Signals in the Soil (SitS)

PROGRAM SOLICITATION
NSF 19-556

National Science Foundation

Directorate for Biological Sciences
    Division of Integrative Organismal Systems

Directorate for Computer & Information Science & Engineering
    Division of Computer and Network Systems

Directorate for Engineering
    Division of Chemical, Bioengineering, Environmental and Transport Systems
    Division of Civil, Mechanical and Manufacturing Innovation

Directorate for Geosciences
    Division of Earth Sciences
    Office of Polar Programs

National Institute of Food and Agriculture

United Kingdom Research and Innovation

Natural Environment Research Council

U.K. Biotechnology and Biological Sciences Research Council

UK Engineering and Physical Science Research Council

The Science & Technology Facilities Council

Full Proposal Target Date(s):

    May 15, 2019

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 19-1).

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

> Signals in the Soil (SitS)

Synopsis of Program:

> In 1935, Franklin D. Roosevelt stated, "A nation that destroys its soils destroys itself." This statement remains true to this day. Soil forms over thousands of years and can be destroyed in a single event. It is a natural asset, alongside water and air, but is often overlooked, despite being the foundation of terrestrial ecosystems that support food production, economic prosperity, and services that are essential for humanity. Soils are complex living ecosystems containing billions of organisms that mediate a myriad of biological, chemical, and physical processes, interacting to cycle carbon and nutrients essential for plant growth, food and fiber production, and to remove contaminants from water. Soil is also the foundation material for all structures not supported on rock, and, by orders of magnitude, is the most widely-used construction material in the world. Soil ecosystems supply most of the antibiotics used to fight human diseases, control the movement of water and chemical substances between the Earth and atmosphere, and act as source and storage media for gases important to life, such as oxygen, carbon dioxide, and methane. Thus, as the Earth's population grows, we need a better understanding of soil ecosystems that will continue to play a critical role in feeding the world.
>
> The National Science Foundation (NSF) Directorates for Engineering (ENG) and Geosciences (GEO), the Division of Integrative Organismal Systems in the Directorate for Biological Sciences (BIO/IOS), and the Division of Computer and Network Systems in the Directorate Computer and Information Science and Engineering (CISE/CNS), in collaboration with the US Department of Agriculture National Institute of Food and Agriculture (USDA NIFA) and the Natural Environment Research Council (NERC), the Engineering and Physical Sciences Research Council (EPSRC), the Biotechnology and Biological Sciences Research Council (BBSRC), and the Science and Technology Facilities Council (STFC) of United Kingdom Research and Innovation (UKRI) encourage convergent research that transforms existing capabilities in understanding dynamic, near-surface soil processes through advances in sensor systems and modeling. To accomplish this research, multiple disciplines must converge to produce novel sensors and/or sensing systems of multiple modalities that are adaptable to different environments and collect data and report on a wide range of chemical, biological and physical parameters. This type of approach will also be necessary to develop next generation soil models, wireless communication and cyber systems capabilities, and to grow a scientific community that is able to address complex problems through education and outreach. This program fosters collaboration among the partner agencies and the researchers they support by combining resources and funding for the most innovative and high-impact projects that address their respective missions.

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.

- Brandi L. Schottel, National Science Foundation Directorate for Engineering / Division of Chemical, Bioengineering, Environmental, and Transport Systems, telephone: (703) 292-4798, email: bschotte@nsf.gov

- James W. Jones, National Science Foundation Directorate for Engineering / Division of Chemical, Bioengineering, Environmental, and Transport Systems, telephone: (703) 292-4458, email: jwjones@nsf.gov

- Enriqueta C. Barrera, National Science Foundation Directorate for Geosciences / Division of Earth Sciences, telephone: (703) 292-7780, email: ebarrera@nsf.gov

- Ann C. Von Lehmen, National Science Foundation Directorate for Computer and Information Science and Engineering / Division of Computer and Network Systems, telephone: (703) 292-4756, email: avonlehm@nsf.gov

- Irwin N. Forseth, National Science Foundation Directorate for Biological Sciences / Division of Integrative Organismal Systems, telephone: (703) 292-7862, email: iforseth@nsf.gov

- Nancy Cavallaro, National Program Leader, National Institute of Food and Agriculture, telephone: (202) 401-5176, email: ncavallaro@nifa.usda.gov

- Simon Kerley, Head of Research: Terrestrial Ecosystems, Natural Environment Research Council, telephone: +44 (0) 7590 443944, email: simon.kerley@nerc.ukri.org

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

- 10.310 --- USDA-NIFA Agriculture and Food Research Initiative
- 47.041 --- Engineering
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 5 to 10

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Anticipated Funding Amount: $5,600,000

The total amount available for this solicitation is $5,600,000 and £8,000,000. Of this amount, NSF anticipates contributing approximately $4,600,000 (for the US collaborators only), USDA NIFA anticipates contributing approximately $1,000,000 (for the US collaborators only), and UKRI anticipates contributing £8,000,000 (for the UK collaborators only). These amounts are subject to the availability of funds. This program solicitation is being released

prior to the passage of the relevant appropriations. Enactment of additional continuing resolutions or an appropriations act may affect the availability of funds or level of funding for this program.

Projects will request three years of support with a total budget less than or equal to $800,000 per project for the US portion, and three years of support with a total budget less than or equal to £800,000 (at 80% full economic costs/FEC) per project for the UK portion.

Funding requests for the UK partner(s) cannot be included in the US budget request. The UK budget must be prepared as a separate supplementary document that only includes requested UK expenses. Funding requests from international partners in addition to the United Kingdom on this solicitation are independent of and not included in the total request from both the US budget and the UK budget.

This is a partnership between NSF, USDA NIFA, and UKRI; therefore, meritorious proposals may be funded by one or more agencies at the option of the agencies, not the proposer. All agencies will contribute to and participate in a common review process. All proposals MUST conform to NSF budgetary and proposal submission guidelines by the due date. The UK research portion MUST conform to UK budgetary and proposal submission guidelines by the due date.

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

Who May Serve as PI:

Each proposal must have at least one eligible collaborator from the US and one eligible collaborator from the UK. The Lead PI MUST be a US-eligible collaborator. **Only US collaborators can be listed as a PI or a co-PI. The UK collaborator(s) MUST be listed as non-funded Senior Personnel.**

Normal UKRI (NERC) eligibility rules apply for UK-based team members. These can be found in Section C of the NERC Research Grant and Fellowship handbook (https://nerc.ukri.org/funding/application/howtoapply/forms/grantshandbook/).

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

For US Collaborators: An individual can only appear on 2 projects total in any one of the following roles: PI, co-PI, or Senior Personnel.

For UK Collaborators: A UK collaborator can only appear on 2 separate projects (and only as Senior Personnel).

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:**

    At the time of submission, all NSF Proposal & Award Policy & Procedures (PAPPG) guidelines apply.

    If a proposal is selected for funding by USDA NIFA, the PI will be instructed to submit the proposal to USDA with a new budget that conforms to USDA NIFA-specific indirect cost limits. If a proposal or part of a proposal is selected for funding by USDA NIFA, PIs will receive further instruction after the review process. When preparing budgets for NIFA funding, you should limit your request for the recovery of indirect costs to the lesser of your institution's official negotiated indirect cost rate or the equivalent of 30 percent of total Federal funds awarded. Indirect Cost Rates will be reviewed prior to award to ensure compliance with the indirect costs page on the NIFA website (see https://nifa.usda.gov/indirect-costs).

