MID-SCALE RESEARCH INFRASTRUCTURE TRACK 2 (MID-SCALE RI-2) **$25,000,000**

Requested MREFC Funds
(Dollars in Millions)

	FY 2026 Request
Mid-scale Research Infrastructure Track 2	$25.00

Scientific Purpose

The Mid-scale Research Infrastructure program is an NSF-wide effort to meet the research community's needs for modern research infrastructure to support priority science and engineering research. Here, we describe Track 2 (Mid-scale RI-2), covering projects with individual implementation costs between $20.0 million and $100.0 million, with funding provided from the MREFC account.

Baseline History

The scientific importance of mid-scale research infrastructure is reflected in the 2017 American Innovation and Competitiveness Act (AICA), which directed NSF to "evaluate the existing and future needs, across all disciplines supported by the Foundation, for mid-scale projects." NSF issued a Request for Information in late 2017 that resulted in nearly 200 ideas for research infrastructure with project costs in the $20.0 million to $100.0 million range, amounting to a prospective demand for approximately $10 billion in funding.

In the 2018 appropriation for NSF, report language from the House of Representatives encouraged the NSB "to consider further changes that would bridge the gap between the Major Research Instrumentation program and the MREFC account while also developing processes appropriate for mid-scale infrastructure, cyberinfrastructure, and instrument upgrades to be funded through the MREFC account." The NSB issued a report (NSB-2018-40)[1] that made several recommendations, including "a long-term *agency-level* commitment to mid-scale research infrastructure."

NSF's response to the NSB recommendations and the AICA mandate to develop a strategy was the creation of a targeted Mid-scale RI program. As part of that program, funding for projects with implementation costs greater than $20.0 million was requested in the MREFC account as Track 2 of an NSF-wide Mid-scale RI program, and funding was appropriated in that account beginning in FY 2020. NSF issued its first solicitation for Mid-scale RI-2 in December 2018,[2] requesting proposals with total implementation costs between $20.0 million and $70.0 million. A second solicitation[3] with a new upper limit of $100.0 million was issued in December 2020 and the award portfolio was approved

[1] www.nsf.gov/nsb/publications/2018/NSB-2018-40-Midscale-Research-Infrastructure-Report-to-Congress-Oct2018.pdf
[2] www.nsf.gov/pubs/2019/nsf19542/nsf19542.htm
[3] www.nsf.gov/pubs/2021/nsf21537/nsf21537.pdf

in February 2023, resulting in three awards in FY 2023, and a fourth in FY 2024. The third solicitation[4] for Mid-scale RI-2 was released in March 2023. The review process for that solicitation has been completed. NSF does not anticipate making new awards in FY 2026.

Since Mid-scale RI-2 is a portfolio of implementation awards that span all NSF research communities, it does not have a single set of *a priori* scientific goals. Rather, the solicitations define research infrastructure as "any combination of facilities, equipment, instrumentation, or computational hardware or software, and the necessary human capital in support of the same" and, consequently, generate proposal submissions over a wide range of disciplines. As stated in the 2020 solicitation, NSF's intent is that "[t]he Mid-scale Research Infrastructure programs are aimed at transforming scientific and engineering research fields as well as science, technology, engineering, and mathematics education research by making available new capabilities, while simultaneously training early-career researchers in the development, design, and construction of cutting-edge infrastructure."

Management and Oversight

Mid-scale RI-2 proposals have been received from all scientific disciplines covered by NSF. Management and oversight processes for Mid-scale RI awards have been codified in the NSF Research Infrastructure Guide (NSF 21-107[5] and subsequent revisions). Because of the varied nature of potential Mid-scale RI-2 awards, the Research Infrastructure Guide states the following:

> "Mid-scale project oversight requirements are to be tailored based on each project's unique characteristics such as the technical scope, the type and mix of work performed (e.g., standard procurement by the Recipient, software development, or civil construction), and an assessment of the associated technical and programmatic risks. However, NSF is committed to the principle that this flexibility does not preclude the requirement for appropriate rigor on the part of NSF or the Recipient. Appropriate use of NSF major facility oversight practices will be determined on a case-by-case basis…"

Each Mid-scale project is overseen by a program officer from a relevant research directorate as well as an awarding official from BFA. Additionally, within BFA, the Research Infrastructure Office has designated a liaison for the mid-scale award portfolio to assure a consistent and effective approach to project management oversight for these awards. To enable appropriate oversight, all Mid-scale RI-2 proposals are required to include a detailed Project Execution Plan. This plan is the basis for management requirements for the Awardee as referenced by each individual award's Terms and Conditions and helps NSF assess project risk and complexity to tailor the oversight needs prior to award issuance. Portfolio-wide oversight, ensuring that the Mid-scale RI-2 program meets its overall objectives, is led by the Deputy Chief Officer for Research Facilities in the Office of the Director.

Mid-scale RI Track 2 Status

Authorization for the current complement of Mid-scale RI-2 awards was given in May 2020 and February 2023, respectively. The authorized awards underwent full cost analyses and final award

[4] www.nsf.gov/pubs/2023/nsf23570/nsf23570.pdf
[5] www.nsf.gov/pubs/2021/nsf21107/nsf21107.pdf

negotiations, including Independent Cost Estimates as required under AICA. The first three Mid-scale RI-2 awards were made from the MREFC account in October 2020,[6] and followed by two additional awards, made in June 2021 and February 2022, respectively. These awards are listed below:

- "High Magnetic Field Beamline," Cornell University, $32.69 million.
- "Global Ocean Biogeochemistry Array," Monterey Bay Aquarium Research Institute, $52.94 million.
- "Grid-Connected Testing Infrastructure for Networked Control of Distributed Energy Resources," University of California at San Diego, $39.47 million.
- "Network for Advanced NMR [Nuclear Magnetic Resonance]," University of Connecticut, $39.70 million.[7]
- "Research Data Ecosystem: A National Resource for Reproducible, Robust, and Transparent Social Science Research in the 21st Century," University of Michigan, $38.36 million.[8]

Four projects resulting from the second solicitation were added to the Mid-scale RI-2 portfolio, with three awards made in FY 2023:

- "Airborne Phased Array Radar," University Corporation for Atmospheric Research, $91.80 million.[9]
- "Advanced Simons Observatory," University of Pennsylvania, $52.70 million.[10]
- "Compact X-ray Free-Electron Laser," Arizona State University, $90.80 million.[11]

An additional award from this second solicitation was made in May 2024.

