

National Robotics Initiative 2.0: Ubiquitous Collaborative Robots (NRI-2.0)

PROGRAM SOLICITATION

NSF 17-518

REPLACES DOCUMENT(S):

NSF 16-517



National Science Foundation

Directorate for Computer & Information Science & Engineering
Division of Information & Intelligent Systems

Directorate for Engineering

Directorate for Education & Human Resources

Directorate for Social, Behavioral & Economic Sciences



U.S. Dept. of Agriculture



National Institute of Food and Agriculture



U.S. Dept. of Energy



U.S. Department of Energy - Office of Environmental Management (EM)



Department of Defense



Defense Advanced Research Projects Agency



Air Force Office of Scientific Research

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

February 02, 2017

January 11, 2018

Second Thursday in January, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

This solicitation is a revision of [NSF 16-517](#), the solicitation for the National Robotics Initiative (NRI).

Below are several important points for FY 2017 NRI-2.0 submissions:

- This solicitation significantly extends the scope and aims of the original National Robotics Initiative (NRI) program, which was focused on collaborative robots (co-robots). In particular, the NRI-2.0 program expands the co-robot theme in terms of the **scale** and **variety** of collaborative interactions that are the focus of this program – important new themes of the NRI-2.0 program include collaborative teams of humans and robots, easily customized and personalized robots, and infrastructure to lower the barriers to entry into the field of co-robots. Proposers should read this solicitation carefully to determine if their proposals fit the themes of the program.
- There are now two classes of projects, **Foundational** and **Integrative**, that differ in both focus and budget range. PIs should carefully read the descriptions of the different classes (see Section II.A.2) in determining to which class to apply.
- The limit on number of proposals per individual (2) now applies to Senior Personnel, as well as to PIs and Co-PIs.
- The National Institutes of Health (NIH) is no longer a participating agency in this program. NSF will still consider proposals in the areas of assistive robotics, prosthetics, exoskeletons, and surgical robots, as long as they fit the themes of the NRI-2.0 program (see Section II).
- The National Aeronautics and Space Administration (NASA) is not a participating agency in this program in FY 2017; it is anticipated that they will rejoin the program in FY 2018.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPP) ([NSF 17-1](#)), which is effective for proposals submitted, or due, on or after January 30, 2017.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

National Robotics Initiative 2.0: Ubiquitous Collaborative Robots (NRI-2.0)

Synopsis of Program:

The goal of the National Robotics Initiative (NRI) is to support fundamental research that will accelerate the development and use of robots in the United States that work beside or cooperatively with people. The original NRI program focused on innovative robotics research that emphasized the realization of collaborative robots (co-robots) working in symbiotic relationships with human partners. The NRI-2.0 program significantly extends this theme to focus on issues of **scalability**: how teams of multiple robots and multiple humans can interact and collaborate effectively; how robots can be designed to facilitate achievement of a variety of tasks in a variety of environments, with minimal modification to the hardware and software; how robots can learn to perform more effectively and efficiently, using large pools of information from the cloud, other robots, and other people; and how the design of the robots' hardware and software can facilitate large-scale, reliable operation. In addition, the program supports innovative approaches to establish and infuse robotics into educational curricula, advance the robotics workforce through education pathways, and explore the social, behavioral, and economic implications of our future with ubiquitous collaborative robots. Collaboration between academic, industry, non-profit, and other organizations is encouraged to establish better linkages between fundamental science and engineering and technology development, deployment and use. Well-justified international collaborations that add significant value to the proposed research and education activities will also be considered.

The NRI-2.0 program is supported by multiple agencies of the federal government including the National Science Foundation (NSF), the U.S. Department of Agriculture (USDA), the U.S. Department of Energy (DOE), and the U.S. Department of Defense (DOD). Questions concerning a particular project's focus, direction and relevance to a participating funding organization should be addressed to that agency's point of contact listed in section VIII of this solicitation.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

For a full listing of agency contacts see Section VIII. of this solicitation.

- Reid Simmons, CISE/IIS, telephone: (703) 292-4767, email: resimmon@nsf.gov
- Radhakishan Baheti, ENG/ECCS, telephone: (703) 292-8339, email: rbaheti@nsf.gov
- Jordan M. Berg, ENG/CMMI, telephone: (703) 292-5365, email: jberg@nsf.gov
- Ephraim P. Glinert, CISE/IIS, telephone: (703) 292-8930, email: eglinert@nsf.gov
- David L. Haury, EHR/DRL, telephone: (703) 292-5102, email: dhaury@nsf.gov
- Tatiana Korelsky, CISE/IIS, telephone: (703) 292-8930, email: tkorelsk@nsf.gov

- Bruce Kramer, ENG/CMMI, telephone: (703) 292-5348, email: bkramer@nsf.gov
- Frederick M. Kronz, SBE/OAD, telephone: (703) 292-7283, email: fkronz@nsf.gov
- Wendy Nilsen, CISE/IIS, telephone: (703) 292-2568, email: wnilsen@nsf.gov
- Jack Snoeyink, CISE/CCF, telephone: (703) 292-8910, email: jsnoeyin@nsf.gov
- Ralph Wachter, CISE/CNS, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Jie Yang, CISE/IIS, telephone: (703) 292-4768, email: jyang@nsf.gov
- Seta Bogosyan, OD/OISE, telephone: (703) 292-4766, email: sbogosya@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 10.310 --- USDA-NIFA Agriculture and Food Research Initiative
- 12.800 --- Air Force Office of Scientific Research
- 47.041 --- Engineering
- 47.070 --- Computer and Information Science and Engineering
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 81.049 --- Office of Science Financial Assistance Program
- 81.104 --- Environmental Remediation and Waste Processing and Disposal

Award Information

Anticipated Type of Award:

Standard Grant or Continuing Grant or Cooperative Agreement or contract vehicles as determined by the supporting agency

Estimated Number of Awards: 40 to 70

per year, subject to the availability of funds.

Foundational projects will range from \$350,000 to \$750,000 in total costs for up to three years. Integrative projects will range from \$500,000 to \$1,500,000 in total costs for up to four years. Please refer to Section III for agency-specific budget criteria.

Anticipated Funding Amount: \$30,000,000 to \$45,000,000

per year, subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 2

An investigator may participate as PI, co-PI, or Senior Personnel in **no more than two proposals** submitted in response to this solicitation each year.

In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

The above limit applies only to proposals to the NRI-2.0 solicitation, not to the totality of proposals submitted to NSF.

Proposals submitted in response to this solicitation may not duplicate or be substantially similar to other proposals concurrently under consideration by other NSF, USDA, DOE, or DOD programs or study sections. Duplicate or substantially similar proposals will be returned without review, including those substantially similar to previously declined proposals without revisions to address concerns raised by reviewers.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp.
 - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

For NSF, PAPPG guidelines apply.

For DOE and DOD, contact the cognizant program officer. See Section VIII for contact information.

For awards made by USDA/NIFA: Section 715 of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) limits indirect costs to 30 percent of the total Federal funds provided (or 42.857 percent of total direct costs) under each award. Similar language may be included in the FY 2017 appropriation; therefore, when preparing budgets, you should limit your request for the recovery of indirect costs to the lesser of your institution's official negotiated indirect cost rate or the equivalent of 30 percent of total Federal funds awarded. See Part V section 7.9 of the NIFA Grants.gov Application Guide for further indirect cost information. See <http://nifa.usda.gov/indirect-costs> for options.

