

## MAJOR MULTI-USER RESEARCH FACILITIES

### Major Multi-User Research Facilities Funding

(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over FY 2018 Actual	
				Amount	Percent
<b>Total Research and Related Activities</b>	<b>\$1,082.51</b>	-	<b>\$866.55</b>	<b>-\$215.96</b>	<b>-19.9%</b>
Operations and Maintenance of Existing Facilities	714.73	-	605.10	-109.63	-15.3%
Federally Funded Research and Development Centers	291.94	-	240.04	-51.90	-17.8%
Operations and Maintenance of Facilities under Construction	33.10	-	17.01	-16.09	-48.6%
R&RA Design Stage Activities	42.74	-	4.40	-38.34	-89.7%
<b>Major Research Equipment and Facilities Construction</b>	<b>\$185.73</b>	-	<b>\$222.23</b>	<b>\$36.50</b>	<b>19.6%</b>
<b>Total, Major Multi-User Research Facilities</b>	<b>\$1,268.24</b>	-	<b>\$1,088.78</b>	<b>-\$179.46</b>	<b>-14.2%</b>

NSF investments in major multi-user research facilities (major facilities) provide large, state-of-the-art tools for research and education. These can include instrumentation networks, observatories, accelerators, telescopes, research vessels, aircraft, and simulators. In addition, scientific utilization of cyber-enabled and geographically-distributed facilities continues to increase as a result of rapid advances in computer, information, and communication technologies. NSF's investments are coordinated with those of other organizations, federal agencies, and international partners to ensure they are complementary and well-integrated. Planning, operations, and maintenance of major facilities are funded through the R&RA account. Most construction is funded through the MREFC account.

In FY 2018, NSF created the new position of Chief Officer for Research Facilities in the Office of the Director, to enhance oversight of major facilities throughout their complete lifecycle. The individual in that position serves as the senior agency official whose responsibility is oversight of the development, construction, and operations of major facilities across the Foundation, as required by Section 110 of the American Innovation and Competitiveness Act (P.L. 114-329).

The Facility Operation Transition activity proposed in the Integrative Activities (IA) section is a pilot program that reflects NSF's strategic commitment to successful operations and maintenance (O&M) of new major facilities as well as balancing portfolio funding between facilities and investigator research, both of which were emphasized in the NSB's Congressionally requested 2018 report entitled "Study of Operations and Maintenance Costs for NSF Facilities" (NSB-2018-17).<sup>1</sup> NSB envisioned a more flexible MREFC account as one way to achieve these goals; owing to the challenges that would be introduced by maintaining separate construction and operations funding in the MREFC line, the recommended strategic funding is requested in the R&RA account instead. The funds in this activity will be used to (1) partially support initial O&M of new facilities so that the full O&M costs can be gradually absorbed into the managing division or directorate, and (2) partially support divestment of lower-priority facilities, the full cost of which may significantly impact individual division or directorate funding.

A total of \$10 million is requested for the Facility Operation Transition activity. Of this amount, \$8 million will support O&M for NSF facilities that are within the first five years of their operational life—the Ocean

<sup>1</sup> National Science Board, *Study of Operations and Maintenance Costs for NSF Facilities* (NSB-2018-17), May 2018, [www.nsf.gov/pubs/2018/nsb201817/nsb201817.pdf](http://www.nsf.gov/pubs/2018/nsb201817/nsb201817.pdf).

## *Major Multi-User Research Facilities*

Observatories Initiative (OOI), the National Ecological Observatory Network (NEON), and the Daniel K. Inouye Solar Telescope (DKIST). This funding will be divided among the three facilities in proportion to their total O&M requirements. This amount is less than 10 percent of the O&M costs of these three facilities, so that the majority of the funding remains the responsibility of the managing directorate. The Facility Operation Transition funds will assist the research directorates in sustaining the core research needed to take advantage of the new facility capabilities. The remaining \$2 million for this activity will support an analysis of NSF's facilities portfolio in order to determine science priorities and divestment opportunities, as well as investments in actual divestment activities. The distribution of IA support between facilities O&M and divestment will be re-evaluated annually as new facilities come online and lower-priority facilities are removed from NSF's portfolio. This program as a whole will be reevaluated after three years to determine whether it should be modified, continued, or ended.

