MID-SCALE RESEARCH INFRASTRUCTURE TRACK 2 (MID-SCALE RI-2) **$65,000,000**

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. The overall Mid-scale RI program is described in the NSF-wide Investments chapter of this Budget Request. Here, we describe Track 2 (Mid-scale RI-2) of this "enabling" Big Idea, covering projects with individual implementation costs between $20.0 million and $100.0 million,[1] with funding requested from the MREFC account.

Appropriated and Requested MREFC Funds for the Mid-Scale Research Infrastructure Track 2 Program

(Dollars in Millions)

FY 2020	FY 2021 Request	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
$65.00	$65.00	$65.00	$65.00	$65.00

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. Mid-scale RI-2 funding is intended to respond directly to that demand.

In the 2018 appropriation for NSF, report language from the House of Representatives directed "the National Science Board (NSB), in collaboration with the National Academies of Science, Engineering, and Medicine (NASEM), to consider steps to bridge the gap between the NSF's Major Research Instrumentation Program (MRI) and the agency's Major Research Equipment and Facility Construction (MREFC) account and to develop appropriate processes to address this matter through the MREFC account within a restricted funding environment." An NSF-wide strategy for mid-scale projects, also directed by AICA, was deferred until the NSB completed their report in response to the Congressional direction. In that report (NSB-18-40),[2] the first two of the four recommendations of NSB were the following:

- NSF should affirm and sustain the mid-scale Big Idea with a long-term *agency-level* commitment to mid-scale research infrastructure.
- NSF should investigate the feasibility of using the MREFC account as one possible funding mechanism.

NSF responded to these recommendations and the AICA mandate to develop a strategy with the detailed Mid-scale RI program that is described in the NSF-Wide Investments chapter of this Budget Request. As part of that strategy, funding for the mid-scale projects with implementation costs above $20.0 million was requested in the MREFC account as Track 2 of an NSF-wide mid-scale program, and funding was appropriated in that account in FY 2020. NSF issued its first solicitation for Mid-scale RI-2, NSF 19-542,[3]

[1] The first NSF-wide Mid-scale RI-2 solicitation called for implementation proposals with total project costs in the range from $20.0 million to $70.0 million. The long-term intent is for Mid-scale RI-2 to cover a range extending up to $100.0 million, to be maximally consistent with the definition of major multi-user research facility projects in the American Innovation and Competitiveness Act.

[2] www.nsf.gov/nsb/publications/2018/NSB-2018-40-Midscale-Research-Infrastructure-Report-to-Congress-Oct2018.pdf

[3] www.nsf.gov/pubs/2019/nsf19542/nsf19542.htm

in December 2018, requesting proposals with total implementation costs in the range between $20.0 million and $70.0 million.

Since Mid-scale RI-2 is intended to be a portfolio of implementation awards that may range across all NSF communities, it does not have a single set of a-priori scientific goals. In the initial solicitation, NSF stated that "the Mid-scale Research Infrastructure Program is aimed at transforming scientific and engineering research fields as well as science, technology, engineering and mathematics (STEM) education research fields by making available new capabilities, while simultaneously training early-career researchers in the development, design, and construction of cutting-edge infrastructure." The solicitation specifically called for proposals "that comprise any combination of equipment, instrumentation, computational hardware and software, and the necessary commissioning and human capital in support of implementation of the same." Past examples of mid-scale-size awards in individual directorates have included items such as mid-size telescopes or telescope systems, replacement of the Palmer Pier in Antarctica, advanced supercomputing systems, and higher-sensitivity instrumentation at LIGO.

Total Funding Requirements for Mid-scale RI-2[1]

(Dollars in Millions)

	Prior Years	FY 2019 Actual	FY 2020 Estimate	FY 2021 Request	ESTIMATES FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
R&RA:									
Development & Design	-	-	-	-	-	-	-		
Subtotal, R&RA	-	-	-	-	-	-	-	-	-
MREFC:									
Implementation	-	-	$65.00	65.00	65.00	65.00	65.00	65.00	65.00
Subtotal, MREFC	-	-	$65.00	$65.00	$65.00	$65.00	65.00	65.00	65.00
TOTAL REQUIREMENTS	**-**	**-**	**$65.00**	**$65.00**	**$65.00**	**$65.00**	**$65.00**	**$65.00**	**$65.00**

[1]Operations costs to be borne by the lead disciplinary directorates are not included in this table but are discussed below in the section on Future Operations Costs.

