

ANTARCTIC INFRASTRUCTURE RECAPITALIZATION (AIR)**\$60,000,000**

**Appropriated and Requested MREFC Funds for the
for the Antarctic Infrastructure Modernization for Science (AIMS) Project and the
Antarctic Infrastructure Recapitalization (AIR) Program**

(Dollars in Millions)

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023 Estimate	FY 2024 Request	Total Project
Authorized AIMS Total Project Cost	\$103.70	\$97.89	\$90.00	\$90.00	\$28.81	-	\$410.40
COVID-19 Adjustment	-	-19.40	-	-	-	-	-19.40
Unfunded AIMS scope transferred to AIR	-	-	-	-87.19	-28.81	-	-116.00
Revised Estimated AIMS Total Project Cost	\$103.70	\$78.49	\$90.00	\$2.81	-	-	\$275.00
AIR Request	-	-	-	87.19	60.00	60.00	TBD
AIMS+AIR TOTAL	\$103.70	\$78.49	\$90.00	\$90.00	\$60.00	\$60.00	TBD

Brief Description

The Antarctic Infrastructure Recapitalization (AIR) program is a portfolio of investments in facilities and infrastructure across U.S. Antarctic Program (USAP) stations and gateways that will assure safety, enhance efficiency, increase resilience, and support USAP’s continued scientific leadership on the continent. As discussed below, FY 2022 funding supported the newly re-baselined Antarctic Infrastructure Modernization for Science project (AIMS) and initial activities within the broader recapitalization portfolio of NSF’s Antarctic infrastructure under the AIR program.

Previously funded AIMS construction continues, with a focus on meeting near-term needs—the Vehicle Equipment and Operations Center and the Lodging Building. The FY 2023 and FY 2024 Requests of \$60.0 million each will be used to fund activities within the AIR program exclusively.

Baseline History

In 2011, the Office of Science and Technology Policy and NSF convened a Blue Ribbon Panel (BRP) to conduct a review of NSF facilities and operations supporting science in Antarctica and to ensure that those facilities could enable scientific opportunities articulated by an earlier 2011 National Research Council (NRC) report, *Future Science Opportunities in Antarctica and the Southern Ocean*.¹ The BRP report, *More and Better Science in Antarctica Through Increased Logistical Effectiveness*,² made numerous recommendations to maintain and enhance the USAP’s ability to support world-class science in Antarctica.

NSF responded to the BRP report by immediately addressing issues of safety, implementing operational efficiencies that resulted in a rapid return on investment, and developing long-term infrastructure plans for each of the three year-round U.S. stations: Palmer, Amundsen-Scott South Pole, and McMurdo. The AIMS project was a pivotal component of the McMurdo Station Master Plan. The AIR program will continue to refine and carry forward those long-term plans for the three USAP stations.

¹ www.nap.edu/catalog/13169/future-science-opportunities-in-antarctica-and-the-southern-ocean

² www.nsf.gov/geo/opp/usap_special_review/usap_brp/rpt/index.jsp

Major Research Equipment and Facilities Construction

The AIR program will meet critical science needs while engaging the community and stakeholders broadly in an ongoing infrastructure renewal program that will keep the U.S. at the forefront of Antarctic research. AIR will assure safety, enhance efficiency and sustainability, increase resilience, and fulfill NSF's mandate of continued leadership on the continent.

The AIR program comprises a portfolio of investments that improve general-purpose USAP infrastructure including facilities, utilities, equipment, and fleet equipment. This critical infrastructure supports all fields of science. Investments are prioritized across all USAP locations, and acquisition strategies are tailored to individual activities.

Project Status

To manage the severe risks of introducing COVID-19 to Antarctica, on-site AIMS work at McMurdo was paused in March 2020 and construction personnel were not deployed to McMurdo for the FY 2021 or FY 2022 construction seasons. On-ice construction for AIMS resumed in late CY 2022.

Work was initiated in FY 2022 on the highest priority AIR activity—the McMurdo Pier Project, which will dramatically reduce programmatic risk. The McMurdo Pier Project was fully funded in FY 2022 and is being executed through an Inter-Agency Agreement with the U.S. Army Corps of Engineers.

