This document has been archived.

National Robotics Initiative 3.0: Innovations in Integration of Robotics (NRI-3.0)

PROGRAM SOLICITATION
NSF 21-559

REPLACES DOCUMENT(S):
NSF 20-522

National Science Foundation

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

Directorate for Engineering

Directorate for Education and Human Resources

Directorate for Social, Behavioral and Economic Sciences

U.S. Department of Transportation, Federal Highway Administration

National Aeronautics and Space Administration

National Institutes of Health

National Institute of Biomedical Imaging and Bioengineering

National Institute on Aging

National Center for Advancing Translational Sciences

National Eye Institute

National Institute of Nursing Research

The National Institute for Occupational Safety and Health

U.S. Dept. of Agriculture

National Institute of Food and Agriculture

Submission Window Date(s) (due by 5 p.m. submitter's local time):

April 19, 2021 - May 03, 2021

February 08, 2022 - February 22, 2022

February 8 - February 22, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

This solicitation is a revision of NSF 20-522, the solicitation for the National Robotics Initiative.

The significant changes in the FY 2021 NRI-3.0 solicitation are as follows:

- The deadlines have been revised;

This document has been archived.

A single class of projects exists for all proposals for NRI 3.0. The NRI program now focuses on research in the innovative integration of robotic technologies.
- The NRI program has expanded to include robotic research that does not necessarily emphasize collaboration.
- The NRI 2.0 theme requirements have been largely eliminated.
- All proposals must have a collaboration plan as described in V.A.3.
- Additional solicitation-specific sections are required in the project description, as detailed in Section V.A.
- NASA will only consider projects that are within its stated cost limits.
- NIFA will only consider projects that are within its stated cost limits.
- NIOSH will only consider projects that are within its stated cost limits.
- DOT and NIH have been added as partner organizations.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 20-1), which is effective for proposals submitted, or due, on or after June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

National Robotics Initiative 3.0: Innovations in Integration of Robotics (NRI-3.0) (NRI-3.0)

Synopsis of Program:

The National Robotics Initiative 3.0: Innovations in Integration of Robotics (NRI-3.0) program builds upon the preceding National Robotics Initiative (NRI) programs to support fundamental research in the United States that will advance the science of robot integration. The program supports research that promotes integration of robots to the benefit of humans **including** human safety and human independence.

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.

The NRI-3.0 program is supported by multiple agencies of the federal government including the National Science Foundation (NSF), the U.S. Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), the Department of Transportation (DOT), the National Institutes of Health (NIH), and the National Institute for Occupational Safety and Health (NIOSH). 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.

- Juan Wachs, CISE/IIS, telephone: (703) 292-8714, email: jwachs@nsf.gov
- Erion Plaku, CISE/IIS, telephone: (703) 292-8695, email: eplaku@nsf.gov
- Jordan Berg, ENG/CMMI, telephone: (703) 292-5365, email: jberg@nsf.gov
- Peter Brass, CISE/CCF, telephone: (703) 292-2182 email: nri@nsf.gov
- Irina Dolinskaya, ENG/CMMI, telephone: (703) 292-7078, email: idolinsk@nsf.gov
- Ephraim P. Glinert, CISE/IIS, telephone: (703) 292-8930, email: eglinert@nsf.gov
- Wu He, EHR/DRL, telephone: (703) 292-7593, email: wuhe@nsf.gov
- Grace Hwang, ENG/CBET, telephone: (703) 292-4721, email: ghwang@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
- Ralph Wachter, CISE/CNS, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Donald Wunsch, ENG/ECCS, telephone: (703) 292-7102, email: nri@nsf.gov
- Jie Yang, CISE/IIS, telephone: (703) 292-4768, email: jyang@nsf.gov

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

- 10.310 --- USDA-NIFA Agriculture and Food Research Initiative
- 20.200 --- Highway Research and Development Program
- 43.001 --- National Aeronautics and Space Administration (Science)
- 47.041 --- Engineering
- 47.070 --- Computer and Information Science and Engineering
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 93.262 --- The National Institute for Occupational Safety and Health

- 93.286 --- National Institute of Biomedical Imaging and Bioengineering
- 93.350 --- National Center for Advancing Translational Sciences
- 93.361 --- National Institute of Nursing Research
- 93.866 --- National Institute on Aging
- 93.867 --- National Eye Institute

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: 15 to 30

per year, subject to the availability of funds.

Projects will range from $250,000 to $1,500,000 in total costs for up four years.

Anticipated Funding Amount: $12,500,000 to $14,100,000

per year, subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- 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-3.0 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, DOT, NASA, NIH, NIOSH, or USDA programs. 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=pappg.
  - Full Proposals submitted via Research.gov: *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=pappg.
  - 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: https://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 DOT, NIOSH and NASA, contact the cognizant program officer. See Section VIII for contact information.

For NIH, indirect costs on foreign subawards/subcontracts will be limited to eight (8) percent.

For awards made by USDA/NIFA: *Indirect Cost (IDC) is not to exceed 30 percent of Total Federal Funds Awarded (TFFA) of the recipient*.

7 U.S.C. § 3310 limits IDC for the overall award to 30 percent of Total Federal Funds Awarded (TFFA) under a research, education, or extension grant. The maximum IDC rate allowed under the award is determined by calculating the amount of IDC using:

1. the sum of an institution's negotiated indirect cost rate and the indirect cost rate charged by sub-awardees, if any; or
2. 30 percent of TFFA.

The maximum allowable IDC rate under the award, including the IDC charged by the sub-awardee(s), if any, is the lesser of the two rates.

If the result of number 1) above is the lesser of the two rates, the grant recipient is allowed to charge the negotiated IDC rate on the prime award and the sub-award(s), if any. Any sub-awards would be subject to the sub-awardee's negotiated IDC rate. The sub-awardee may charge its negotiated IDC rate on its portion of the award, provided the sum of the IDC rate charged under the award by the prime awardee and the sub-awardee(s) does not exceed 30 percent of the TFFA.