- **Other Budgetary Limitations:**

Not Applicable

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

February 02, 2017

January 11, 2018

Second Thursday in January, Annually Thereafter

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

TABLE OF CONTENTS

Summary of Program Requirements

- I. Introduction
- II. Program Description
- III. Award Information
- IV. Eligibility Information
- V. Proposal Preparation and Submission Instructions
 - A. Proposal Preparation Instructions
 - B. Budgetary Information
 - C. Due Dates
 - D. FastLane/Grants.gov Requirements
- VI. NSF Proposal Processing and Review Procedures
 - A. Merit Review Principles and Criteria
 - B. Review and Selection Process
- VII. Award Administration Information
 - A. Notification of the Award
 - B. Award Conditions
 - C. Reporting Requirements
- VIII. Agency Contacts
- IX. Other Information
- X. Appendix

I. INTRODUCTION

Robots – smart electro-mechanical devices that sense and operate within the environment of their surroundings – have the potential to transform our lives for the better. Specialized **collaborative robots (co-robots)** will safely assist people in their work and daily activities, while other robots will perform jobs too dangerous for people. We envision a future in which co-robots will no longer be expensive novelties, but rather ubiquitous technologies that significantly enrich the **quality of life** and **quality of work** for each of us.

Building upon foundational research in co-robots that began with the National Robotics Initiative (NRI), in NRI-2.0 NSF seeks research to help achieve this vision of **ubiquitous collaborative robots**, where robots are as commonplace as today's automobiles, computers, and cell phones. Robots will be found in homes, offices, hospitals, factories, farms, and mines; and in the air, on land, under water, and in space. Robots will be helping the elderly and people with disabilities in their activities of daily living. Robots will assist workers on the factory floor, performing mundane or dangerous tasks and helping to monitor worker safety. Robots will be among the first responders at natural disasters. We envision teams of humans and co-robots, large and small, reliably and efficiently cooperating on tasks. We envision democratizing robotics and transforming industries, benefiting the individual and society.

The NRI-2.0 program seeks research on the fundamental science, approaches, technologies, and integrated systems needed to achieve this vision. The program extends and advances the *co-robot* theme of the first five years of the NRI, in terms of the **scale** and **variety** of collaborative interactions. While the previous NRI co-robot theme focused on single robots collaborating with single humans, the NRI-2.0 program expands that theme to focus on issues relating to scaling up the technologies in ways that are necessary to achieve the vision of ubiquitous collaborative robots. One significant new aspect of this is **co-robot teams**: multiple co-robots collaborating with multiple people. Such teams will need to coordinate with people and robots, and possibly interact with software agents or make use of other devices (such as cell phones or the Internet of Things). Robots are characterized by **embodied intelligence**, and fundamental advances are needed in both the physical and digital domains. Furthermore, the added dimension of human interaction and the requirement to safely and productively work with human partners requires fundamental advances in modeling of human perception and cognition. To achieve the overall vision of this program, co-robot teams will facilitate communication not only through transfer of data, but also through physical and emotional channels. Collaboration will be enabled by innovative sensing and actuation schemes, and by new ways to leverage resources from the cloud. Co-robot teams will anticipate the behavior and needs of others, plan and learn from both human and robot collaborators, reason about alternate strategies, and allocate resource usage to promote efficient and effective collaboration.

While autonomy, embodiment, and human-machine interfaces have been extensively investigated separately, creating effective co-robot teams will require understanding of the interactions between these elements. In particular, the physical embodiment of ubiquitous co-robots will substantially affect both how they perform and how they are perceived. Research is needed to understand, and take advantage of, the fundamental differences between embodied systems, such as robots, and virtual agents.

To scale up effectively, robots will need to be easily **customizable** and **personalizable**. Features of both the hardware and software should facilitate robots achieving a wide variety of tasks, in a wide variety of situations, for a wide diversity of people. Ubiquitous co-robots should be designed to operate reliably and safely in real-world environments, with significant mean time between failure, in unstructured, uncertain environments. They should be designed for maintenance and incorporate capabilities for self-diagnosis and self-repair. Scaling up will require new approaches to the challenges of accountability, interoperability, and trust. Scalability also implies lowering the barrier to entry in robotics research, in terms of accessible, composable hardware and software infrastructure, and shareable testbeds and other resources that can be easily accessed and used by the larger research community.

Finally, the advent of ubiquitous co-robots will bring to the forefront social, economic, ethical, and legal issues. This program encourages fundamental research on the social and economic impact of robots on our work, our social institutions, and our quality of life and work. Pertinent research questions include understanding the complexities of the future co-robot economy; how economic and social inequality will be affected by ubiquitous co-robots; and what societal policies can be instituted to ensure that stakeholder groups can benefit from the presence of co-robots in our everyday lives.

The NRI-2.0 program represents a natural evolution in robotics research and the co-robot perspective that is in alignment with the Administration's 2011 National Robotics Initiative and the report to the House Robotics Caucus Advisory Committee of the U.S. Congress, "A Roadmap for U.S. Robotics From Internet to Robotics" (<http://www.us-robotics.us/reports/CCC%20Report.pdf>), which was updated in 2013 (<http://robotics-vo.us/sites/default/files/2013%20Robotics%20Roadmap-rs.pdf>). Other informative reference reports include the *Office of the Secretary of Defense Unmanned Systems Roadmap (2009-2034)* (<http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA522247>) and the *WTEC Panel Report on International Assessment of Research and Development In Robotics* (<http://www.wtec.org/robotics/report/screen-robotics-final-report.pdf>). The NRI is a part of a "broader effort to promote a renaissance of American manufacturing ... developing robots that work with or beside people to extend or augment human capabilities, taking advantage of the different strengths of humans and robots ... investing in the core technology needed for next-generation robotics."

II. PROGRAM DESCRIPTION

Building upon the successes of the National Robotics Initiative (NRI), the goal of the NRI-2.0 program is to support fundamental research that will accelerate the development and use of robots in the United States that work beside or cooperatively with people. Innovative robotics research and applications emphasizing the realization of such scalable co-robot teams is supported by multiple agencies of the federal government including the National Science Foundation (NSF), the U.S. Department of Agriculture (USDA), the U.S. Department of Energy (DOE), and the U.S. Department of Defense (DOD). While the first five years of the NRI program focused on single robots collaborating with single humans, the NRI-2.0 program significantly expands that theme to focus on issues of **scalability**: how teams of multiple robots and multiple humans can interact and collaborate effectively; how robots can be designed to facilitate achievement of a variety of tasks in a variety of environments, with minimal modification to hardware and software; how robots can utilize large pools of information (from the cloud, other robots, and other people) to learn to perform more effectively and efficiently; how the design of the robots' hardware and software can facilitate large-scale, reliable operation; and the economic, societal, and educational impacts of having ubiquitous co-robots in our everyday lives.