Normal UKRI (NERC) financial rules apply for the UK portion of the projects. These can be found in Section C of the NERC Research Grants and Fellowships Handbook (see https://nerc.ukri.org/funding/application/howtoapply/forms/grantshandbook/).

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

- **Full Proposal Target Date(s)**:

  May 15, 2019

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria apply.

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

Soils support economic prosperity and provide services that are essential for humanity. Soils are complex, living ecosystems containing billions of organisms that mediate a myriad of biological, chemical, and physical processes, including cycling carbon, nitrogen, phosphorous, and nutrients essential

for plant growth, food and fiber production, and removing contaminants from water. Soil ecosystems supply most of the antibiotics used to fight human diseases, control the movement of water and chemical substances between the Earth and its atmosphere, and act as source and storage media for nutrients and gases important to life, such as nitrogen, phosphorus, oxygen, carbon dioxide, and methane. Soil is also the foundation material for all structures not supported on rock, and is, by orders of magnitude, the most widely-used construction material in the world. Underground structures such as pipelines, tunnels, and basements must resist soil movement, corrosion, and groundwater seepage to perform properly. Historically, solid and liquid waste materials have been disposed of in the ground, often resulting in significant soil and groundwater pollution. Hundreds of billions of dollars have been spent in the U.S. to locate and treat soil and groundwater contamination from nuclear weapons production, deliberate and accidental chemical spills, pipeline ruptures, and many other sources of hazardous materials. We need to improve our understanding of how rapidly changing environmental factors govern microbial degradation of soil carbon, nitrogen, and phosphorous compounds in active soil layers and permafrost. Thus, as the Earth's population grows, we need a better understanding of the complex processes and problems of soil ecosystems that will continue to play a critical role in feeding the world and other important life support functions. As global demands rise for food, fibers and bioenergy, and as land degradation, driven by land use change, poor agricultural practices, contamination, and urbanization occurs, we require more from a diminishing soil resource. Thus, advancing our understanding of soil ecosystems and our capacity to manage this vital resource becomes increasingly urgent and important.

The National Science Foundation (NSF) Directorates for Engineering (ENG) and Geosciences (GEO), the Division of Integrative Organismal Systems in the Directorate for Biological Sciences (BIO/IOS), and the Division of Computer and Network Systems in the Directorate Computer and Information Science and Engineering (CISE/CNS), in collaboration with the US Department of Agriculture National Institute of Food and Agriculture (USDA NIFA) and the Natural Environment Research Council (NERC), the Engineering and Physical Sciences Research Council (EPSRC), the Biotechnology and Biological Sciences Research Council (BBSRC), and the Science and Technology Facilities Council (STFC) of United Kingdom Research and Innovation (UKRI) encourage convergent research that transforms existing capabilities in understanding dynamic, near-surface soil processes through advances in sensor systems and modeling. To accomplish this research, multiple disciplines must converge to produce novel sensors and/or sensing systems of multiple modalities that are adaptable to different environments and collect data and report on a wide range of chemical, biological and physical parameters. This type of approach will also be necessary to develop next generation soil models, wireless communication and cyber systems capabilities, and to grow a scientific community that is able to address complex problems through education and outreach. This program fosters collaboration among the partner agencies and the researchers they support by combining resources and funding for the most innovative and high-impact projects that address their respective missions.

II. PROGRAM DESCRIPTION

Existing knowledge of dynamic changes in soils is hampered by the inability to make site-specific measurements of key variables, *in situ,* and by the lack of integration among dynamic measurements of biological, chemical, and physical properties. Scientists and engineers use many geophysical, biochemical, and genomics methods to evaluate the physical, chemical, and biological properties of soil. For many applications, the current state of the art is to collect soil core samples at field sites and transport them to the laboratory for assessment. In addition, these researchers rely on modeling to predict soil states where and when measurements are not available. However, these models are based on limited data, made over limited timeframes, and use assumptions that are not reliable across spatially-variable landscapes, from tropical rainforests, to temperate farmland, to permafrost in Arctic, and to arid/semi-arid regions. For example, measurements are needed to better understand the potential influence of thawing permafrost on soil organism activity, the carbon cycle, and the fundamental biogeochemical and hydrological processes in areas that are particularly sensitive to changes in water and climate. Environmental changes in soil and warming permafrost also can have significant deleterious effects on civil infrastructure, resulting in damage or collapse of buildings and structures, rupture of pipelines, changes in ground motions from earthquakes, and slope instability. An essential challenge for researchers is to develop the underlying science and technologies for new sensing systems that advance our current understanding of spatially and temporally dynamic soil processes and organismal activity (microbial, plant, and animal) and to engineer systems for monitoring these processes. Accomplishing this goal will require major advances in 1) instrumentation for measuring changes of biological, chemical, and physical processes with minimal disturbance, 2) data transmission protocols in semantic data storage, and 3) models to predict key soil ecosystem variables. Recent advances in miniature, low powered, wireless sensors show considerable promise for long-term *in situ* measurements of soil physical, chemical, and biological variables. In particular, multi-functional sensors that can be embedded in soils are needed to ground-truth either geophysical or satellite measurements. However, many of these technological advances are occurring in other fields (e.g., health/medicine, energy, and transportation) and have not yet been widely explored for novel uses in soil. Likewise, advances in the data sciences, such as cloud computing, the semantic web, data mining, and the internet of things are being explored and advanced in other application areas, but they have been under-exploited for studying soil systems.

This solicitation encourages research concepts that integrate fundamental science and engineering knowledge in different disciplines in a convergent[i] approach with the aim of developing the next generation of sensors capable of *in-situ* measurement of dynamic soil biological, physical, and chemical variables. This solicitation also encourages the development of sensor systems that include all of the needed components to operate the sensor, communicate its signals, integrate them with other information, and perform analytics needed to produce observations at desired temporal and spatial scales in managed and unmanaged soils. No single measure can define soil health, and, indeed, there is no agreed definition of a "healthy soil". Thus, to assess, monitor, and deliver sustainable, resilient, and functional soils, we will require interdisciplinary expertise from the ecological, biological, atmospheric, biogeochemical, hydrological, and geological sciences and engineering and the use of established and new tools and technologies, or new and innovative applications of these tools and technologies. These sensor systems will also require associated advances in data transmission, ground penetration, data analytics, dynamic modeling, and visualization tools. If successful, this research will advance basic understanding of soil dynamics and will enable others to develop new ways of managing soils and natural resources. Furthermore, successful sensors will lead to advances and provide a deeper understanding of the interactions between soil and the life it supports. Advances in measurement systems for ecological, environmental, and climate research will also provide data for the development of new models. Results from innovative SitS science research will enable practitioners to use these newly-developed sensors, models, analytics, and time series data and make major contributions to the future of sustainable management, protection, and efficient or higher use of soil resources in both managed and natural ecosystems. In addition to reducing contamination of soil and water supplies and improving food security, this program addresses the National Academy of Engineering "Grand Challenge" of managing the Nitrogen cycle[ii], and the National Academy of Sciences (NAS) call for "Breakthroughs in Field-Deployable Sensors for Advancing Food and Agricultural Research"[iii]. Internationally, research from this solicitation will also address aspects of the United Nation's 2030 Agenda Sustainable Development Goals for Land Degradation Neutrality[iv], the Aichi Biodiversity Targets[v], and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) assessment programs[vi].