If the result of number 2) above is the lesser of the two rates, then the maximum IDC rate allowed for the overall award, including any sub-award(s), is limited to 30 percent of the TFFA. That is, the IDC of the prime awardee plus the sum of the IDC charged by the sub-awardee(s), if any, may not exceed 30 percent of the TFFA.

In the event of an award, the prime awardee is responsible for ensuring the maximum indirect cost allowed for the award is not exceeded when combining IDC for the Federal portion (i.e., prime and sub-awardee(s)) and any applicable cost-sharing (see 7 CFR 3430.52(b)). Amounts exceeding the maximum allowable IDC is considered unallowable. See sections 408 and 410 of 2 CFR 200.

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

  April 19, 2021 - May 03, 2021

  February 08, 2022 - February 22, 2022

  February 8 - February 22, Annually Thereafter

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria 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

I. INTRODUCTION

The National Robotics Initiative 3.0: Innovations in Integration of Robotics (NRI-3.0) program seeks research on integrated robot systems and builds upon the previous NRI programs to focus on **innovative integration of robotics technologies**. An NRI proposal should convince the reader that the proposed system will enable new functionality or significantly improve upon the state of the art of integrated robotics.

The NRI-3.0 program seeks to strengthen the robotics research community, fostering innovation and workforce development, accelerating progress, demonstrating novel capabilities, and building ecosystems for innovation. The program seeks to promote new integrated approaches to the challenges of accountability, interoperability, ethical operation and trust which will be engendered by integrated functional ubiquitous robots.

II. PROGRAM DESCRIPTION

Building upon the successes of earlier versions of NRI, the goal of the NRI-3.0 program is to support fundamental research that will accelerate the development and use of integrated robot systems in the United States. Innovative robotics research and applications emphasizing the realization of robots is supported by multiple agencies of the federal government including the National Science Foundation (NSF), Department of Transportation (DOT), National Aeronautics and Space Administration (NASA), the National Institutes of Health (NIH), National Institute for Occupational Safety and Health (NIOSH), and U.S. Department of Agriculture (USDA).

The NRI-3.0 program encourages cross-disciplinary projects. Collaboration among academic, industry, government, 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. Fundamental research in integration of robotics is the focus of the NRI-3.0 program. Proposals focused on foundational robotics research in the Directorate for Computer and Information Science and Engineering (CISE) and the Directorate for Engineering (ENG) topics should not be submitted to this program.

II.A. Program Scope

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-3.0 program is administered jointly by CISE and 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 DOT, the program is led by the Federal Highway Administration (FHWA). Within NASA, the program is led by the Space Technology Mission Directorate (STMD): Game Changing Development program. Within NIH, the program is led by the National Institute of Biomedical Imaging and Bioengineering (NIBIB). 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," "DOT," "USDA," "NASA," "NIH," or "NIOSH"), 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.B. Sponsoring Agency Mission-Specific Research

DOT FHWA has interest in robotics research and development that provides improved safety and mobility for the U.S. highway system. In particular, FHWA is interested in fundamental advances that solve important public needs and can scale for national use.

Increasing access to transportation for all people is an example of how robotics research could respond to public needs across highway transportation. Robotics can provide assistive technology that will increase the ability of all people to travel safely across the highway system from daily local trips such as picking up groceries to longer distance travel. Assistive technology could include components that build on commercial platforms that assist people with overcoming physical and cognitive travel barriers for a complete trip where the traveler may use multiple modes of transportation.

These are only illustrative examples. Proposals should respond to critical public needs that could overlap the examples above or be entirely different. Investigators are encouraged to consider and propose truly novel solutions that provide transformative advances over current or near market robotics technology. When proposing research, investigators should consider the open nature of the transportation system, integration with legacy components and processes, and the distributed nature of asset ownership and operations.

FHWA seeks proposals that demonstrate awareness of and can leapfrog recent and ongoing DOT-supported applied research programs in order to provide next generation solutions. Relevant DOT programs and activities include

- Complete Trip - ITS4US Deployment program information is located at https://www.its.dot.gov/its4us/index.htm
- Pedestrian Safety Summit information is located at https://cms8.fhwa.dot.gov/pedestrian-safety-summit
- Accessible Transportation Technologies Research Initiative (ATTRI) program information is located at https://www.its.dot.gov/research_archives/attri/index.htm.

NASA seeks research and technology development that will significantly increase the performance of robots to collaboratively support deep space human exploration and science missions. NASA's focus on "Moon to Mars" highlights objectives to establish a long-term presence in the vicinity of and on the Moon, and to invest in technologies needed for the exploration of Mars and other deep-space destinations. NASA environments present unique challenges for human-robot collaboration, including high communication latencies and limited bandwidth between non-collocated robots and humans, operation in reduced (or zero) gravity environments, and operation on other worlds (with associated issues due to radiation, temperature, illumination, dust, etc.).

Proposals should focus on research and technology development that contribute to the seamless integration and operation of non-collocated human-robot teams. These teams will experience communication latencies from seconds to hours round-trip, with network bandwidths ranging from a few hundred bits per second to a few megabits per second. Additionally, these teams may intermittently be unable to communicate. Robot team members may be located in habitats (both in-orbit and surface), on planetary surfaces, and underground/underwater on icy and ocean worlds. Human team members may be on Earth, or in orbiting habitats.

