

**National Aeronautics and Space Administration
Johnson Space Center
Human Exploration and Operations Mission Directorate
Human Research Program
Houston, TX 77058**

Human Exploration Research Opportunities (HERO)

National Aeronautics and Space Administration

NASA Research Announcement

Catalog of Federal Domestic Assistance (CFDA) Number: 43.003

**NNJ13ZSA002N
NRA Issued: July 30, 2013**

OVERVIEW

**Proposals Due
Starting no earlier than September 4, 2013
Through no later than September 2, 2014**

REFER TO APPENDICES FOR EXACT DUE DATES

Human Exploration Research Opportunities

Table of Contents

A. EXECUTIVE SUMMARY	4
B. HUMAN RESEARCH PROGRAM.....	5
1. BACKGROUND.....	5
2. ORGANIZATIONAL STRUCTURE	5
3. GOALS AND OBJECTIVES	6
C. SOLICITATION.....	6
1. SOLICITATION PROCESS.....	7
2. SOLICITED RESEARCH RESPONSE AREAS	7
3. EDUCATION AND PUBLIC OUTREACH	8
4. VERTEBRATE ANIMAL SCIENTIFIC REVIEW	8
5. SAMPLE SIZE SPECIFICATION GUIDELINES FOR NASA HUMAN RESEARCH STUDIES	8
6. NASA SAFETY POLICY.....	9
7. AVAILABILITY OF FUNDS FOR AWARD.....	9
8. ADDITIONAL FUNDING RESTRICTIONS	9
9. SALARY LIMITATION	10
10. AWARD INFORMATION	10
D. ELIGIBILITY INFORMATION	11
1. ELIGIBILITY OF APPLICANTS	11
2. GUIDELINES FOR INTERNATIONAL PARTICIPATION.....	11
<i>a. Guidelines for International Team Members on U.S. Proposals</i>	<i>11</i>
<i>b. Guidelines for International Proposals.....</i>	<i>11</i>
<i>c. Assurance of Compliance – China Funding Restriction</i>	<i>12</i>
<i>d. Export Control Guidelines Applicable to Proposals Including Foreign Participation.....</i>	<i>13</i>
3. COST SHARING OR MATCHING	13
4. DATA ACCESSIBILITY	14
5. SOFTWARE SHARING POLICY.....	14
6. OTHER CONSIDERATIONS	15
E. PROPOSAL INFORMATION	15
1. TYPES OF PROPOSALS: GROUND-BASED, ANALOG DEFINITION, FLIGHT DEFINITION.....	15
<i>a. Ground-Based.....</i>	<i>16</i>
<i>b. Analog Definition.....</i>	<i>16</i>
<i>c. Flight Definition.....</i>	<i>17</i>

2. TYPES OF RESEARCH PRODUCTS	19
<i>a. Countermeasure Readiness Level</i>	20
<i>b. Technology Readiness Level</i>	21
F. PROPOSAL REVIEW INFORMATION.....	22
1. EVALUATION CRITERIA	22
2. REVIEW AND SELECTION PROCESSES	22
3. SELECTION ANNOUNCEMENT AND AWARD DATES	23
4. OMBUDSMAN	23
G. RESEARCH RESOURCES.....	23
1. CURRENT RESEARCH PORTFOLIOS FOR NASA AND NSBRI	23
2. BIOMEDICAL DATA ARCHIVES	24
3. BIO-SPECIMEN SHARING PROGRAM.....	25
4. FLIGHT CAPABILITIES	25
5. RADIATION CAPABILITIES	25
6. ANALOG CAPABILITIES.....	25
<i>a. Bed Rest Facilities</i>	26
<i>b. Human Exploration Research Analog</i>	26
<i>c. Parabolic Aircraft</i>	26
<i>d. Suborbital Capabilities</i>	27
<i>e. NASA Extreme Environment Mission Operations</i>	27
<i>f. Antarctica</i>	27
<i>g. Exercise Countermeasures Laboratory</i>	28
H. BIBLIOGRAPHY.....	28
I. NASA CONTACT.....	30
J. ACRONYM LIST.....	30

A. Executive Summary

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA), entitled Human Exploration Research Opportunities (HERO)–2013, solicits applied research in support of NASA’s Human Research Program (HRP). The HRP contains six Elements: Space Radiation, Human Health Countermeasures, Exploration Medical Capability, Behavioral Health and Performance, Space Human Factors and Habitability, and International Space Station Medical Project. Fourteen disciplines or areas support the Program: Behavioral Health and Performance, Bone, Cardiovascular, Extravehicular Activity, Immunology, Medical Capabilities, Muscle, Nutrition, Pharmacology, Radiation, Sensorimotor, Advanced Food Technology, Advanced Environmental Health, and Space Human Factors Engineering. The National Space Biomedical Research Institute (NSBRI) is a non-profit organization competitively selected by NASA that uses an integrated team approach to advance biomedical research and countermeasure development. The NSBRI works in close partnership with the HRP through a Cooperative Agreement. This NRA covers all aspects of research to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration, and to ensure safe and productive human spaceflight.

Awards generally range from under \$100K per year for focused, limited efforts (e.g., data analysis) to \$450K per year for extensive activities (e.g., development of scientific hardware). The funds available for awards in each program element offered in this NRA range from less than one to several million dollars, which allow selection from a few to as many as a dozen proposals depending on the program objectives and the submission of proposals of merit. Awards will be made as grants. The period of performance for an award can range from one to five years. All categories of United States (U.S.) institutions are eligible to submit proposals in response to this NRA. Any changes or modifications to any of these guidelines will be specified in the descriptions of the relevant program elements in the solicited research response area appendices of this solicitation.

Details of the solicited program elements are given in the solicited research response area appendices of this NRA, and it is anticipated that several response area appendices will be issued throughout the year as needed. Most program elements will use a two-step proposal submission process though some program elements may use a one-step submission process. Proposals that do not conform to the standards outlined in this solicitation will be declared noncompliant and will be handled in accordance with the NASA Federal Acquisition Regulation Supplement 1815.305-70 (http://www.hq.nasa.gov/office/procurement/regs/5228-41.htm#52_235-72). Proposal due dates are given in this NRA, which will be posted at <http://nspires.nasaprs.com/>. Interested proposers should monitor [the website](#) or subscribe to the Human Exploration and Operations Mission Directorate (HEOMD) electronic notifications system through their NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) account for new program elements or amendments to this NRA through July 2014, at which time release of a subsequent HERO NRA is planned.

B. Human Research Program

1. Background

The HRP investigates and mitigates the highest risks to astronaut health and performance in exploration missions. The goal of the HRP is to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration, and to ensure safe and productive human spaceflight. The scope of these goals includes both the successful completion of exploration missions and the preservation of astronaut health over the life of the astronaut.

Two foundational documents of the HRP are the Human Research Program Requirements Document (PRD, Rev. F) and the Human Research Program Integrated Research Plan (IRP, Rev. E). The PRD lists the crew health and performance risks that the HRP must understand and mitigate. The IRP describes the plan to understand and reduce the risks.

The PRD

(http://www.nasa.gov/pdf/579466main_Human_Research_Program_Requirements_DocumentRevF.pdf) describes the high-level requirements that the HRP must meet. The requirements in the PRD are divided into the following three categories: 1) human system standards (PRD section 4), 2) human health & performance risks (PRD section 5) and 3) provisions of enabling capabilities (PRD section 6). Table C-2 of the PRD contains Human Research Program Risks and Research Ratings. All of the risks, and risk factors, in the table are dynamic. New risks will likely be identified with further mission experience. Other risks, or risk factors, may be retired if they are successfully mitigated, or if increased understanding lessens their severity. The research topic areas described in the appendices of this NRA derive from the need to address crew health and performance risks articulated in Table C-2 of the PRD.

The IRP describes HRP's research activities that are intended to address the needs of human space exploration and serve HRP customers. The IRP illustrates the HRP's research plan through 2025. The Human Research Roadmap (<http://humanresearchroadmap.nasa.gov>) is a web-based version of the IRP that allows users to search HRP risks, gaps, and tasks.

