

**MAJOR RESEARCH EQUIPMENT  
AND FACILITIES CONSTRUCTION (MREFC)**

**\$229,750,000  
-\$13,480,000 / -5.5%**

**Major Research Equipment and Facilities Construction  
Funding**

(Dollars in Millions)

FY 2019 Actual	FY 2020 Estimate	FY 2021 Request	Change over FY 2020 Estimate	
			Amount	Percent
\$285.27	\$243.23	\$229.75	-\$13.48	-5.5%

**Overview**

The Major Research Equipment and Facilities Construction account supports the acquisition, construction, and commissioning of major and larger mid-scale research infrastructure that provide unique capabilities at the frontiers of science and engineering. Initial development, design, and post-construction operations and maintenance are funded through the R&RA account.

**MREFC Account Funding, by Project**

(Dollars in Millions)

	FY 2019 Actual	FY 2020 Estimate	FY 2021 Request	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate	FY 2025 Estimate	FY 2026 Estimate
AIMS	\$103.70	\$97.89	\$90.00	\$90.00	\$28.81	-	-	-
DKIST	19.59	-	-	-	-	-	-	-
HL-LHC Upgrade	-	33.00	33.00	36.00	33.00	18.00	-	-
Vera C. Rubin Observatory	53.48	46.34	40.75	5.36	-	-	-	-
Mid-scale Research Infrastructure <sup>1</sup>	-	65.00	65.00	65.00	65.00	65.00	65.00	65.00
NEON	0.07	-	-	-	-	-	-	-
RCRV	108.12	-	-	-	-	-	-	-
Dedicated Construction Oversight <sup>2</sup>	0.32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<b>Total</b>	<b>\$285.27</b>	<b>\$243.23</b>	<b>\$229.75</b>	<b>\$197.36</b>	<b>\$127.81</b>	<b>\$84.00</b>	<b>\$66.00</b>	<b>\$66.00</b>

<sup>1</sup> Mid-scale Research Infrastructure funding in the FY 2019 Actual is reflected in the R&RA account within Integrative Activities to support mid-scale infrastructure activities with an implementation cost between \$6 million and \$20 million or a design cost between \$600,000 and \$20 million. Mid-scale projects in this table have a total project cost between \$20 million and \$100 million. Outyear funding numbers for Mid-scale Research Infrastructure are assumed based on maintaining the program at a steady level in the future.

<sup>2</sup> Dedicated Construction Oversight in FY 2019 was funded from prior year recoveries.

Modern and effective research infrastructure is critical to maintaining U.S. international leadership in science and engineering. The future success of entire fields of research depends upon access to new generations of powerful research tools. Increasingly, these tools are large and complex and have a significant information technology or cyber-infrastructure component. To be considered for MREFC funding, NSF requires that a major multi-user research facility project represent an exceptional opportunity to enable research and education. The project should be transformative in nature, with the potential to shift the paradigm in scientific understanding. The major facility projects included in this budget request meet these criteria based on NSF and National Science Board review and approval. The mid-scale research infrastructure projects funded through this budget line are evaluated separately as described in the section below.