Research and technology development should focus on being customizable to both the human and robot, preventing single-system or “one-off” solutions. Robotic systems will be of varying archetypes and modalities – it is expected that many of these systems will be mobile and include manipulation capabilities. Some systems may operate with rich data (from sensors, models, etc.), while others may operate with minimal data derived from limited on-board sensors. NASA’s 2015 technology roadmap and 2020 technology taxonomy cite critical technologies needed to enable and advance Human-Systems Interaction, which includes human-robot teams. In addition, some example research and technology areas include, but are not limited to, the following:

- Strategies to decrease data needed between human and robot while not impacting team performance;
- Remote operator interfaces that increase situation awareness and robotic intent understanding, and that optimize operator workload;
- Autonomous performance monitoring; and
- Autonomous command planning and sequencing.

It is desired that research and technology development include testing to assess human-robot team performance.

NASA’s “Moon to Mars” focus is described here: https://www.nasa.gov/feature/nasas-exploration-campaign-back-to-the-moon-and-on-to-mars

NASA's 2015 Technology Roadmaps are available here: https://www.nasa.gov/offices/oct/home/roadmaps/index.html

NASA’s 2020 Technology Taxonomies are available here: https://www.nasa.gov/offices/oct/taxonomy/index.html

NASA’s Risk of Adverse Outcome Due to Inadequate Human Systems Integration Architecture is described here:

https://humanresearchroadmap.nasa.gov/risks/risk.aspx?i=175

The NIH encourages robotics research and technology development to enhance health, lengthen life and reduce illness and disability. The NIH also supports non-hypothesis driven applications, which includes technology-driven and problem-driven applications. Specifically, the participating NIH institutes on this solicitation are interested in targeting this solicitation to support the development and integration of assistive robotic technology to achieve functional independence in humans; improve quality of life; assist with behavioral therapy and personalized care; and promote wellness/health. The most significant challenges will be in addressing safety issues, especially for applications to be used in home-based and long-term care settings where integration of complex systems will be required. Additionally, these assistive robots need to quickly adapt to changes of the user and the environment. Human assistive devices should be designed to assist healthcare providers as well as the individuals needing care. Development of robotic applications is important to NIH because of their potential significant impact on healthcare in the future. Human assistive devices will revolutionize healthcare in the next 20 years as much as personal electronics have changed our daily lives in the past two decades. Affordable and accessible robotic technology can facilitate wellness and personalized healthcare. Continual health assessment and personalized intervention have the potential to offset the shrinking size of the healthcare workforce and the growing elderly and disabled population. In the future, assistive robotics will enable people to engage in all aspects of human life with endurance and dignity

Examples of assistive robotic technology development include, but are not limited to:

- Home care and long-term personalized care robots;
- Robotic wellness/health promotion and maintenance;
- Robotic behavioral, geriatric, and rehabilitative therapy;
- Robotic aids for mobility, manipulation, human communication and cognition, vision for non-sighted persons;
- Assistive robotics to eliminate health disparities across populations; and
- Infectious disease monitoring and assessments.

When developing appropriate integrative robotic technologies, applicants should consider the following basic characteristics: effectiveness, affordability, cultural acceptability, and accessibility to those who need them. Applicants should describe how these technologies will address the healthcare needs of the end user (healthy individuals, persons with disabilities, and or health disparity populations).

NIOSH seeks research on integration of robotics technologies for reducing workplace risk exposures, research to identify potential physical risks and sociotechnical challenges of robotics technologies to workers, and research to evaluate different risk control strategies. NIOSH seeks research in various industry sectors that are likely to deploy and benefit from robotics technologies (e.g., agriculture, construction, healthcare, mining, manufacturing, public safety, retail and wholesale trade, services, transportation, warehousing and utilities). NIOSH seeks research using modeling and simulation to evaluate potential hazards to humans from implementing innovative robotics technologies and to test robot and human interactions using simulated test beds. The purpose of the simulated test beds is to enable engineered solutions to the identified hazards before the technology is deployed in the physical world. Simulations may include incorporation of humans into the simulated workspace using a virtual reality interface.

NIOSH has identified research priorities in the areas of basic cause-and-effect research and intervention to address knowledge gaps related to integration of robotics technologies and worker safety and health.

Basic cause-and-effect research builds a foundation of scientific knowledge on which to base future interventions. Specific research topics include the following:

- Risk factors involving human worker’s cognitive, physical, physiological, and emotional capability and limitations when working with robots and robotics technologies;
- Refinement and development of science-based human pain and injury thresholds for collaborative robots, wearable robots (including powered exoskeletons), and new robotics technologies;
- Robotics technologies and engineering features for safe, intuitive, and useful collaborative and co-existing robot systems;
- Risk factors involving human-robot interface and safety communication;
- Task-related and environmental risk factors that are specific to each industrial sector, particularly for the industries in which integrated robotics technology has high potential for improving workplace safety; and
- Risk factors associated with adaptability of robots in dynamically changing work environments or situations outside normal operating conditions.

Intervention research involves development and evaluation of interventions to reduce injury incidents among human workers working with new robotics systems, and also evaluates integrated robotics technologies as preventive measures for existing workplace hazards. Specific research topics include the following:

- Evaluation of integrated robotics technologies as potential interventions to reduce or prevent existing hazards and resulting injuries and illnesses to workers;
- Evaluation of training that helps human workers acquire skills, knowledge, and abilities needed to work with integrated robotics systems safely in complex and dynamic industrial environments; and
- Innovative workplace interventions including engineering controls and administrative controls. Research may address costs of the intervention and impacts on productivity.

Additional information can be found in the NIOSH Strategic Plan which is available at www.cdc.gov/niosh/about/strategicplan/. Robotics-related goals are included in Strategic Goals for Musculoskeletal Health, Traumatic Injury Prevention, and Healthy Workplace Design.

The NIOSH Center for Occupational Robotics Research webpage provides more information and is available at: www.cdc.gov/niosh/topics/robotics.