2. Organizational Structure

NASA is composed of four Mission Directorates, one of which is the Human Exploration and Operations Mission Directorate (HEOMD). The HRP (<http://www.nasa.gov/exploration/humanresearch/>) resides in the HEOMD, and the Program Office for the HRP is located at the NASA Johnson Space Center (JSC) in Houston, Texas. The HRP contains six Elements: Space Radiation, Human Health Countermeasures, Exploration Medical Capability, Behavioral Health and Performance, Space Human Factors and Habitability, and International Space Station Medical Project. Fourteen disciplines or areas support the program: Behavioral Health and Performance, Bone, Cardiovascular, Extravehicular Activity, Immunology, Medical Capabilities, Muscle, Nutrition, Pharmacology, Radiation, Sensorimotor,

Advanced Food Technology, Advanced Environmental Health, and Space Human Factors Engineering.

The National Space Biomedical Research Institute (NSBRI) in Houston, Texas is a non-profit organization competitively selected by NASA that uses an integrated team approach to advance biomedical research and countermeasure development. The NSBRI works in close partnership with the HRP through a Cooperative Agreement. Program information for each of the NSBRI research teams is available at <http://www.nsbri.org>.

3. Goals and Objectives

The goal of the HRP is to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. The scope of this goal includes both the successful completion of exploration missions and the preservation of astronaut health over the life of the astronaut. Specific objectives in support of this goal are:

1. Quantification of the crew health and performance risks associated with human spaceflight for the various exploration missions.
2. Development of countermeasures to provide mission planners and system developers with strategies for mitigating crew health and performance risks.
3. Development of technologies to provide mission planners and system developers with strategies for monitoring and mitigating crew health and performance risks.

This NRA solicits research that addresses at least one of these objectives.

C. Solicitation

It is critical for investigators to read carefully ALL of the instructions in this NRA.

Proposals in response to this NRA should be submitted to the most relevant program element described in the solicited research response area appendices (see also the *Table of Contents* that prefaces this NRA). Many of the programmatic emphases are different from those that have appeared in previous NRAs. All proposals will ultimately undergo peer review using similar processes and procedures, but procedures and forms for proposal submission differ for each solicited research response area appendix. The eventual funding of selected proposals will vary for the different types of awards. Applicants must determine if their proposed research is best suited to be conducted independently with NASA or as part of an integrated research team of the NSBRI. **Do not submit the same research proposal to more than one opportunity within this solicitation (i.e., submit either a NASA individual investigator proposal or an NSBRI team proposal).**

1. Solicitation Process

Most program elements require that proposals be submitted using a two-step process, while other program elements employ a one-step process. In the two-step process, Step-1 proposals submitted in response to this NRA will be evaluated by NASA or the NSBRI to determine how well they match one of the stated areas of emphasis identified in the solicited research response area appendices. Only those proposals that NASA or the NSBRI considers responsive to their respective areas of emphases will be invited to submit Step-2 proposals. NASA reserves the right to act in the best interests of the Federal Government in the matter of acceptance and evaluation of all proposals. NASA and the NSBRI may share Step-1 and Step-2 proposals submitted in response to this solicitation with each other. Step-1 proposals submitted in response to one opportunity within this solicitation may be invited to submit to a Step-2 proposal to a different opportunity within this solicitation. In the one-step process, proposers will submit only one proposal that is evaluated for merit and relevancy to the Program.

2. Solicited Research Response Areas

This solicitation focuses on the following areas.

- **Appendix A:** NASA Research and Technology Development to Support Crew Health and Performance in Space Exploration Missions - proposals are solicited in the areas of Short-Term Mild Hypoxia (Exploration Atmosphere) Effects on Visual Impairment and Intracranial Pressure (VIIP) Related Variables, Immune Function and Oxidative Stress and Damage during Long-Term Spaceflight on the International Space Station (ISS), Cerebral Spinal Fluid Production/Absorption and Various Other Effects of 90 Days Hind-Limb Suspension in Rats: Tissue Sharing Opportunities, Combined Effects of Simulated Deep Space Radiation and Weightlessness on Health Related Biomarkers and Oxidative Stress and Damage in Cell Cultures, Standardized Behavioral Health Measures List, Antarctic Long Duration Neurostructural Change, Neurobehavioral Conditions List for Characterizing Behavioral Health Risk for Exploration Missions, Specialized Roles Necessary for Effective Team Function and Performance on Exploration Missions, Biomarkers as Predictors of Behavioral Health Outcomes, Computational Modeling and Simulation for Habitat/Vehicle Design and Assessment, Automated Data Collection Tools for Habitability Design and Assessment, and Kinetics of Degradation of Vitamins B1 and K through Processing and Storage of Spaceflight Foods. Unless otherwise noted, these projects are expected to be multiple year efforts.
- **Appendix B:** NSBRI Research and Technology Development to Support Crew Health and Performance in Space Exploration Missions - proposals are solicited in the areas of Cardiovascular Alterations, Human Factors and Performance, Musculoskeletal Alterations, Neurobehavioral and Psychosocial Factors, Sensorimotor Adaptation, and Smart Medical Systems and Technology. These projects are expected to be multiple year efforts.
- **Appendix C:** NASA Human Research Program Omnibus Opportunity - proposals are solicited that address any of the risks listed in the Integrated Research Plan. These projects are expected to last no more than one year.
- **Appendix D:** NASA Differential Effects on Homozygous Twin Astronauts Associated with Differences in Exposure to Spaceflight Factors - proposals are solicited for small, short-term

investigations of the differences in genetic and related function in twin male monozygous astronauts associated with differential exposure to spaceflight conditions. These projects are expected to be multiple year efforts.

- **Appendix E:** NASA Ground-Based Studies in Space Radiobiology - proposals are solicited in the area of Space Radiation Biology utilizing beams of high charge and energy particles simulating space radiation at the NASA Space Radiation Laboratory (NSRL), at Brookhaven National Laboratory (BNL) in Upton, New York. These projects are expected to be multiple year efforts. **Please note that this Appendix does not currently exist and will be released in 2014.**

Additional appendices may be issued throughout the year as needed. Investigators may submit more than one proposal in response to this NRA; **however, identical proposals may NOT be submitted to more than one solicited research response area appendix.**

3. Education and Public Outreach

Research projects funded by NASA present an opportunity for NASA to enhance and broaden public knowledge, understanding of and appreciation for biological and biomedical research, and the value of this research in space environments. Individuals participating in NASA research projects have a responsibility to foster the development of a scientifically informed public. Therefore, all participants in this NRA are strongly encouraged to promote general scientific literacy and public understanding of biological and biomedical sciences, space environments, and HRP projects through formal and informal education opportunities.

4. Vertebrate Animal Scientific Review

NASA requires that any and all research proposals that request funding for vertebrate animal research shall be reviewed as described in the Vertebrate Animal Scientific Review (VASR) section posted alongside each applicable solicited research response area. Each response that requires vertebrate animals must address the five points outlined in the VASR. The VASR requirements are in addition to Institutional Animal Care and Use Committee (IACUC) requirements as outlined in each solicited research response area appendix, if appropriate.

5. Sample Size Specification Guidelines for NASA Human Research Studies

Statistical planning plays an important role in virtually all scientific research. It plays a particularly valuable role in the design of experiments, including specification of sample size(s), and also in the analysis of outcomes that address primary aims and hypotheses. As a result, principal investigators (PI) are highly encouraged to recruit statisticians as co-investigators (Co-I), so that they can apply their skills to help produce high-quality research proposals.

The Sample Size Specification Guidelines document posted alongside this NRA gives particular emphasis to the problem of how to arrive at and justify experiment sample size(s). The recommendations are necessarily general, and may not be universally applicable. Nevertheless, these guidelines are intended to clarify an understanding among PI's, grant reviewers, and NASA pertaining to sample-size issues for NASA human research studies.