- "A National Research Infrastructure for Large-Scale Learning Science and Engineering" Rice University, $89.93 million.[12]

A solicitation for a third round of proposals for Mid-scale RI-2 was released in March 2023. NSF has completed the review of those proposals. NSF does not anticipate making new awards in FY 2026.

Future Operations Costs

The Mid-scale RI-2 solicitations specifically prohibited inclusion of operations costs in the individual project budgets, but proposers are required to present operations and utilization plans as well as estimates of full lifecycle costs. For each proposal considered for inclusion in the award portfolio, the lead directorate is required to confirm the submission of adequate operational funding models for the projects, and to estimate and commit to any additional operations costs necessary to reap the scientific benefits of an award. At the total planned award amount of $528.40 million from the first two solicitations and an estimated upper limit to the operations cost of 10 percent of the capital costs per project per year,[13,14] the total operations cost impact from the current portfolio of Mid-scale RI-2

[6] www.nsf.gov/news/special_reports/announcements/102920.jsp
[7] www.nsf.gov/news/special_reports/announcements/061621.jsp
[8] www.nsf.gov/news/special_reports/announcements/020422.jsp
[9] www.new.nsf.gov/news/nsf-announces-investment-research-infrastructure
[10] www.new.nsf.gov/news/detecting-faint-traces-universes-explosive-birth
[11] new.nsf.gov/news/nsf-announces-infrastructure-investment
[12] new.nsf.gov/news/nsf-invests-90m-innovative-national-scientific
[13] www.nsf.gov/nsb/publications/2018/NSB-2018-17-Operations-and-Maintenance-Report-to-Congress.pdf
[14] An annual operations cost of 10 percent of the total capital costs is a typical "high-end" estimate for a major infrastructure project. Since some of the Mid-scale RI-2 awards being made by NSF are additions to existing

awards could potentially ramp up to a steady state of about $52.0 million per year, spread across the sponsoring Directorates, when implementation is complete. Given the variety of operational models for the funded infrastructure, this cost would only be partially borne by NSF and such costs within NSF are spread across multiple directorates and divisions. Some of the first projects funded by the Mid-scale RI-2 program have transitioned to full operations in FY 2025, so those costs will be captured within the budgets of the sponsoring Directorate. Operations costs of projects funded from the second solicitation, released in FY 2021, and from subsequent solicitations, would not begin until well after FY 2026.

Reviews

The Mid-scale RI-2 program only considers projects that have reached a high state of readiness for implementation through previous investments in development. As a result, the multi-phase Design Stage and accompanying reviews that are typical of major facility projects are not used. Instead, the program has been designed to include a two-step, pre-proposal and full-proposal process to limit the burden on the research community of both preparing and reviewing full proposals and Project Execution Plans. Lead NSF directorates are identified to coordinate the review of each pre-proposal and full proposal. Pre-proposals are reviewed externally according to the standard NSF merit review criteria and solicitation-specific review criteria, with a subset of teams invited to submit full proposals based on the outcomes of the pre-proposal reviews. Full proposals are also reviewed externally, with a subset selected for a Site Visit. Based on the results of the site visit, a further subset of proposals is invited to a Reverse Site Visit at NSF (or held virtually) for detailed assessment of the Project Execution Plans.

Based on the extensive input from external merit review, the most meritorious proposals are identified by the lead directorates and submitted to the Mid-scale RI-2 Working Group. That working group identifies potential funding scenarios of those proposals at different levels of total funding and forwards them to the Office of the Director for further consideration. The Deputy Chief Officer for Research Facilities convenes an independent Portfolio Recommendation Group to evaluate the scenarios from the working group and develop one or more final recommended portfolios that consider agency strategy, technical and programmatic risk, projected funding availability, and overall portfolio balance. During the portfolio construction process, NSF also conducts a rigorous cost analysis of each candidate project to ensure compliance with Government Accountability Office good practices, as required by the solicitation and the Research Infrastructure Guide. That analysis may inform modifications to the requested budget if it reveals substantial deficiencies in the development of the proposed cost of a project.

Risks

Technical risks and risk management approaches are described in each project's Project Execution Plan and are evaluated rigorously by an external panel of project management experts during a Reverse Site Visit, as described above. The assembly of the final portfolio also relies significantly on an evaluation of agency risks. These include, for example, a constraint that not all the projects should

facilities or infrastructure, the predicted increments to the operations costs are less than that high-end estimate for several projects.

have very high or very low technical risk,[15] potential cost risks identified during the review process, assessment of any partnership risks, the risk that events outside the control of an award recipient might significantly impact an individual project, and/or the risk of overcommitting future budgets such that the next solicitation might be significantly delayed.

[15] NSF does not want all projects to have very high technical risk because of the desire for a high probability of very successful projects coming out of the Mid-scale program. On the other hand, NSF does not want all projects to be "safe" projects with very low technical risk because a portfolio consisting only of such projects might have less potential for dramatic increases in scientific knowledge.