Research Priorities:

Each proposal must address **at least one** of the following priorities; systems approaches and attention to NSF's cross-cutting themes (described below) are particularly encouraged:

Develop novel sensors (including multifunctional sensors) or other materials for sensing soil biological, chemical, or physical characteristics to monitor soil health, soil-organism interactions, and changes in properties, and to address the need for inexpensive sensors that can operate for long time periods in highly variable conditions. Sensors that are not buried, or otherwise minimally invasive, are also considered if they can fill the soil sensing capacity needs. There may also be a role for data fusion of rapid, cheap soil-based sensors and remote sensing data to provide ground truthing and high-resolution spatial coverage of soil properties and change. Innovative manufacturing processes for such sensors are also included in this category. Ideally, sensors that will be placed in the ground should be placed with minimal disturbance, be bio-degradable, and have minimal impact on land use and land management. This may include novel methods for deployment, operation, and removal of new sensor systems as appropriate. Proposals with emphasis on sensor systems for measurement of soil properties that either cannot be measured or are difficult to measure, such as soil structure, and to develop non-intrusive real time monitoring of soil gas fluxes (O_2, CO_2, CH_4, NH_3, N_2O, N_2) at local (plot to field) and landscape scales are welcomed.

- Advance wireless communications and internet of things to collect and transmit data from sensors buried in soils over extended periods of time. For projects that focus on wireless systems, PIs must explain the existing constraints to wireless signal transmission of low power signals through soils, inadequacy of state-of-the-art solutions, and system approaches spanning circuits, signal processing, data fusion, and wireless networking aspects. Additionally, they must describe the approaches that will be researched to overcome those constraints, along with expected gains in data-transfer and power-consumption performance.
- Develop real-time cyber systems for collection, storage, and sharing of massive data volumes from many wireless sensors in soils with long-life operation capabilities, and potentially including innovative data analytics and visualization tools to enable quantitative data to be represented and interpreted over space and time.
- Advance our knowledge of signaling and interactions between the soil and the biological entities in it, as well as among the organisms. Examples include but are not limited to assessment of root exudates, microbial effectors, quorum sensors, nutrient flow and cycling, biofilms, etc.
- Advance our understanding of dynamic soil processes that operate at different temporal and spatial scales through quantitative predictive modeling that includes feedbacks and will enable a new generation of soil models for a range of purposes. This could include next-generation soil models of biological, chemical, and/or physical components that can make use of new sensing and data communications and data science capabilities that can describe dynamic interactions among soil biological, chemical, and physical processes at different temporal and spatial scales. Dynamic models that are holistic and cross interdisciplinary boundaries, e.g. biological, physical and chemical, to predict soil function are desirable. In addition, these models should incorporate feedbacks and changes to soils from drivers such as climate and land use change.

In addition, **all proposals must address the following**:

- All projects must engage and grow the scientific community's capabilities of addressing complex problems through education and outreach across disciplines using novel mechanisms. This priority could include, for example, undergraduate and graduate programs (undergraduate and graduate training programs will NOT be supported through UK portions of the projects), as well as short training programs for professionals on manufacturing, calibration, and operation of next generation sensor systems.
- Projects should include collaborators from more than one background to help define the intellectual merits of the research and the visions for its applications and broader impacts. These backgrounds can be, for example, in some combination of soil microbiology, chemistry, or physics, plant-soil interactions, engineers familiar with sensor development and deployment, engineers involved in research on properties for structural uses of soil, computer scientists, and biophysical modelers of soil biological, chemical, and physical components.

Cross Cutting Themes

Proposals that address topics of NSF's 10 Big Ideas, particularly "Understanding the Rules of Life"[vii], "Navigating the New Arctic"[viii], and "Harnessing the Data Revolution"[ix], are strongly encouraged. For those addressing "Understanding the Rules of Life", collaborators are encouraged to focus on sensing of soil-organism dynamics and interactions, inter-organism signals, root and microbial exudates, metabolic activity, etc. For proposals focused in the Arctic, investigators must demonstrate a clear understanding of the unique challenges associated with working in regions where winters are characterized by extreme and prolonged cold and high winds, and where soils experience significant freeze-thaw activity.

Applicants should also consider addressing topics central to the goal of sustainable agricultural systems including improving soil health through enhanced understanding of the physical and biogeochemical processes affecting the fluxes, fate and transport, transformation, and storage of the critical components of agroecosystems (including forest and range systems), as well as chemicals and agents that threaten them. Considerations for soil sensors in these managed systems include the extreme heterogeneity introduced by management and inputs, and the interplay between natural heterogeneity and the disturbance introduced by management options.

Other Considerations: Proposals that use current or planned data, samples, or assignable assets from NSF-, USDA NIFA-, and UKRI- supported activities, or those that enhance broader scientific infrastructure are encouraged. Where appropriate, investigators are encouraged to work in association with existing projects, observational networks (NEON), long-term ecological research sites (LTER), long term agricultural research sites (LTAR, ARS), or research centers, or testing and evaluation facilities, whether supported by NSF, UKRI, or other agencies, such as the US Environmental Protection Agency (USEPA), the United States Geological Survey (USGS), USDA NIFA, the USDA Agricultural Research Service (USDA ARS) or the National Oceanic and Atmospheric Administration (NOAA). In such proposals, the project description should make clear how the proposed work differs from and augments activities already supported. In all cases, however, proposals must clearly demonstrate how the research will develop fundamentally new knowledge and enhance theory. A letter stating the specifics of cooperation or support from the ongoing activity for the proposed project should be included as Supplementary Documents.

i. For more information on convergent research approaches, see "Convergence Research at NSF - https://www.nsf.gov/od/oia/convergence/index.jsp" " and the Dear Colleague Letter: Growing Convergence Research at NSF March 2018 - https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18058.
ii. For more information on the NAE Grand Challenge for Engineering to "Manage the Nitrogen Cycle", please see: http://www.engineeringchallenges.org/challenges/nitrogen.aspx.
National Academies of Sciences, Engineering, and Medicine. 2018. Science Breakthroughs to Advance Food and Agricultural Research by 2030. Washington, DC: The National Academies Press. https://www.nap.edu/catalog/25059/science-breakthroughs-to-advance-food-and-agricultural-research-by-2030.
iii. For more information on the UN Land Degradation Neutrality Goals, see: https://www.unccd.int/actions/achieving-land-degradation-neutrality.
iv. For more information on the Aichi Biodiversity Targets, See: https://www.cbd.int/sp/targets/.
v. For more information on the IPBES assessment program, please see: https://www.ipbes.net/assessment-reports.
vi. For information on "Understanding the Rules of Life", see https://www.nsf.gov/news/special_reports/big_ideas/life.jsp and https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18031.
vii. For information on "Navigating the New Artic", see https://www.nsf.gov/news/special_reports/big_ideas/arctic.jsp and https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18048.
viii. For more information on "Harnessing the Data Revolution", see https://www.nsf.gov/news/special_reports/big_ideas/harnessing.jsp and

III. AWARD INFORMATION

Projects will request three years of support with a total budget less than or equal to $800,000 per project for the US portion, and three years of support with a total budget less than or equal to £800,000 (at 80% full economic costs/FEC) per project for the UK portion.

