BioFoundries to Enable Access to Infrastructure and Resources for Advancing Modern Biology and Biotechnology (BioFoundries)

PROGRAM SOLICITATION
NSF 23-585

National Science Foundation

Directorate for Biological Sciences

Directorate for Computer and Information Science and Engineering

Directorate for Engineering

Directorate for Geosciences

Directorate for Mathematical and Physical Sciences

Directorate for Social, Behavioral and Economic Sciences

Directorate for STEM Education

Directorate for Technology, Innovation and Partnerships

Office of Integrative Activities

Office of International Science and Engineering

Letter of Intent Due Date(s) *(required)* (due by 5 p.m. submitter's local time):

August 01, 2023

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

October 02, 2023

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation should be submitted in accordance with the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) that is in effect for the relevant due date to which the proposal is being submitted. The NSF PAPPG is regularly revised and it is the responsibility of the proposer to ensure that the proposal meets the requirements specified in this solicitation and the applicable version of the PAPPG. Submitting a proposal prior to a specified deadline does not negate this requirement.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

BioFoundries to Enable Access to Infrastructure and Resources for Advancing Modern Biology and Biotechnology (BioFoundries)

Synopsis of Program:

Grand challenge questions requiring a deeper understanding of biological systems and technologies are as diverse as life itself. Understanding the complexity of living systems and their interactions with human-derived products and processes, ensuring the safe, ethical and equitable access to and co-generation of knowledge and products, requires the sustained development of technologies, sophisticated instrumentation, workflow pipelines and their automation, and advanced computing that are beyond the capabilities found in the laboratories of individual investigators. Broad access to these tools, workflows, processes, and knowledge bases in a facility that is capable of bespoke design and process scale-up, in response to user needs, is essential for addressing grand challenges and translating the knowledge created into applications for the bioeconomy, to meet societal and national needs.

BioFoundries is an infrastructure program from the National Science Foundation (NSF) that is designed to accelerate advances in the biological sciences, chemical biology, biotechnology, and bioengineering via access to modern infrastructure, technology, and capacity. BioFoundries will provide the intellectual, technical, digital, and physical frameworks needed for tight integration of technology innovations and

applications with foundational interdisciplinary research and training, by:

1. serving as access points for new biological technologies, workflows, processes, automations, and knowledge-bases to enable transformative discoveries;
2. catalyzing new innovations and transformative discoveries by supporting in-house and external user-initiated research programs that take full advantage of technological and methodological advances;
3. continuing to develop novel technologies, workflows, processes, automations, and knowledge-bases that are both forward-looking and user-responsive;
4. increasing the reproducibility of life science discoveries and data and knowledge sharing capabilities;
5. training the next generation of the scientific workforce; and
6. facilitating pathways to translation.

Leveraging lessons learned from existing national and international biofoundries, NSF encourages researchers to consider a diversity of models (centralized, distributed, consortium) in the design and implementation of BioFoundries. Each BioFoundry should enclose a scientific ecosystem, that includes in-house research scientists across all relevant disciplines supported by NSF, technical staff including cyberinfrastructure experts, external users, and other contributors who, collectively, form a community of practitioners and share tools, reagents, workflows, software, samples, and data. Knowledge sharing should be a central tenet, designed to strengthen collaborations among researchers and enable them to work in new ways and to foster new modalities of research and education/training, for the purpose of accelerating discovery and advancing development. BioFoundries should promote diversity, equity, inclusion, and accessibility in their in-house programs and external user programs. BioFoundries should also promote new avenues for translating such knowledge and technology broadly in ways that benefit society.

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.

- Sridhar Raghavachari, Program Director, BIO/DBI, telephone: (703) 292-4845, email: sraghava@nsf.gov
- Anthony G. Garza, Program Director, BIO/MCB, telephone: (703) 292-8440, email: aggarza@nsf.gov
- Steven W. Peretti, Program Director, ENG/CBET, telephone: (703) 292-4201, email: speretti@nsf.gov
- Laurel C. Kuxhaus, Program Director, ENG-CMMI, telephone: (703) 292-4465, email: lkuxhaus@nsf.gov
- Mitra Basu, Program Director, CISE/CCF, telephone: (703) 292-8649, email: mbasu@nsf.gov
- Vladimir Pavlovic, Program Director, CISE/IIS, telephone: (703) 292-8318, email: vpavlovi@nsf.gov
- Gregory Collins, Program Director, MPS/CHE, telephone: (703) 292-7064, email: grcollin@nsf.gov
- Z. C. Ying, Program Director, MPS/DMR, telephone: (703) 292-8428, email: cying@nsf.gov
- Ruth M. Shuman, Program Director, TIP/TI, telephone: (703) 292-2160, email: rshuman@nsf.gov
- Alberto Perez-Huerta, Program Director, GEO/EAR, telephone: 703 292 8500, email: aperezhu@nsf.gov
- Lee D. Walker, Program Director, SBE/SES, telephone: (703) 292-7174, email: lwalker@nsf.gov
- Dwight Kravitz, Program Director, SBE/BCS, telephone: (703) 292-4502, email: dkravitz@nsf.gov
- John-David Swanson, Program Director, OD/OIA, telephone: (703) 292-2898, email: jswanson@nsf.gov

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- STEM Education
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)
- 47.084 --- NSF Technology, Innovation and Partnerships

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 2 to 4

The number of awards will depend on the availability of funds and the quality of the proposals.