This chapter provides descriptions of each major facility supported through the R&RA account and provides funding information by lifecycle phase for each facility. The information presented for each facility follows the overall framework established by NSF for major facility projects. Information on projects under construction and funded through NSF's MREFC account is provided in the MREFC chapter. The following pages contain information on NSF's major facilities in FY 2020.

**MAJOR MULTI-USER RESEARCH FACILITIES FUNDING, BY PROJECT**

(Dollars in Millions)

	FY		Change over	
	FY 2018 Actual <sup>1</sup>	2019 (TBD)	FY 2020 Request	FY 2018 Actual Amount Percent
<b>Operations and Maintenance of Major Facilities</b>	<b>\$1,039.77</b>	-	<b>\$861.94</b>	<b>-\$177.83 -17.1%</b>
<b>Biological Sciences</b>	<b>\$67.90</b>	-	<b>\$62.60</b>	<b>-\$5.30 -7.8%</b>
National Ecological Observatory Network (NEON)	67.90	-	62.60	-5.30 -7.8%
<b>Engineering</b>	<b>\$22.37</b>	-	<b>\$11.75</b>	<b>-\$10.62 -47.5%</b>
Natural Hazards Engineering Research Infrastructure (NHERI)	22.37	-	11.75	-10.62 -47.5%
<b>Geosciences</b>	<b>\$342.11</b>	-	<b>\$293.40</b>	<b>-\$48.71 -14.2%</b>
Academic Research Fleet <sup>2</sup>	86.03	-	74.10	-11.93 -13.9%
Geodesy Advancing Geosciences and EarthScope (GAGE)	12.66	-	12.64	-0.02 -0.1%
International Ocean Discovery Program (IODP)	47.55	-	45.80	-1.75 -3.7%
National Center for Atmospheric Research (NCAR) FFRDC	126.34	-	99.70	-26.64 -21.1%
Ocean Observatories Initiative (OOI)	44.08	-	38.00	-6.08 -13.8%
Seismological Facilities for the Advancement of Geoscience & EarthScope (SAGE)	25.45	-	23.16	-2.29 -9.0%
<b>Mathematical and Physical Sciences</b>	<b>\$368.57</b>	-	<b>\$295.05</b>	<b>-\$73.52 -19.9%</b>
Arecibo Observatory	13.52	-	4.26	-9.26 -68.5%
Cornell High Energy Synchrotron Source (CHESS)	22.00	-	7.00	-15.00 -68.2%
Gemini Observatory	34.02	-	20.28	-13.74 -40.4%
Large Hadron Collider (LHC) - ATLAS and CMS <sup>3</sup>	15.86	-	20.00	4.14 26.1%
Large Synoptic Survey Telescope (LSST)	11.10	-	-	-11.10 -100.0%
Laser Interferometer Gravitational Wave Observatory (LIGO) <sup>4</sup>	39.43	-	44.60	5.17 13.1%
National High Magnetic Field Laboratory (NHMFL)	54.16	-	36.78	-17.38 -32.1%
National Optical Astronomy Observatory (NOAO) FFRDC	26.76	-	22.91	-3.85 -14.4%
National Radio Astronomy Observatory (NRAO) FFRDC <sup>5</sup>	83.01	-	85.66	2.65 3.2%
National Solar Observatory (NSO) FFRDC <sup>6</sup>	30.82	-	21.14	-9.68 -31.4%
National Superconducting Cyclotron Laboratory (NSCL)	24.00	-	22.00	-2.00 -8.3%
Other Astronomical Facilities FFRDC <sup>7</sup>	13.91	-	10.42	-3.49 -25.1%
<b>Office of Polar Programs</b>	<b>\$238.82</b>	-	<b>\$199.14</b>	<b>-\$39.68 -16.6%</b>
Antarctic Facilities and Operations <sup>8</sup>	231.82	-	192.14	-39.68 -17.1%
IceCube Neutrino Observatory	7.00	-	7.00	-0.00 -0.0%
<b>Major Research Facilities Construction Investments</b>	<b>\$228.47</b>	-	<b>\$226.63</b>	<b>-\$1.84 -0.8%</b>
<b>R&amp;RA Design Stage Activities<sup>9</sup></b>	<b>\$42.74</b>	-	<b>\$4.40</b>	<b>-\$38.34 -89.7%</b>
<b>Major Research Equipment and Facilities Construction (MREFC)</b>	<b>\$185.73</b>	-	<b>\$222.23</b>	<b>\$36.50 19.6%</b>
<b>Total, Major Multi-User Research Facilities</b>	<b>\$1,268.24</b>	-	<b>\$1,088.57</b>	<b>-\$179.67 -14.2%</b>