Funding requests for the UK partner(s) cannot be included in the US budget request. The UK budget must be prepared as a separate supplementary document that only includes requested UK expenses. Funding requests from international partners in addition to the United Kingdom on this solicitation are independent of and not included in the total request from both the US budget and the UK budget.

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IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

Who May Serve as PI:

Each proposal must have at least one eligible collaborator from the US and one eligible collaborator from the UK. The Lead PI MUST be a US-eligible collaborator. **Only US collaborators can be listed as a PI or a co-PI. The UK collaborator(s) MUST be listed as non-funded Senior Personnel.**

Normal UKRI (NERC) eligibility rules apply for UK-based team members. These can be found in Section C of the NERC Research Grant and Fellowship handbook (https://nerc.ukri.org/funding/application/howtoapply/forms/grantshandbook/).

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

For US Collaborators: An individual can only appear on 2 projects total in any one of the following roles: PI, co-PI, or Senior Personnel.

For UK Collaborators: A UK collaborator can only appear on 2 separate projects (and only as Senior Personnel).

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) 292-7827 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) 292-7827 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) 292-7827 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 the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

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

The following instructions supplement or deviate from the guidance in the PAPPG and NSF Grants.gov Application Guide.

Please note: All materials must be submitted to NSF, and NSF will share all submitted materials with USDA NIFA and UKRI. **Please DO NOT submit the proposal through the normal JES submission system as this mechanism is not available for this call.**

For all proposals, there are specific instructions regarding the Cover Sheet, the "Project Description", the "Biographical Sketches", "Results from Prior NSF Support", and the Supplementary Documents.

Cover Sheet

1. Title: The proposal must have "SitS NSF-UKRI" in the title. Please note that, in the event the proposal is selected for funding by USDA NIFA, the title will be changed to add "USDA NIFA - UKRI" in the title at a later date.
2. All proposals must have an international dimension with the UK reported on the cover sheet. If there are other international dimensions beyond the UK, those extra countries involved should be identified as well.
3. Listing of UK collaborators: All UK collaborators should be listed as "non-funded" Senior Personnel. Therefore, they should NOT appear on the cover sheet.

Project Description

1. Proposals should clearly describe the work that will be accomplished by the entire team, including the UK partners.
2. Proposals must include an explicit statement of research questions being addressed in the proposed project, addressing advances in both soil ecosystem science and technological developments.
3. A successful SitS proposal should present a convergent research approach and address the following in the project description:
   - Describe the disciplines involved. Note that a successful proposal must propose research that could potentially be reviewed in at least TWO of the seven different NSF directorates (BIO, CISE, EHR, ENG, GEO, MPS, and SBE), or one NSF directorate and USDA NIFA.
   - A vision that is developed using a convergent process of technological and scientific advances enabled by the proposed research. The vision should relate to specific domains of research, including (but not limited to) increasing ability to monitor and understand key processes in the Arctic Tundra; Agricultural production systems and precision agriculture; Forest and rangeland ecosystems, "Understanding the Rules of Life", soil-organism interactions, inter-organism signals, root and microbial exudates, metabolic activity, and, evolution of soil organisms over short and long timescales; dynamic interactions between soil and organisms; advanced methods of soil penetration to place, move, and retrieve sensors with minimal disturbance; and advanced capabilities for monitoring and understanding environmental risks of soil and water contaminants.
   - Provide a clear statement of variables to be sensed and the technologies to be developed or evaluated for sensing them, and a justification for selecting these particular variables. Proposals should also identify the technology to be advanced in sensing, wireless communications, cyber systems, or modeling/data analytics.

   Thus, proposals must include the rationale for selecting target soil measurements, the importance of these measurements in advancing basic science, and a vision of how the innovative science could make major contributions to future sustainable management and protection of soil resources in managed and/or natural ecosystems. For projects that focus on wireless systems, PIs must explain the existing constraints to wireless signal transmission of low power signals through soils, inadequacy of state-of-the-art solutions, and system approaches spanning circuits, signal processing, and wireless networking aspects. Additionally, the PI(s) must describe how they will overcome those constraints, along with expected gains in result in improved data-transfer and power-consumption performance.

4. The Results from Prior NSF Support Section typically contained with the Project Description should be moved to the Supplementary Documents Section (see below) and must not exceed 4 pages total. UK collaborators are exempt from the Results from Prior NSF Support section requirement.

Biographical Sketches

All UK collaborative partners should be listed as "non-funded Senior Personnel" and should have a biographical Sketch in the appropriate section.

Budget

In addition to the US Budget and Budget Justification in the normal section, the UK budget and budget justification should be included as a supplementary document using the UK Budget Information form found at https://nerc.ukri.org/research/funded/programmes/soil/news/ao/ . The US budget and budget justification should ONLY include the costs for the US collaborators. The UK budget and budget justification should ONLY include the costs for the UK collaborators. Information for UK applicant requirements will be available to UK participants on the NERC website [see https://nerc.ukri.org/research/funded/programmes/soil/news/ao/].

Please note that both the US and UK budgets should include a budget to send at least 1 project participant (and at least one student for US projects for a total of at least 2 US participants) to a program workshop in Washington DC once in the first and third years of their 3-year project span, and once to the UK in the second year of their 3 year project span.

Current and Pending Support

This section must be filled out for all US PIs, co-PIs and Senior Personnel. All UK collaborative partners are exempt for this requirement unless they have funding from a US government organization. Otherwise, please list "None" or $0 if text is required for the UK collaborators.

Facilities, Equipment, and Other Resources

This section should contain descriptions of both US and UK facilities, equipment, and other resources.

SUPPLEMENTARY DOCUMENTS

Document 1: Researcher Mentoring Plan for US-supported postdoctoral scholars (if Applicable) (up to 1 page)

Proposals that request funding to support postdoctoral researchers at any of the participating US organizations must include a description of the disciplinary and cross-disciplinary mentoring activities that will be provided for such individuals. Only one single-page mentoring plan is allowed per proposal even if multiple postdoctoral researchers from different organizations are involved. Thus, the postdoctoral researcher mentoring plan will be an additional means of providing cross-disciplinary mentoring across organizations and the project as a whole.

The US Postdoctoral Researcher Mentoring Plan must be submitted under the specific tab indicated in Supplementary Materials

Document 2: Data Management Plan

This plan should describe issues related to information exchange, intellectual property rights, derived products, databases, software, model output, and materials sharing. For example, if the proposed activity is expected to result in community resources (such as databases or collections of materials and samples), the "Data Management Plan" should present a clear plan for sharing of these resources not only among the network participants, but also with the scientific community at large. The "Data Management Plan" should also address plans for determining authorship or proper attribution of credit for peer-reviewed or other publications, internet resources, etc. that may be expected to result from the activity. It should not exceed 2 pages.

Document 3: Other Supplementary Documents (one PDF containing the five documents described below, preferably in this order).

Please note that NO Biographical Sketches should appear in this section.

1. Results from Prior NSF Support (not to exceed 4 pages - change in placement from the PAPPG requirements)

    The Results from Prior NSF Support Section typically contained with the Project Description should be moved to the Supplementary Documents Section (see below) and must not exceed 4 pages total. UK collaborators are exempt from the Results from Prior NSF Support section requirement.