It is the responsibility of the PI to propose a study that has a reasonable likelihood of detecting an effect with some clinical, operational, or scientific meaning. If applicable, the study description should include a range of possible sample sizes and their associated power. If your study is selected as a candidate for funding, you may be asked to explain or modify assumptions and calculations pertaining to sample size prior to funding determination.

6. 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) astronauts and pilots, 3) the NASA workforce (including employees working under NASA instruments), and 4) high-value equipment and property. All research conducted under NASA auspices shall conform to this philosophy.

7. Availability of Funds for Award

Funds are not currently available for awards under this NRA. 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.

8. 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 allowability of costs, refer to the cost principles cited in the *NASA Federal Acquisition Regulations Supplement (NFS)* and the *Guidebook for Proposers* (<http://www.hq.nasa.gov/office/procurement/nraguidebook/>). Travel, including foreign travel, is allowed as may be necessary for the meaningful completion of the proposed investigation, as well as for publicizing its results at an appropriate professional meeting.

This solicitation will result in grant awards only. Profit to commercial organizations under grants is not allowed.

Regardless of whether functioning as a team lead 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/>.

9. Salary Limitation

For this research announcement, NASA will limit the amount of direct salary for an investigator on a grant to Executive Level II of the Federal Executive Pay scale. The Executive Level II salary is \$179,700 per year. NASA grant awards for proposals that request direct salaries of individuals in excess of the applicable rate per year will be adjusted in accordance with the \$179,700 cap.

NASA grant awards for proposals that request salaries of individuals in excess of the applicable rate per year will be adjusted in accordance with the legislative salary limitation and will include a notification such as the following: None of the funds in this award shall be used to pay the salary of an individual at a rate in excess of the applicable salary cap.

An individual's base salary, per se, is NOT constrained by the legislative provision for a limitation of salary. The rate limitation simply limits the amount that may be awarded and charged to NASA grants. An institution may pay an individual's salary amount in excess of the salary cap with non-federal funds.

The salary limitation does NOT apply to payments made to consultants under a NASA grant, although, as with all costs, those payments must meet the test of reasonableness and be consistent with institutional policy.

The salary limitation provision DOES apply to sub-awards or subcontracts for substantive work under a NASA grant.

Example:

Individual's institutional base salary for a full-time calendar year appointment: \$200,000

Research effort requested in proposal: 6 months (50%)

If a grant is to be funded, the amount included for the above individual will be \$89,850 instead of \$100,000 due to the salary limitation.

For further information, please see National Institutes of Health (NIH) Notice NOT-OD-12-035 (<http://grants.nih.gov/grants/guide/notice-files/NOT-OD-12-035.html>).

10. Award Information

The selected proposal is expected to be funded as a research grant in one-year increments for activities lasting one to five years as stipulated for each solicited research response area. 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 project review. The funding duration will depend on proposal requirements, review panel recommendations, and

continuing progress of the activity. Proposals will be evaluated as described under each solicited research response area. Proposals to continue or supplement existing grants, if selected, will result in a new grant.

Anticipated award amounts are listed in each solicited research response area appendix. 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.

D. Eligibility Information

1. Eligibility of Applicants

All categories of United States (U.S.) institutions are eligible to submit proposals in response to this NRA. Principal Investigators 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.

2. Guidelines for International Participation

a. Guidelines for International Team Members on U.S. Proposals

HRP welcomes international team members on U.S. proposals. International collaborations that demonstrate clear scientific benefits or cost savings are particularly encouraged.

Services and direct purchases provided by international team members are allowable as subcontracts on U.S. proposals. Additional information on international participation can be referenced at http://www.hq.nasa.gov/office/procurement/regs/1835.htm#35_016-70.

b. Guidelines for International Proposals

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 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.

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 NASA FAR Supplement Provision 1852.235-72, 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 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.

Also see NASA Policy Directive 1360.2B 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_002B_&page_name=main

c. Assurance of Compliance – China Funding Restriction

All proposals submitted to this NRA must comply with the following: Assurance of Compliance with the Department of Defense and Full-Year Appropriation Act, Public Law 112-10 Section 1340(a); The Consolidated and Further Continuing Appropriation Act of 2012, Public Law 112-55, Section 539; and future-year appropriations herein after referred to as “the Acts”, whereas:

- a) NASA is restricted from using funds appropriated in the Acts to enter into or fund any grant or cooperative agreement of any kind to participate, collaborate, or coordinate

bilaterally with China or any Chinese-owned company, at the prime recipient level and at all sub-recipient levels, whether the bilateral involvement is funded or performed under a no-exchange of funds arrangement.

- b) Definition: “China or Chinese-owned Company” means the People’s Republic of China, any company owned by the People’s Republic of China, or any company incorporated under the laws of the People’s Republic of China.
- c) The restrictions in the Acts do not apply to commercial items of supply needed to perform a grant or cooperative agreement.
- d) By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any sub-recipient level, whether the bilateral involvement is funded or performed under a no-exchange of funds arrangement.

d. 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 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.bis.doc.gov/licensing/exportingbasics.htm>

3. 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 discussed in NFS 1816.303-70:

<http://prod.nais.nasa.gov/cgi-bin/common/wg/mfs.cgi/data/glimpse/archives/63?link=http://prod.nais.nasa.gov:80/far/far0553-nfs0463/1816.htm&file=/data/web/html/far/far0553-nfs0463/1816.htm&line=528#mfs>

4. Data Accessibility

NASA has a license as to all data collected through research programs sponsored by NASA. See 14 C.F.R. 1260.30. Therefore, all research data resulting from NASA HRP funded studies must be submitted to NASA. These data are then archived in the NASA Life Sciences Data Archive (LSDA) (<http://lsda.jsc.nasa.gov/>) for the benefit of the greater research and operational spaceflight community. Archival data products may include but are not limited to low-level (raw) data, high-level (processed) data, and data products such as calibration data, documentation, related software, and other tools or parameters that are necessary to interpret the data. Once a grant is awarded, the PI and the supporting NASA HRP Element Scientist shall work with LSDA to outline specific archiving requirements in an LSDA Data Submission Agreement. These requirements shall include which data are to be included, the format of the data, and the timeframe in which the data is expected to be submitted for archiving. Per the NASA Grant and Cooperative Agreement Handbook (http://prod.nais.nasa.gov/pub/pub_library/grcover.htm), the Government has the right to use and disclose all data generated from this grant:

“As a Federal Agency, NASA requires prompt public disclosure of the results of its sponsored research and, therefore, expects significant findings from supported research to be promptly submitted for peer reviewed publication with authorship(s) that accurately reflects the contributions of those involved. Likewise, as a general policy and unless otherwise specified, NASA no longer recognizes a “proprietary” period for exclusive use of any new scientific data that may be acquired through the execution of the award; instead, all data collected through any of its funded programs are to be placed in the public domain at the earliest possible time following their validation and calibration.”

The NASA HRP recognizes the importance of the right of first publication in demonstrating and maintaining the scientific credentials of its funded investigators. In general, the NASA HRP intends to continue its discretionary policy of allowing the funded PIs a period of one (1) year after final data collection from subjects or acquisition of final specimen in spaceflight or ground-based investigations, before making the data available to other investigators through release from the LSDA. The details and any exceptions or special circumstances of this policy will be documented in each investigation’s Data Submission Agreement. However, the NASA HRP Chief Scientist has the prerogative, at any time, to include all extant results, whether published or unpublished, in HRP’s internal analyses as needed for decisions pertaining to astronaut safety, health and performance and programmatic scope and direction. These analyses will not be published within the one-year period described above unless required by law or NASA policy.

