

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

**\$223,230,000  
-\$72,510,000 / -24.5%**

**Major Research Equipment and Facilities Construction Funding  
(Dollars in Millions)**

|              | FY 2018<br>Actual | FY 2019<br>Enacted | FY 2020<br>Request | Change over<br>FY 2019 Enacted<br>Amount | Percent       |
|--------------|-------------------|--------------------|--------------------|--|---------------|
| <b>MREFC</b> | <b>\$186.30</b>   | <b>\$295.74</b>    | <b>\$223.23</b>    | <b>-\$72.51</b>                          | <b>-24.5%</b> |

**MREFC Overview**

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

**MREFC Account Funding, by Project**

(Dollars in Millions)

|  | FY 2018<br>Actual | FY 2019<br>Enacted | FY 2020<br>Request | FY 2021<br>Estimate | FY 2022<br>Estimate | FY 2023<br>Estimate | FY 2024<br>Estimate | FY 2025<br>Estimate |
|--|-------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| AIMS   | -                 | \$103.70           | \$97.89            | \$90.00             | \$90.00             | \$28.81             | -                   | -                   |
| DKIST <sup>1</sup>                             | 18.24             | 16.13              | -                  | -                   | -                   | -                   | -                   | -                   |
| HL-LHC Upgrade                                 | -                 | -                  | 33.00              | 33.00               | 33.00               | 33.00               | 18.00               | -                   |
| LSST <sup>1</sup>                              | 66.70             | 48.82              | 46.34              | 40.75               | 5.36                | -                   | -                   | -                   |
| Mid-scale Research Infrastructure <sup>2</sup> | -                 | -                  | 45.00              | <i>TBD</i>          | <i>TBD</i>          | <i>TBD</i>          | <i>TBD</i>          | <i>TBD</i>          |
| NEON <sup>3</sup>                              | 12.79             | -                  | -                  | -                   | -                   | -                   | -                   | -                   |
| RCRV <sup>1</sup>                              | 88.00             | 127.09             | -                  | -                   | -                   | -                   | -                   | -                   |
| Dedicated Construction Oversight <sup>4</sup>  | 0.56              | [1.00]             | 1.00               | 1.00                | 1.00                | 1.00                | 1.00                | 1.00                |
| <b>Total</b>                                   | <b>\$186.30</b>   | <b>\$295.74</b>    | <b>\$223.23</b>    | <b>\$164.75</b>     | <b>\$129.36</b>     | <b>\$62.81</b>      | <b>\$19.00</b>      | <b>\$1.00</b>       |

<sup>1</sup> Of the funding appropriated to DKIST, LSST, and RCRV, \$3.46 million, \$4.74 million, and \$17.0 million, respectively, is excluded in the amounts above. This is being held as part of NSF's enhanced oversight of budget contingency

<sup>2</sup> Mid-scale Research Infrastructure funding in the FY 2019 Request is reflected in the R&RA account within Integrative Activities. In the FY 2020 Request, \$30.0 million remains in Integrative Activities to support mid-scale infrastructure in the \$6 million to \$20 million range. Outyear funding levels for Mid-scale will be shown in future budget requests.

<sup>3</sup> No new funds were appropriated for NEON in FY 2018. The FY 2018 Actual obligations reflect spending of prior year carryover in FY 2018, and \$1.42 million was carried over for future obligation.

<sup>4</sup> In FY 2019, support for Dedicated Construction Oversight activities will be 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 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 research infrastructure projects included in this budget request meet these criteria based on NSF and National Science Board review and approval. The mid-scale projects funded through this budget line are evaluated separately as described in the section below.

In FY 2020, NSF requests \$223.23 million for mid-scale research infrastructure and to continue construction on four ongoing major research infrastructure projects: the Antarctic Infrastructure

## Major Research Equipment and Facilities Construction

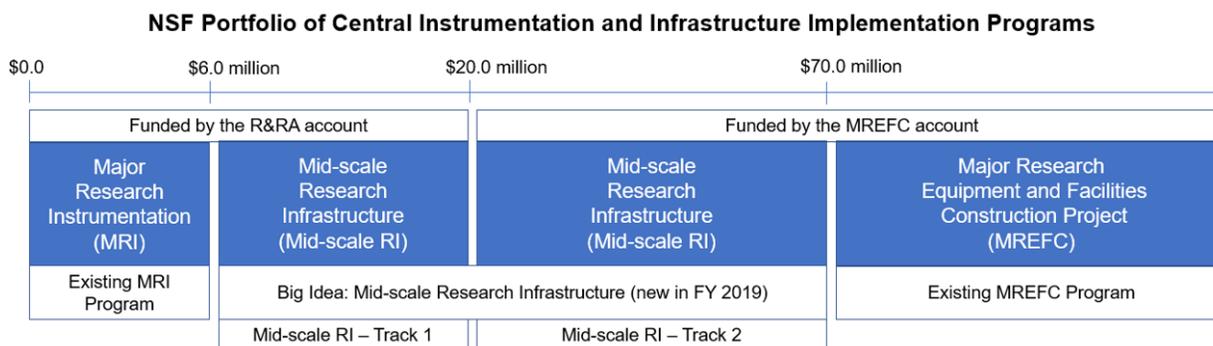
Modernization for Science (AIMS), the High Luminosity-Large Hadron Collider (HL-LHC), the Large Synoptic Survey Telescope (LSST), and the Regional Class Research Vessels (RCRV). For more information on each major research infrastructure project see the individual narratives later in this chapter.