Anticipated Funding Amount: $52,000,000 to $72,000,000

Awards totaling $15,000,000 to $24,000,000 over a six-year period are anticipated. The proposed budget must be commensurate with the scope of the project and thoroughly justified in the proposal. BioFoundries funding will be provided yearly. Pending availability of funds, it is anticipated that $37,000,000 will be available in Fiscal Year 2024.

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds and the quality or responsiveness of proposals received in response to this solicitation.

Awards will be made via cooperative agreements. Pending availability of funds, NSF anticipates that the initial ramp-up period (Years 1 and 2) will incur higher costs due to the need for equipment purchases and /or facility commissioning and lower personnel costs in the absence of major equipment, and proposed budgets should reflect this.

Proposals Involving Multiple Organizations. Of the two types of collaborative proposal formats described in the PAPPG, this solicitation allows only a single proposal submission with subawards administered by the lead organization (PAPPG Chapter II.E.3.a). The requirement for a single organization to submit the proposal is meant to facilitate effective coordination among participating organizations and to avoid difficulties that ensue in funded projects when individuals change organizations and/or cease to fulfill project responsibilities.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Not-for-profit, non-degree-granting domestic U.S. organizations, acting on behalf of their employees, for example (but not limited to) independent science centers, observatories, research laboratories and similar organizations that are directly associated with the Nation's research activities. These organizations must have an independent, permanent administrative organization (e.g., a sponsored projects office) located in the United States, its territories, or possessions, and have 501(c)(3) tax status.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

One (1) per organization as lead institution.

Limit on Number of Proposals per PI or co-PI: 1

Individuals may appear as Senior Personnel (Principal Investigator/Project Director, co-PI, and other faculty or equivalent with biographical sketches included in the proposal even though their names may not be listed on the proposal Cover Sheet) on only one proposal.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**

  - 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:**

  Not Applicable

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

- **Letter of Intent Due Date(s)** *(required)* (due by 5 p.m. submitter's local time):

  August 01, 2023

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

  October 02, 2023

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

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

Reporting Requirements:

Standard NSF reporting requirements apply.

TABLE OF CONTENTS

I. INTRODUCTION

Grand challenge questions requiring a deeper understanding of biological systems and technologies are as diverse as life itself. Understanding the complexity of living systems and their interaction with human-derived products and processes, ensuring safe, ethical and equitable access to and co-generation of knowledge and products, requires the sustained development of technologies, sophisticated instrumentation, workflow pipelines and their automation, and advanced computing that are beyond the capabilities found in the laboratories of individual investigators. Broad access to these tools, workflows, processes, and knowledge bases in a facility that is capable of bespoke design and process scale-up, in response to user needs, is essential for addressing grand challenges and translating the knowledge created into applications for the bioeconomy, to meet societal and national needs.

Recognizing this gap, NSF is establishing the BioFoundries Program. NSF envisions its BioFoundries serving both as user facilities and as innovation hubs for cutting-edge, multidisciplinary research with the important role of democratizing access to the tools of modern biology and biotechnology for the purposes of advancing scientific discoveries and translating those discoveries to address pressing societal challenges. A BioFoundry is an integrated facility that combines biological, chemical biology, and engineering biology systems and tools with automation, high throughput measurement, integrated data acquisition and analysis, and artificial intelligence (AI) and machine learning to enable feedback loops that facilitate progressive end-to-end cycles of design, build, test, and learn. In addition to providing broad access, a BioFoundry develops innovative (bio)technologies, invents new processes and workflows, integrates advanced computation, and creates reproducible results and shareable knowledge-bases to accelerate the design-build-test-learn pipeline from basic research to translation. By applying the same streamlining and automation principles that continue to revolutionize manufacturing, BioFoundries can operate with speed and at scales not possible in individual laboratories or typical university core facilities.

The NSF BioFoundries Program will address a critical need for national infrastructure to support biotechnology and the bioeconomy, which has been highlighted by recent publications[1,2], workshop reports[3,4,5], white papers[6,7], the U.S. White House Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy[8], and the ensuing reports on Bold Goals for U.S. Biotechnology and Biomanufacturing[9]. The BioFoundries Program also aligns with, and follows naturally from, NSF's investments in diverse areas of biological sciences, chemical biology, biotechnology and bioengineering through programs such as: Enabling Discovery through Genomic Tools; NeuroNex; Plant Genome Research Program; Dimensions of Biodiversity (now Biodiversity on a Changing Planet); Organismal Response to Climate Change; Future Manufacturing; Cyber-Physical Systems; Smart Health and Biomedical Research in the Era of Artificial Intelligence; Foundations of Emerging Technologies; Molecular Foundations of Biotechnology; Reproducible Cells and Organoids via Directed Differentiation Encoding; Accelerating Innovations in Biomanufacturing Approaches through Collaboration Between NSF and the DOE BETO funding Agile Biofoundry and others. The foundational or use-inspired scientific research drivers for NSF BioFoundries could leverage these prior investments or address any other field of science and engineering supported by NSF.

BioFoundries are intended to empower the research community by providing the infrastructure needed to match new technologies to specific research drivers and facilitate transformative discoveries through cutting-edge research as well as broadening access, training, *de facto* standardization, centralization, and integration of data and technologies. By providing this infrastructure at scale **with broad opportunity for access**, each BioFoundry would also offer research and training opportunities for a diversity of institutions, including R1 and non-R1 research universities, primarily undergraduate and minority-serving institutions, and institutions in EPSCoR jurisdictions, and increase the capacity of a scientific workforce prepared to meet the challenges of the 21st century and improve the bioeconomy. In short, NSF envisions BioFoundries embodying Sydney Brenner's famous assertion that "*Progress in science depends on new techniques, new*

discoveries, and new ideas, probably in that order."

