenological approaches with no significant mechanistic basis or likely gain in scientific knowledge are not acceptable.

All of the following criteria will be used in determining the merit score (significance and approach are the most important and weigh more than innovation, investigator, and environment):

- **Significance:** Does this study address an important problem? If the aims of the

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- application are achieved, how will scientific knowledge or technology be advanced? What will be the effect of these studies on the concepts, methods, or products that drive this field? Is there a significant societal or economic impact?
- **Approach:** Are the conceptual framework, design, methods, and analyses adequately developed, well integrated, and appropriate to the aims of the project? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas and consider alternative tactics?
  - **Innovation:** Does the project employ appropriate novel concepts, approaches, or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?
  - **Investigators:** Are the proposers appropriately trained and well suited to carry out this work? Is the work proposed appropriate to the experience level of the principal investigator and any co-investigators? Is the evidence of the proposers' productivity satisfactory?
  - **Environment:** Does the scientific environment in which the work will be performed contribute to the probability of success? Do the proposed experiments take advantage of unique features of the scientific environment or employ useful collaborative arrangements? Is there evidence of institutional support?

### C. Programmatic Balance and Cost Review

Only those proposals most highly rated in the merit review process will undergo additional review. This review will evaluate the programmatic balance and cost of all proposals in the fundable range. This review will be conducted by NASA Exploration Technology Development Program (ETDP) Program Scientists and Managers. Evaluation of the cost of a proposed effort includes consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds. Programmatic balance will include an evaluation of how the proposed work may help achieve an appropriate balance of scientific and technical tasks required by critical research issues faced by NASA.

### D. Selection

The information resulting from the reviews described above will be used to prepare selection recommendations by NASA Program Scientists and Managers in coordination with the NASA Headquarters Program Executive. Selection for funding will be made by the designated NASA Selecting Official (the Director of Advanced Capabilities Division, Exploration Systems Mission Directorate [ESMD] at NASA Headquarters).

The most important element in the evaluation process is the merit review, which carries the highest weight in final evaluation and selection. Programmatic balance and cost are approximately equal in weight to each other. Deficiencies in any one of these factors may prevent selection of a proposal. Additional information can be referenced in Appendix A, Section (k).

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### **E. Ombudsman**

(1) An ombudsman has been appointed to hear and facilitate the resolution of concerns from offerors, potential offerors, and contractors during the preaward and postaward phases of this acquisition. When requested, the ombudsman will maintain strict confidentiality as to the source of the concern. The existence of the ombudsman is not to diminish the authority of the contracting officer, the Proposal Evaluation Panel, or the selection official. Further, the ombudsman does not participate in the evaluation of proposals, the source selection process, or the adjudication of formal contract disputes. Therefore, before consulting with an ombudsman, interested parties must first address their concerns, issues, disagreements, and/or recommendations to the contracting officer for resolution.

(2) If resolution cannot be made by the contracting officer, interested parties may contact the NASA ombudsman. Concerns, issues, disagreements, and recommendations which cannot be resolved at the installation may be referred to the NASA ombudsman, James A. Balinskas, the Director of the Contract Management Division, at 202-358-0445, fax 202-358-3083, email [james.a.balinskas@nasa.gov](mailto:james.a.balinskas@nasa.gov). Please do not contact the ombudsman to request copies of the solicitation, verify due date, or clarify technical requirements. Such inquiries shall be directed to the contacts specified in Section VII of this document.

## **VI. Award Administration Information**

### **A. Award Notices**

At the end of the selection process, each proposing organization will be notified of its selection or non-selection status. NASA will provide debriefings to those proposers who request one. Selection notification will be made electronically through NSPIRES and by a letter signed by the selecting official. The selection letters are not an authorization to begin performance. The selected organization's business office will be contacted by a NASA Grant Officer to negotiate an award. Any costs incurred by the proposer in anticipation of an award are at their own risk until contacted by a NASA Grant Officer. The NASA Procurement Office will determine the type of award instrument, request further business data, and negotiate the resultant action. NASA Grant Officers are the only personnel with the authority to award NASA grants and obligate government funds. NASA reserves the right to offer selection of only a portion of a proposal. In these instances, the proposer will be given the opportunity to accept or decline the offer. Additional information can be referenced in Appendix A, Section (k)(2).