Collaboration among academic, industry, non-profit and other organizations is encouraged to establish better linkages between fundamental science and engineering and technology development and use, through partnerships among researchers, applications developers, users and industry. International collaborations that enhance and add significant value to the proposed research and education activities will also be considered. While the NRI encourages projects that include some aspects of technology development, fundamental research should dominate. Proposers focused on developmental work are encouraged to consider submission to the Small Business Innovative Research (SBIR) and Small Technology Transfer Research (STTR) programs (see <https://www.nsf.gov/eng/iip/sbir/>).

II.A. Program Scope

All proposals submitted to NRI-2.0 should support the research themes, listed in Section II.A.1, that are the primary foci of the NRI-2.0 program.

Section II.A.2 defines the two classes of proposals – Foundational and Integrative – that will be supported by the program.

Proposals to this solicitation may be selected for funding by any of the sponsoring agencies, although all proposals will go through a uniform review process. Proposals of special relevance to sponsoring agencies listed in this solicitation should address the domain-specific interests listed in Section II.A.3, Sponsoring Agency Mission-Specific Research.

Within NSF, the NRI-2.0 program is administered jointly by the Directorate for Computer and Information Science and Engineering (CISE) and the Directorate for Engineering (ENG). Supporting directorates include the Directorate for Education and Human Resources (EHR) and the Directorate for Social, Behavioral & Economic Sciences (SBE). Within USDA, the program is led by the National Institute of Food and Agriculture (NIFA). Within DOD, the program is led by the Deputy Assistant Secretary of Defense for Research, and is supported by multiple departments and agencies. Within DOE, the program is led by the Assistant Secretary for Environmental Management and is supported by multiple offices and agencies. Contacts for these and related activities at other sponsoring agencies can be found in Section VIII of this solicitation.

Those proposals that are targeting a specific agency sponsorship should indicate so in the last line of the last box of the Project Summary, e.g., "Requested funding agency:" followed by that agency's abbreviated name ("NSF," "USDA," "DOE," or "DOD"), but only if they have previously communicated with a program officer from that agency and received permission or instruction to do so. Those not so designated will be considered for funding by all of the joint sponsoring agencies.

II.A.1. Research Themes

To achieve the vision of the NRI-2.0 program, funding will support foundational research in robotics science and technology, as well as innovative research in integrated robotic systems. While disciplinary research is important, the NRI-2.0 program encourages cross-disciplinary projects with an emphasis on scaling co-robot interaction. This section presents the main research themes that are fundamental for achieving the overall program goals. While this list of themes and subthemes is not exhaustive, proposers are encouraged to incorporate one or more of the themes into their proposals. In all cases, proposers are reminded that NRI-2.0 proposals **must** show a compelling connection to the overall goal of enabling ubiquitous co-robots.

- *Collaboration*:
 - Enable robots to collaborate and coordinate effectively with multiple other agents, either people or robots;

- o Enable robotic systems to perceive, act, plan and learn in a distributed fashion;
 - o Enable robots to learn efficiently from direct experience, people, other robots, and digital media; and
 - o Enable robots to inform and instruct multiple other agents, either people or robots.
- *Interaction:*
 - o Enable natural interaction with novice users, including use of language and non-verbal communication;
 - o Enable effective interaction with experts, including through remote operation;
 - o Enable robots to reliably recognize and predict the behavior and activities of others;
 - o Investigate social intelligence in robots, including use of mental models, perspective taking, and joint attention; and
 - o Investigate issues of trust with respect to ubiquitous co-robots.
- *Scalability:*
 - o Investigate easily customizable robots for achieving a variety of tasks in a variety of situations;
 - o Investigate easily personalizable robots for interacting with a variety of people;
 - o Investigate composable hardware or software that supports the development of ubiquitous co-robots;
 - o Investigate approaches to managing data produced/consumed by robots, especially data shared among agents; and
 - o Investigate hardware and software approaches to increase mean time between failure by orders of magnitude and enable robots to fail gracefully.
- *Physical Embodiment:*
 - o Investigate designs and materials (e.g., soft robots) for facilitating ubiquitous interaction and for making co-robots inherently safe;
 - o Facilitate physical collaboration (including peer-to-peer; collaborative manipulation; and augmentation of human capabilities);
 - o Investigate physical information gathering, sensor modalities, and cooperative and distributed sensing; and
 - o Investigate alternate robot-human communication modalities (e.g., voice, gesture, visual, movement, tactile) to enhance cooperation amongst team members.
- *Lowering Barriers to Entry (see also Section II.B):*
 - o Investigate innovative programming languages/paradigms for robots;
 - o Develop robust, easy-to-use infrastructure for software, hardware, and systems;
 - o Develop techniques that would facilitate shareable physical testbeds, especially techniques to make existing testbeds easily available communally; and
 - o Develop shareable resources, such as software and data.
- *Societal Impact:*
 - o Investigate the impact of ubiquitous co-robots on social and economic equality;
 - o Investigate needed economic and governance policies;
 - o Investigate ethical and legal issues related to ubiquitous co-robots;
 - o Investigate issues related to teamwork and integration, partnerships, and worker training for collaboration with robots; and
 - o Develop innovative uses for co-robots in education (see also Section II.C).

Note: while security and privacy are also important issues for ubiquitous co-robots, proposals in such areas should be sent to other relevant NSF programs, such as Secure and Trustworthy Cyberspace (SaTC, https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504709).

II.A.2. Classes of Projects

There are two classes of NRI-2.0 projects, with differing requirements and budget ranges. While there will not be a separate competition for the two classes, they will be evaluated using different criteria.

Foundational (FND) projects focus on research into technologies that directly support one or more of the themes of the NRI-2.0 program. Such projects should lead to transformative approaches that address scientific or technology gaps that currently limit the development, use, or acceptance of co-robots in society. Proposals should clearly explain how the proposed results will further the overall program vision of ubiquitous co-robots. Foundational projects will be in the range of \$350,000 - \$750,000 in total budget, with durations of up to three years.

Integrative (INT) projects focus on research leading to complete co-robotic systems. The focus of these projects should be on the innovative integration of technologies. Integrative projects need to address more than one of the NRI-2.0 program themes or subthemes, and must include evaluation on physical robots, preferably in real-world settings. These projects should have a longer-term vision, with objectives that could not be attained simply by a collection of smaller projects provided with similar resources. The overall impact to the science of the NRI-2.0 program should be greater than the sum of each individual investigator contributions. Integrative projects should include multiple PIs, preferably from different disciplines. Integrative projects will be in the range of \$500,000 - \$1,500,000 in total budget, with durations of up to four years.

II.A.3. Sponsoring Agency Mission-Specific Research

NSF will consider for funding proposals addressing any of the research themes described above in Section II.A.1, as well as those described below and in Sections II.B and II.C.

DOD encourages basic research in robotics to support the United States Department of Defense's broad vision for the use of autonomous systems to achieve capability increases and cost savings via increased manpower efficiencies, increased capability, and reduced manpower needs. According to this vision, the value of autonomous and robotics systems is not to replace humans, but to build human-robot teams that complement each other and extend the team's capability to perform a mission. Central to the goal of effective human-robot teaming is the establishment of trust between humans and robots. Research is needed to investigate behaviors, processes and capabilities that support properly calibrated human-robot trust. Examples of research areas on trusted human-robot teaming include the following: (1) investigating socially-designed cues such as humanoid appearance, voice, personality, and other social elements on human trust and overall human-robot team performance; (2) physical "embodiment" features versus non-physical features to determine which have the most influence on human trust and performance; (3) sensing of human intent, cognitive and affective states, such as workload, stress, fatigue and fear; (4) modeling the processes of high-performing human teams, such as teammate monitoring, backup behavior, joint attention, shared mental models, coordination and negotiation; (5) dynamic modeling of

the human-robot partnerships to allow continuous improvement of joint performance in real-world applications; (6) investigations regarding the effectiveness of various models of human-robot interaction, such as delegation and supervisory control; (7) practical methods for robotic systems to sense and measure trust and changes in trust over time; and (8) investigations of the impact of culture and cross-cultural interactions on reliance and human-machine cooperation. Interdisciplinary research and research in collaboration with government labs, such as Air Force Research Lab (AFRL), is especially encouraged.