FFRDC is an acronym for Federally-Funded Research and Development Center.

<sup>1</sup> In FY 2018 Congress appropriated additional one-time funding to NSF above the Request level, which was in part allocated to numerous major facilities. These include: NEON, NHERI, Academic Research Fleet, NCAR, Antarctic Facilities & Operations, CHESS, Gemini, LHC, LIGO, NHMFL, NOAO, NRAO, and NSO. In addition, Arecibo Observatory and NRAO received supplemental appropriations (PL 115-123) in the amount of \$16.30 million. For more information, please refer to the individual narratives in the Facilities chapter.

<sup>2</sup> Includes ship operations and upgrade support. ALVIN operations and upgrade is also included here. For more information on which vessels are considered major facilities, please refer to the Academic Fleet narrative. Regional Class Research Vessels (RCRV) began construction in FY 2017 and is included in the MREFC line below.

<sup>3</sup> Excludes \$16.60 million in FY 2018 for planning for a potential High-Luminosity LHC upgrade. That funding is captured on the R&RA Design Stage Activities line below.

<sup>4</sup> Excludes \$10.0 million in FY 2018 and \$400,000 in FY 2020 for LIGO A+. That funding is captured on the R&RA Design Stage Activities line below.

<sup>5</sup> Includes operations and maintenance support for the Atacama Large Millimeter Array of \$38.55 million in FY 2018 and \$47.26 million in FY 2020. FY 2020 includes \$3.43 million for the reintegration of the Long Baseline Observatory (LBO). Also included is early developmental funding for the potential next generation Very Large Array (ngVLA) of \$6.0 million in FY 2018.

<sup>6</sup> Includes \$22.0 million in FY 2018 and \$17.01 in FY 2020 for operations and maintenance support for the Daniel K. Inouye Solar Telescope (DKIST) facility construction project.

<sup>7</sup> Includes funding in FY 2018 for the Green Bank Observatory (GBO) and the Long Baseline Observatory (LBO). FY 2020 funding includes support for GBO only as LBO funding is reintegrated into NRAO beginning in FY 2019. \$2.0 million is included in each year for cultural mitigation activities as agreed to during the environmental compliance process for DKIST.

<sup>8</sup> Excludes \$16.14 million in FY 2018 for planning AIMS. That funding is captured on the R&RA Design Stage Activities line below.

<sup>9</sup> Design Stage Activities include support for potential next generation multi-user facilities. This line reflects funding for AIMS in FY 2018 (\$16.14 million); for a potential HL-LHC in FY 2018 (\$16.60 million, of which \$7.50 million funds FY 2019 and FY 2020 activities); for LIGO A+ (\$10.0 million in FY 2018 and \$400,000 in FY 2020); and for the potential Leadership Class Computing Facility in FY 2020 (\$4.0 million).