[1] Holowko MB, Frow EK, Reid JC, Rourke M, Vickers CE. Building a biofoundry. Synthetic Biology (2021). Link.

[2] Vickers CE and Freemont PS. Pandemic preparedness: synthetic biology and publicly funded biofoundries can rapidly accelerate response time. Nat Commun (2022). Link.

[3] World without Waste: A Circular Bioeconomy. Link.

[4] Feeding the Planet Sustainably. Link.

[5] Building a Biotechnology Innovation Ecosystem to Mitigate Climate Change. Link.

[6] Hodgson A, Alper J, and Maxon ME. The U.S. Bioeconomy: Charting a Course for a Resilient and Competitive Future. New York, New York: Schmidt Futures (2022). Link.

[7] Engineering Biology Research Consortium. EBRC Policy Papers in Response to the 2022 Bioeconomy Executive Order (2022). Link.

[8] Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy. Link.

[9] Bold Goals for U.S. Biotechnology and Biomanufacturing: Harnessing Research and Development to Further Societal Goals. Link.

II. PROGRAM DESCRIPTION

The goal of this solicitation is to support the establishment of BioFoundries that focus on the innovation pipeline and research, while ensuring broad access to the research resources, training, education, and outreach to catalyze our understanding of biological or bio-engineered systems and to support the design-build-test-learn pipeline for rapid translation of basic discoveries into applications. The research must aim to integrate advances in modern biology, chemical biology, biotechnology, and related fields with innovations in automation, high-end measurement infrastructure, nanotechnology, micro-fabrication, integrated testing and data acquisition, and AI-enabled analysis and automation of the scientific discovery process. The user-facing activities of the BioFoundry must ensure that these advances are accessible to the widest possible scientific community. A desirable outcome of the BioFoundry is to establish the standardization of instrumentation, data, and scientific practices that will make possible the integration of data from multiple sources/databases and allow the construction of data analysis pipelines using heterogeneous software data analysis and AI tools that communicate through standard data structures. Ultimately the BioFoundries should aspire to support open collaborations among scientists.

BioFoundries are expected to include mechanisms and resources to ensure reproducibility of results and the ability to share data in both human- and machine-usable formats. BioFoundries should address the issue of reproducibility through verifiable algorithmic approaches to build trust and confidence of the research as well as user community and by providing repositories of data, tools, and algorithms that would allow outside groups to reproduce the scientific results obtained.

The research supported by BioFoundries may follow from the work supported by previous or existing NSF programs, or it could represent an entirely new direction. A key feature of the BioFoundries should be the deep integration of advanced discovery, technological innovation, knowledge sharing, and collaborations to open new avenues for translating results from basic research to societally beneficial outcomes. Additional information on the research and technology components of the BioFoundries can be found in the Proposal Preparation section of this solicitation.

BioFoundries are envisioned to combine characteristics of user facilities and research centers in a scientific ecosystem that includes:

- A user facility that provides strategic technical capacity and infrastructure, resources, samples, workflows, and data, in a manner that is open and responsive to a diverse community of external researchers at various institutions and that fosters the creation of standards for the above;
- Multidisciplinary research teams and technology development teams that conduct in-house research on a focused topic central to the BioFoundry theme, while simultaneously pushing the technical state of the art to develop next-generation instrumentation, experimental and computational methods, standardization and validation processes, workflows and automations, and advancing the capabilities of existing tools in concert with the in-house research teams and the external user community. Such research and technology development may span any aspect of biological and biotechnology domains supported by the NSF.
- Programs for training the next generation of researchers; and
- Activities that permit the BioFoundries to serve as nexus points for academic/industry collaborations and partnerships to enable pathways to translation.

NSF is committed to the inclusion of all people and institutions in the research enterprise. To be competitive, proposers should leverage the full spectrum of diverse talent that the society has to offer.. NSF urges proposers to engage institutions across diverse geographies and types in meaningful and substantive partnerships to ensure that the cohorts of users and trainees involved in this program are broad, diverse, and inclusive, reflective of the Nation's demography and geography. The program recognizes that in the specific areas of entrepreneurship and technology transfer, several groups are underrepresented and/or under-served. The challenges and barriers for these communities may include limited network access to critical decision-makers, lack of funding, academic incentives, conscious and unconscious bias, and limited availability of mentors. Therefore, one component of building a diverse and inclusive cohort is to ensure that the leadership and management of the project includes robust participation of individuals from groups who have remained underrepresented and/or under-served in their involvement in such endeavors. Proposals must clearly articulate specific steps, both in the short and long term, that will be undertaken to demonstrate the principles of diversity and equity along with commitments to inclusiveness and accessibility.

