

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

**\$187,230,000**

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

	FY 2021		FY 2022	FY 2023	Change over	
FY 2021	ARP	FY 2022	FY 2023	FY 2021 Actual		
Actual	Actual	Request	Request	Amount	Percent	
\$161.27	\$8.95	\$249.00	\$187.23	\$25.96	16.1%	

**Overview**

The Major Research Equipment and Facilities Construction account supports the acquisition, construction, and commissioning of major facilities 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 2021		FY 2022 <sup>1</sup>	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
	Actual	Actual	Request	Request	Estimate	Estimate	Estimate	Estimate	Estimate
Antarctic Infrastructure Recapitalization	\$3.86	-	\$90.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00
DKIST	9.38	8.95	-	-	-	-	-	-	-
HL-LHC Upgrade	28.74	-	36.00	33.00	38.00	-	-	-	-
Mid-scale Research Infrastructure <sup>2</sup>	74.04	-	76.25	76.25	76.25	76.25	76.25	76.25	76.25
RCRV <sup>3</sup>	10.98	-	5.00	1.98	-	-	-	-	-
Vera C. Rubin Observatory	34.09	-	40.75	15.00	7.61	-	-	-	-
Dedicated Construction Oversight	0.17	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<b>Total</b>	<b>\$161.27</b>	<b>\$8.95</b>	<b>\$249.00</b>	<b>\$187.23</b>	<b>\$182.86</b>	<b>\$137.25</b>	<b>\$137.25</b>	<b>\$137.25</b>	<b>\$137.25</b>

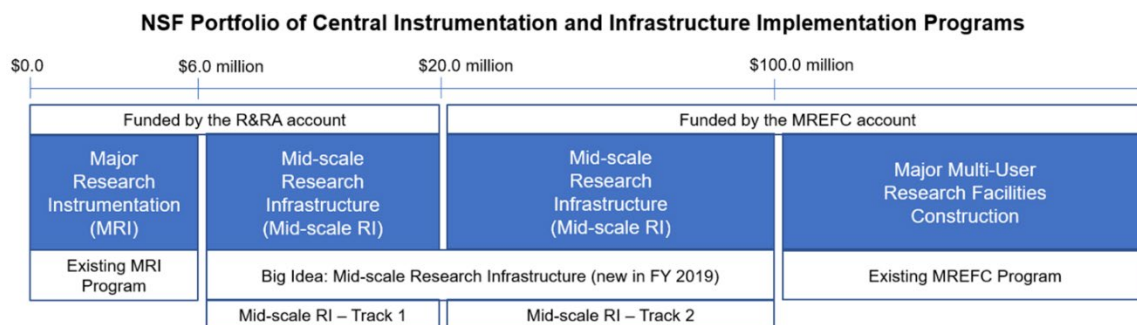
<sup>1</sup> A total of \$260.21 million was carried forward from FY 2021 into FY 2022 including \$51.05 million in ARP funding: \$73.68 million for Mid-scale RI including \$6.45 million in ARP funding, \$115.84 million for AIMS, \$14.05 million in ARP funding for RCRV, \$46.74 million for the Rubin Observatory including \$30.0 million in ARP funding, \$553,350 in ARP funding for DKIST, \$4.26 million for LHC, and \$830,000 for Dedicated Construction Oversight.

<sup>2</sup> Outyear amounts are for planning purposes only. NSF will evaluate Mid-Scale Research Infrastructure in the context of agency priorities for future budgets

<sup>3</sup> FY 2022 Request excludes \$25.0 million in one-time funding for necessary expenses related to RCRV construction impacted by Hurricane Ida as provided in P.L. 117-43, the "Extending Government Funding and Delivering Emergency Assistance Act."

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. Over time, these tools are becoming larger and more technically 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 (major 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 a distinct section below.