2. Project Management Plan (Addition to PAPPG Requirements): *Not to exceed 3 pages – must be in the "Supplementary Documents" Section of the Proposal.* At the beginning of the Management Plan, the research disciplines included in the proposal must be listed. Researchers from diverse fields are expected to work collaboratively and interdependently, creating shared visions, models, methods, and discoveries. Each proposal must contain a Management Plan that describes how the project will be managed across disciplines, institutions, and community entities. This plan should identify specific collaboration mechanisms that will enable cross-discipline and cross-sector integration of teams, and provide a timeline including principal tasks and associated interactions. Each proposal must provide a brief summary of expertise of the team members in the Management Plan. The plan must also address the specific roles and responsibilities of the collaborating PI, Co-PIs, other Senior Personnel, paid consultants, and stakeholder participants, and describe how tasks will be integrated over the course of the project.
3. Institutional Statement in Support of the Joint Submission from the UK partner organization: An institutional statement addressed to "SitS Program Officer" in support of the joint submission must be provided by each UK partner organization in the proposal submission. This statement should be in the form of a signed letter from an authorized institutional representative including the following text: "I confirm on behalf of [insert name or institution] that the US-UK Collaborative proposal between [insert name of lead agency PI and institution] and [insert UK PI and institution] is endorsed and has been submitted by [name of research office of UK organization/institution]." This letter must be included in the Supplementary Documents. *Please note that, if an international collaborator from a country in addition to the UK is also part of the proposal, then a similar letter is also required for that collaborator. However, that collaborator is NOT eligible for funds from NSF, USDA NIFA, or UKRI.*
4. Additional Letters of Collaboration: Proposers needing to document collaborative arrangements (confirmatory of cooperation on the project) or other types of commitments must submit letters of collaboration (as Supplementary Documents). All letters of collaboration must be included at the time of the proposal submission. Letters should confirm that the organization/individual agrees to the responsibilities identified in the project description and the "Management Plan". Letters of Collaboration that convey an excessive sense of enthusiasm for the project or highlight research team qualifications are not permitted. It should NOT be a letter of endorsement, but rather, a commitment to the participation as defined in the project description. Submission of a letter of collaboration is not the same as submitting a separately submitted collaborative proposal.
5. UK Budget and Budget Justification: The UK budget and budget justification must be included as a Supplementary Document. A detailed breakdown of funding requested from UKRI, using the UK Budget Form found at https://nerc.ukri.org/research/funded/programmes/soil/news/ao/), should be added to the proposal as a Supplementary Document. This document will be shared with UKRI to verify eligibility of costs requested. **Please note that UK collaborators should include a budget to send at least 1 (preferably more) project participants to a program workshop in Washington DC in the first and third years of their 3-year project span, and once to the UK in the second year of their 3-year project span.**

Other Considerations: Where appropriate in both the US and UK, investigators are encouraged to work in association with existing projects, observational networks (NEON), long-term ecological research sites (LTER), long term agricultural research sites (LTAR, ARS) or research centers, or testing and evaluation facilities, whether supported by NSF, UKRI, or other agencies, such as the US Environmental Protection Agency (EPA), the United States Geological Survey (USGS), USDA NIFA, USDA Agricultural Research Service (USDA ARS), or the National Oceanic and Atmospheric Administration (NOAA). In such proposals, the project description should make clear how the proposed work differs from and augments activities already supported. A letter stating the specifics of cooperation or support from the ongoing activity for the proposed project should be included as Supplementary Documents.

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. **All UK Senior Personnel must fill out this section as well as US PIs, Co-PIs, and Senior Personnel.**

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Indirect Cost (F&A) Limitations:

At the time of submission, all NSF Proposal & Award Policy & Procedures (PAPPG) guidelines apply.

If a proposal is selected for funding by USDA NIFA, the PI will be instructed to submit the proposal to USDA with a new budget that conforms to USDA NIFA-specific indirect cost limits. If a proposal or part of a proposal is selected for funding by USDA NIFA, PIs will receive further instruction after the review process. When preparing budgets for NIFA funding, you should limit your request for the recovery of indirect costs to the lesser of your institution's official negotiated indirect cost rate or the equivalent of 30 percent of total Federal funds awarded. Indirect Cost Rates will be reviewed prior to award to ensure compliance with the indirect costs page on the NIFA website (see https://nifa.usda.gov/indirect-costs).

Normal UKRI (NERC) financial rules apply for the UK portion of the projects. These can be found in Section C of the NERC Research Grants and Fellowships Handbook (see https://nerc.ukri.org/funding/application/howtoapply/forms/grantshandbook/).

Budget Preparation Instructions:

For all proposals, the US budgetary total must not exceed $800,000.00, and the UK portion must not exceed 800,000.00 (at 80% of full economic costs/FEC). Proposals submitted with budgets in excess of these limits will be "Returned Without Review (RWR)".

In addition to the US Budget and Budget Justification in the normal section, a detailed breakdown of funding requested from UKRI, using the UK Budget Information form found at https://nerc.ukri.org/research/funded/programmes/soil/news/ao/, should be added to the proposal as a Supplementary Document. This document will be shared with UKRI to verify eligibility of costs requested. The US budget and budget justification should ONLY include the costs for the US collaborators. The UK budget and budget justification should ONLY include the costs for the UK collaborators. **Please note that both the US and UK budgets should include a budget to send at least 1 project participants (and at least one student for US projects for a total of at least 2 US participants) to a program workshop in Washington DC once in the first and third years of their 3-year project span, and once to the UK in the second year of their 3 year project span.**

Please note: All materials must be submitted to NSF and must conform to NSF PAPPG guidelines (including budgetary/indirect cost considerations) at the time of submission. NSF will share all submitted materials with USDA NIFA and UKRI. If all or a portion of a submitted proposal is determined by NSF and USDA NIFA to be funded by USDA NIFA, the lead PI/organization or subawardee will be instructed to update those portions of the proposal that must conform to differing USDA guidelines. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency. If a proposal that contains a UK collaboration is determined by NSF, USDA NIFA, and UKRI to be funded, the UK PI will be instructed to submit the proposal to NERC through the Je-S system.

C. Due Dates

- **Full Proposal Target Date(s)**:

    May 15, 2019

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: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

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

Proposers that submitted via FastLane 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.

B. Review and Selection Process

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

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

All proposals will be assessed jointly by NSF, USDA NIFA and NERC/UKRI. Program Officers from all agencies will be involved in selecting ad hoc reviewers and panelists, operating a joint panel, and, following joint discussion of overall feasibility, settling on recommendations to their respective leadership.

NSF Process: 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.

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. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

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

USDA NIFA Process: Applicants selected for funding by USDA NIFA will be required to provide additional information in accordance with policies and procedures of the Agriculture and Food Research Initiative (AFRI) program. Applications selected for funding by USDA NIFA will be forwarded to the USDA NIFA Awards Management Division for award processing in accordance with the USDA NIFA procedures.

UKRI Process: For all proposals selected for funding, NERC, as the lead council within UKRI for this program, will provide instructions on how to officially submit a copy of the proposal to NERC for award processing of the UK portion of the collaboration. Applicants may be required to provide further information in accordance with the policies and procedures of NERC.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

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) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *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.

Special Award Conditions:

Additional award conditions apply.