Organization and Management: It is expected that the management of the BioFoundry will have the necessary intellectual vision, leadership and entrepreneurial experience and the ability to communicate and engage diverse stakeholders (including researchers, industry partners, and the public). The leadership model should empower all team members to contribute, regardless of status and power differences, while establishing a culture of collaboration and inclusion. It is expected that the team should build consensus around goals and activities and facilitate communication among all stakeholders, to build trust and effectively resolve conflicts. Each BioFoundry will have a lead Project PI with demonstrated vision, experience, and capacity to manage a complex, multi-

faceted, and innovative enterprise that integrates research, technology development, user facility operations, training, and knowledge transfer. The PI will assemble an effective executive leadership team, with individuals that have clear responsibility for each aspect of the BioFoundry. At the minimum, the leadership team should be comprised of:

- A **Managing Director** (distinct from the lead PI), whose responsibilities include ongoing operations, financial management, reporting and oversight as well as coordination between the different aspects of the BioFoundry
- A **User Facility Coordinator**, who will lead the operations of the user facility, coordinate the engagement with the user community and manage the user proposal submission, review and selection process; staffing, instrument time/resource allocation, user training, safety, and user fee structure and other related aspects.
- An **External Advisory Board** is required for all BioFoundries. (Potential Advisory Board members should not be approached or identified until the BioFoundry is funded.)

Supported and Non-Supported Costs: The BioFoundries Program will support acquisition and development of instrumentation and technologies; cyberinfrastructure, including software and databases; professional staffing, including support for the principal investigators; technical staff; other senior personnel; and a limited number of students and postdoctoral researchers.

Awards for BioFoundries will be made as cooperative agreements with an anticipated initial commitment of six years and total funding of $15,000,000 to $24,000,000. The possibility of continuation is dependent upon overall program evaluation, individual BioFoundry performance, and availability of funding.

While research and technology development are anticipated to occur throughout the duration of the award, user facility operation may ramp up over time and is expected to reach a steady state by Year 3. **Approximately 50% of the BioFoundry funds provided by NSF, after subtracting equipment costs (budget form line D) costs, should be devoted to user-facing activities.**

The Biofoundries Program will NOT support requests for any of the following:

- Construction, renovation, or modernization of rooms, buildings or research facilities;
- General-purpose and supporting equipment. Supporting equipment refers to basic, durable components of a research facility that are integral to its operation (e.g., biosafety and chemical hoods; elevators; laboratory casework; cryogen storage systems; other general-purpose equipment; general-purpose computational or data storage systems, etc.);
- Sustaining infrastructure and/or building systems. This category includes, but is not limited to, the installation of upgrades to infrastructure related to the supply of power, ventilation, water or research gases; routine multi-purpose computer networks;, standard safety features; and other general purpose systems, such as toxic waste removal systems and telecommunications equipment); or
- General-purpose platforms or environment. This category includes, but is not limited to, general-purpose fixed or non-fixed structures and vehicles whose role is to host or transport an instrument.

In addition, the BioFoundries Program will not support projects that would be eligible for support through core, center, or infrastructure programs funded by other parts of NSF. Proposed BioFoundries should complement investments such as those funded through the Mid-Scale Research Infrastructure Programs or Materials Innovation Platforms.

NSF also does not support research that might be considered exclusively focused on drug testing or biological mechanisms of human diseases. BioFoundry proposal submissions focused exclusively on drug screening for treatment of human diseases will be returned without review.

Prospective PIs are **strongly encouraged** to consult a cognizant program director prior to submitting to the BioFoundries Program.

III. AWARD INFORMATION

Anticipated Type of Award: Cooperative Agreement.

The number of awards will depend on the availability of funds and the quality of the proposals.

Awards totaling $15,000,000 to $24,000,000 over a six-year period are anticipated. The proposed budget must be commensurate with the scope of the project and thoroughly justified in the proposal. BioFoundries funding will be provided yearly. Pending the availability of funds, it is anticipated that $37,000,000 will be available for the Program in Fiscal Year 2024.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Not-for-profit, non-degree-granting domestic U.S. organizations, acting on behalf of their employees, for example (but not limited to) independent science centers, observatories, research laboratories and similar organizations that are directly associated with the Nation's research activities. These organizations must have an independent, permanent administrative organization (e.g., a sponsored projects office) located in the United States, its territories, or possessions, and have 501(c)(3) tax status.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

One (1) per organization as lead institution.

Limit on Number of Proposals per PI or co-PI: 1

Individuals may appear as Senior Personnel (Principal Investigator/Project Director, co-PI, and other faculty or equivalent with biographical sketches included in the proposal even though their names may not be listed on the proposal Cover Sheet) on only one proposal.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent *(required)*:

A one-page Letter of Intent (LOI) is required and must be submitted via Research.gov, even if the full proposal will be submitted via Grants.gov. Submission of multiple Letters of Intent by a Project PI is not allowed.

Submitting a LOI does not oblige potential proposers to submit a full proposal. For planned collaborative proposals, a single LOI should be submitted by the lead institution only. LOIs are not subject to merit review, but instead are used for internal planning purposes. Investigators should not expect to receive any feedback on their LOIs. **One LOI may be submitted per organization as lead institution.**

Each letter must include the following information:

1. Title: Title of the proposal should be preceded by "**BioFoundry:**".
2. In the Manage Senior Personnel section, include all Co-PIs and senior personnel on the project, including unfunded collaborators and subawardees.
3. In the Manage Participating Organizations section, include all the institutions involved in the project.
4. In the "Project Synopsis" section, provide a synopsis that describes the proposed Biofoundry, including expertise of the Project PI and Senior Project Personnel, and sufficient detail to permit an appropriate selection of potential reviewers. (limit: 2500 characters, including spaces).

Upon successful submission of the Letter of Intent by the Sponsored Projects Office, please save a PDF copy of the submitted LOI, for use in the Full Proposal submission.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through Research.gov in response to this Program Solicitation please note the conditions outlined below:

- Submission by an Authorized Organizational Representative (AOR) is required when submitting Letters of Intent.
- A Minimum of 1 and Maximum of 4 Other Senior Project Personnel are permitted
- A Minimum of 0 and Maximum of 5 Other Participating Organizations are permitted
- Submission of multiple Letters of Intent is not permitted

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

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

See PAPPG Chapter II.D.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.