## Major Research Equipment and Facilities Construction



The graphic above summarizes NSF's centralized instrumentation and infrastructure programs. Information presented in this chapter focuses on the items funded at levels above \$20.0 million, through the MREFC account. All Mid-scale Research Infrastructure (RI) – Track 2 (Mid-scale RI-2) investments are managed as a single portfolio, with individual projects selected from submissions to a dedicated program solicitation and evaluated using 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 earlier presentations to provide for greater consistency with definitions in the 2017 American Innovation and Competitiveness Act (AICA), as amended by the National Defense Authorization Act (NDAA) for FY 2021. Information on the Mid-scale RI program (Tracks 1 and 2) can be found in the Mid-scale section of the Big Ideas narrative within the NSF-wide Investments chapter. Information on the Major Research Instrumentation (MRI) program can be found in the Integrative Activities narrative in the R&RA chapter.

In FY 2023, NSF requests a total of \$187.23 million to support mid-scale research infrastructure and continued construction on four ongoing major facility projects; Antarctic Infrastructure Recapitalization (AIR),<sup>1</sup> the High Luminosity-Large Hadron Collider (HL-LHC) Upgrade, the Vera C. Rubin Observatory, and Regional Class Research Vessels (RCRV). For more information on each major facility project, see the individual narratives later in this chapter.

### Major Facilities

Since FY 2009, major 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 Research Infrastructure Guide (RIG) 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 impacts resulting from unforeseen

<sup>1</sup> "Antarctic Infrastructure Recapitalization (AIR)" replaces the item called Antarctic Infrastructure Modernization for Science (AIMS) in previous budget requests. Appropriated funds from FY 2021 and a fraction of the funds requested from FY 2022 will be used to complete a re-baselined AIMS project. The nature of Antarctic infrastructure investments has been revised in light of the impacts of COVID-19.

events that are beyond the recipient's control. The ongoing COVID-19 pandemic constituted such an unforeseen event for all major facility construction projects, and mitigation of that risk continues to fall outside the "no cost overrun policy" and the use of contingency. NSF policy allows for both authorization of management reserve and re-baselining, with a subsequent increase in total project cost, to address the consequences of unforeseen events. The overall NSF response to COVID-19 for its major facilities is described at the end of this section.

### **Mid-scale Research Infrastructure**

AICA required the agency to develop a strategy for supporting research infrastructure with a total project cost above the upper limit for the 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 assessed community demand that resulted in the submission of approximately \$10.0 billion in ideas for projects in the NSF cost range of \$20.0-\$100.0 million. After evaluating that community input, existing mechanisms, and implementation options, NSF included a dedicated funding line within the MREFC account beginning in FY 2020 for research infrastructure projects in the \$20.0-\$70.0 million range. The upper limit has been increased to \$100.0 million in the second Mid-scale RI-2 solicitation to align with the lower threshold defining a major facility project as given in the FY 2021 NDAA, which amended the original AICA definition. This funding line supports upgrades to major facilities as well as stand-alone projects. Projects with total project costs between \$6.0 million and \$20.0 million are addressed by individual directorates and through an NSF-wide program (Mid-scale RI-1) that draws its heritage from the NSF-wide MRI program.

### **Dedicated Construction Oversight**

All major facility projects funded through the MREFC account undergo periodic cost, schedule, and risk reviews as required by the RIG and the terms and conditions of the cooperative agreements or contracts governing the projects. 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.

Enhanced oversight of the construction stage includes mandatory incurred cost audits, Earned Value Management System surveillance, and re-baseline 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.

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 are required to provide a detailed Project Execution Plan for review. The RIG, Section 5, notes that the detailed oversight requirements, and application of major facility oversight practices, depend on characteristics such as the technical scope, type and mix of work performed, and assessment of the technical and programmatic risks.