5. Software Sharing Policy

A software dissemination plan, with appropriate timelines, is expected in the application only if software development is a part of the application. There is no prescribed single use license for software produced through grants responding to this announcement. In accordance with federal law, NASA will protect the privacy and ownership rights of software developers. However, NASA HRP does have goals for software dissemination, and reviewers will be instructed to evaluate the dissemination plan relative to these goals:

1. The software should be freely available to biomedical researchers and educators in the non-profit sector, such as institutions of education, research institutions, and government laboratories.
2. The terms of software availability should permit the dissemination and commercialization of enhanced or customized versions of the software, or incorporation of the software or pieces of it into other software packages.
3. To preserve utility to the community, the software should be transferable such that another individual or team can continue development in the event that the original investigators are unwilling or unable to do so.
4. The terms of software availability should include the ability of researchers to modify the source code and to share modifications with other colleagues. An applicant should take responsibility for creating the original and subsequent “official” versions of a piece of software.
5. To further enhance the potential impact of their software, applicants are expected to propose a plan to manage and disseminate the improvements or customizations of their tools and resources by others. This proposal may include a plan to incorporate the enhancements into the “official” core software, may involve the creation of an infrastructure for plug-ins, or may describe some other solution.

The plan for software sharing will be evaluated during peer review together with any other resource sharing plans.

The adequacy of the software sharing plans will be considered by NASA when making recommendations about funding applications as appropriate. In making such considerations, prior to funding, NASA may negotiate modifications of software sharing plans with the PI. Any software dissemination plans represent a commitment by the institution (and its subcontractors as applicable) to support and abide by the plan.

6. Other Considerations

Required Travel

The proposal must include travel costs for the following: Annual NASA Human Research Program Investigators’ Workshop. All NASA and NSBRI PIs are required to attend this workshop usually scheduled for February of each year in the vicinity of Houston, Texas.

Optional Travel

- Visits to NASA JSC.
- Presentation at a professional society meeting (highly desirable).

E. Proposal Information

1. Types of Proposals: Ground-Based, Analog Definition, Flight Definition

Proposals selected for support through this NRA will be designated as either: 1) ground-based, 2) analog definition, or 3) flight definition. Analog facilities, including NASA bed rest facilities at

the University of Texas Medical Branch (UTMB) at Galveston, TX and flight resources are limited. Commitment by NASA to proceed from analog definition or flight definition to the execution phase will be made only after additional engineering and feasibility assessments have been performed.

Proposals that use appropriate non-human experimental models will be considered if the proposer can demonstrate that the approach will accelerate the achievement of one or more of the three program goals enumerated in section [B.3](#) of the HERO Overview, or enable the achievement of one of the goals entirely without the use of human subjects.

a. Ground-Based

Investigations that do not propose to use analog facilities or to conduct flight studies are referred to as ground-based proposals in this solicitation. Investigators offered support for a ground-based study addressing topics in Section II or Section III of this solicitation will normally be expected to provide results useful to NASA after no more than three years for NASA and NSBRI awards. If additional research is necessary to obtain results, the investigator will be required to submit a new proposal for competitive renewal after no more than three years of support from a NASA or NSBRI award. Such follow-on proposals may be ground-based (with or without use of analog facilities) or flight-based.

b. Analog Definition

Proposals that propose to use analog facilities, but not flight resources, are referred to as analog definition proposals in this solicitation. Analog definition investigations must represent mature studies strongly anchored in previous ground-based research or previous analog research and must be thoroughly justified.

Additional information for analog definition proposals will be collected through an Analog Study Resource Worksheet as part of the proposal upload. This worksheet is required for a complete Step-2 proposal. It is very important that this information be clear and accurate as it will be used to determine the feasibility of implementing the experiment. Examples of such information for a bed rest study are: preferred duration and bed rest orientation (six-degree head-down tilt, horizontal, etc.) number of subjects required for appropriate power analyses, age of subjects, gender composition of sample, physical characteristics of subjects.

Selected proposals will enter a definition period usually lasting between three to 12 months, depending on the complexity of the experiment. During this definition period the detailed experiment requirements of the proposal and implementation approaches and options are prepared in cooperation with an assigned representative from the HRP. In addition, where appropriate, NASA and the NSBRI reserve the right to form teams of investigators whose experiments have compatible requirements for human subjects, specimens, operations, data, and treatment and sharing of biological samples. A selected investigator who becomes a member of a research team will be required to work with other team members to develop an integrated set of objectives that can be met within fiscal and analog resource constraints. Development of this integrated approach may result in modification, transfer, or deletion of some objectives put forth

in an individual proposal. Specifics associated with the definition period will be addressed with the investigator at the time of selection.

Selection for definition neither assures an analog study, nor continued funding beyond the definition period. Investigations selected for analog experiment definition must successfully complete subsequent development steps to be considered for an analog assignment. NASA and NSBRI do not guarantee that any investigation selected for definition will advance to analog experiment status. Commitment by NASA and the NSBRI to proceed from analog definition to the execution phase of an analog experiment will be made only after several additional engineering and scientific reviews and project milestones have established the feasibility and continued relevance of the proposed experiment.

Analog experiments will also be reviewed periodically for continued relevance, availability of analog opportunities and implementation feasibility. These reviews may result in a decision by the Selection Official to discontinue an analog experiment before its implementation or completion.

c. Flight Definition

Any proposal, either NASA or the NSBRI, which proposes to use NASA flight resources, is referred to as flight definition proposals in this solicitation. Flight definition investigations must represent mature studies strongly anchored in previous ground-based research or previous flight research and must be thoroughly justified. Two types of flight experiments are germane for this solicitation:

1. Research performed on long duration human subjects prior to and on return from space; and
2. On-orbit experiments that can be implemented on the ISS.

Additional information for flight definition proposals will be collected through a Flight Experiment Resource Worksheet as part of the proposal upload. This worksheet is required for a complete Step-2 proposal. The information requested includes number of subjects, pre/in/post-flight testing and crew time requirements, flight hardware requirements, cold stowage requirements, etc. It is very important that this information be clear and accurate, as it will be used to determine the feasibility of implementing the experiment.

Selected proposals will enter a definition period usually requiring six to twelve months. During this definition period the detailed experiment requirements of the proposal and implementation approaches and options are prepared in cooperation with an assigned representative from the HRP. In addition, where appropriate, NASA reserves the right to form teams of investigators whose experiments have compatible requirements for human subjects, specimens, operations, data, and treatment and sharing of biological samples. A selected investigator who becomes a member of a research team will be required to work with other team members to develop an integrated set of objectives that can be met within fiscal and flight resource constraints. Development of this integrated approach may result in modification, transfer, or deletion of some objectives put forth in an individual proposal. Specifics associated with the definition period will be addressed with the investigator at the time of selection.

Selection for definition neither assures a flight opportunity, nor continued funding beyond the definition period. Investigations selected for flight experiment definition must successfully complete subsequent development steps to be considered for a flight assignment. NASA and the NSBRI do not guarantee that any investigation selected for definition will advance to flight experiment status. Commitment by NASA to proceed from flight definition to the execution phase of a flight experiment will be made only after several additional engineering and scientific reviews, and project milestones have established the feasibility of the proposed experiment.

Once an experiment is selected for flight implementation, it will be also reviewed periodically for availability of flight opportunities and implementation feasibility. These reviews may result in a decision by the Selection Official to discontinue a flight experiment before its implementation or completion.

Proposals must be compatible with the operational constraints and capabilities of the spaceflight environment, as well as the Soyuz landings. There are certain human life sciences experimental requirements that, while not impossible to perform, are difficult to implement. Investigators should consider these limitations when developing their experiment protocols, knowing that technical feasibility is an important part of the overall assessment. The Flight Experiment Resources Worksheet

(http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html) specifically addresses several of these requirements, and investigators should fill this out carefully and thoroughly in order for technical reviewers to better understand the experiment's requirements.

Those requirements that may be difficult to accommodate include:

1. Any new flight hardware required. The extent of how difficult this development will be is dependent on how much design and development is required for custom made equipment and how extensive off the shelf equipment will have to be modified.
2. Return of hardware for refurbishment or data retrieval. Down mass resources will be protected for critical science samples; data should be planned to be downlinked and hardware will likely be discarded.
3. Requirements for cold stowage that exceed the capabilities of the equipment identified on the cold stowage website. Experiment unique refrigerators or freezers will not be developed.
4. Studies requiring more than twelve subjects.
5. Studies requiring overly invasive or complicated procedures that may hinder crew consent.
6. Total pre-flight Baseline Data Collection (BDC) requirements of more than 10 hours per subject.
7. Single BDC sessions requiring more than two hours per subject.
8. More than two hours of BDC per subject required within three months of launch.
9. BDC testing requirements within two months of launch.