DOE/EM encourages robotics research and technology development for: (1) handling of high-hazard, high-consequence materials and waste; (2) tasks that are dirty, dull, dangerous, and/or difficult to perform; (3) easing the performance of worker/operator tasks that are physically demanding on or stressful to human body or are otherwise ergonomically challenging; (4) performing tasks that are beyond human abilities; (5) improving the ability to respond to and recover from unplanned events or operational emergencies; and (6) improving the safety, quality, efficiency, and productivity of facility operations.

Topics and areas of academic, scientific and engineering pursuit for the application of DOE/EM robotics technologies include but are not limited to:

- **Wearable Robotic Devices for Workers:**
DOE/EM seeks wearable, prosthetic-like, exoskeletal, bionic, and other attachable human assistive robotic devices that can serve the workforce by functioning as (1) smart personal protective equipment (PPE) and/or (2) performance augmentation and amplification devices (PAADs).

Traditional PPE (e.g., hard hats, safety glasses, and steel-toed shoes) is designed to protect workers from external injuries caused by exposure to workplace and environmental hazards. Focused differently, wearable robotic devices can protect workers from internal injuries due to, for example, overexertion, bodily reaction, repetitive motion, hyperextensions, over-rotation, excessive and repetitive vibration, and even the latent effects of aging. The integration of sensing devices provides added protection.

Wearable robotic devices also serve as PAADs. They can enable workers to perform tasks that are physically stressful or demanding, mentally taxing, ergonomically challenging, or even beyond human capability. This allows workers to work with much greater ease and efficiency as well as with improved safety and quality.

- **Gaining Remote Access:**
DOE/EM is pursuing robots that provide remote access to areas and spaces that are inaccessible or prohibit direct entry by workers due to: (1) unsafe, unstable, or unknown physical or structural conditions; (2) configurations that are hard to reach or beyond reach without taking extraordinary mechanical measures; or (3) the presence or potential presence of chemical, biological, radiological, or physical hazards that will or may result in unacceptable occupational exposure or increased health or safety risk. Other workplace conditions that preclude safe worker entry or are otherwise uninhabitable include those that: are oxygen-deprived or have poor air quality; have explosive gases, materials or devices; have extreme temperatures or extreme pressures; have poor or no visibility, no direct line of sight, or are dimly lit; and are submerged or substantially liquid-covered surfaces. Robotic devices help to keep occupational exposures as low as reasonably achievable.
- **Glovebox Operations:**
Gloveboxes have widespread use for the handling of radioactive and nuclear materials within an enclosed, hermetically sealed, and controlled environment. Gloveboxes are typically robust, self-standing structures that are not easily movable or adjustable. Their design features create ergonomic challenges for operators/lab techs of different heights, torso sizes, arm lengths, and hand sizes. Maintenance can become costly as gloves routinely require replacement.

DOE/EM is pursuing advanced robotic technologies that will address challenges associated with doing work within a glovebox. The integration of robotic arms and hands that can be tele-operated by an operator/lab tech, for example, can offer increased ability (dexterity, fine motor skills and grip), efficiency (work longer and with more focus), capability (added strength and extended reach), and safety (improved ergonomics).

- **Multi-Use and Multi-User (MU2) Robotic Technologies:**
DOE/EM is pursuing dual-purpose robotic technologies that can be used to support normal as well as off-normal operations - that is, MU2 robots that are used to perform routine operations can also be deployed in response to emergencies. For example, an assistive robot that is used by a health physics technician for performing routine radiological surveys can also be deployed by a first-responder to screen for the presence of airborne radioactivity prior to entering an area or space.

The **USDA/NIFA** encourages robotics research, applications, and education to enhance agricultural production, processing, and distribution systems that benefit consumers and rural communities. These robotics efforts address USDA goals (www.usda.gov/documents/usda-strategic-plan-fy-2014-2018.pdf), including: protecting agricultural health to ensure access to safe, plentiful, and nutritious food (Goal 4.4), increasing agricultural opportunities by supporting a competitive agricultural system (Goal 1.1), contributing to clean and abundant water by protecting and enhancing water resources (Goal 2.3), and ensuring that U.S. agricultural resources contribute to global food security (Goal 3.1). The USDA/REE Action Plan is also supported through the following goals (http://www.ree.usda.gov/ree/news/USDA_2014_REE_Action_Plan_08-2014_Final.pdf): sustainable intensification of agricultural production, sustainable use of natural resources, and education and science literacy. Furthermore, NIFA Science goals are supported, including (http://nifa.usda.gov/about/pdfs/strat_plan_2014.pdf): advancing our Nation's ability to achieve global food security and fight hunger, optimizing the production of goods and services from working lands while protecting the Nation's natural resource base and environment, and ensuring the development of human capital, communities, and a diverse workforce. In the process, it is expected that projects will engage academia, industry, stakeholders/users, students, and other organizations to identify fundamental research needs and to conduct both basic and applied research, while providing training for the next generation of scientists, engineers, and technologists. Projects involving the following topics are particularly desired, although other robotics topics will be considered:

Scalable Robotic Technologies. Examples include the following areas:

- Automated systems for planting, scouting, spraying, culturing, irrigating, and harvesting plant crops (including forests) to decrease costs, improve efficiency, or reduce inputs of water, fertilizer, or chemicals;
- Improved robotics for inspection, monitoring, culturing, sorting, and handling of plants and flowers in controlled environment facilities and nurseries, or for managing or studying (e.g., monitoring, inspecting, sorting, vaccinating, deworming) large

- numbers of live animals, either domestic or wild;
- Automated systems for inspection, sorting, processing, or handling of animal or plant products (including forest products) in post-harvest, processing, or product distribution environments; and
- Multi-modal and rapid sensing systems for detecting defects, ripeness, physical damage, microbial contamination, size, shape, and other quality attributes of plant or animal products (including forest products), or for monitoring air or water quality.

Configurable Multi-Agent Teams. Examples include the following areas:

- High-level task planning, execution, and control systems for spatially distributed autonomous or semi-autonomous robots that operate in concert with co-workers, either human, robotic, or other devices/systems;
- Communication protocols and standards for inter-agent coordination (including natural language) and for unsupervised collaboration; and
- Distributed intelligence, fault tolerance, and “failure with grace” that will allow high-level task completion despite failure of one or more agents (or teams) or temporary loss of human attention.

II.B. Infrastructure and Testbeds

As a way to lower the barrier to entry for robotics researchers and the broader community, this program aims to fund the development of innovative infrastructure projects. As examples, support is available for development of new paradigms for programming robots (especially teams of co-robots), distributed robot operating systems (especially with connections to the cloud), and design and validation environments for robot hardware and software.