### **B. Administrative and National Policy Requirements**

All grant awards are subject to the NASA Grant and Cooperative Agreement Handbook (NPR 5800.1). This handbook consists of four sections that prescribe the policies and procedures relating to the award and administration of NASA grants. Section A provides the text of provisions and special conditions and addresses NASA's authority, definitions,

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applicability, amendments, publications, deviations, pre-award requirements and post-award requirements currently covered by 14 CFR Part 1260. Section B relates to grants with institutions of higher education, hospitals, and other nonprofit organizations. Sections A and B, with the special considerations in subpart 1260.4(b), apply to awards with commercial firms that do not involve cost sharing. Section C adopts the administrative requirements of OMB Circular No. A-102 and relates to administrative requirements for grants to state and local governments. Section D relates to awards with commercial firms. The Handbook is located at <http://ec.msfc.nasa.gov/hq/grcover.htm>.

### **C. Program Reporting/Individual Researcher Reporting**

#### **Annual Reporting and Task Book Reporting**

The PI shall provide an annual written report to NASA on or before the anniversary of the start of funding. This information will be used to assess the degree of progress of the project. A component of this annual report will be used for the NASA Task Book (<http://taskbook.nasaprs.com/>). The Task Book includes descriptions of all peer-reviewed activities funded by the ESMD. The Task Book is an invaluable source of information for NASA biological and biomedical researchers as well as the external scientific and technical communities.

This information will consist primarily of:

- An abstract
- A bibliographic list of publications
- Copies of publications
- A statement of progress, including a comparison with the originally proposed work schedule

#### **Final Report**

A final report must be provided to NASA at the end of the award funding period, including a detailed listing of all peer-reviewed publications. This information will consist primarily of:

- Statement of the specific objectives
- Significance of the work
- Background
- Overall progress during the performance period
- Narrative discussion of technical approaches including problems encountered
- Accomplishments related to approach
- An appendix with bibliography and copies of all publications and reports

Any publications or other public materials containing data are particularly important to include in this section.

### **D. Other Considerations**

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### Optional Travel

Any travel for presentation at a professional society meeting (highly desirable).

## VII. Contacts

Additional technical information for the NASA Fluid Physics NRA is available from:

Dr. Francis Chiamonte  
Program Executive  
NASA Headquarters  
Email: [francis.p.chiamonte@nasa.gov](mailto:francis.p.chiamonte@nasa.gov)  
Phone: 202-358-0693

Additional NASA contracting information for this NRA is available from:

Cassandra Williams  
Contract Specialist  
NASA Stennis Space Center  
Email: [casandra.williams-1@nasa.gov](mailto:casandra.williams-1@nasa.gov)  
Phone: 228-813-6271

## VIII. References

**Guidebook For Proposers Responding To A NASA Research Announcement (NRA), January 2008 Edition.** This document is available online at the following address: <http://www.hq.nasa.gov/office/procurement/nraguidebook/>.

**NASA Task Book.** This document is available online at the following address: <http://taskbook.nasaprs.com/>

**NASA Federal Acquisition Regulations Supplement.** This document is available online at the following address: <http://www.hq.nasa.gov/office/procurement/regs/nfstocA.htm>.

**NASA Grant and Cooperative Agreement Handbook.** This document is available online at the following address: <http://ec.msfc.nasa.gov/hq/grcover.htm>.

**Microgravity Research in Support of Technologies for the Human Exploration and Development of Space and Planetary Bodies,** Committee on Microgravity Research, National Academy Press, 2000.

McQuillen, J., Rame, E., Kassemi, M., Singh, B., and Motil, B., "Results of the Workshop on Two-Phase Flow, Fluid Stability and Dynamics: Issues in Power, Propulsion, and Advanced Life Support Systems," NASA TM-2003-21258, 2003.