## Major Research Equipment and Facilities Construction

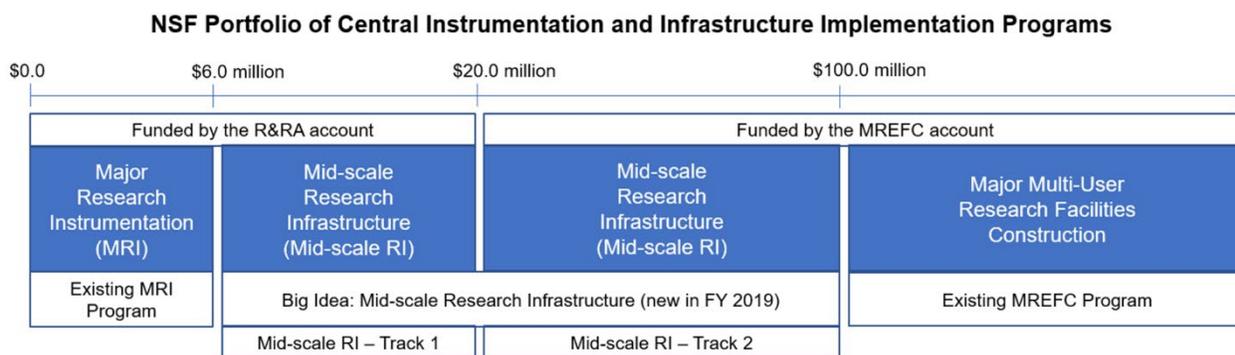
In FY 2021, NSF requests \$229.75 million for mid-scale research infrastructure and to continue construction on three ongoing major research facility projects; the Antarctic Infrastructure Modernization for Science (AIMS), the High Luminosity-Large Hadron Collider (HL-LHC) Upgrade, and the Vera C. Rubin Observatory (formerly the Large Synoptic Survey Telescope-LSST). For more information on each major facility project see the individual narratives later in this chapter.

### Major Facilities

Since FY 2009, major research facility projects funded through the MREFC account have been subject to NSF's "no cost overrun" policy. As a result, NSF processes and procedures must assure the development of realistic and well-supported total project cost estimates such that approved budgets for the award recipient are sufficient to accomplish the scientific objectives. The current policy as published in NSF's Major Facilities Guide (MFG) requires that: (1) the total project cost estimate when exiting the preliminary design phase includes adequate contingency to cover foreseeable risks manageable by the recipient; (2) any cost increases not covered by contingency be accommodated first by reductions in scope with any significant scope reductions reviewed by the agency prior to implementation; and (3) if the project is approved to continue and further scope reductions become too detrimental to science, then the first 10 percent of any cost increase must be covered by the sponsoring directorate through R&RA funding. NSF holds the risk to total project cost for events that are beyond the recipient's control.

### Mid-scale Research Infrastructure

The American Innovation and Competitiveness Act (AICA) of 2017 required the agency to develop a strategy for supporting research infrastructure with a total project cost above the upper limit for the Major Research Instrumentation (MRI) program, which is \$6.0 million including cost sharing, and below the lower threshold for the MREFC account, which was then at \$70.0 million. NSF has evaluated community demand through the issuance of a Request for Information (NSF 18-013)<sup>1</sup> that resulted in the submission of approximately \$10 billion in ideas for projects in the NSF cost range of \$20 - \$100 million. After evaluating that community input, existing mechanisms, and implementation options, NSF has included a dedicated funding line within the MREFC account for research infrastructure projects in the \$20 - \$100 million range.<sup>2</sup> This funding line supports upgrades to major facilities as well as stand-alone projects. Projects between \$6.0 million and \$20.0 million in total project cost are being addressed by individual directorates and by a new NSF-wide program drawing its heritage from the NSF-wide MRI program.



The graphic above shows NSF's centralized instrumentation and infrastructure programs. Information presented in this chapter focuses on the MREFC account. All Mid-scale Research Infrastructure (RI) –

<sup>1</sup> [www.nsf.gov/pubs/2018/nsf18013/nsf18013.jsp](http://www.nsf.gov/pubs/2018/nsf18013/nsf18013.jsp)

<sup>2</sup> The first NSF solicitation for large mid-scale projects covered the \$20 million to \$70 million range; NSF has extended that range up to \$100 million to achieve consistency with AICA definitions regarding the threshold for major facility projects.

Track 2 investments will be managed as a single portfolio, with individual projects selected from submissions to a dedicated program solicitation and NSF's merit review process. The NSF-established thresholds for Mid-scale RI – Track 2 projects and major facilities construction projects have been updated from initial presentations to provide for greater consistency with AICA definitions. Information on Mid-scale RI programs (Tracks 1 and 2), as part of the Mid-scale Big Idea, can be found in the Mid-scale narrative in the NSF-wide priorities chapter. Information on the MRI program can be found in the IA narrative in the R&RA chapter.