10. In-flight procedures that require a high degree of proficiency and training prior to crewmember launch (e.g. requires more than three, two-hour sessions for one unique procedure or skill; requires refresher session within 60 days of launch).
11. Two or more hours of testing required per subject within the first three days of landing.
12. More than three hours of total testing per subject in the first week post-flight.
13. Strenuous or provocative sessions on R+0 or R+1. Any activity that could be considered strenuous or provocative for a healthy normal subject may not be feasible for crewmembers in this time frame.
14. Complicated in-flight sessions before the second week in-flight (e.g. requires set-up of multiple pieces of equipment, followed by testing session of more than an hour; sessions that require privatized voice or video).
15. More than five complicated in-flight sessions involving multiple pieces of equipment. (e.g., requires set-up of multiple pieces of equipment, followed by testing of more than two to three hours, requires extensive privatized resources).
16. A single session with one crewmember requiring four hours in one day.
17. Crew activity that must be performed daily or more than once a week.
18. Very precise or inflexible timing requirements for sessions (e.g., +/- window for testing of less than one week, multiple timed blood draws, sessions that are linked to other crew activities like eating, Extravehicular Activity (EVA), etc.). Note that occasional fasting data collections upon crew wake up are not difficult to implement.
19. Extended, continuous activities over multiple days that could interfere with other operations.

The HRP Flight Experiment Information Package

(http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html) provides detailed information on these constraints as well as a description of the unique aspects of the evaluation and selection process for flight experiments. Proposals that require spaceflight equipment, facilities, or other resources not identified in this NRA or in the accompanying HRP Flight Experiment Information Package will have a lower priority for selection.

2. Types of Research Products

The three types of objectives listed in section [B.3](#) of this document give rise to three types of research products. If applicable for the specific research topic, proposers will identify, through answers to questions prompted by NSPIRES, which of the three types of research products best characterizes the proposed research:

1. For the quantification of a crew health and performance risk objective, the research product should define the likelihood or the consequence of a risk more completely. Such proposals must specify how much the uncertainty in the likelihood or the consequence of the risk is anticipated to be reduced by the proposed research.
2. For the countermeasure development objective, the research product should be a

countermeasure to mitigate a risk, or reduce the impact of a risk factor, or reduce the resources required to mitigate a risk. Such proposals must specify the Countermeasure Readiness Level (CRL) at the beginning of the proposed work and the anticipated CRL at the conclusion of the proposed work.

3. For technology development objective, the research product should be a technology to mitigate a risk, reduce the impact of a risk factor, or better define a risk or risk factor. Such proposals must specify the Technology Readiness Levels (TRL) at the beginning of the proposed work and the anticipated TRL at the completion of the proposed work.

a. Countermeasure Readiness Level

A countermeasure is any means or procedural strategy that prevents or reduces the negative effects on crew health or performance or facilitates recovery upon return to Earth. The astronaut corps is diverse, comprised of men and women 30-60 years of age and of various ethnic backgrounds. Countermeasures should be robust enough to be efficacious across this population, but also be flexible enough to be tailored for individual specificity.

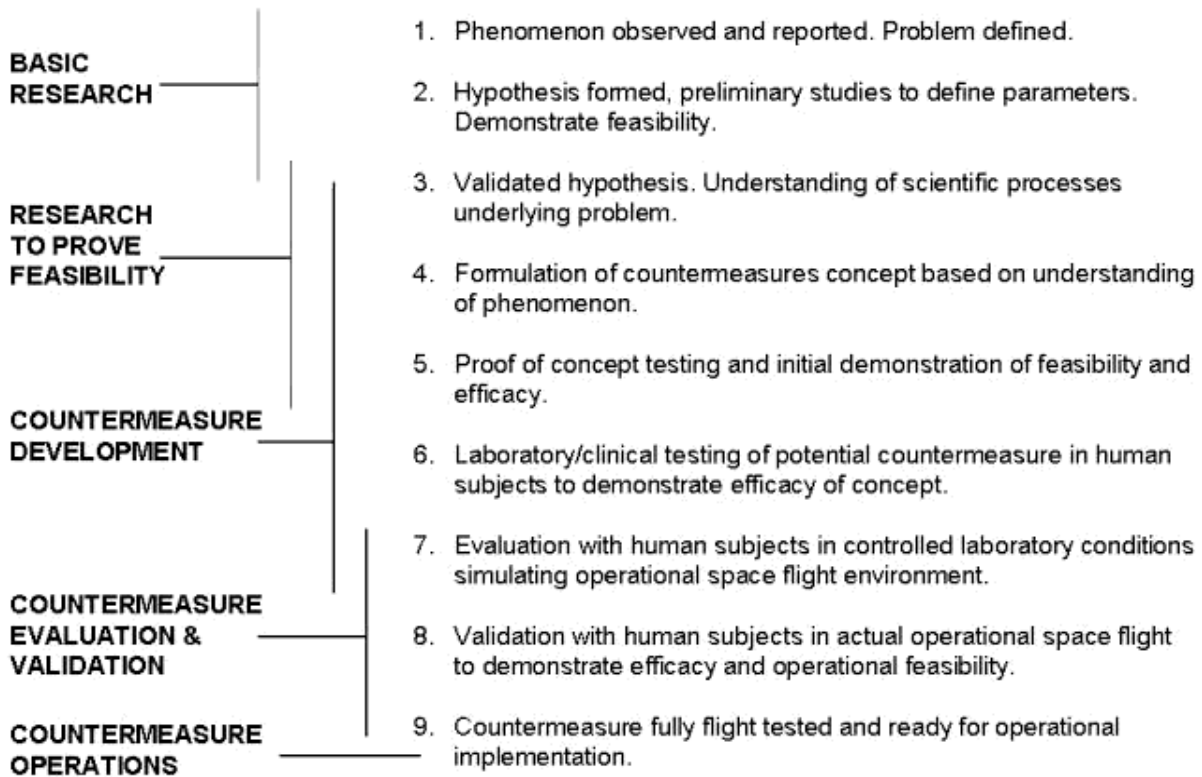


Figure 1. Countermeasure Readiness Levels

NASA has developed a scale to allow it to define, assess, and quantify the level of “countermeasure readiness.” The use of this scale allows Program Managers to determine and describe how each funded research project fits into the countermeasure development “pipeline”

and to monitor progress in countermeasure development. Each investigator must examine and understand the CRL scale and specify in the proposal the CRL that will result from the funding and conduct of their proposed research. Figure 1 illustrates the CRL scale, which describes the level of scientific maturity of research ranging from the fundamental studies that suggest potential countermeasures to studies that allow the systematic evaluation and validation of countermeasures prior to operational implementation.

b. Technology Readiness Level

Within NASA strategy, nine TRLs have been defined, ranging from the basic physical principles to a "flight-proven" system. The figure below provides these definitions. Typically, the goal is to take technology to TRL 6 after which it can be picked up and used in an exploration mission. Each investigator must examine and understand the TRL scale and specify in the proposal the TRL that will result from the funding and conduct of their proposed research. Figure 2 illustrates the TRL scale.