The USDA has launched the Agricultural Innovation Agenda for using automation, artificial intelligence and data to transform American agriculture (https://www.usda.gov/aia). **USDA/NIFA** encourages robotics research, applications, and education to enhance agricultural production, processing, and distribution systems that address the following goals of the USDA science blueprint (https://www.usda.gov/sites/default/files/documents/usda-science-blueprint.pdf): sustainable agricultural intensification, climate adaptation in agriculture, value added innovation in agricultural systems, and translation of food and nutritional information technological advances in food industry. These robotics efforts address USDA strategic goals (https://www.usda.gov/sites/default/files/documents/usda-strategic-plan-2018-2022.pdf). USDA emphasizes automation (including robotics) and associated development of decision tools for plant and animal production and protection; particularly as it applies to fruit and vegetable production and of precision livestock farming and processing.

Projects involving the following topics are particularly desired, although other robotics topics will be considered:

Scalable Robotic Technologies. Examples include the following areas:

- Automated and mechanized intelligent systems that focus on labor-intensive tasks in production and distribution of crops;
- 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 meat 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;
- Innovative use of intelligently coupled robot drones and unmanned ground vehicles (UGVs) to improve crop and animal management;
- 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.C. Robotic Projects for K-16 Education

To promote further exploration of the linkages of research on Integrated robots to one or more levels of K-16 education, NSF's Directorate for Education and Human Resources will provide funding at the lower end of the funding range. Successful projects will advance the vision of integrating technologies to make robots more capable by developing and testing innovative strategies for either: a) engaging students or teachers in the study of robotics in the context of science, technology, engineering, or mathematics (STEM) education; or b) designing, developing, optimizing or using robotics to enhance teaching and learning in formal or informal STEM education settings. 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 teaching and learning in formal and informal learning environments;
- Development of innovative robotic technologies as tools for augmenting teaching and supporting students in face-to-face, online and blended learning environments;
- Applications that further the development of robot systems and approaches that support optimized human-robot interaction and personalized learning;
- Design, implementation, and rigorous study of robotics competitions or instructional materials that impact student engagement, motivation to learn STEM content, and STEM career awareness and interests;
- Research and development of learning experiences and instructional models that integrate robotics into STEM courses;
- Development, testing and evaluation of teacher professional growth opportunities that support teaching, learning and integration of robotics in school or college settings;
- Research of learning environments and instructional approaches in formal and informal settings to advance workforce preparedness in robotics; and
- Development, testing and evaluation of education strategies for broadening participation of students from groups underrepresented in education pathways to careers in robotics.

II.D. Principal Investigator Meetings

The NRI-3.0 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 robots.

III. AWARD INFORMATION

All awards made under this solicitation by NSF, DOT, NASA, NIH, NIOSH, and USDA 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.

NSF supported projects will range from $250,000 to $1,500,000 **in total costs** for a period of up to four years. In addition to these **overall** budget ranges, individual agency requirements and funding mechanisms place limits on **per-year** budget ranges:

- **NASA** will consider projects with budgets ranging from $85,000 to $150,000 **per year in total annual costs** (direct plus indirect) averaged over the duration of the project, with durations of up to three years.
- **NIH** will consider projects with budgets ranging from approximately $100,000 to $250,000 **per year in direct costs** averaged over the duration of the project, with durations of one to three years. Applicants who wish to submit a proposal to NIH of more than $250,000 in direct costs for any grant should contact the program staff of an NIH Institute/Center directly for alternate proposal mechanisms.
- **NIOSH** will consider projects with budgets ranging from $85,000 to $250,000 **per year in total annual costs** (direct and indirect), with durations up to three years.
- **USDA/NIFA** will consider projects with budgets ranging from $150,000 to $300,000 **per year in total annual 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.

Projects with budgets over the limit may be returned without further review.

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.

Upon conclusion of the NSF review process, meritorious research proposals may be recommended for funding by one of NSF, DOT, NASA, NIH, NIOSH, 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 for additional information on agency-specific processes).

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- 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-3.0 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, DOT, NASA, NIH, NIOSH, or USDA programs. 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 USDA/NIFA: Eligible applicants/Principal Investigators (PIs) 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 FastLane, Research.gov, or Grants.gov.

- 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=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@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 Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and 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=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.

- 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: (https://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) 292-8134 or by e-mail from nsfpubs@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 FastLane or Research.gov. 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 title of the project. For Collaborative proposals where all participating institutions submit separate proposals, the title should be the same and start with “Collaborative Research”, followed by a colon; then NRI, followed by a colon, then the title. For example, **Collaborative Research: NRI: Title**.

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

Project Summary (one-page limit): Provides an overview description of the project, including its research and education goals, and the community (or communities) that will be impacted by its results. In separate statements, provide a succinct overview of the project in the "overview" text box, a summary of the intellectual merit in the "intellectual merit" box, and a summary of the broader impacts of the proposed project in the "broader impacts" box. At the top of the "overview" text box, enter the title of the project, the name of the PI, and the lead institution. Those proposals that are targeting a specific agency sponsorship should indicate so in the last line of the "broader impacts" box, e.g., "Requested funding agency:" followed by that agency's abbreviated name ("NSF," "DOT," "NASA," "NIH," “NIOSH” 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 proposal processing, add the term "Keywords:" in the last line of the Project Summary "overview" box. The list of keywords may contain, as applicable, one or more of the following technology terms: **Control, Design, Dynamics, Human-Robot Interaction, Learning, Locomotion, Manipulation, Mechanisms, Modeling/Representation, Multi-Robot, Natural Language, Perception, Planning, Reasoning, Robustness, Safety, Social Intelligence, Soft Robotics**, and/or **Trust**. If none of the listed keywords apply, use **Other**. These may be followed, if applicable, by at most one of the following primary application areas: **Agriculture, Assistive, Construction, Disaster Recovery, Education, Environmental Monitoring, Field Robotics, Healthcare, Infrastructure, Manufacturing, Mining, Public Safety, Rehabilitation, Retail and Wholesale, Services, Shareable Resources, Testbeds, Transportation, Warehousing, and Utilities, Worker Safety**, **Workplace/Industry Safety** or **Workforce Development**.