Proposal Title. The proposal title must begin with "**BioFoundry:**" followed by an informative project title.

Project Description (No more than 37 pages):

The Project Description must include the following sections and section headers:

1. **Senior Participant List. Limit: A combined limit of 3 pages for sections 1-2.** Provide a list of participating Senior Personnel (university faculty and equivalent) by full name, organizational and departmental affiliation, and major roles in the proposed BioFoundry (e.g., research teams, technology development and innovation, user and service facility operation, and/or education, outreach and training). Describe briefly the team's expertise with respect to the proposed research, technology development, user facility operation, and knowledge sharing. (It will be helpful to boldface the name of each Senior Personnel wherever it occurs throughout the whole Project Description.)

2. **Results from Prior NSF Support. Limit: A combined limit of 3 pages for sections 1-2.** Description of collaborative research, technology development, user facility operation, and knowledge sharing should be an emphasis of this section. **All** PIs and co-PIs listed on the proposal Cover Sheet who have received an NSF award with an end date in the past five years must provide information on their NSF award; in cases where a PI or co-PI has received more than one award, they need only report on the single award most closely related to the proposal. There is no need to list awards of Senior Personnel not listed on the proposal Cover Sheet.

3. **Vision, Goals, and Rationale. Limit: 3 pages.**
   a. Provide a vision statement for the proposed BioFoundry.
   b. Discuss how the proposed BioFoundry addresses a fundamental or grand challenge in science or engineering of biological systems.
   c. State how the multidisciplinary research groups and the technology innovation groups will work towards addressing this challenge.
   d. Describe how the knowledge sharing and enabling activities of the user facility and the education and training activities will empower the community, as a whole, to make progress towards addressing the challenge.
   e. Outline activities that have the potential to foster partnerships that enable translation of knowledge, technologies, and research results into applications.
   f. Describe how the proposed BioFoundry advances relevant NSF or national priorities.

4. **Research Program. Limit: 6 pages.** Describe the scope and targeted scientific outcome of the BioFoundry and specific in-house research activities. The scope of in-house research should be focused, smaller than the scope covered by the whole BioFoundry, and synergistic to the user program. This section must also discuss how the proposed in-house research iteratively works with the technology development teams to advance instrumentation/workflow/tools/reagents/cyberinfrastructure to have maximal scientific impact. If more than one institution is involved in the in-house research, mechanisms to prevent the negative impact of distance on the collaborative, interactive nature of the BioFoundry must be clearly described.

5. **User Facility Operation Plans**. Limit: 4 pages. The BioFoundries Program aims to 1) provide resources that serve users who are external to the funded institution, and moreover 2) increase access to cutting-edge research tools beyond just R1 institutions. Specify the envisioned user community and how they will be made aware of, engaged with, and provided access to the proposed BioFoundry. Describe the proposed user access modes (e.g., independent, collaboration, fee for service, sample requests, and/or remote access) for users and for in-house researchers; the process for user proposal submission, review, and selection; staffing, instrument time/resource allocation; user training and safety; user fee structure (where applicable); and plans for coordination and management of user-facing activities. Specific metrics that will be collected to quantify use of the BioFoundry by the envisioned community should be outlined. If the planned user facilit(ies) are located at more than one institution, mechanisms to minimize the negative impact of distance on user service must be clearly described. For major new instruments acquired through the BioFoundry, at least 50% of the instrument operational time must be devoted to external users; the BioFoundry may not charge academic users in the U.S. for time with experts, technicians, or use of the instruments acquired through the BioFoundry funding. As much as possible, the BioFoundry should support the residence of academic users/participants while they are engaged in research or training at a BioFoundry location. Specific plans should be provided for how access will be facilitated, and budget for those efforts should be included as needed. Full-cost recovery may be applied to proprietary research. Proposals should also discuss plans for sustaining operations following the expiration of NSF support.

6. **Technology development. Limit: 6 pages.** Describe the experimental and computational capabilities needed for both the in-house research and user program of the proposed BioFoundry. Describe the strategies for development, deployment, and refinement of relevant research tools, including software and AI based approaches, technologies, or instrumentation. Describe the potential technical challenges and bottlenecks for technology development and a plan to overcome them. Provide justification (in terms of critical needs in science and/or uniqueness in the U.S.) for new instrument acquisition (if required), as well as a timeline for the said acquisition. Provide an assessment of the risk associated with the technological development, instrument acquisition, and user facility commissioning. This section should emphasize how the technology development groups are operating at the technological forefront and will enable transformational discoveries and accelerate understanding in the chosen scientific focus area of the BioFoundry.

7. **Platform/Knowledge Sharing. Limit: 4 pages.** BioFoundries are designed to foster new modalities of research and education, through sharing of tools, reagents, workflows, designs, codes, samples, data, and know-how. In addition, BioFoundries are expected to incorporate the emerging fields of data science, including artificial intelligence and/or machine learning, as appropriate. In this section, identify likely challenges, including cyberinfrastructure needs and development of community accepted standards, in creating a culture of knowledge sharing, and describe strategies to overcome these challenges. Describe goals and proposed mechanisms for knowledge sharing, the anticipated results, and the expected outcome and impacts. Include mechanisms for knowledge sharing within the in-house research team, among external users, and for the whole community of practitioners that the proposed BioFoundry represents (in-house research scientists, external users, and other contributors). Different mechanisms could be needed, depending on the resources to be shared. The mechanisms should balance between the need for confidentiality and creation of a culture of knowledge sharing, as well as be consistent with relevant NSF policies (see, for example, PAPPG Chapter XI.D) and FAIR data principles. (The required Data Management Plan can be used to provide additional details for data access and sharing, as well as other issues such as types and format of data and metadata, data archiving, data security, etc., as appropriate.)