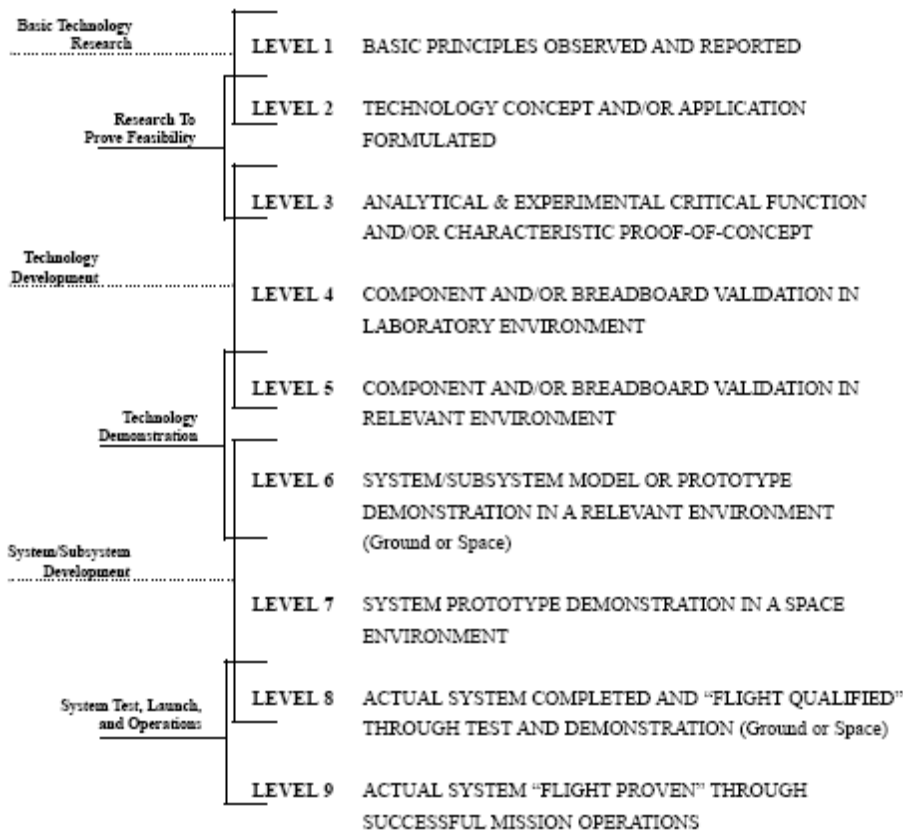


Figure 2. Technology Readiness Levels

F. Proposal Review Information

1. Evaluation Criteria

Evaluation by peers of the proposing personnel will be used to assess each proposal's intrinsic scientific and technical merit, its relevance to NASA's stated objectives, and its cost realism. See Appendix C.2 of the *NASA Guidebook for Proposers* for further discussion of these criteria and their relative weights. The evaluation criteria include factors evaluated by peer reviewers, as well as programmatic factors evaluated by NASA program personnel. Note the following specific points:

- The solicited research response areas may give specific factors, based on the solicited research objectives, which will be considered when evaluating a proposal's science and/or technical merits and/or its relevance to program objectives.
- Relevance will be judged in part by the proposal's focus on specific strategic and science objectives for that HERO solicited research response area, as given in the call. This focus on relevance to the call, rather than NASA's broader goals, supersedes any instructions in the *Guidebook for Proposers*.
- Cost data for U.S. proposals will be evaluated both by peer review (for cost realism and cost reasonableness) and by NASA program personnel (for total cost and comparison to available funds). Proposers must follow the budget requirements in Section 2.3.10 of the *NASA Guidebook for Proposer*. In evaluating the cost reasonableness of the proposals, reviewers will assess whether the proposed level of effort (i.e., labor Full Time Equivalent (FTE)) and the proposed other direct costs (i.e., supplies, equipment, travel) are commensurate with those required to accomplish the goals of the investigation.
- Neither the existence of proposed voluntary cost sharing nor the lack thereof, or the magnitude of such cost sharing will be used as evaluation criteria or as a precondition for award. If voluntary cost sharing is proposed, the proposer should describe, in detail, any proposed cost sharing arrangements.

2. Review and Selection Processes

Review of proposals submitted to this NRA will be consistent with the general policies and provisions given in Sections C.1 through C.4 of Appendix C of the *NASA Guidebook for Proposers*, and selection procedures will be consistent with the provisions of Section C.5 of that document. For some solicited research response areas, the desire to achieve a balance of efforts across the solicited program objectives may play a role in the selections, taking into account not only the new proposals of merit that are suitable for selection, but also those that seek an extension of activities initiated through previous but now concluded selections, i.e., "successor" proposals.

Unless otherwise specified, the HRP Manager (or his/her delegate) is the Selection Official for NASA Appendices. Unless otherwise specified, the NSBRI Director (or his/her delegate) is the Selection Official for NSBRI Appendices.

3. Selection Announcement and Award Dates

NASA's goal is to announce selections within 150 days of the final proposal due date. In order to announce selection decisions as soon as is practical, even in the presence of budget uncertainties, the Selection Official may decide to defer selection decisions on some proposals while making selection decisions on others. If a Selection Official uses this option, then proposals will be selected, not selected, or not selected at this time. Proposals that are not selected at this time will be considered for a supplemental selection when circumstances allow. All proposers whose proposals are not selected at this time will eventually be notified whether their proposal is selected through a supplemental selection or is no longer being considered for a supplemental selection. Proposers will be notified via NSPIRES and offered a debriefing consistent with the policy in Section C.6 of the *NASA Guidebook for Proposers*.

4. Ombudsman

A NASA ombudsman has been appointed to hear and facilitate the resolution of concerns from proposers during the pre-award and post-award phases of this solicitation. 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 selecting official. Further, the ombudsman does not participate in the evaluation of the proposals, source selection process, or the adjudication of formal 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.

If resolution cannot be made by the contracting officer, interested parties may contact the installation ombudsman, Perri Fox, 2101 NASA Parkway, Houston, TX, 77058, 281-483-3157, E-mail perri.e.fox@nasa.gov. Concerns, issues, disagreements, and recommendations which cannot be resolved at the installation level may be referred to the NASA ombudsman, Ron Poussard, Director of the Contract Management Division, at 202-358-0445, fax 202-358-3083, E-mail agency-procurementombudsman@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 contacting officer as specified in Section H of this document.

G. Research Resources

1. Current Research Portfolios for NASA and NSBRI

Investigators are encouraged to review summaries of currently funded NASA and NSBRI research by accessing the NASA Task Book at http://taskbook.nasaprs.com/peer_review/index.cfm and the NSBRI website at <http://www.nsbri.org/SCIENCE-and-TECHNOLOGY/>. In order to achieve programmatic balance, specific topics that are currently well represented in the scope of NASA or the NSBRI research may be de-emphasized.

2. Biomedical Data Archives

Access to NASA's human and animal life sciences data can assist the research community in providing a better understanding of the appropriate strategies required to mitigate spaceflight-related health risks. These archives include data collected on the astronaut corps as part of medical evaluations and research studies. Researchers who are awarded a grant may submit more detailed data requests, including requests for ISSMP, Shuttle, or other retrospective astronaut data. These requests are evaluated on a case-by-case basis and data is preferentially provided in grouped or de-identified format. Please note that identifiable (attributable) human medical and research data are only available with the consent of the astronaut.

Research Data: Life Sciences Data Archive

The Life Sciences Data Archive (LSDA) (http://lsda.jsc.nasa.gov/lsda_home.aspx) is a publicly accessible archive of data from NASA-funded spaceflight, flight analog and ground-based life sciences research experiments. This searchable database includes human (astronaut and ground test subject), animal and plant studies conducted from 1958 to the present. It contains over 1,500 experiment descriptions, and non-attributable data for many investigations can be downloaded directly from the website.

Additional information on and inquiries about the LSDA data can be made online at: <http://lsda.jsc.nasa.gov/common/dataRequestFAQ.aspx> or by email at jsc-lsda@mail.nasa.gov

Medical Data: The Lifetime Surveillance of Astronaut Health Project

The Lifetime Surveillance of Astronaut Health (LSAH) is a proactive occupational surveillance program for the astronaut corps to screen and monitor astronauts for occupational related injury or disease. The LSAH program examines the incidence of acute and chronic morbidity and mortality of astronauts, and defines the risks of morbidity and mortality associated with the occupational exposures encountered by astronauts. Data associated with the LSAH project includes clinical, mission, and occupational health information recorded during each astronaut's career as a NASA astronaut or payload specialist and from annual LSAH examinations after retirement from the astronaut corps.