Please note that at least 1 US AND 1 UK senior personnel (and at least one student for US projects for a total of at least 2 US participants) from each project is required to attend a program workshop in Washington DC in the first and third years of the 3-year project span. The travel to these workshops must be included in the proposal budget for both the US and the UK partners as described in the proposal preparation section.

USDA NIFA

Awards issued by USDA NIFA as a result of this solicitation will have designated the Automated Standard Applications for Payment System (ASAP), operated by the Department of Treasury's Bureau of the Fiscal Service, as the payment system for funds. For more information, see Award List.

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 USDA NIFA web page (see https://nifa.usda.gov/regulations-and-guidelines).

The USDA NIFA Federal Assistance Policy Guide(see https://nifa.usda.gov/policy-guide) is 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.

Other Requirements

USDA NIFA:

Delegation of Fiscal Responsibility

Unless the terms and conditions of the award state otherwise, awardees may not in whole or in part delegate or transfer to another person, institution, or organization the responsibility for use or expenditure of award funds.

Changes in Budget or Project Plans
In accordance with 2 CFR 200.308, awardees must request prior approval from NIFA for the following program or budget-related reasons:

    i. Change in the scope or the objective of the project or program (even if there is no associated budget revision requiring prior written approval).
    ii. Change in a key person specified in the application or the federal award.
    iii. The disengagement from the project for more than three months, or a 25 percent reduction in time devoted to the project, by the approved project director or principal investigator.
    iv. The inclusion, unless waived by the federal awarding agency, of costs that require prior approval in accordance with 2 CFR 200 Subpart E— Cost Principles of this part or 45 CFR Part 75 Appendix IX, "Principles for Determining Costs Applicable to Research and Development under Awards and Contracts with Hospitals," or 48 CFR Part 31, "Contract Cost Principles and Procedures," as applicable.
    v. The transfer of funds budgeted for participant support costs as defined in §200.75 Participant support costs to other categories of expense.
    vi. Unless described in the application and funded in the approved federal awards, the subawarding, transferring or contracting out of any work under a federal award, including fixed amount subawards as described in §200.332 Fixed amount subawards. This provision does not apply to the acquisition of supplies, material, equipment, or general support services.
    vii. Changes in the approved cost-sharing or matching provided by the non-federal entity.
    viii. The need arises for additional federal funds to complete the project.

The awardee will be subject to the terms and conditions identified in the award. See link to information about NIFA award terms: https://nifa.usda.gov/terms-and-conditions.

UKRI

The successful UK applicants to this programme will be funded by NERC as part of a programme with BBSRC, EPSRC and STFC. As such, the UK applicants will be required to comply with standard UKRI (NERC) terms and conditions in addition to any programme specific terms and conditions of

award.

C. Reporting Requirements

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

USDA NIFA:

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

Additional Reporting Requirements

- For awards funded by NSF, US PIs will be required to include descriptions of their project milestones and their data management activities in their annual reports. Data reporting should conform to current NSF data policy guidelines; PIs should consult with the PAPPG.
- For awards funded by USDA NIFA, reporting requirements will conform to those specified by USDA NIFA.
- For the US portion of projects that are funded by NSF and USDA NIFA, the annual report of the lead project in the collaborative must be resident at NSF and must include a description of the activities and milestones of the parts of the project that are funded by the other agencies.
- When the US portion of a project is funded by both agencies, the NSF-lead organizations should submit a unified annual report and the USDA NIFA funded portion of the project should include the NSF-unified annual report as part of its USDA NIFA annual report (see also FAQ).

UKRI

Standard reporting conditions are a requirement of UK supported awards. All Principal Investigators (for lead and component grants) are required to provide an annual update of information relating to the outputs, outcomes and impacts (referred to as research outcomes) that arise from their UKRI funded research. They are required to have a Researchfish account and to use the Researchfish system to provide these updates annually during the period of the awards and usually for five years after their awards have finished. Further information can be found in the Research Grants and Fellowships Handbook at https://nerc.ukri.org/funding/application/howtoapply/forms/grantshandbook/.

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:

- Brandi L. Schottel, National Science Foundation Directorate for Engineering / Division of Chemical, Bioengineering, Environmental, and Transport Systems, telephone: (703) 292-4798, email: bschotte@nsf.gov

- James W. Jones, National Science Foundation Directorate for Engineering / Division of Chemical, Bioengineering, Environmental, and Transport Systems, telephone: (703) 292-4458, email: jwjones@nsf.gov

- Enriqueta C. Barrera, National Science Foundation Directorate for Geosciences / Division of Earth Sciences, telephone: (703) 292-7780, email: ebarrera@nsf.gov

- Ann C. Von Lehmen, National Science Foundation Directorate for Computer and Information Science and Engineering / Division of Computer and Network Systems, telephone: (703) 292-4756, email: avonlehm@nsf.gov

- Irwin N. Forseth, National Science Foundation Directorate for Biological Sciences / Division of Integrative Organismal Systems, telephone: (703) 292-7862, email: iforseth@nsf.gov

- Nancy Cavallaro, National Program Leader, National Institute of Food and Agriculture, telephone: (202) 401-5176, email: ncavallaro@nifa.usda.gov

- Simon Kerley, Head of Research: Terrestrial Ecosystems, Natural Environment Research Council, telephone: +44 (0) 7590 443944, email:

simon.kerley@nerc.ukri.org

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.

All questions regarding proposal submissions should be directed to Sits at questions@nsf.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 http://www.grants.gov.

USDA NIFA requires a Felony Convictions or Tax Delinquent Status certification. Additional information will be provided prior to award if selected for funding.

Responsible and Ethical Conduct of Research: For information, link to Responsible and Ethical Conduct of Research.

The USDA NIFA authority for this solicitation is contained in section 2(b) of the Competitive, Special, and Facilities Research Grant Act (7 U.S.C. 450i(b)), of the Agriculture and Food Research Initiative (AFRI). AFRI authorizes the Secretary of Agriculture to award competitive grants for fundamental and applied research, extension, and education to address food and agricultural sciences. AFRI awards are subject to the NIFA regulations found at 7 CFR Part 3430. NIFA's authority to participate in the issuance of a joint RFA is 7 U.S.C. § 3319b.

About the National Institute of Food and Agriculture

The National Institute of Food and Agriculture (NIFA) is an agency within the U.S. Department of Agriculture (USDA), part of the executive branch of the Federal Government. Congress created NIFA through the Food, Conservation, and Energy Act of 2008. NIFA replaced the former Cooperative State Research, Education, and Extension Service (CSREES), which had been in existence since 1994. NIFA's unique mission is to advance knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations. NIFA doesn't perform actual research, education, and extension but rather helps fund it at the state and local level and provides program leadership in these areas. Through grants offered by NIFA, the USDA enables researchers throughout the United States to solve problems critical to our farmers, consumers, and communities. NIFA is the USDA's major extramural research agency, funding individuals, institutions, and public, private, and non-profit organizations. NIFA's education programs supports and promotes teaching excellence, enhances academic quality, and develops tomorrow's scientific and professional workforce. In cooperation with public institutions, private sector partners, and the Land-Grant University System, NIFA provides national leadership to address critical educational issues. NIFA's extension projects deliver science-based knowledge and informal educational programs to people, enabling them to make practical decisions.