Sections 8-10 should be included in a separate section labeled "Broader Impacts". Please note that this heading must be on its own line with no other text on that line.

8. **Education/Training. Limit: 4 pages.** Describe a limited number of well-chosen education and training activities that integrate strategically with the research goals and advance the educational experiences for users, especially external users (the major emphasis of the education/training component), as well as graduate and undergraduate students, postdoctoral researchers, and others associated with the BioFoundry as a unique national resource. Potential activities such as hands-on workshops, summer/winter schools, webinars, and/or research experiences for undergraduates may be considered. Include outreach plans designed to increase the external user base, attract users from diverse communities and expertise (from experts to entrants to the field), and reach potential users in industry, whose work could inform or benefit from instrumentation and technique development activities.

9. **Diversity Strategic Plan. Limit: 2 pages.** Describe the BioFoundry's strategic plan of broadening participation at all levels, the desired outcome for the 6-year award period, and the metrics that will be used to measure progress. BioFoundries are expected to demonstrate a significant commitment to the involvement of individuals from groups that are underrepresented in STEM as BioFoundry participants (e.g., faculty, scientific experts, technicians, postdoctoral researchers, and students) and as users. BioFoundries are also expected to reach users from a broad range of academic institutions in the U.S. (including primarily undergraduate institutions, minority serving institutions, and institutions from EPSCoR jurisdictions).

10. **Partnerships and Translation. Limit: 2 pages.** One of the intended outcomes of the BioFoundry Program is accelerated translation of products and processes, such that they deliver societal benefit. Progress towards translation may include the generation of new intellectual property, creation of new or broader collaborations with industry, licensing of NSF-funded research by a third party or a start-up initiated by BioFoundry-affiliated researchers, creation of new technology and/or processes adopted by the public and/or philanthropic sector, and the training of future innovation and entrepreneurship leaders. Each BioFoundry is expected to describe a translation focus that may advance one or more of the above outcomes

depending upon the research and technology focus of the BioFoundry. BioFoundry technology development and research activity in collaboration with users may result in the generation of intellectual property (IP). Each BioFoundry should describe the overall IP strategy, consistent with the planned value creation in the BioFoundry, and corresponding management of BioFoundry IP that includes management of possible conflicts of interest of BioFoundry researchers, technology developers, and visitors in technology transfer endeavors. If an award is made, an agreement for IP ownership and management in compliance with chapter 18 of title 35 of the United States Code, commonly called the Bayh-Dole Act should be developed for BioFoundry users. The Industry University Cooperative Research Centers Membership Agreement contains a potentially useful example.

11. **Management Plan. Limit: 3 pages**

   - Organizational Chart: Show all critical components of the governance structure of the proposed BioFoundry.
   - Describe functions of key leadership positions and major committees, e.g., the executive committee, the user proposal review committee, the user committee, the external advisory committee, etc., especially for decision-making on directions of research and technology development and allocation of resources for new vs. continuing efforts.
   - Define the approach that will be used during the first 120 days to develop a Strategic Implementation Plan (which will include a Project Execution Plan for the user-facing activities) for the BioFoundry.
   - Describe the procedures and criteria used to select, administer, and evaluate in-house research projects. (The procedures for user projects are described in Section 7.)
   - Provide a description of the resources that the organization(s) will provide to the proposed BioFoundry, should it be funded. Resources may include space, faculty release time, faculty and staff positions, capital equipment, access to existing facilities, collaboration, support of education activities, and/or others. Do not give as dollar equivalents.
   - In a tabular form, enter the NSF budget request (in $K) for each of the major BioFoundry activities. For each entry in the table, include direct and indirect costs. Equipment acquisition and development is expected to be mainly in the first few years. User facility operation may ramp up over time and is expected to reach a steady state by year 3, at which time approximately 50% of the BioFoundry funds provided by NSF--after subtracting instrument acquisition and development costs--should be devoted to the user facility operation. Student support is typically not included under education/training, but instead should be included under appropriate categories depending on what roles the students will play.

Table of NSF Funding Request (in $K).

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Years 1-6
Instrument acquisition and development							
Technology, workflow, processes and knowledge-base development							
User facility operation							
In-house research							
Education/training							
Platform/Knowledge sharing							
Collaboration with Industry and translational activities if any.							
Administration							
Others, if any (please specify)							
Total							

References Cited: List only references cited in the Project Description. See PAPPG for format instructions.

Budget and Budget Justification: Provide a budget for each of the six years. **Important information for Grants.gov users**: Grants.gov supports proposal budgets for up to five years. After the proposal is submitted to NSF via Grants.gov and successfully transferred to NSF for processing, Grants.gov applicants

should use the Proposal File Update feature in Research.gov to enter the proposal budget for the 6th year. The proposed budget should be consistent with the needs and complexity of the proposed activity. The budget and budget justification should reflect start-up activities at the commencement of the institute activities. Funds allocated for research, technology development, user facility activities, education, broadening participation, and knowledge transfer areas must be discernible. Some costs, e.g., travel, meals, or housing to enable users to travel to the facility for on-site activities, may be appropriate for budgeting as Participant Support Costs. Guidance on budgeting for participant support is available in PAPPG Chapter II.D.2.f(v). Travel funds for project personnel should be included for attendance at up to three site visits (and/or reverse site visits) and any other activities listed in the Special Award Conditions section of this solicitation.