### **Dedicated Construction Oversight**

All projects funded through the MREFC account undergo periodic cost, schedule, and risk reviews as required by the MFG and the terms and conditions of the cooperative agreements. NSF policies and routine reporting are designed to ensure timely and reliable tracking of progress including the use of Earned Value Management, project spending, and use of contingency, and that program managers and recipients each have sufficient oversight and management authority (respectively) to meet project objectives.

NSF has greatly strengthened its oversight of major facility projects in recent years, with a number of those enhancements now codified in AICA. One significant enhancement is holding a portion of budget contingency (up to 100 percent) and only allocating contingency funds for obligation to the project based on demonstrated need. This oversight mechanism will generally result in some MREFC carryover each year. However, future obligation of this carryover is anticipated to manage project risks. Enhanced oversight of the construction stage now also includes mandatory incurred cost audits and independent cost estimates, as well as other audits and reviews based on NSF's annual major facility portfolio risk assessment. These efforts are conducted by NSF and are generally not attributable to a specific project at the time of budget formulation, nor are they part of the total project cost developed and managed by the recipient. To properly support and transparently account for these efforts, actual costs and future estimates for Dedicated Construction Oversight are shown separately from each project in the MREFC account table. From FY 2017 through FY 2019, these activities were supported with funds recovered from projects completed in previous years. Beginning in FY 2020, dedicated funding was requested for these activities in the MREFC account.

Oversight of the mid-scale research infrastructure projects is more flexible and tailored to the technical nature of the project. All mid-scale research infrastructure projects funded through the MREFC account will be required to provide a detailed Project Execution Plan for review. The MFG, Section 5, notes that the detailed oversight requirements, and application of major facility oversight practices, will depend on characteristics such as the technical scope, type and mix of work performed, and assessment of the technical and programmatic risks.<sup>3</sup>

### **Appropriations Language**

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950 (42 U.S.C. 1861 et seq.), including authorized travel, ~~\$243,230,000~~\$229,750,000, to remain available until expended.

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<sup>3</sup> AICA currently requires the same level of oversight for all projects funded through the MREFC account. NSF is currently seeking a slight modification of AICA language to enable large mid-scale projects to have the more tailored oversight discussed in the MFG.

*Major Research Equipment and Facilities Construction*

**Major Research Equipment and Facilities Construction  
FY 2021 Summary Statement  
(Dollars in Millions)**

	Enacted/ Request	Unobligated Balance Available Start of Year	Unobligated Balance Available End of Year	Adjustments to Prior Year Accounts	Transfers	Obligations Actual/ Estimates
FY 2019 Appropriation	\$295.74	\$28.43	-\$38.95	\$0.05	-	\$285.27
FY 2020 Enacted	243.23	38.95				282.18
FY 2021 Request	229.75					229.75
\$ Change from FY 2020 Enacted						-\$52.43
% Change from FY 2020 Enacted						-18.6%

**Explanation of Carryover**

Within the Major Research Equipment and Facilities Construction (MREFC) account, \$38.95 million was carried over into FY 2020.

Regional Class Research Vessels

- Amount: \$35.97 million
- Purpose: Budget contingency funding not obligated in FY 2019.
- Obligation: Anticipated FY 2020 Quarter 3

Vera C. Rubin Observatory

- Amount: \$82,943
- Purpose: Budget contingency funding not obligated in FY 2019.
- Obligation: Anticipated FY 2020 Quarter 3

National Ecological Observatory Network

- Amount: \$1.35 million
- Purpose: NSF-held management reserve funding not obligated in FY 2019.
- Obligation: Anticipated FY 2020 Quarter 3

Dedicated Construction Oversight

- Amount: \$64,155
- Purpose: Budget contingency funding not obligated in FY 2019.
- Obligation: Anticipated FY 2020 Quarter 4

The remaining MREFC carryover of \$1.48 million resulted from downward adjustments recovered at the close of FY 2019.