NIFA Web site:

https://www.nifa.usda.gov/
Phone: (202) 720-4423

Street Address:

National Institute of Food and Agriculture
Waterfront Centre
800 9th St. SW., Washington, DC 20024

Mailing Address:

United States Department of Agriculture
National Institute of Food and Agriculture
1400 Independence Avenue SW., Stop 2201
Washington, DC 20250-2201

About UKRI

UK Research and Innovation is a new body which works in partnership with universities, research organisations, businesses,

charities, and government to create the best possible environment for research and innovation to flourish. It aims to maximise the contribution of each of our component parts, working individually and collectively. It works with our many partners to benefit everyone through knowledge, talent and ideas.

Operating across the whole of the UK with a combined budget of more than £6 billion, UK Research and Innovation brings together the seven Research Councils, Innovate UK and a new organisation, Research England

About the UKRI Natural Environment Research Council

NERC is the driving force of investment in environmental science in the UK. NERC advances the frontier of environmental science by commissioning new research, infrastructure and training that delivers valuable scientific breakthroughs to help solve major issues and bring benefits to the UK, such as affordable clean energy, air pollution, and resilience of our infrastructure.

About the UKRI Engineering and Physical Sciences Research Council

EPSRC is the main funding agency for engineering and physical sciences research. Their portfolio covers a vast range of fields from healthcare technologies to structural engineering, manufacturing to mathematics, advanced materials to chemistry.

About the UKRI Biotechnology and Biological Sciences Research Council

BBSRC invests in world-class bioscience research and training. Their research is helping society to meet major challenges, including food security, green energy and healthier, longer lives and underpinning important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

About the UKRI Science and Technologies Facilities Council

STFC is a world-leading multi-disciplinary science organisation. Their research seeks to understand the Universe from the largest astronomical scales to the tiniest constituents of matter, yet creates impact on a very tangible, human scale.

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**   (703) 292-5111
>   (NSF Information Center)**:**
>
> - **TDD (for the hearing-impaired):**   (703) 292-5090
>
> - **To Order Publications or Forms:**
>
>   Send an e-mail to: nsfpubs@nsf.gov
>
>   or telephone: (703) 292-7827

- **To Locate NSF Employees:**   (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

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

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Alexandria, VA 22314

X. APPENDIX

SitS Frequently Asked Questions (FAQs)

1. What is meant by interdisciplinary SitS research?

Proposals are expected to document that the proposed research is truly interdisciplinary and that the respective components are fully integrated and of high relevance for the successful execution of the proposed project. Plans for integration of the respective research components must be clearly described in the proposal and reinforced within the project management plan.

2. What is meant by "Convergent Research"?

Convergence research is a means of solving vexing research problems, in particular, complex problems focusing on societal needs. It entails integrating knowledge, methods, and expertise from different disciplines and forming novel frameworks to catalyze scientific discovery and innovation. Convergence research is related to other forms of research that span disciplines - *transdisciplinarity, interdisciplinarity, and multidisciplinarity*. It is the closest to transdisciplinary research which was historically viewed as the pinnacle of evolutionary integration across disciplines. For more information on Convergence Research at NSF, please see https://www.nsf.gov/od/oia/convergence/index.jsp and https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18058.

3. What is the preferred contribution level that should be provided by each project participant/discipline?

There are no specific requirements for the relative distribution of disciplinary expertise, yet each component should be included at a level commensurate with the problem scope. The project team should be developed in accordance with the specific project objectives. Multidisciplinary integrative research requires multidisciplinary expertise. The appropriateness of the research team's disciplinary composition and expertise will be factors in the merit review of the proposals.

4. Is there a limit to how large my team can be? Likewise, is there a minimum size?

The team size depends on the overall scope of the project, but should reflect budgetary and practical constraints. There are no specific limits on the maximum number of participants, but each project should include at least one US PI and one UK non-funded Senior Personnel.

5. How many proposal submissions can I be on? For example, is it feasible to serve as the PI on one proposal, a co-PI on a second proposal, and an unpaid consultant on a third proposal?

For this solicitation, an individual from an eligible US organization may be PI, co-PI, Senior Personnel, or Consultant on 2 proposals. UK investigators may only be involved (listed only as Senior Personnel) on 2 proposals submitted to this call.

6. Can an SitS project involve international research and/or involve international collaborators beyond the required UK collaborators?

The challenges and complexities of SitS topics are global in scope. Therefore, international collaborations beyond the US-UK collaboration are encouraged where appropriate. Non-UK international collaborators, however, should seek support from non-NSF and non-UKRI sources. Funding

guidelines for involving international collaborators (see Budgetary Information section of the SitS solicitation) allow only the following expenses to be included in the NSF budget: 1) Travel expenses for U.S. scientists and students participating in travel integral to the project; 2) Limited project-related expenses for non-UK international partners to engage in research activities while in the United States as project participants; 3) costs for specific services provided by a non-UK international partner that are essential to the success of the project and cannot be provided by a U.S. person or organization or by the UK collaborator; and 4) project-related expenses for U.S. participants to engage in research activities while abroad. Although services listed under (3) above could be provided by a researcher from a developed country with its own sources of research funding, such a request that includes more than minimal and truly essential expenses is unlikely to review well. The NSF proposal may include limited funds for services that are essential to the success of the research project, only if those services could not be provided by a US-based person or organization. "Limited" is not specifically defined, but remember that NSF is not an aid agency. Your proposal can include requests for essential services that would be provided by a researcher from a developed country with its own sources of research funding; however, such requests tend not to review as well.

7. I would like to include undergraduate students in the US portion of my project. How do I incorporate a Research Experiences for Undergraduates (REU) experience within my proposal?

Incorporation of an REU experience within a proposal is an effective mechanism to integrate undergraduate educational activities into a research project. The Research Experiences for Undergraduates (REU) solicitation (NSF 13-542) notes that support for undergraduate students involved in carrying out research under NSF awards should be included as part of the research proposal itself instead of as a post-award supplement to the research proposal. Please consult the REU solicitation for further details.

8. My international collaborator in addition to my required UK collaborator is applying for funding from her/his own country's research funding agency. How will this affect the success of my proposal?

International collaborations beyond the required US-UK collaboration in this solicitation are encouraged. We appreciate that it is hard to synchronize funding with the limited opportunities for co-funding beyond this US-UK collaboration requirement. You should describe the research that your non-UK international collaborator would do and how it improves the intellectual merit and broader impacts of your proposed efforts. However, since your non-UK collaborator's funding is not guaranteed, it would be best to ensure that their research effort is not essential for your project to be successful. For instance, it may be preferable to rely on existing data or analyses that your non-UK international collaborator can do without additional funding. You should explain that if your non-UK international collaborator does receive funding, your collaborative efforts would go further, even though your efforts would not be fully integrated. If your non-UK international collaborator efforts are required for your research to be successful and they do not already have funding, your proposal is unlikely to review well.

9. This seems to be a very complicated solicitation with many required parts and pieces. Is there a checklist to ensure I have submitted all the necessary parts?

Yes. We recommend starting the upload and submission process early and referring to the checklist provided below.

SitS Proposal Checklist

A. Cover Sheet; title must include "SitS NSF UKRI:". All proposals should have an international dimension with the UK reported on the cover sheet. If there are further international dimensions beyond the UK, those extra countries involved should be reported on the cover sheet. All UK collaborators should be listed as "non-funded" Senior Personnel. Do NOT list UK collaborators as PIs or co-PIs.