Information about the medical requirements (MR) for both short-duration and long-duration human spaceflight is available online at <http://lsda.jsc.nasa.gov/docs/MRID/MRIDhome.aspx>

Limitations of the Data: The primary goal for collecting these data is for clinical purposes, rather than for a research study. The data content is driven by crew surgeon need – the data may list outcome (e.g. “normal”) rather than a specific value, the data may not always be collected for each crew member, or the data may be taken under different circumstances (e.g. an astronaut returning on a Soyuz may have different types of tests or test dates than an astronaut returning on a Shuttle).

Additional information on and inquiries about the LSAH data can be made online at: <http://lsda.jsc.nasa.gov/common/dataRequestFAQ.aspx> or by email at jsc-lsah@mail.nasa.gov

3. Bio-specimen Sharing Program

Animal bio-specimen sharing provides the scientific community with access to NASA's inventory of biological materials from organisms that have flown in space or from related ground control studies. Make inquiries about questions or visit the Frequently Asked Questions about Bio-specimens at <http://lsda.jsc.nasa.gov/common/dataRequestFAQ.aspx>
Search: For specific information regarding which samples are still available, characteristics of each mission from which the samples were obtained, experimental conditions used to obtain and preserve the samples, and protocols (e.g. diet, light/dark cycle, housing, fixation/storage, etc.) visit the LSDA website at <http://lsda.jsc.nasa.gov>

4. Flight Capabilities

The HRP Flight Experiment Information Package (http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html) provides detailed information on flight capabilities and constraints as well as a description of the unique aspects of the evaluation and selection process for flight experiments. A comprehensive list of research facilities on board the ISS may be found at (http://www.nasa.gov/mission_pages/station/research/facilities_category.html).

Proposals that require spaceflight equipment, facilities, or other resources not identified in this NRA or in the accompanying HRP Flight Experiment Information Package will have a lower priority for selection.

5. Radiation Capabilities

The NSRL at BNL in Upton, New York is an irradiation facility based on BNL Booster Synchrotron beams -- particles from protons to gold with primary energies in the range of 50-2500 MeV for protons and 50-1100 MeV/nucleon for High Charge and Energy (HZE) particles. NASA plans to operate the NSRL for about 900 hours per year; selection of beam species and energies for experimental periods will be made by NASA officials in consultation with scientists proposing experiments for these beams. Activities at the NSRL are a joint effort of BNL's Collider-Accelerator Department, providing accelerated particle beams; the Biology Department, providing experimental area support; and the Medical Department, which provides animal care facilities and cell laboratories. The NSRL includes irradiation stations, beam controls, and laboratory facilities required for most radiobiological investigations. Additional information concerning NSRL may be found at http://www.bnl.gov/medical/nasa/nsrl_description.asp

6. Analog Capabilities

Proposers who require the use of any of the analogs listed below (a-h) should fill out the Flight Analogs Project Study Feasibility Assessment Form or Analog Study Resource Worksheet

(http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html), as appropriate, and include the worksheet as part of their proposal upload.

a. Bed Rest Facilities

The HRP Bed Rest Experiment Information Package (http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html) provides detailed information on bed rest capabilities and constraints as well as a description of the standard conditions of bed rest, standard measures of bed rest and services provided to individual investigators. Proposals that require resources beyond those described in the HRP Bed Rest Experiment Information Package (i.e., experiment unique resources) should include adequate budget for those resources.

Regardless of site location, all bed rest investigations must comply with the NASA-defined standard conditions of bed rest unless compelling scientific reasons why this is not possible are described in the proposal.

b. Human Exploration Research Analog

The HRP Human Exploration Research Analog (HERA) Experiment Information Package posted alongside this NRA provides information on the capabilities of this new exploration research analog. The HERA was acquired by the NASA HRP in 2012. This habitat is located on site at JSC and is housed in building 220. The HERA is a two-story, four-port habitat unit. It is cylindrical with a vertical axis, and connects to a simulated airlock and hygiene module. Currently, the HERA represents an analog for simulation of isolation, confinement and remote conditions of mission exploration scenarios. Studies suitable for this analog may include, but are not limited to, behavioral health and performance assessments, communication and autonomy studies, human factors evaluations and exploration medical capabilities assessments and operations. Proposals that require resources beyond those described in the HRP HERA Experiment Information Package (i.e., experiment unique resources) should include adequate budget for those resources.

c. Parabolic Aircraft

NASA's C-9 or subcontracted 727 aircraft can provide up to 40 periods of low-gravity for 25 second intervals each during one flight. The aircraft accommodates a variety of experiments and is often used to refine spaceflight experiment equipment and techniques and to train crewmembers in experiment procedures, thus giving investigators and crewmembers valuable experience working in a weightless environment. The aircraft obtain a low-gravity environment by flying a parabolic trajectory. Gravity levels twice those of normal gravity (1g) occur during the initial and final portions of the trajectory, while the brief pushover at the top of the parabola produces less than one percent of Earth's gravity ($<10^{-2}$ g). Several experiments, including a combination of attached and free-floated hardware (which can provide effective gravity levels of 10^{-3} g for periods up to 10 seconds) can be integrated in a single flight. More detailed information is available in user guides at http://jsc-aircraft-ops.jsc.nasa.gov/Reduced_Gravity/index.html and by contacting Ms. Wanda Thompson at 281-483-3252 or wanda.thompson-1@nasa.gov, or Mr. Dominic Del Rosso at 281-244-9113 or dominic.l.delrosso@nasa.gov.

d. Suborbital Capabilities

PLEASE NOTE: NASA is presently not considering human-tended payloads to be flown on suborbital reusable launch vehicles (sRLVs) and there will not be any NASA-sponsored participants on sRLV flights. The payloads to be flown on sRLV flights must either be automated or remotely operated. Remote operation capability should be confirmed with the flight operator.

Suborbital spaceflight opportunities are expected to be available during the lifetime of selected proposals from this solicitation which may provide longer—but still brief—exposure to weightlessness and other spaceflight conditions than parabolic aircraft flights. Suborbital flight opportunities are described at <https://flightopportunities.nasa.gov/>.

Reusable suborbital research enables a new generation of science by providing frequent access to a new region of space heretofore unexplored with user-friendly g-loads in a pressurized, temperature-controlled environment and payload accommodation from 1 to 100kg, soda-can sized to human sized. Short-duration flights will permit researchers to access payloads both pre- and post-flight.

A typical suborbital flight will accelerate briefly using rocket propulsion to achieve high vertical velocity. When above the sensible atmosphere, will follow a typical ballistic arc providing reduced gravity for approximately four minutes, then will decelerate on re-entry into the atmosphere. Landing on Earth may use some or all of winged flight, parachutes or rocket propulsion. Proposals employing suborbital flights must make a strong case that the use of that modality is necessary to meet HRP's objectives of reducing the human risks of space exploration.

e. NASA Extreme Environment Mission Operations

NASA Extreme Environment Mission Operations (NEEMO) missions are conducted at the Aquarius habitat located southeast of Key Largo, Florida owned by National Oceanic and Atmospheric Administration's National Undersea Research Program and operated by Florida International University. NASA typically participates in one to three missions each year. NEEMO missions typically last seven to 14 days and are conducted from April through November. NEEMO missions are intended to facilitate opportunities for NASA astronauts, scientists, physicians, Mission Control Center personnel and engineers to effectively utilize the Aquarius Underwater Research Facility as an analog for spaceflight, and to develop operations concepts, conduct experiments, perform space-analog tasks and sharpen team and interpersonal skills. Additional information can be found at <http://aquarius.fiu.edu/>.

f. Antarctica

The United States' Antarctic Program maintains research facilities at McMurdo, Palmer, and South Pole Stations. Researchers believe that Antarctica's remoteness, danger, climate, lighting conditions, terrain, team interactions, and duration of isolation provide an environment on Earth that closely parallels many of the conditions of isolation and stress to be faced on long-duration

human spaceflight missions. Thus, the Antarctic analog will provide a unique and accessible test bed to develop prototype lunar and Mars systems and technologies. Additional information can be found at <http://usap.gov/index.cfm>.