In addition, proposals are encouraged that will develop shareable resources that foster collaborative work environments. Examples include data sets and collections of algorithms of general utility to the community, and approaches to hardware co-robotic testbeds that can be effectively accessed and operated by the community, enabling researchers to perform experiments and collect data remotely. Proposers of such testbeds may want to consider collaborating with a national lab to house and maintain the testbed (see below, for instance), since NSF requires long-term availability and maintainability of any such shareable resource.

To facilitate the advancement of robotics technologies for nuclear applications, DOE/EM is establishing the capability for “radioactive” (rad) testbeds, which are existing DOE/EM nuclear facilities and assets that are utilized as physical platforms for researchers and technologists to demonstrate innovative tooling, treatment technologies, and other technical solutions. These rad testbeds would provide researchers and technologists with the unique opportunity to conduct research and technology demonstrations in spaces and areas that (1) have radiation fields; (2) are contaminated with surface and/or fixed radioactivity; (3) are inaccessible, inhabitable, or not safe for worker entry; and/or (4) are under conditions and configurations of nuclear facilities that are difficult or too expensive to replicate or mock up. Researchers and technologists would also be given the opportunity to use, albeit in small amounts, radioactive wastes and nuclear materials for research and technology demonstrations. DOE/EM encourages the utilization of rad testbeds, particularly when mature technologies originally intended for non-nuclear applications are proposed for nuclear applications.

II.C. Robotic Projects for K-16 Education

To explore the linking of robotics research efforts for K-16 education, NSF’s Directorate for Education and Human Resources will provide funding at the lower end of the Foundational project funding range for planning, study and prototyping projects. Successful applicants are expected to demonstrate high potential to advance K-16 science, technology, engineering, and mathematics (STEM) education. Due to limited funds and the multi-agency nature of this solicitation, **education-focused proposals are discouraged at the higher end of the funding range.**

Example activities are:

- Design of innovative robotic technologies as tools for enhancing STEM learning in formal and informal learning environments;
- Applications that further the development of co-robot systems that support personalized learning;
- Design, implementation, and rigorous study of robotics competitions that impact student engagement, motivation to learn STEM content, and STEM career motivation;
- Research and development of learning experiences and instructional models that integrate co-robotics within STEM courses;
- Research of learning environments and instructional approaches in formal and informal settings to advance workforce preparedness in robotics; and
- Education research and development of strategies for broadening participation in education pathways to careers in robotics.

II.D. Principal Investigator Meetings

The NRI-2.0 program anticipates holding annual Principal Investigator (PI) meetings for research investigators, industrial partners, and sponsoring agency representatives. Budgets should account for such trips to the Washington, DC area for each of the project PIs and other team members as appropriate from all collaborating institutions. These meetings will be highlighted by technology demonstrations and progress reports, and will provide a forum for all to discuss best practices, concerns, and high-risk, high-return ideas and challenges pertinent to the vision of ubiquitous collaborative robots.

III. AWARD INFORMATION

All awards made under this solicitation by NSF, DOE, USDA, and DOD will be as grants or cooperative agreements or other contract vehicles as determined by the supporting agency. All awards made under this solicitation by USDA/NIFA will be standard grants. A standard grant is an award instrument by which the agency agrees to support a specified level of effort for a predetermined project period without the announced intention of providing additional support at a future date.

This solicitation will make awards for two classes of projects. Foundational projects will range from \$350,000 to \$750,000 **in total costs** for up to three years. Integrative projects will range from \$500,000 to \$1,500,000 **in total costs** for up to four years. In addition to these

overall budget ranges, agency requirements and funding mechanisms place limits on **per-year** budget ranges:

- **USDA/NIFA** will consider projects comprising one or more investigators with budgets ranging from \$150,000 to \$300,000 **per year in total costs** (direct plus indirect) averaged over the duration of the project, with durations of two to four years. Projects exceeding \$1,200,000 in total costs may be accepted by USDA/NIFA with prior approval.
- **DOE** and **DOD** will consider projects comprising one or more investigators with budgets ranging from \$100,000 to \$400,000 **per year in total costs** (direct plus indirect) averaged over the duration of the project, with durations of two to four years. It is expected that the bulk of awards will be made at the lower end of the range.

The number of awards will depend on the quality of proposals received, the availability of funds, considerations for creating a balanced overall program, and the degree to which meaningful collaboration across institutions is realized for Integrative projects. Innovative methods of collaboration across geographic boundaries are encouraged.

Upon conclusion of the NSF review process, meritorious research proposals may be recommended for funding by one of NSF, DOD, DOE, or USDA/NIFA, determined at the option of the agencies, not the proposer. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency, and may require submission of a revised proposal that meets the administrative requirements of the funding agency (see Section V.B for additional information on agency-specific processes).

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 2

An investigator may participate as PI, co-PI, or Senior Personnel in **no more than two proposals** submitted in response to this solicitation each year.

In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

The above limit applies only to proposals to the NRI-2.0 solicitation, not to the totality of proposals submitted to NSF.

Proposals submitted in response to this solicitation may not duplicate or be substantially similar to other proposals concurrently under consideration by other NSF, USDA, DOE, or DOD programs or study sections. Duplicate or substantially similar proposals will be returned without review, including those substantially similar to previously declined proposals without revisions to address concerns raised by reviewers.

Additional Eligibility Info:

For U.S. universities and two- and four-year colleges with overseas campuses, this solicitation restricts eligibility to research activities using the facilities, equipment, and other resources of the campus(es) located in the U.S. only. Note: this restriction is directed at institutional eligibility only; it is not intended to restrict international collaborations or research activities by subsequent awardees.

International collaborations should be well-justified in terms of enhancing and adding value to the proposed research and education activities. Questions related to such collaborations should be directed to the NSF Office of International Science and Engineering (OISE) point of contact (see section VIII).

For USDA/NIFA: Eligible applicants for the grant program implemented under this subpart include: (1) state agricultural experiment stations; (2) colleges and universities (including junior colleges offering associate degrees or higher); (3) university research foundations; (4) other research institutions and organizations; (5) Federal agencies, (6) national laboratories; (7) private organizations or corporations; (8) individuals who are U.S. citizens, nationals, or permanent residents; and (9) any group consisting of 2 or more entities identified in (1) through (8). Eligible institutions do not include foreign and international organizations.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nspfpubs@nsf.gov). Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nspfpubs@nsf.gov).

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

The following information supplements the NSF PAPPG or NSF Grants.gov Application Guide.

Proposal Titles: Proposal titles must indicate the NRI program followed by a colon, then the project class ("FND" or "INT") followed by a colon, then the title of the project. For example, an Integrative proposal would be **NRI: INT: Title**. For collaborative proposals, all participating institutions should use the same title, which should also include the keyword "COLLAB" followed by a colon; for example, **NRI: FND: COLLAB: Title**.

Proposals from institutions that have RUI (Research in Undergraduate Institutions) eligibility should have a proposal title that begins with "NRI: RUI:" followed by either "FND:" or "INT:", then "COLLAB:" (if applicable), followed by the title; for example, **NRI: RUI: FND: COLLAB: Title**.