Project Description: 15-page limit for all proposals. The proposal **must** meet all formatting requirements, including font, font size, margin width, and lines per inch, as specified in the PAPPG Chapter II.B.2.

To aid the proposers and reviewers all submissions to the NRI 3.0 Program **must have the following section labels in their Project Description (failure to include these section labels may result in proposals being returned without review)**. Proposers can add subsections and additional sections as desired. The required section headers are:

Motivation [Why is this project important and what is the problem to be addressed by this project?]

Intellectual Merit [What is the potential of this work to advance knowledge? The intellectual merit may be spread throughout the proposal, but this required section is the proposer's opportunity to summarize and clarify the specific contribution to the reviewers.]

Broader Impacts [What is the potential of this work to benefit society and contribute to the achievement of specific, desired societal outcomes? This may also include broadening participation[1] and educational and outreach contributions. The broader impact may be spread throughout the proposal, but this required section is the proposer's opportunity to summarize and clarify the specific impact of this work to the reviewers.]

Risk & Mitigation [Are there risks to this work? What are they and how are they being addressed? This required section is the proposers' opportunity to convince the reviewers that the proposers understand the risks and have a plan to handle those risks.]

Evaluation [How will this project be evaluated? This required section is the proposer's opportunity to summarize and enumerate the methods and metrics that will be used in evaluating the technical success of the proposed methods.]

Previous relevant work by members of the proposal team [What previous experience does the team possess? Previous relevant work not captured by the bio-sketches and/or next section should be described in this required section. If there is no additional previous relevant work this section should include a reference to the next section and/or bio-sketches -- or state that the team has no relevant previous experience.]

Results from Prior NSF Support [If the investigators have previous NSF work, list the most relevant previous project that meets the PAPPG guidelines]

Proposals without these clearly identifiable sections listed above may be returned without review.

Supplementary Documents: For NRI 3.0 proposals Supplementary Documents must be submitted for:

- ***Collaboration Plan.*** **A Collaboration Plan is REQUIRED for ALL projects. The Collaboration Plan must be submitted as a Supplementary**

Document and cannot exceed two pages . Single investigator projects may have a collaboration plan that consists entirely of "Single Investigator." Projects that have multiple PIs, multiple Institutions or any senior personnel or collaborators should follow the directions below. Proposals that do not include a collaboration plan, may be returned without review. The Collaboration Plan should be labeled "Collaboration Plan" and should provide a thoughtful, strong justification for the team of researchers. The Collaboration Plan should 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) a timeline of activities.

- ***Human Subjects Protection.*** **Proposals involving human subjects are required to 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, reviewers will evaluate: 1) the justification for the exemption; 2) human subjects' involvement and characteristics; and 3) sources of materials.

Applications seeking funding from the **NIH** and that involve human subjects but does not involve one of the six categories of research that are exempt under 45 CFR Part 46, the application must address the following five criteria: 1) risk to subjects, 2) adequacy of protection against risks, 3) potential benefits to the subjects and others, 4) importance of the knowledge to be gained, and 5) data and safety monitoring for clinical trials. Inclusion of Women, Minorities, and Children must be addressed for all proposals that involve human subjects. When the proposed project involves clinical research, the committee will evaluate the proposed plans for inclusion of minorities and members of both genders, as well as the inclusion of children, https://grants.nih.gov/grants/funding/women_min/women_min.htm, https://grants.nih.gov/grants/funding/children/children.htm. Applicants proposing research involving human subjects must provide a Planned Enrollment Report (https://grants.nih.gov/grants/funding/phs398/PlannedEnrollmentReport.docx). The Planned Enrollment Report, if included, does not count against the two-page limitation.) For more information please go this website, https://grants.nih.gov/grants/policy/hs/.

- ***Vertebrate Animals.*** **Proposals involving vertebrate animals are required to include a Supplementary Document** of no more than two pages in length. Reviewers 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.
- ***List of Project Personnel and Partner Institutions.*** **All submissions to NRI 3.0 are required to include a Supplementary Document** that lists 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 manage reviewer selection. The list should include all PIs, co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Sub-awardees, 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:

    - Mary Smith; XYZ University; PI
    - John Jones; University of PQR; Senior Personnel
    - Jane Brown; XYZ University; Postdoc
    - Bob Adams, ABC Community College; Paid Consultant
    - Susan White; DEF Corporation; Unpaid Collaborator
    - Tim Green; ZZZ University; Subawardee

Single Copy Documents:

Collaborators and Other Affiliations Information:

Proposers should follow the guidance specified in Chapter II.C.1.e of the NSF PAPPG. Grants.gov Users: The COA information must be provided through use of the COA template and uploaded as a PDF attachment.

Note there is a distinction to the List of Project Personnel and Partner Institutions specified 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.

---

1 The sites https://www.nsf.gov/cise/oad/cise_bp.jsp and https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf19090 may be useful for starting ideas and resources

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Indirect Cost (F&A) Limitations:

For NSF, PAPPG guidelines apply.

For DOT, NIOSH and NASA, contact the cognizant program officer. See Section VIII for contact information.

For NIH, indirect costs on foreign subawards/subcontracts will be limited to eight (8) percent.

For awards made by USDA/NIFA: *Indirect Cost (IDC) is not to exceed 30 percent of Total Federal Funds Awarded (TFFA) of the recipient*.

7 U.S.C. § 3310 limits IDC for the overall award to 30 percent of Total Federal Funds Awarded (TFFA) under a research, education, or extension grant. The maximum IDC rate allowed under the award is determined by calculating the amount of IDC using:

1. the sum of an institution's negotiated indirect cost rate and the indirect cost rate charged by sub-awardees, if any; or
2. 30 percent of TFFA.