## **NRA NNH08ZTT002N: Research Opportunities in Fluid Physics**

Lahey, R. T., and Dhir, V., “Research in Support of the Use of Rankine Cycle Energy Conversion Systems for Space Power and Propulsion,” NASA/CR—2004-213142, 2004

## Appendix A: Instructions for Responding to NASA Research Announcements

(A) **General.**

- (1) Proposals received in response to a NASA NRA will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.
- (2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.
- (3) NRAs contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.
- (4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate award instrument. Contracts resulting from NRAs are subject to the FAR and the NASA FAR Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPR 5800.1).
- (5) NASA does not have mandatory forms or formats for responses to NRAs; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposer's most favorable terms.
- (6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

(B) **NRA-Specific Items.** Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

(C) The following information is needed to permit consideration in an objective manner. NRAs will generally specify topics for which additional

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information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

- (1) **Transmittal Letter or Prefatory Material.**
  - (i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;
  - (ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;
  - (iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;
  - (iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;
  - (v) Identification of other organizations that are currently evaluating a proposal for the same efforts;
  - (vi) Identification of the NRA, by number and title, to which the proposal is responding;
  - (vii) Dollar amount requested, desired starting date, and duration of project;
  - (viii) Date of submission; and
  - (ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).
- (2) **Restriction on Use and Disclosure of Proposal Information.**

Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals 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.

### **Notice**

#### **Restriction on Use and Disclosure of Proposal Information**

The information (data) contained in [insert page numbers or other identification] of this proposal 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

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used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

- (3) **Abstract.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.
- (4) **Project Description.**
  - (i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.
  - (ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.
- (5) **Management Approach.** For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.
- (6) **Personnel.** The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with

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information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) **Facilities and Equipment.**

- (i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that is proposed for use. Include evidence of its availability and the cognizant Government points of contact.
- (ii) 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. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

(8) **Proposed Costs (U.S. Proposals Only).**

- (i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.
- (ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.
- (iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).
- (iv) Use of NASA funds--NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted. Additionally, in accordance with the National Space Transportation Policy, use

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of a non-U.S. manufactured launch vehicle is permitted only on a no-exchange-of-funds basis.

- (9) **Security.** Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.
  - (10) **Current Support.** For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.
  - (11) **Special Matters.**
    - (i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.
    - (ii) Identify and discuss risk factors and issues throughout the proposal where they are relevant, and your approach to managing these risks.
    - (iii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.
- (D) **Renewal Proposals.**
- (1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.
  - (2) NASA may renew an effort either through amendment of an existing contract or by a new award.
- (E) **Length.** Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.
- (F) **Joint Proposals.**
- (1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and

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- managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.
- (2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.
- (G) **Late Proposals.** Proposals or proposal modifications received after the latest date specified for receipt may be considered if a significant reduction in cost to the Government is probable or if there are significant technical advantages, as compared with proposals previously received.
- (H) **Withdrawal.** Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.
- (I) **Evaluation Factors.**
- (1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.
  - (2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.
  - (3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:
    - (i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.
    - (ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.
    - (iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.
    - (iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.
  - (1) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.
- (J) **Evaluation Techniques.** Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full

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external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

**(K) Selection for Award.**

- (1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.
- (2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

**(L) Additional Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation.**

- (1) NASA welcomes proposals from outside the U.S. However, foreign entities are generally not eligible for funding from NASA. Therefore, unless otherwise noted in the NRA, proposals from foreign entities should not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and if the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.
- (2) All foreign proposals must be typewritten in English and comply with all other submission requirements stated in the NRA. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with paragraph (g) of this provision. Sponsoring foreign government agencies or funding institutions may, in exceptional situations, forward a proposal without endorsement if endorsement is not possible before the announced closing date. In such cases, the NASA sponsoring office should be advised when a decision on endorsement can be expected.
- (3) Successful and unsuccessful foreign entities will be contacted directly by the NASA sponsoring office. Copies of these letters will be sent to the foreign sponsor. Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of External Relations

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will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding institution will each bear the cost of discharging their respective responsibilities.

(4) Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

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

(M) **Cancellation of NRA.** NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.