Project Summary (one page limit): At the top of the "overview" text box, enter the title of the project, the name of the PI, and the lead institution. Provide an overview description of the project, including its research and education goals, and the community (communities) that will be impacted by its results. In separate statements, provide a succinct overview of the project in the first box, a summary of the intellectual merit in the "intellectual merit" box, and broader impacts of the proposed project in the "broader impacts" box. Those proposals that are targeting a specific agency sponsorship should indicate so in the last line of the last box, e.g., "Requested funding agency:" followed by that agency's abbreviated name ("NSF," "DOD," "DOE," or "USDA") but only if they have previously communicated with a program officer from that agency and received permission or instruction to do so. Those not so designated will be considered for funding by all of the joint sponsoring agencies.

To aid in the reviewing process, in the last line of the "overview" box, add the term "Keywords:" followed by one, or more, of the following technology terms (if more than one, order by the importance to your proposed research): **Control, Design, Dynamics, Human-Robot Interaction, Learning, Locomotion, Manipulation, Mechanisms, Modeling/Representation, Multi-Robot, Natural Language, Perception, Planning, Reasoning, Robustness, Safety, Social Intelligence, and Trust**; and at most one, if applicable, of the following application areas: **Agriculture, Assistive, Construction, Defense, Disaster Recovery, Education, Environmental Monitoring, Field Robotics, Infrastructure, Manufacturing, Medical, Nuclear, Rehabilitation, Shareable Resources, Societal Impact, Space, Testbeds, and Worker Safety**.

Project Description: 15-page limit for all proposals. **Project descriptions that do not explicitly address the intellectual merit and broader impacts of the proposed project in separate statements may be returned without review.**

For Integrative (INT) proposals, the Project Description **must** contain a separate section labeled "Evaluation." This section must include a discussion of how the project will be evaluated on a physical robot, including a description of the robot and associated testbed, proposed experiments, and evaluation metrics to be used. Proposals without this clearly-identifiable section will be returned without review.

Supplementary Documents: Supplementary documents are limited to the specific types of documentation listed in the PAPPG, with the following exceptions:

1. Collaboration Plan. A Collaboration Plan is required for projects with **more than one** investigator. **The Collaboration Plan must be submitted as a Supplementary Document and cannot exceed two pages. Proposals that require a Collaboration Plan, but do not submit one, will be returned without review.** The Collaboration Plan must be labeled "Collaboration Plan" and must provide a

thoughtful, strong justification for the team of researchers. The Collaboration Plan must include: 1) the specific roles of the collaborating PIs, Co-PIs, other Senior Personnel and paid consultants at all organizations involved; 2) how the project will be managed among participants, especially across institutions and disciplines, with a description of how the researchers will work together collaboratively and effectively; 3) identification of the specific coordination mechanisms that will enable cross-institution and/or cross-discipline scientific integration (e.g., workshops, graduate student exchange, project meetings at conferences, use of videoconferencing and other communication tools, software repositories, etc.); 4) specific references to the budget line items that support these coordination mechanisms; and 5) for Integrative projects, a timeline for the integrative activities.

2. Documentation of collaborative arrangements of significance to the proposal through letters of collaboration. Any substantial collaboration with individuals not included in the budget or not employed by the submitting institution(s) should be described and documented with a letter from each collaborator, which should be provided in the supplementary documentation section. **Such letters should simply confirm the commitment to collaborate, as illustrated in the recommended format provided in the PAPPG.** They must explicitly state the nature of the collaboration, appear on the organization's letterhead, and be signed by the appropriate organizational representative. These letters must not otherwise deviate from the restrictions and requirements set forth in PAPPG Chapter II.C.2.j. General letters of support are not allowed by the PAPPG, and must not be included.

3. Human Subjects Protection. Proposals involving human subjects should include a supplementary document of no more than two pages in length summarizing potential risks to human subjects; plans for recruitment and informed consent; inclusion of women, minorities, and children; and planned procedures to protect against or minimize potential risks.

For research that involves human subjects and meets the criteria for one or more of the six categories of research that are exempt under 45 CFR Part 46, the committee will evaluate: 1) the justification for the exemption; 2) human subjects involvement and characteristics; and 3) sources of materials.

4. Vertebrate Animals. Proposals involving vertebrate animals should include a supplementary document of no more than two pages in length. The committee will evaluate the involvement of live vertebrate animals as part of the scientific assessment according to the following five points: 1) proposed use of the animals, and species, strains, ages, sex, and numbers to be used; 2) justifications for the use of animals and for the appropriateness of the species and numbers proposed; 3) adequacy of veterinary care; 4) procedures for limiting discomfort, distress, pain and injury to that which is unavoidable in the conduct of scientifically sound research including the use of analgesic, anesthetic, and tranquilizing drugs and/or comfortable restraining devices; and 5) methods of euthanasia and reason for selection if not consistent with the AVMA Guidelines on Euthanasia.

5. Data Management Plan. All proposals must include a supplementary document of no more than two pages in length labeled "Data Management Plan". This document should describe how the proposal will conform to NSF policy on the dissemination and sharing of research results. See Chapter II.C.2.j of the PAPPG for full policy implementation.

For additional information on the Dissemination and Sharing of Research Results, see: <https://www.nsf.gov/bfa/dias/policy/dmp.jsp>.

For specific guidance for Data Management Plans submitted to the Directorate for Computer and Information Science and Engineering (CISE) see: http://www.nsf.gov/cise/cise_dmp.jsp.

6. List of Project Personnel and Partner Institutions. Provide current, accurate information for all personnel and institutions involved in the project (note: for collaborative proposals, the lead institution should provide this information for all participants). NSF staff will use this information in the merit review process to find reviewers who are not conflicted with proposals. The list should include all PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

1. Mary Smith; XYZ University; PI
2. John Jones; University of PQR; Senior Personnel
3. Jane Brown; XYZ University; Postdoc
4. ABC Community College; Paid Consultant
5. Susan White; DEF Corporation; Unpaid Collaborator
6. Tim Green; ZZZ University; Subawardee

7. Postdoctoral Researcher Mentoring Plan (if applicable). See Chapter II.C.2.j of the PAPPG for further information about the implementation of this requirement.

Single Copy Documents:

Collaborators and Other Affiliations Information: In lieu of the instructions specified in the PAPPG, Collaborators and Other Affiliations Information should be submitted as follows.

For this solicitation, the *Collaborators & Other Affiliations* information specified in the PAPPG should be submitted using the spreadsheet template found at <https://www.nsf.gov/cise/collab>. For each proposal, a completed spreadsheet for each PI, co-PI, or senior personnel must be uploaded directly into Fastlane in .xls or .xlsx format as a "Collaborator and Other Affiliations" Single Copy Document. NSF staff use this information in the merit review process to help manage reviewer selection; the spreadsheet will ensure the Collaborator and Other Affiliations information has a common, searchable format.

Note the distinction to item 6, above, for Supplementary Documents: the listing of all project participants is collected by the project lead and entered as a Supplementary Document, which is then automatically included with all proposals in a project. The Collaborators and Other Affiliations are entered for each participant within each proposal and, as Single Copy Documents, are available only to NSF staff. Collaborators and Other Affiliations due to participants listed on Supplementary Document (item 6) that are not PIs, co-PIs, or senior personnel can be uploaded under Additional Single Documents using Transfer File.