The maximum allowable IDC rate under the award, including the IDC charged by the sub-awardee(s), if any, is the lesser of the two rates.

If the result of number 1) above is the lesser of the two rates, the grant recipient is allowed to charge the negotiated IDC rate on the prime award and the sub-award(s), if any. Any sub-awards would be subject to the sub-awardee's negotiated IDC rate. The sub-awardee may charge its negotiated IDC rate on its portion of the award, provided the sum of the IDC rate charged under the award by the prime awardee and the sub-awardee(s) does not exceed 30 percent of the

TFFA.

If the result of number 2) above is the lesser of the two rates, then the maximum IDC rate allowed for the overall award, including any sub-award(s), is limited to 30 percent of the TFFA. That is, the IDC of the prime awardee plus the sum of the IDC charged by the sub-awardee(s), if any, may not exceed 30 percent of the TFFA.

In the event of an award, the prime awardee is responsible for ensuring the maximum indirect cost allowed for the award is not exceeded when combining IDC for the Federal portion (i.e., prime and sub-awardee(s)) and any applicable cost-sharing (see 7 CFR 3430.52(b)). Amounts exceeding the maximum allowable IDC is considered unallowable. See sections 408 and 410 of 2 CFR 200.

Budget Preparation Instructions:

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

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

  April 19, 2021 - May 03, 2021

  February 08, 2022 - February 22, 2022

  February 8 - February 22, Annually Thereafter

D. FastLane/Research.gov/Grants.gov Requirements

For Proposals Submitted Via FastLane or Research.gov:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://www.fastlane.nsf.gov/a1/newstan.htm. To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html. For FastLane or Research.gov user support, call the FastLane and Research.gov Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov or rgov@nsf.gov. The FastLane and Research.gov Help Desk answers general technical questions related to the use of the FastLane and Research.gov systems. 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: https://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 or Research.gov may use Research.gov 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 PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.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 *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. 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 strategic objectives 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 must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of 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
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. 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

Integration and Evaluation. 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. An important criterion for review of the evaluation plan will be its adherence to the scientific methodology, including statement of formal hypotheses, controlled experiments, evaluation metrics, and statistical analyses of results.

Subsequent to the uniform merit 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.

Additional NASA Review Criteria

Programmatic Relevance. Reviewers will assess relevancy to future NASA space exploration missions, as stated in NASA's Exploration Campaign objectives (https://www.nasa.gov/feature/nasas-exploration-campaign-back-to-the-moon-and-on-to-mars). The proposed research should demonstrate an understanding of

the unique environment of human-robot teams functioning in this space.

Additional NIH Review Criteria

The mission of the NIH is to support science in pursuit of knowledge about the biology and behavior of living systems and to apply that knowledge to enhance health, lengthen life and reduce illness and disability. While many of the NIH and NSF review criteria are based on the same standards of scientific evaluation, some scoring mechanisms and programmatic emphases vary. For example, all proposals under consideration by NIH will be scored by their respective review panels using the NIH 1-9 scoring system, which does not include consideration of broader impacts. Additionally, proposers should pay particular attention to NIH clinical evaluation standards represented by criteria for human protections, inclusion of women, minorities, and children in the study population, and animal subjects' protections, as well as biohazards. In general, NIH funding priorities will be directed toward proposals that best address the following criteria that are used by NIH:

Overall Impact - Reviewers will provide an overall impact/priority score to reflect their assessment of the likelihood for the project to exert a sustained, powerful influence on the research field(s) involved, in consideration of the following review criteria and additional review criteria (as applicable for the project proposed). An application does not need to be strong in all categories to be judged likely to have major scientific impact.

Significance - Does the project address an important problem or a critical barrier to progress in the field? If the aims of the project are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved? How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?

Investigator(s) - Are the PD(s)/PI(s), collaborators, and other researchers well suited to the project? If Early Stage Investigators or New Investigators, or in the early stages of independent careers, do they have appropriate experience and training? If established, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)? If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance and organizational structure appropriate for the project?

Innovation - Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense? Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed?

Approach - Are the overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project? Are potential problems, alternative strategies, and benchmarks for success presented? If the project is in the early stages of development, will the strategy establish feasibility and will particularly risky aspects be managed? If the project involves clinical research, are the plans for 1) protection of human subjects from research risks, and 2) inclusion of minorities and members of both sexes/genders, as well as the inclusion of children, justified in terms of the scientific goals and research strategy proposed?

Environment - Will the scientific environment in which the work will be done contribute to the probability of success? Are the institutional support, equipment and other physical resources available to the investigators adequate for the project proposed? Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?

Where applicable, the following items will also be considered:

Protections for Human Subjects. For research that involves human subjects but does not involve one of the six categories of research that are exempt under 45 CFR Part 46, the committee will evaluate the justification for involvement of human subjects and the proposed protections from research risk relating to their participation according to the following five review criteria: 1) risk to subjects, 2) adequacy of protection against risks, 3) potential benefits to the subjects and others, 4) importance of the knowledge to be gained, and 5) data and safety monitoring for clinical trials.

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.

Inclusion of Women, Minorities, and Children. When the proposed project involves clinical research, the committee will evaluate the proposed plans for inclusion of minorities and members of both genders, as well as the inclusion of children.

Vertebrate Animals. 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.

Biohazards. Reviewers will assess whether materials or procedures proposed are potentially hazardous to research personnel and/or the environment, and if needed, determine whether adequate protection is proposed.

Budget. The reasonableness of the proposed budget and the requested period of support in relation to the proposed research will be assessed.

Additional NIOSH Review Criteria

As applicable for the project proposed, reviewers will evaluate the following additional items while determining scientific and technical merit.