B. Project Description (See PAPPG – Note change: "Results from Prior NSF Support" is NOT included in the 15-page limit for this solicitation). The project description should be fully integrated and present the US and UK portions in one 15-page description. Please refer to Section V.A. "Proposal Preparation Instructions" in this solicitation for further solicitation-specific requirements of the project description.

C. Biographical Sketch(es) (See PAPPG). Please note that UK Collaborators must be listed as non-funded Senior Personnel. This should allow the placement of their Biographical Sketches in the appropriate sections. No biographical sketches should appear in the Supplementary Documents.

D. Proposal Budget (See PAPPG. Please note that all proposal budgets MUST comply with NSF policy at the due date). Please note that both the US and UK budgets should include a budget to send at least 1 project participants (and at least one student for US projects for a total of at least 2 US participants) to a program workshop in Washington DC once in the first and third years of their 3-year project span, and once to the UK in the second year of their 3 year project span. Note that the US budget and budget justification should only include costs for the US collaborators and that the UK budget and budget justification should only include costs for the UK collaborators. The US budget and budget justification should be included in the normal "Budget and Budget Justification" section of the proposal. The UK budget and budget justification should be included in the Supplementary Documents section of the proposal using the UK Budget Form found at https://nerc.ukri.org/funding/available/researchgrants/international/uk-budget-form/.

E. Current and Pending Support (for all US PIs, Co-PIs, and Senior Personnel) at a US organization. All UK collaborative partners are exempt for this requirement unless they have funding from a US government organization. Otherwise, please list "None" or $0 if text is required for the UK collaborators– See PAPPG).

F. Facilities, Equipment, and Other Resources - This section should contain descriptions of both US and UK facilities, equipment, and other resources.

G. Supplementary Documents

H. Data Management Plan (See PAPPG)

I. Postdoctoral Researcher Mentoring Plan for US postdocs (if applicable – see PAPPG)

J. Other Supplementary Documents

- Results from Prior NSF Support (Previously this was in the Project Description – it has been moved to this section for this solicitation only). This is only a requirement for US collaborators.
- Project Management Plan (3-page limit-addition for this solicitation).
- Institution Statement(s) of support from UK collaborator institutions.
- Additional (if needed) letters of Collaboration
- UK Budget and Budget Justification

K. Single Copy Documents (1 separate PDF file):

Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found on the Collaborators and Other Affiliations Information website. This should be filled out for all US and UK collaborators. Please see the COA website for updated guidance at https://www.nsf.gov/bfa/dias/policy/coa.jsp.

9. I see a deadline for submission is indicated in this solicitation. Does this deadline mean I can submit 2 proposals to this solicitation up until 5 pm (local time) on that date?

Yes. You are only able to submit proposals up to the deadline, with the local time designation coinciding with the local time of the lead US institution. Please note that proposals will not be accepted after the deadline. Starting the submission process early is strongly encouraged to ensure that you meet the deadline.

10. I am not an engineer and I see that I have to submit my project to the ENG Directorate. Is that correct?

Yes. For administrative purposes only, the proposals are being directed to ENG. ALL proposals will be subject to review, evaluation, and assessment by ALL participating NSF Directorates/Divisions, USDA NIFA, and UKRI.

11. Can I submit the same proposal to other programs or solicitations at NSF?

No. NSF prohibits PIs from submitting the same or a substantially similar proposal to more than one program or solicitation at NSF. Please be aware that submission of duplicate or substantially similar proposals concurrently for review by more than one program at NSF without prior NSF approval will result in the return of the redundant proposals.

12. Can I obtain a waiver of the page limitation for the project description if my project is large and complex, or if my project includes multiple organizations?

No. All proposals must adhere to the page limit given in the solicitation. Note that "Results from Prior NSF Support" has been moved to "Supplementary Documents" for this solicitation.

13. Do all proposals require a Data Management Plan?

All proposals are required to have a Data Management Plan (Supplementary Document). The proposal must include a section that describes data and model sharing plans (in the Data Management Plan). Please note that the supplementary documents should not repeat the information in the body of the proposal, but provide concise information as defined in the NSF PAPPG and in the Proposal Preparation Instructions section of the SitS solicitation. Please note that Data Management Plan will be included in the merit review of the proposal.

14. Do all proposals require a Project Management Plan?

Yes. All proposals submitted are required to have a Project Management Plan. This plan (up to 3 pages long) should appear in the Supplementary Documents as described in the proposal preparation section of this solicitation.

15. The solicitation requires a Collaborators and Other Affiliations (COA) information for US AND UK Personnel. How do I make sure I can fill out the COA information for the UK Personnel?

Collaborators & Other Affiliations (COA) information is seen by NSF ONLY (and not the reviewers). To make sure the UK collaborators also can fill out their own information, they must be listed as Senior Personnel on the cover page of the proposal. This addition will allow their information to be included properly in the COA section of the proposal. COA information specified in the PAPPG should be submitted using the instructions and spreadsheet template found on the Collaborators and Other Affiliations Information website at https://www.nsf.gov/bfa/dias/policy/coa.jsp. Please see the COA website for updated guidance.

16. I submitted my proposal to NSF and the US portion of my project was chosen for funding by USDA NIFA. What will I need to do to get my award?

For proposals selected for funding by USDA NIFA, the US PIs will be asked to withdraw their proposal from NSF and resubmit it to USDA NIFA in accordance with instructions given by the cognizant NIFA Program Officer. You will be personally contacted by this program office and provided with detailed instructions on how to resubmit your proposal to USDA NIFA (such as changing the title to include "USDA NIFA-UKRI" and the budgetary indirect costs). Your proposal will not need to compete again, as it has already been reviewed through the joint NSF/USDA NIFA INFEWS SitS process detailed in this solicitation. Project funds will be dispersed to your organization through the Automated Standard Applications for Payment Systems (ASAP), operated by the Department of Treasury's Financial Management Service. For more information see http://www.nifa.usda.gov/business/method_of_payment.html.

17. I am a UK collaborator listed on a proposal submitted to NSF, and USDA NIFA and/or NSF has decided to fund the US portion of my project. What will I need to do to get my award?

For proposals selected for funding by USDA NIFA and NSF, the UK collaborator(s), listed as Senior Personnel on the original proposal to NSF, will be asked to submit a copy of the proposal to NERC in accordance with instructions given by the cognizant NERC Program Officer. You will be personally contacted by this program office and provided with detailed instructions on how to submit this proposal to NERC. Your proposal will not need to compete again, as it has already been reviewed through the joint NSF/USDA NIFA/UKRI SitS process detailed in this solicitation.

18. My proposal was selected for award. What are the additions/differences for the post-award management and post-award activities, such as the planned PI/project conferences/workshops, of this project?

Post award management will be done jointly with NSF. All PI meetings will be held jointly by NSF, USDA NIFA, and UKRI. All projects funded by USDA NIFA will need to submit their project reports through the USDA NIFA reporting system. When projects are jointly funded through NSF and USDA NIFA, they should submit a unified annual report that is a summary of the outcomes, impacts, and progress of the entire project. Reports should be drafted by the team, but will need to be submitted to both NSF and USDA NIFA to meet the federal grant reporting standards of each agency. A similar report can be submitted to the reporting systems of both agencies to present a unified annual report. The UK Portion will be required to submit reports through Researchfish as part of standard reporting requirements.