Facilities, Equipment and Other Resources: Provide a synopsis of organizational resources that will be available to the BioFoundry (dedicated space, access to facilities and instrumentation, faculty and staff positions, access to programs that assist with technology development, or other organizational programs that could provide support to the BioFoundry). In order for NSF to assess the scope of a proposed project, all resources (including those from collaborating organizations) available to the project, must be described in this section. Note that inclusion of voluntary committed cost sharing is prohibited.

Supplementary Documents:

Letters of Collaboration: Limit: 5 pages (with no more than one letter per page).

No letters of collaboration or support from anticipated users are allowed. If a proposal involves collaboration with scientists not at the lead institution, include only official letters of collaboration from participating organizations. Such letters should not contain endorsements or evaluation of the proposed project, but instead should follow the suggested format contained in the PAPPG Chapter II.D.i(iv). Details about collaborative work to be done under this project should be included within the Project Description, not in the letter(s) of collaboration.

Additional Required Documentation

A PDF copy of the corresponding **Letter of Intent** must be included as a **single-copy document**, not as a supplementary document.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

Important information for Grants.gov users: Grants.gov supports proposal budgets for up to five years. After the proposal is submitted to NSF via Grants.gov and successfully transferred to NSF for processing, Grants.gov applicants should use the Proposal File Update feature in Research.gov to enter the proposal budget for the 6*th* year.

C. Due Dates

- **Letter of Intent Due Date(s)** *(required)* (due by 5 p.m. submitter's local time):

    August 01, 2023

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

    October 02, 2023

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

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 Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

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

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

Proposers that submitted via 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 *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. 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.D.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.D.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 other underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

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

Additional Solicitation Specific Review Criteria

- **Vision, Goals, and Rationale:** Does the science focus of the proposed BioFoundry address one or more grand challenge questions in biology, biotechnology, bioengineering or related field? To what extent will the vision for the BioFoundry, if realized, have a transformative impact upon the biosciences, biotechnology, and bioengineering and society as a whole? To what extent will the knowledge sharing, enabling activities, and education and training empower the community to make progress towards addressing the grand challenge and advancing NSF or national priorities?

- **Research:** How well is the proposed in-house research focused and targeted to addressing a critical scientific challenge? How well are the research activities integrated with the technology development activities of the BioFoundry?

- **User Facility Operation:** How well-conceived are the plans for the user facility operation (e.g., access modes, user proposal review and selection process, staffing, instrument time/resource allocation, user training, and safety, etc.)? How effective are the plans to enable access and the research and technology needs for a broad external user base?

- **Technology Development activities:** To what extent do the proposed technology development activities have the potential to yield catalytic and transformative impact on the relevant disciplines? To what extent are the anticipated range of uses for the proposed technologies appropriate in scope and likely to be responsive to community needs? How appropriate are the plans for instrumentation acquisition and use? How well does the timetable for implementation account for possible technical bottlenecks? How comprehensive is the analysis of the risk and potential goals/aims associated with the technological development?

- **Platform/Knowledge Sharing:** How substantially will the proposed BioFoundry contribute beyond current capabilities towards accelerating discovery and development, through development of new platforms and sharing of knowledge (tools, codes, samples, data, and know-how)? How effective will the knowledge sharing mechanisms likely be? Is there a reasonable plan for development of appropriate standards? How sound are the plans for the BioFoundry to take advantage of opportunities provided by the emerging data science?

- **Education/Training:** o what extent will the Biofoundry serve as an educational focal point for training the next generation of researchers, technology developers, and users?

- **Diversity Plan:** To what extent is the plan strategic and likely to meet the stated goals for participation by a diverse group of users (including those from groups that are underrepresented in STEM, and from a broad range of academic institutions in the United States, such as R1, non-R1, predominantly undergraduate, minority-serving, or EPSCoR institutions)?

- **Partnerships and Translation:** How well will the proposed strategies for fostering translation and innovation meet the stated goals for users and key non-academic stakeholders, particularly in the context of intellectual property protection, licensing, entrepreneurship, partnerships, development and distribution of open-source tools, or other knowledge transfer paths?

- **Management plan:** To what extent will the facility's Management Plan foster sound decisions in balancing the proposed research and technology development tools with the needs of the user community? What role will internal leadership and any external advisory groups play in the decision-making processes? How will decisions be made with regards to fostering and encouraging facility use by the external user community? How will decisions be made on the direction of the in-house research and technology development program with respect to allocation of resources, ability to initiate new lines of research and terminate support for lower priority efforts? What process will be employed for developing and implementing the strategic plan, including facility-wide data management and diversity plans? How well are funds distributed across the proposed activities of the BioFoundry?

B. Review and Selection Process

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

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, and Site Review or Reverse Site Review. Proposals submitted in response to this program solicitation will be reviewed by panels, supplemented with ad hoc review as needed. Finalists will be invited for a reverse site visit at NSF. At the reverse site visit, finalists will make oral presentations to a second panel and NSF staff and engage in a question and answer session. NSF reserves the option to conduct a site visit prior to making an award.

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.