Protections for Human Subjects

For research that involves human subjects but does not involve a research category that is exempt under 45 CFR Part 46, reviewers will evaluate the justification for involvement of human subjects and the proposed protections from research risk relating to their participation according to the following five criteria: 1) risk to subjects, 2) adequacy of protection against risks, 3) potential benefits to the subjects and others, 4) importance of the knowledge to be gained, and 5) data and safety monitoring for clinical trials.

For research that involves human subjects and meets the criteria for one or more of the categories of research exempt under 45 CFR Part 46, NIOSH reviewers will evaluate: 1) the justification for the exemption, 2) human subjects' involvement and characteristics, and 3) sources of materials. For additional information on review of the Human Subjects section, please refer to the Guidelines for the Review of Human Subjects.

Inclusion of Women, Minorities, and Children

When the proposed project involves human subjects research, reviewers will evaluate the proposed plans for the inclusion (or exclusion) of individuals on the basis of sex/gender, race, and ethnicity, and the inclusion (or exclusion) of children to determine if it is justified in terms of the scientific goals and research strategy proposed.

Vertebrate Animals

NIOSH Reviewers will evaluate the involvement of live vertebrate animals as part of the scientific assessment according to the following criteria: (1) description of proposed procedures involving animals, including species, strains, ages, sex, and total number to be used; (2) justifications for the use of animals versus

alternative models and for the appropriateness of the species proposed; (3) interventions to minimize discomfort, distress, pain and injury; and (4) justification for euthanasia method if NOT consistent with the AVMA Guidelines for the Euthanasia of Animals. Reviewers will assess the use of chimpanzees as they would any other application proposing the use of vertebrate animals. For additional information on review of the Vertebrate Animals section, please refer to the Worksheet for Review of the Vertebrate Animal Section.

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.

B. Review and Selection Process

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

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 an 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.

DOT Process: Applications selected for funding by DOT will be awarded by NSF using funds transferred from DOT.

NASA Process: NASA will make final funding decisions based on the results of the peer review process; the selection official may take portfolio balance and other program-related factors into account when selecting proposals for award. Applications selected for funding by NASA will be forwarded to NASA Awards Management for award processing in accordance with NASA procedures.

NIH Process: For those proposals that are selected for potential funding by participating NIH Institutes or Centers, the PI will be required to resubmit the proposal in an NIH-approved format directly to the Center for Scientific Review (http://www.csr.nih.gov/) of the NIH. PIs invited to resubmit to NIH will receive further information on resubmission procedures from NIH. An applicant will not be allowed to increase the proposed budget or change the scientific content of the proposal in the resubmission to the NIH as an NIH application. For NSF Collaborative Proposals converting to the NIH subcontract mechanism, the overhead charged by Institution A on the subcontract to Institution B (on the first $25,000) would be deducted from the direct costs (approximately $12,500) so that the total costs are not increased. Indirect costs on any foreign subawards/subcontracts will be limited to eight (8) percent. These NIH applications will be entered into the NIH IMPAC II system. The results of the review will be presented to the involved Institutes' or Centers' National Advisory Councils for the second level of review. Subsequent to the Council reviews, NIH Institutes and Centers will make their funding determinations and selected awards will be made. Subsequent grant administration procedures for NIH awardees, including those related to New and Early Stage Investigators (https://grants.nih.gov/grants/new_investigators/index.htm), will be in accordance with the policies of NIH. Applications selected for NIH funding will use the NIH funding mechanisms. Proposals that are funded by the NIH are expected to be renewed as competing continuing applications. Principal Investigators should contact their NIH Program Officer for additional information. For informational purposes, NIH Principal Investigators may wish to consult the NIAID web site, "All About Grants," which provides excellent generic information about all aspects of NIH grantsmanship, including competitive renewals (https://www.niaid.nih.gov/grants-contracts/find-funding-opportunity).

NIOSH Process: Upon completion of the NSF peer review process, NIOSH will conduct a second level of review for programmatic relevance and balance. The following will be considered in making funding decisions:

- summary ratings of the peer reviewers regarding scientific and technical merit,
- alignment of the application with the NIOSH areas of interest identified in this announcement,
- the burden, need and impact on worker safety and health addressed by the proposal,
- contribution of meritorious applications to occupational safety and health research on a diverse mix of robotics technologies,
- contribution of meritorious applications to occupational safety and health research on robotics technologies with potential application in diverse industry sectors,
- commitment of the applicant institution to collaborative efforts, and
- availability of funds.

Applications selected for funding by NIOSH will be awarded by NSF using funds transferred from NIOSH.

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. NIFA reserves the right to negotiate with the PD/PI and/or with the submitting organization or institution regarding project revisions (e.g., reductions in the scope of work, funding level, period, or method of support) prior to recommending any AFRI project for funding.

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:

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator.

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 https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 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 *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

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.

DOT, NASA, NIH and NIOSH:

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.

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

In accordance with sections 2, 3, and 8 of 2 CFR Part 422, institutions that conduct USDA-funded extramural research must foster an atmosphere conducive to research integrity, bear primary responsibility for prevention and detection of research misconduct, and maintain and effectively communicate and train their staff regarding policies and procedures. In the event an application to NIFA results in an award, the Authorized Representative (AR) assures, through acceptance of the award, that the institution will comply with the above requirements. Award recipients shall, upon request, make available to NIFA the policies, procedures,

and documentation to support the conduct of the training. See 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 Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Additional data may be required for NSF sponsored Cooperative Agreements.

DOT:

For grant or cooperative agreement projects supported using DOT funds, grantees should plan to comply with the NSF reporting requirements. Additional guidance may be provided after these awards are issued.