## Continued COVID-19 Impacts on MREFC Projects

Beginning in FY 2020 and continuing into FY 2022, NSF has increased investments in programs that aid institutions and groups of people most strongly impacted by COVID-19, with an emphasis on supporting individuals at vulnerable career transition points. The COVID-19 pandemic constitutes an unforeseen event that was not within the control of the recipients managing the ongoing major facility construction projects. NSF expects most or all of these projects to cost more than their originally authorized total project costs, which only included sufficient contingency to cover the known risks that were within the recipient's control. NSF had policies for responding to unforeseen events that were established in advance of the COVID-19 pandemic, which subsequently have been further refined to support the current situation.

Funding for FY 2022, the FY 2023 Request, and out-year forecasts for all projects have been adjusted from previous estimates based on NSF's current assessment of COVID-19 impacts. As appropriate, re-baselining of several projects will continue to take place, as cost and schedule impacts become better known. Impacts due to COVID-19 that can now be forecast (e.g., higher personnel costs and slower progress due to known social-distancing and quarantining requirements) are included in the re-baseline as known risks. Potential impacts that cannot be forecast (e.g., deteriorating circumstances because of the impact of a new COVID-19 variant) are held as agency-level risks that would be covered by application of management reserve, in accordance with existing policy described in the RIG. Further details for each project can be found in the individual narratives later in this chapter.

## 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, ~~\$249,000,000~~187,230,000, to remain available until expended.

### Major Research Equipment and Facilities Construction FY 2023 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 2021 Appropriation	\$301.00	\$129.35	-\$260.21	\$0.08	-	\$170.22
FY 2022 Annualized CR	241.00	260.21				501.21
FY 2022 CR ( Emergency funding H.R 5305) <sup>1</sup>	25.00					25.00
FY 2023 Request	187.23					187.23
\$ Change from FY 2022 Annualized CR						-\$313.98
% Change from FY 2022 Annualized CR						-62.6%

<sup>1</sup>FY 2022 CR includes \$25.0 million for necessary expenses related to Regional Class Research Vessel construction impacted by Hurricane Ida, to remain available until expended.

## Explanation of Carryover

Within the MREFC account, \$260.21 million (including \$51.05 million in American Rescue Plan Funding) was carried over into FY 2022.

### *Mid-scale Research Infrastructure Track 2 (Mid-scale RI-2)*

- Amount: \$73.68 million (including \$6.45 million in American Rescue Plan funding)
- Purpose: Funding for continuing Mid-scale Track 2 awards, awards pending independent cost estimates required by Congress in the American Innovation and Competitiveness Act (AICA), and to complete the NSF cost analysis on the new projects prior to award.
- Obligation: FY 2022 Quarter 1–2 and remaining amounts to be obligated in Quarter 3.

### *Antarctic Infrastructure Recapitalization (AIR)*

- Amount: \$115.84 million
- Purpose: Baseline and budget contingency funding not obligated in FY 2021.
- Obligation: FY 2022 Quarter 3.

### *Regional Class Research Vessel (RCRV)*

- Amount: \$14.05 million in American Rescue Plan funding
- Purpose: Management reserve funding not obligated in FY 2021.
- Obligation: FY 2022 Quarter 1-2.

### *Vera C. Rubin Observatory*

- Amount: \$46.74 million (including \$30.0 million in American Rescue Plan funding)
- Purpose: Management reserve funding not obligated in FY 2021.
- Obligation: FY 2022 Quarter 1–2 and remaining amounts to be obligated in Quarter 3.

### *Daniel K. Inouye Solar Telescope (DKIST)*

- Amount: \$553,350 in American Rescue Plan funding
- Purpose: Management reserve funding not obligated in FY 2021.
- Obligation: FY 2022 Quarter 3.

### *High-Luminosity Large Hadron Collider (HL-LHC)*

- Amount: \$4.26 million
- Purpose: Management reserve funding not obligated in FY 2021.
- Obligation: FY 2022 Quarter 3.

### *Dedicated Construction Oversight*

- Amount: \$830,000
- Purpose: Support for major facility construction oversight required under AICA and NSF policy, National Ecological Observatory Network construction close-out.
- Obligation: FY 2022 Quarter 1–2 and remaining amounts to be obligated in Quarter 3.