g. Exercise Countermeasures Laboratory

Exercise Countermeasures Laboratory (ECL) at NASA Glenn Research Center (Cleveland, OH) is a ground-based test bed which provides high-fidelity weightlessness, lunar (1/6g) and Martian (1/3g) human-in-the-loop exercise simulations for developing exercise countermeasure devices, equipment, and exercise protocols for spaceflight, and quantifying the physiological demands of performing exercise in shirt-sleeve environment. The enhanced Zero-g Locomotion Simulator (eZLS) exercise platform (e.g., treadmill modality) is mounted to a three degree-of-freedom air bearing table which allows frictionless translation and rotation such that vibration isolation systems and their interactions with the human and the vehicle may be evaluated. The test subjects are suspended in a supine orientation from a motorized system of bungees for weightlessness locomotion simulation, or at the appropriate pitch angle for whole-body partial gravity simulations. A subject load device (SLD) interface provides gravity-replacement loads via Series Bungee System bungees, or a near-constant pneumatic SLD whereby load is proportional to system pressure. Both are used to provide gravity-replacement loads at the desired levels. The current data acquisition user interface is programmed in LabVIEW and is setup to continuously monitor foot forces under treadmill belt, in-line SLD force, accelerations, displacements, heart rate, and treadmill speed. The laboratory uses a BTS Bioengineering motion capture system (SMART-DX500) to analyze human movement, either while in the eZLS or on the ground. Test protocols are conducted under approval of the JSC Committee for the Protection of Human Subjects, and the PI's host institution Institutional Review Board (IRB). Medical monitoring is provided at Level 3 (<http://irb.nasa.gov>). Recent test protocols include a treadmill harness comfort study, a vibration isolation system dynamic characterization study for the Passive Rack Isolation System for the International Space Station (ISS) T2 Treadmill, and kinematic and electromyographic study comparing gait parameters and muscle-activation patterns in the eZLS and in parabolic flight during treadmill running, and development of wireless biometric sensors that have been also evaluated in parabolic flight.

More detailed information is provided at <http://spaceflightsystems.grc.nasa.gov/Advanced/HumanResearch/Exercise/> and by contacting Gail Perusek at Gail.P.Perusek@nasa.gov.

H. Bibliography

The **Human Research Program, Program Requirements Document** is available online at: http://www.nasa.gov/pdf/579466main_Human-Research-Program-Requirements.pdf

The **Human Research Program, Human Research Roadmap** is available online at: <http://humanresearchroadmap.nasa.gov>

The **Human Research Program Evidence Book** is available online at:

<http://humanresearchroadmap.nasa.gov/evidence/>

The **Human Research Program Task Book** is available online at:

http://taskbook.nasaprs.com/peer_review/index.cfm

The **Human Research Program, Lunar Human Research Requirements Document** is available online

at: http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html under “Related Documents.”

National Space Biomedical Research Institute (NSBRI). The Institute’s research overview, as well as the program information for each of the NSBRI teams, is available

at: <http://www.nsbri.org>.

NASA Life Sciences Data Archive (LSDA) is an online database containing descriptions and results of completed NASA-sponsored flight experiments. Descriptions are included of experiments, missions, procedures, hardware, bio-specimens collected, personnel, and documents. The LSDA is available online at: http://lsda.jsc.nasa.gov/lsda_home.aspx.

Medical Requirement Integration Document (MRID) defines integration activities to support the medical requirements (MR) for both short-duration and long-duration human spaceflight for the Space Shuttle/International Space Station (ISS) programs. The MRID is available online at: <http://lsda.jsc.nasa.gov/docs/MRID/MRIDhome.aspx>.

Guidebook for Proposers Responding to a NASA Research Announcement (NRA) is available online at: <http://www.hq.nasa.gov/office/procurement/nraguidebook/>

NASA Federal Acquisition Regulations Supplement Instructions for Responding to NASA Research Announcements (Provision NFS 1852.235-72 November 2004) is available online at the following address: http://www.hq.nasa.gov/office/procurement/regs/5228-41.htm#52_235-72

Standard Format for NASA Research Announcements (NRAs) and other Announcements for Grants and Cooperative Agreements are available online at:

http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_5810_0001_&page_name=main

NASA Grant and Cooperative Agreement Handbook is available online

at: http://prod.nais.nasa.gov/pub/pub_library/grcover.htm

HRP Bed Rest Experiment Information Package is available online at:

http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html

HRP Flight Experiment Information Package is available online

at: http://www.nasa.gov/exploration/humanresearch/research_info/overview/SMO_NRA_info_detail.html

Safe Passage, Astronaut Care for Exploration. Institute of Medicine, National Academy Press, 2101 Constitution Avenue NW, Washington DC 20418 (2001). This document is available online at: <http://www.iom.edu/CMS/3740/5479.aspx>

National Academy of Sciences. National Research Council Committee on Space Biology and Medicine. Mary J. Osborn, Committee Chairperson. **A Strategy for Research in Space Biology and Medicine in the New Century.** 1998. Washington D.C.: National Academy Press. This document is available online at: http://www.nap.edu/catalog.php?record_id=6282

I. NASA Contact

NASA Selecting Official: HRP Program Manager or his designee

Additional technical information for the NASA programs is available from:

Mark J. Shelhamer, Sc.D.
Chief Scientist, Human Research Program
NASA Johnson Space Center (Mail Code SA2)
Houston, TX 77058
Telephone: 281-244-7330
Fax: 281-483-6089
E-mail: mark.j.shelhamer@nasa.gov

JSC Procurement Point of Contact:

Dana Altmon-Cary
Contracting Officer
NASA Johnson Space Center (Mail Code BH4)
Houston, Texas 77058
Telephone: 281-483-8228
Fax: 281-483-4066

J. Acronym List

AEH	Advanced Environmental Health
AFT	Advanced Food Technology
AVMA	American Veterinary Medical Association
B	Bone
BDC	Baseline Data Collection
BHP	Behavioral Health and Performance
BMed	Behavioral Medicine
BSC	Board of Scientific Counselors
CCR	Central Contractor Registry

CFR	Code of Federal Regulations
CRL	Countermeasure Readiness Level
Co-I	Co-Investigator
CV	Cardiovascular
CV	Curriculum Vitae
DSA	Data Submission Agreement
EAC	External Advisory Council
EO	Education and Outreach
FAQ	Frequently Asked Questions
FAR	Federal Acquisition Regulations
FCA	Full Cost Accounting
FTE	Full-Time Equivalent
EBPOC	Electronic Business Point-of-Contact
ESMC	Executive Science and Medicine Council
EVA	Extra-Vehicular Activity
GCRC	General Clinic Research Center
HARI	Human and Automation/Robotic Integration
HEOMD	Human Exploration and Operations Mission Directorate
HERO	Human Exploration Research Opportunities
HRP	Human Research Program
HRPEO	Human Research Program Education and Outreach
IACUC	Institutional Animal Care and Use Committee
IM	Immunology
IRB	Institutional Review Board
IRP	Integrated Research Plan
ISS	International Space Station
ISSMP	International Space Station Medical Project
LSAH	Lifetime Surveillance of Astronaut Health
LSDA	Life Sciences Data Archive
M	Muscle
MOU	Memorandum of Understanding
MR	Medical Requirements
MRID	Medical Requirement Integration Document
N	Nutrition
NASA	National Aeronautics and Space Administration
NPD	NASA Policy Directive
NRA	NASA Research Announcement
NSBRI	National Space Biomedical Research Institute
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
NSSC	NASA Shared Services Center
OMB	Office of Management and Budget
PDF	Portable Document Format
PH	Pharmacology
PHS	Public Health Service
PHYS	Physical Environment
PI	Principal Investigator

PRD	Program Requirements Document
SHFE	Space Human Factors Engineering
SM	Sensorimotor
STS	Space Transport System
TRL	Technology Readiness Level
USOS	U.S. Operating Segment
UTMB	University of Texas Medical Branch
UWS	Usability, Workload, and Scheduling
VASR	Vertebrate Animal Scientific Review
VIIP	Visual Impairment and Intracranial Pressure