NASA:

The reporting requirements will be consistent with 2 CFR 1800.902, “Technical Publications and Reports,” and Exhibit E - Required Publications and Reports of the NASA *Grant and Cooperative Agreement Manual*. Grants and cooperative agreements typically require annual and final technical reports, financial reports, and final patent reports. The following additional requirements will be incorporated into the NASA NRI-3.0 awards:

- Progress Reports due every 90 days;
- Continuation Review Package/Presentation: For awards greater than one year, an annual continuation package and virtual presentation will also be required; and
- Annual Technical Seminar: The PI shall present a technical seminar at a minimum of one NASA center annually.

NIH:

Contact the cognizant organization program officer for additional information.

NIOSH:

For grant or cooperative agreement projects supported using NIOSH funds, grantees should plan to comply with the NSF reporting requirements. Additional guidance may be provided after these awards are issued.

USDA/NIFA:

Expected Program Outputs and Reporting Requirements

The output and reporting requirements are included in the award terms and conditions (see NIFA/USDA Terms-and-Conditions 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: NIFA/USDA Government Regulations and Guidelines.

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 NIFA 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:

- Juan Wachs, CISE/IIS, telephone: (703) 292-8714, email: jwachs@nsf.gov
- Erion Plaku, CISE/IIS, telephone: (703) 292-8695, email: eplaku@nsf.gov
- Jordan Berg, ENG/CMMI, telephone: (703) 292-5365, email: jberg@nsf.gov
- Peter Brass, CISE/CCF, telephone: (703) 292-2182 email: nri@nsf.gov
- Irina Dolinskaya, ENG/CMMI, telephone: (703) 292-7078, email: idolinsk@nsf.gov
- Ephraim P. Glinert, CISE/IIS, telephone: (703) 292-8930, email: eglinert@nsf.gov
- Wu He, EHR/DRL, telephone: (703) 292-7593, email: wuhe@nsf.gov

- Grace Hwang, ENG/CBET, telephone: (703) 292-4721, email: ghwang@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
- Ralph Wachter, CISE/CNS, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Donald Wunsch, ENG/ECCS, telephone: (703) 292-7102, email: nri@nsf.gov
- Jie Yang, CISE/IIS, telephone: (703) 292-4768, email: jyang@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
- FastLane Help Desk e-mail: fastlane@nsf.gov.
- Research.gov Help Desk e-mail: rgov@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.

U.S. Department of Transportation

Mr. David Kuehn

Turner Fairbank Highway Research Center

6300 Georgetown Pike

McLean, VA 22101

Email: david.kuehn@dot.gov

Telephone: (202) 493-3414

National Aeronautics and Space Administration

Dr. Terry Fong

NASA Ames Research Center

M/S 269-1

Moffett Field, CA 94035-1000

Email: terry.fong@nasa.gov

Telephone: (650) 604-1349

National Institutes of Health

Dr. Moria Bittmann

National Institute of Biomedical Imaging and Bioengineering

6707 Democracy Blvd, Suite 200

Bethesda, MD 20892

Email: moria.bittmann@nih.gov

Telephone: 301-451-4778

Dr. Lyndon Joseph

National Institute on Aging

National Institute on Aging, NIH, DHHS

7201 Wisconsin Avenue, Suite 3C307

Bethesda, MD 20892-9205

Email: Josephlj@nia.nih.gov

Telephone: 301-496-6926

Dr. Danilo Tagle

National Center for Advancing Translation Sciences

6701 Democracy Blvd., Room 940

Bethesda, MD 20892

Email: danilo.tagle@nih.gov

Telephone: 301-594-8064

Dr. Cheri Wiggs

National Eye Institute

6700B Rockledge Dr., MSC 6914
Bethesda, MD 20892

Email: cheri.wiggs@nih.gov

Telephone: 301-451-2020

Dr. Kristopher Bough

National Institute of Nursing Research

6701 Democracy Blvd., Room 710
Bethesda, MD 20892-4870

Email: kristopher.bough@nih.gov

Telephone: 301-496-6204

National Institute for Occupational Safety and Health

Dr. Sharon Chiou

NIOSH/CDC

1095 Willowdale Road, MS L1055

Morgantown, WV 26505

Email: schiou@cdc.gov

Telephone: 304-285-6029

United States Department of Agriculture

Dr. Steven Thomson
USDA-National Institute of Food and Agriculture (NIFA)

6501 Beacon Drive

5NW054, 5th Floor

Kansas City, MO 64133

Ph: 202-603-1053

Email: steven.j.thomson@usda.gov

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 https://www.grants.gov.

NATIONAL SCIENCE FOUNDATION
https://www.nsf.gov

U.S. Department of Transportation
https://www.cdc.gov/niosh/

National Institute for Occupational Safety and Health
https://www.cdc.gov/niosh/

National Institutes of Health
https://www.nih.gov

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
http://www.nasa.gov

NATIONAL INSTITUTE OF FOOD AND AGRICULTURE,
UNITED STATES DEPARTMENT OF AGRICULTURE
http://www.nifa.usda.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 (FASED) 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 https://www.nsf.gov

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **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: nsfpubs@nsf.gov

  or telephone: (703) 292-8134
- **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 System of Record Notices, NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." 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
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
Alexandria, VA 22314

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. 3157) 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.

The NIOSH authority and regulations are described in the Catalog of Federal Domestic Assistance and is not subject to the intergovernmental review requirements of Executive Order 12372 or Health Systems Agency Review. Awards are made under the authorization of the Occupational Safety and HealthAct of 1970, Section 20(a) and 21(a) (29 USC 669(a) and 29 USC 670); Federal Mine Safety and Health Act, Section 501(a), 30 USC 1 (Note), and 30 USC 951(a);and Section 301 of the Public Health Service Act as amended (42 USC 241) and under Federal Regulations 42 CFR Part 52. All awards are subject to 45 CFR Part75, the terms and conditions, and other considerations described in the HHS Grants Policy Statement.