Proposals that do not comply with these requirements will be returned without review.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Indirect Cost (F&A) Limitations:

For NSF, PAPPG guidelines apply.

For DOE and DOD, contact the cognizant program officer. See Section VIII for contact information.

For awards made by USDA/NIFA: Section 715 of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) limits indirect costs to 30 percent of the total Federal funds provided (or 42.857 percent of total direct costs) under each award. Similar language may be included in the FY 2017 appropriation; therefore, when preparing budgets, you should limit your request for the recovery of indirect costs to the lesser of your institution's official negotiated indirect cost rate or the equivalent of 30 percent of total Federal funds awarded. See Part V section 7.9 of the NIFA Grants.gov Application Guide for further indirect cost information. See <http://nifa.usda.gov/indirect-costs> for options.

Budget Preparation Instructions:

Budgets should include travel funds to attend annual NRI Principal Investigator (PI) meetings.

For DOE/EM proposals, budgets should include travel estimates for at least two site visits to DOE/EM field offices and/or DOE national laboratories each year.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

February 02, 2017

January 11, 2018

Second Thursday in January, Annually Thereafter

D. FastLane/Grants.gov Requirements**For Proposals Submitted Via FastLane:**

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <http://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the PAPPG as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years (FY) 2011-2016*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the core strategies in support of NSF's mission is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.C.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.C.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to

the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 1. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 2. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

Programmatic Relevance. All NRI-2.0 proposals must be responsive to the vision of the program. Specifically, proposals must explicitly address the goal of achieving ubiquitous collaborative robots in terms of collaboration, interaction, scalability, lowering barriers to entry, and/or societal impact.

Integration and Evaluation (for Integrative projects only). Integrative projects focus on research involving complete robotic systems, and are typically collaborative and multi-disciplinary. Thus, Integrative projects will also be reviewed on the basis of (1) the innovation in the integration of the system; and (2) the evaluation plan for the robotic system in its intended (preferably real-world) setting.

Subsequent to the uniform review process, a process of selection by the supporting agencies will be conducted. When considering their funding choices appropriate to the interests and goals described in the solicitation, each agency may apply and prioritize the additional review criteria below to highlight the specific objectives of their programs and activities, although all of the following are considered by each of the supporting agencies, when applicable.

Additional DOD Review Criteria

There are no additional review criteria for DOD.

Additional USDA/NIFA Review Criteria

Programmatic Relevance. The extent to which the proposed research meets USDA/NIFA goals and advances the sciences related to agriculture and food systems will be evaluated.

Adequacy of Facilities. Reviewers will assess the adequacy of the necessary research infrastructure capacity for the performing organization to conduct the proposed work.

Additional DOE Review Criteria

Programmatic Relevance. Reviewers will assess relevancy to the DOE nuclear cleanup mission. DOE/EM is engaged in protecting the environment and the health and safety of local constituents by cleaning up the environmental legacy of the Cold War. To achieve this in the safest, fastest and most economical manner, DOE/EM has established a goal to accelerate cleanup of the nuclear weapons manufacturing and testing sites. This acceleration will necessitate the identification, evaluation, development, demonstration and implementation of innovative, transformational technologies and approaches that can improve on the current baseline of activities. It will also require human capital development programs to assure a sufficient supply of trained environmental professionals over the entire period of performance of DOE/EM activities.

Radioactive and/or Hazardous Waste. When radioactive testbeds are utilized, reviewers will assess whether materials or procedures will potentially generate orphan waste (i.e., no known disposition path) or other radioactive and/or hazardous waste streams, and if needed, determine whether treatment, storage and/or disposal is beyond current DOE facility capabilities.

Occupational Exposure to Ionizing Radiation. When radioactive testbeds are utilized, reviewers will assess whether the work will require monitoring for occupational exposure to ionizing radiation.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Proposals submitted in response to this program solicitation will be reviewed by the process below.

A uniform review process will be conducted by NSF for all proposals received responding to this program solicitation. Multiple review panels of experts in the field and additional ad hoc reviewers as needed will be assembled. The number and topical clustering of panels will be determined according to the number and topical areas of the proposals received. Staff members from the other supporting agencies will be assigned to work cooperatively with NSF staff on each panel, as appropriate to the category of funding requested.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. Reviewers will be asked to formulate a recommendation to either support or decline each proposal. A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. The Program Officer(s) assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

Upon conclusion of the review process, meritorious proposals may be recommended for funding by one of the participating agencies, the choice to be determined at the option of the agencies, not the proposer. Those not so designated will be considered for funding by all of the joint sponsoring agencies. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency.

NSF Process: Those proposals selected for funding by NSF will be handled in accordance with standard NSF procedures. This process begins with NSF drafting and releasing the joint agency solicitation, which includes program requirements.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

USDA/NIFA Process: USDA/NIFA will make final funding decisions based on the results of the peer review process. Applications selected for funding by NIFA will be forwarded to the USDA/NIFA Awards Management Division for award processing in accordance with the USDA/NIFA procedures.

DOD Process: DOD will make final funding decisions based on the results of the peer review process. Applications selected for funding by DOD will be forwarded to the DOD Awards Management Division for award processing in accordance with the DOD procedures.

DOE Process: DOE/EM will make final funding decisions based on the results of the peer review process. Applications selected for funding by DOE/EM will be forwarded to the EM Consolidated Business Center for award processing in accordance with the DOE/EM procedures.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award will be made through use of standard processes of the relevant funding agencies. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. (See Section VI.B. for additional information on the review process).

B. Award Conditions

NSF:

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1); * or Research Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are

administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

Attribution of support in publications must acknowledge the joint program, as well as the funding organization and award number, by including the phrase, "as part of the Joint National Robotics Initiative program."

The final version of any accepted software and robotics operating systems sharing plans will become a condition of the award grant, contract or agreement. The effectiveness of software and robotics operating system sharing may be evaluated as part of the administrative review of each award.

DOD and DOE:

Contact the cognizant organization program officer for additional information.

USDA/NIFA Award Administration and Conditions:

Within the limit of funds available for such purpose, the NIFA awarding official shall make grants to those responsible, eligible applicants whose applications are judged most meritorious under the procedures set forth in this solicitation. The date specified by the NIFA awarding official as the effective date of the grant shall be no later than September 30 of the federal fiscal year in which the project is approved for support and funds are appropriated for such purpose, unless otherwise permitted by law. The project need not be initiated on the grant effective date, but as soon thereafter as practical so that project goals may be attained within the funded project period. All funds granted by NIFA under this solicitation may be used only for the purpose for which they are granted in accordance with the approved application and budget, regulations, terms and conditions of the award, applicable federal cost principles, USDA assistance regulations, and NIFA General Awards Administration Provisions at 7 CFR part 3430, subparts A through E.