Management and Oversight

Mid-scale RI-2 proposals have been solicited from all disciplines covered by NSF, as noted above. In anticipation of the funding of such proposals, the NSF Major Facilities Guide (NSF 19-068)[4] was updated with an extensive discussion of management and oversight processes for Mid-scale RI, found in Section 5 of that Guide. Because of the varied nature of potential Mid-scale RI-2 awards, the Major Facilities 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."

[4] www.nsf.gov/pubs/2019/nsf19068/nsf19068.pdf

In order to enable appropriate oversight, all Mid-scale RI-2 proposals were required to submit an extensive Project Execution Plan that will help NSF determine the appropriate oversight for each project once awards are made.

Reviews

The Mid-scale RI-2 proposals do not go through the Conceptual/Preliminary/Final Design stages of major facility projects, enabling a more agile process for these substantial, but smaller, projects. However, the Mid-scale RI-2 program only considers projects at a high state of readiness for implementation that have reached that mature stage through previous developmental investments. The solicitation was designed to include a two-step, pre-proposal/full-proposal process in order to limit the burden on the research community of both preparing and reviewing full proposals. Lead NSF directorates were identified for the review of each pre-proposal and proposal, based on the proposal submissions and assessments by NSF. Pre-proposals were externally reviewed according to the standard NSF merit review criteria and six solicitation-specific review criteria, with a subset invited to submit full proposals. Those full proposals were again externally reviewed, with a subset of these full proposals invited to a Reverse Site Visit (again with an external panel) for detailed assessment of the Project Execution Plans.

Based on the extensive input from external merit review, the most meritorious proposals were identified by the lead directorates and submitted to the Mid-scale RI-2 Working Group. That working group prepared sample portfolios of those proposals at different levels of total funding, and forwarded them to the Office of the Director. The Director will recommend a portfolio of awards to the National Science Board at its May 2020 meeting, which will consider the portfolio and then authorize any awards. All proposals reaching this final stage of portfolio selection demonstrate highly meritorious science. The final portfolio recommendation also will include consideration of the project readiness as evaluated by the Reverse Site Visits, breadth of science disciplines to be awarded, diversity in awardees and awardee institutions, and contributions to student training and workforce development. During the recommendation process, NSF's Office of Budget, Finance, and Award Management will also carry out rigorous cost analyses of the projects that are candidates for award, consistent with AICA requirements for MREFC-funded projects, and in order to assure best value for the taxpayer dollar. It is anticipated that the first awards will be started with the funds appropriated by Congress in FY 2020.

Project Status

The final steps in the portfolio selection and award process are in progress and anticipated for completion late in FY 2020. Depending on the status of the Project Execution Plans and the NSF cost analyses, some awards may not be made until FY 2021.

Cost and Schedule

FY 2020 funds will be used to make the first Mid-scale RI-2 awards, most of which are anticipated to last for five years. A sample budget portfolio for multiple solicitation rounds is shown in the table below.

Sample Budget Profile for Mid-Scale RI-2 Porfolio
(Dollars in Millions)

	FY 2020 Estimate	FY 2021 Request	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate	FY 2025 Estimate
Solicitation 1	$65.00	$65.00	$30.00	$30.00	$30.00	-
Solicitation 2	-	-	35.00	35.00	35.00	30.00
Solicitation 3	-	-	-	-	-	35.00
Total	**$65.00**	**$65.00**	**$65.00**	**$65.00**	**$65.00**	**$65.00**

Risks

Technical risks and risk management for the individual projects have been included as part of the Project Execution Plans and evaluated rigorously by an external panel of experts. The final portfolio recommendation will also rely significantly on an evaluation of agency risks. These will include, for example, a constraint that not all of the projects should be very high or very low risk, assessment of any potential partnership risks, the risk that events out of the control of an awardee might significantly impact an individual project, or the risk of overcommitting future budgets such that the next solicitation might be significantly delayed.

Future Operations Costs

The Mid-scale RI-2 solicitation specifically prohibited inclusion of operations costs in the individual project budgets, but proposers were required to present operations and utilization plans as well as estimates of full lifecycle costs. For each individual proposal considered for inclusion in the award portfolio, the lead directorate was required to estimate and commit to any additional operations costs in order to reap the scientific benefits of an award. At a hypothetical level of $220.0 million in awards from the first solicitation, and anticipating maximum operations costs of 10 percent of the capital costs per year, the total operations cost impact from the first round of Mid-scale RI-2 awards would ramp up to a steady state of no more than $22.0 million per year by about FY 2025. If any awarded proposals in the portfolio are upgrades to existing facilities or instrumentation, the anticipated increment to annual operations costs could be considerably less.