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 or the Division of Acquisition and Cooperative Support 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.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by an NSF Grants and Agreements Officer. 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) 292-8134 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Administrative and National Policy Requirements

Build America, Buy America

As expressed in Executive Order 14005, Ensuring the Future is Made in All of America by All of America's Workers (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's Build America, Buy America webpage.

Special Award Conditions:

BioFoundries awards are made in the form of cooperative agreements. The cooperative agreements will have an extensive section of Special Conditions relating to the period of performance, statement of work, awardee responsibilities, NSF responsibilities, joint NSF-awardee responsibilities, funding and funding schedule, reporting requirements, key personnel, and other conditions.

NSF has responsibility for providing general oversight and monitoring of BioFoundries to help assure effective performance and administration, as well as facilitating any coordination among the BioFoundries as necessary to further the objectives of the program. Within the first 120 days of the Award, the **awardee must submit a Strategic Implementation Plan (SIP), which will include a Project Execution Plan for the User facing activities and a sustainability plan for operations after NSF support expires,** against which NSF will evaluate the start-up of the BioFoundry. **NSF will make a template for the SIP available at the time of award**.

Support for each year of the cooperative agreement of a funded BioFoundry will be contingent upon a satisfactory annual review by NSF of the BioFoundry's progress and future plans, with an emphasis on the quality of the research, technology development, user engagement, knowledge sharing, and education activities. All funding is subject to availability.

NSF may conduct site visits and/or reverse site visits as part of annual review of performance. These visits will be led by cognizant agency staff and may include a panel of external evaluators. The frequency or schedule of site visits and/or reverse site visits for a BioFoundry will be further specified in the award-specific terms and conditions of that BioFoundry's cooperative agreement.

Ensuring Adequate COVID-19 Safety Protocols

(a) This clause implements Section 3(b) of Executive Order 14042, Ensuring Adequate COVID Safety Protocols for Federal Contractors, dated September 9, 2021 (published in the Federal Register on September 14, 2021, 86 FR 50985). Note that the Department of Labor has included "cooperative agreements" within the definition of "contract-like instrument" in its rule referenced at Section 2(e) of this Executive Order, which provides:

For purposes of this order, the term "contract or contract-like instrument" shall have the meaning set forth in the Department of Labor's proposed rule, "Increasing the Minimum Wage for Federal Contractors, " 86 Fed. Reg. 38816, 38887 (July 22, 2021). If the Department of Labor issues a final rule relating to that proposed rule, that term shall have the meaning set forth in that final rule.

(b) The awardee must comply with all guidance, including guidance conveyed through Frequently Asked Questions, as amended during the performance of this award, for awardee workplace locations published by the Safer Federal Workforce Task Force (Task Force Guidance) at https://www.saferfederalworkforce.gov/contractors/.

(c) Subawards. The awardee must include the substance of this clause, including this paragraph (c), in subawards at any tier that exceed the simplified acquisition threshold, as defined in Federal Acquisition Regulation 2.101 on the date of subaward, and are for services, including construction, performed in whole or in part within the United States or its outlying areas. That threshold is presently $250,000.

(d) Definition. As used in this clause, United States or its outlying areas means:

(1) The fifty States;

(2) The District of Columbia;

(3) The commonwealths of Puerto Rico and the Northern Mariana Islands;

(4) The territories of American Samoa, Guam, and the United States Virgin Islands; and

(5) The minor outlying islands of Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Midway Islands, Navassa Island, Palmyra Atoll, and Wake Atoll.

(e) The Foundation will take no action to enforce this article, where the place of performance identified in the award is in a U.S. state or outlying area subject to a court order prohibiting the application of requirements pursuant to the Executive Order (hereinafter, "Excluded State or Outlying Area"). A current list of such Excluded States and Outlying Areas is maintained at https://www.saferfederalworkforce.gov/contractors/.

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.

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:

- Sridhar Raghavachari, Program Director, BIO/DBI, telephone: (703) 292-4845, email: sraghava@nsf.gov
- Anthony G. Garza, Program Director, BIO/MCB, telephone: (703) 292-8440, email: aggarza@nsf.gov
- Steven W. Peretti, Program Director, ENG/CBET, telephone: (703) 292-4201, email: speretti@nsf.gov
- Laurel C. Kuxhaus, Program Director, ENG/CMMI, telephone: (703) 292-4465, email: lkuxhaus@nsf.gov
- Mitra Basu, Program Director, CISE/CCF, telephone: (703) 292-8649, email: mbasu@nsf.gov
- Vladimir Pavlovic, Program Director, CISE/IIS, telephone: (703) 292-8318, email: vpavlovi@nsf.gov
- Gregory Collins, Program Director, MPS/CHE, telephone: (703) 292-7064, email: grcollin@nsf.gov
- Z. C. Ying, Program Director, MPS/DMR, telephone: (703) 292-8428, email: cying@nsf.gov
- Ruth M. Shuman, Program Director, TIP/TI, telephone: (703) 292-2160, email: rshuman@nsf.gov
- Alberto Perez-Huerta, Program Director, GEO/EAR, telephone: 703 292 8500, email: aperezhu@nsf.gov
- Lee D. Walker, Program Director, SBE/SES, telephone: (703) 292-7174, email: lwalker@nsf.gov
- Dwight Kravitz, Program Director, SBE/BCS, telephone: (703) 292-4502, email: dkravitz@nsf.gov
- John-David Swanson, Program Director, OD/OIA, telephone: (703) 292-2898, email: jswanson@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-673-6188
- 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.

IX. OTHER INFORMATION

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

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

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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.

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