The award document will provide pertinent instructions and information including, at a minimum:

- Legal name and address of performing organization or institution to which the director has issued an award under the terms of this request for applications;
- Title of project;
- Name(s) and institution(s) of PDs chosen to direct and control approved activities;
- Identifying award number and the Federal Agency Identification Number assigned by NIFA;
- Project period, specifying the amount of time NIFA intends to support the project without requiring recompetition for funds;
- Total amount of financial assistance approved for the award;
- Legal authority(ies) under which the award is issued;
- Appropriate Catalog of Federal Domestic Assistance (CFDA) number;
- Applicable award terms and conditions (see <http://www.nifa.usda.gov/business/awards/awardterms.html> to view NIFA award terms and conditions);
- Approved budget plan for categorizing allocable project funds to accomplish the stated purpose of the award; and
- Other information or provisions deemed necessary by NIFA to carry out its respective awarding activities or to accomplish the purpose of a particular award.

Changes in Project Plans

- The permissible changes by the grantee, PD(s), or other key project personnel in the approved project grant shall be limited to changes in methodology, techniques, or other similar aspects of the project to expedite achievement of the project's approved goals. If the grantee or the PD(s) is uncertain as to whether a change complies with this provision, the question must be referred to the Authorized Departmental Officer (ADO) for a final determination. The ADO is the signatory of the award document, not the program contact.
- Changes in approved goals or objectives shall be requested by the grantee and approved in writing by the ADO prior to effecting such changes. In no event shall requests for such changes be approved which are outside the scope of the original approved project.
- Changes in approved project leadership or the replacement or reassignment of other key project personnel shall be requested by the grantee and approved in writing by the ADO prior to effecting such changes.
- Transfers of actual performance of the substantive programmatic work in whole or in part and provisions for payment of funds, whether or not Federal funds are involved, shall be requested by the grantee and approved in writing by the ADO prior to effecting such transfers, unless prescribed otherwise in the terms and conditions of the grant.
- Changes in Project Period: The project period may be extended by NIFA without additional financial support, for such additional period(s) as the ADO determines may be necessary to complete or fulfill the purposes of an approved project, but in no case shall the total project period exceed five years. Any extension of time shall be conditioned upon prior request by the grantee and approval in writing by the ADO, unless prescribed otherwise in the terms and conditions of a grant.
- Changes in Approved Budget: Changes in an approved budget must be requested by the grantee and approved in writing by the ADO prior to instituting such changes if the revision will involve transfers or expenditures of amounts requiring prior approval as set forth in the applicable Federal cost principles, Departmental regulations, or grant award.

Responsible and Ethical Conduct of Research

- See <http://nifa.usda.gov/responsible-and-ethical-conduct-research> for further information.

C. Reporting Requirements

NSF:

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Additional data may be required for NSF sponsored Cooperative Agreements.

DOD and DOE:

Contact the cognizant organization program officer for additional information.

USDA/NIFA:

Expected Program Outputs and Reporting Requirements

The output and reporting requirements are included in the award terms and conditions (see <http://www.nifa.usda.gov/business/awards/awardterms.html> for information about NIFA award terms). If there are any program or award-specific award terms, those, if any, will be identified in the award.

Other USDA/NIFA Requirements: Several federal statutes and regulations apply to grant applications considered for review and to project grants awarded under this program. These may include, but are not limited to, the ones listed on the NIFA web page: <http://nifa.usda.gov/federal-regulations>.

The NIFA Federal Assistance Policy Guide—a compendium of basic NIFA policies and procedures that apply to all NIFA awards, unless there are statutory, regulatory, or award-specific requirements to the contrary—is available at <http://nifa.usda.gov/policy-guide>.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Reid Simmons, CISE/IIS, telephone: (703) 292-4767, email: resimmon@nsf.gov
- Radhakishan Baheti, ENG/ECCS, telephone: (703) 292-8339, email: rbaheti@nsf.gov
- Jordan M. Berg, ENG/CMMI, telephone: (703) 292-5365, email: jberg@nsf.gov
- Ephraim P. Glinert, CISE/IIS, telephone: (703) 292-8930, email: eglinert@nsf.gov
- David L. Haury, EHR/DRL, telephone: (703) 292-5102, email: dhaury@nsf.gov
- Tatiana Korelsky, CISE/IIS, telephone: (703) 292-8930, email: tkorelsk@nsf.gov
- Bruce Kramer, ENG/CMMI, telephone: (703) 292-5348, email: bkramer@nsf.gov
- Frederick M. Kronz, SBE/OAD, telephone: (703) 292-7283, email: fkronz@nsf.gov
- Wendy Nilssen, CISE/IIS, telephone: (703) 292-2568, email: wnilsen@nsf.gov
- Jack Snoeyink, CISE/CCF, telephone: (703) 292-8910, email: jsnoeyin@nsf.gov
- Ralph Wachter, CISE/CNS, telephone: (703) 292-8950, email: rwachter@nsf.gov

- Jie Yang, CISE/IIS, telephone: (703) 292-4768, email: jyang@nsf.gov
- Seta Bogosyan, OD/OISE, telephone: (703) 292-4766, email: sbogosya@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

United States Department of Agriculture

Daniel Schmoltdt, Ph.D.
National Institute of Food and Agriculture
Waterfront Centre, Ste. 3328
800 9th Street SW
Washington DC 20024

Electronic mail: dschmoltdt@nifa.usda.gov
Telephone: 202-720-4807

Dr. Steven Thomson
National Institute of Food and Agriculture

Electronic mail: steven.j.thomson@nifa.usda.gov
Telephone: 202-401-6301

Department of Defense

Dr. David Han
Office of the Assistant Secretary of Defense, Basic Research Office
875 N. Randolph Street, ONR, Room 1020
Arlington, VA 22203

Electronic mail: david.k.han@navy.mil
Telephone: (703) 696-4299

Department of Energy, Office of Environmental Management

Rodrigo V. Rimando, Jr.
U.S. Department of Energy, Headquarters
1000 Independence Ave, SW
Washington, DC 20585

Electronic mail: rodrigo.rimando@em.doe.gov
Telephone: (240) 676-6470

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.

NATIONAL SCIENCE FOUNDATION
<http://www.nsf.gov>

DEPARTMENT OF DEFENSE
<http://www.acq.osd.mil/rd/>

**NATIONAL INSTITUTE OF FOOD AND AGRICULTURE,
UNITED STATES DEPARTMENT OF AGRICULTURE**
<http://www.nifa.usda.gov>

OFFICE OF ENVIRONMENTAL MANAGEMENT,

DEPARTMENT OF ENERGY
<https://neup.inl.gov>

PUBLIC BRIEFINGS

One or more collaborative webinar briefings with question and answer functionality may be held prior to the submission deadline date. Schedules will be posted on the sponsor announcement web sites.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nspubs@nsf.gov
 - or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select

potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, [NSF-50](#), "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and [NSF-51](#), "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230

X. APPENDIX

Legislative Authority:

The USDA authority for this solicitation is contained in Section 7406 of the Food, Conservation, and Energy Act of 2008 (FCEA) (Pub. L. 110-246) which amends section 2(b) of the Competitive, Special, and Facilities Research Grant Act (7 U.S.C. 450i(b)) to authorize the Secretary of Agriculture to establish the Agriculture and Food Research Initiative (AFRI); a new competitive grant program to provide funding for fundamental and applied research, extension, and education to address food and agricultural sciences. AFRI is subject to the provision found at 7 CFR Part 3430.

[Policies and Important Links](#) | [Privacy](#) | [FOIA](#) | [Help](#) | [Contact NSF](#) | [Contact Web Master](#) | [SiteMap](#)



The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (800) 281-8749

[Text Only](#)