### Major Research Infrastructure (Major Facilities)

Since FY 2009, major research infrastructure 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 are sufficient to accomplish the scientific objectives. The current policy as published in NSF's Large Facilities Manual (to be replaced by the Major Facilities Guide, or MFG, by the start of FY 2020) requires that: (1) the total project cost estimate when exiting the preliminary design phase includes adequate contingency to cover foreseeable risks; (2) any cost increases not covered by contingency be accommodated first by reductions in scope, provided that the actual enacted funding levels have been consistent with the established annual cash flow requirements; 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 transferred to MREFC, with Congressional approval.

### Mid-scale Research Infrastructure

As part of the American Innovation and Competitiveness Act (AICA) of 2017, Congress 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, \$5.71 million, and below the lower threshold for the MREFC account, \$70 million. NSF has evaluated community demand through the issuance of a Request for Information (NSF 18-013) 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 is proposing a new dedicated line within the MREFC account for research infrastructure projects in the \$20 - \$70 million range. Prior to this, such large mid-scale projects could only be minimally supported by the individual directorates due to constraints on R&RA funding. This dedicated funding line implements a high-priority, agency-wide mechanism that includes upgrades to major facilities as well as stand-alone projects, such that all research infrastructure investments above \$20 million will be managed as a single portfolio. Individual projects will be selected from submissions to a dedicated program solicitation developed in FY 2019, using NSF's merit review process. Once selected, funding will be allocated from the MREFC account to the responsible directorate for award. The lower part of the mid-scale gap, between \$6 million and \$20 million in Total Project Cost, will be addressed by the individual directorates and by a new program drawing its heritage from the NSF-wide MRI program.



This graphic shows NSF's central instrumentation and infrastructure programs. Information presented in this chapter focuses on the MREFC account. Information on Mid-scale Research Infrastructure programs, Mid-scale track 1 and track 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 reporting requirements are designed to ensure routine and reliable tracking of progress (including the use of Earned Value Management), project spending, and use of contingency, and that program 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 Enhanced Oversight are shown separately from each project in the MREFC account table. In FY 2017 and FY 2018, these activities were supported with funds recovered from projects completed in previous years. In FY 2019 and FY 2020, funding is requested for these activities in the MREFC account.

**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, ~~\$94,650,000~~, ~~\$223,230,000~~, to remain available until expended.

**Major Research Equipment and Facilities Construction  
FY 2020 Summary Statement  
(Dollars in Millions)**

|                                | Enacted/<br>Request | Unobligated<br>Balance Available<br>Start of Year | Unobligated<br>Balance Available<br>End of Year | Adjustments<br>to Prior Year<br>Accounts | Transfers | Obligations<br>Actual/<br>Estimates |
|--------------------------------|---------------------|---|---|--|-----------|-------------------------------------|
| FY 2018 Appropriation          | \$182.80            | \$31.36   | -\$28.43  | \$0.57                                   | -         | \$186.30                            |
| FY 2019 Annualized CR          | 182.80              | 28.43   |   |  |           | 211.23                              |
| FY 2019 Enacted                | 295.74              |   |   |  |           | 295.74                              |
| FY 2020 Request                | 223.23              |   |   |  |           | 223.23                              |
| \$ Change from FY 2019 Enacted |                     |   |   |  |           | -\$72.51                            |
| % Change from FY 2019 Enacted  |                     |   |   |  |           | -24.5%                              |

**Explanation of Carryover**

Within the Major Research Equipment and Facilities Construction (MREFC) account, \$28.43 million was carried over into FY 2019.

**Regional Class Research Vessels**

- Amount: \$17.0 million
- Reason: FY 2017 appropriation exceeded project requirements and unobligated FY 2018 budget

*Major Research Equipment and Facilities Construction*

contingency.

- Obligation: Anticipated FY 2019 Quarter 3; and combined with FY 2019 funding to exercise option on the third hull.

Large Synoptic Survey Telescope

- Amount: \$4.74 million
- Reason: Budget contingency funding not obligated in FY 2018.
- Obligation: Anticipated FY 2019 Quarter 3

Daniel K. Inouye Solar Telescope

- Amount: \$3.46 million
- Reason: Budget contingency funding not obligated in FY 2018.
- Obligation: Anticipated FY 2019 Quarter 4

National Ecological Observatory Network

- Amount: \$1.42 million
- Reason: Budget contingency funding not obligated in FY 2018.
- Obligation: Anticipated FY 2019 Quarter 3

Dedicated Construction Oversight

- Amount: \$1.24 million
- Reason: Budget contingency funding not obligated in FY 2018.
- Obligation: Anticipated FY 2019 Quarter 4

The remaining \$570,000 consists of funds from selected projects that were not ready for obligation in FY 2018.