Meeting Intellectual Community Needs

- The need for upgrades in many components of Antarctic infrastructure was informed by the 2011 NRC report and the 2012 BRP report. Additionally, the critical need to flexibly support a broad range of Antarctic research was further affirmed in a 2015 NRC report, *A Strategic Vision for NSF Investments in Antarctic and Southern Ocean Research* and in the 2022 follow-on mid-term assessment.^{3,4}
- Members of the research community participated in requirements development and refinement in the planning and design stages for AIMS, as well as in design reviews.
- Community engagement was intrinsic to the development of the McMurdo and Palmer Station master plans—critical documents that describe the future desired state of the respective stations and inform the AIR Program—and will again be sought in routine updates to the plans for each station. Similarly, community input will be central to the development of the South Pole master plan.
- The research community, through the merit review process, informs OPP's focus areas for logistics support. For example, through this process, the case was made for the West Antarctic Ice Sheet Divide field camp from which logistics support for the Thwaites Glacier project is based.

³ www.nap.edu/catalog/21741/a-strategic-vision-for-nsf-investments-in-antarctic-and-southern-ocean-research

⁴ <https://nap.nationalacademies.org/read/26338/chapter/1>

Governance Structure and Partnerships

NSF Governance Structure

The AIR program is managed by GEO and implemented by the OPP Antarctic Infrastructure and Logistics (AIL) section. For oversight of AIR, NSF tailors the best practices outlined by NSF’s Research Infrastructure Guide, which includes the use of independent cost estimates where appropriate, routine status reports at the program and activity level, and periodic reviews of the portfolio by internal and external experts. The AIR program is overseen by NSF’s Chief Officer for Research Facilities and by a Capital Investment Review Board (CIRB) that includes representatives from OPP’s AIL, Antarctic Sciences section, Polar Safety and Occupational Health section, and NSF’s MPS directorate, as well as representatives from the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration (NOAA), and military partners.

Partnerships and Other Funding Sources

NOAA is partnering with NSF to support upgrading satellite weather/communications data down/uplink facilities. That project is separate from, but will complement, AIR in modernizing McMurdo Station and facilitating future communication improvements.

Cost and Schedule

Total Funding Requirements for AIMS and AIR

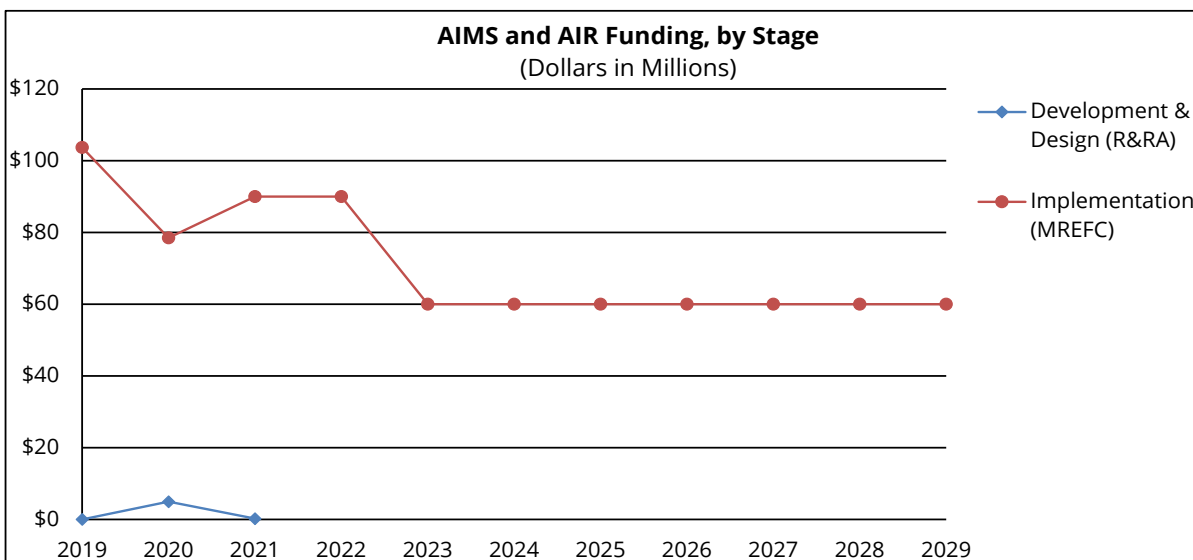
(Dollars in Millions)

	Prior Years	FY 2022 Actual ¹	FY 2023 Estimate	FY 2024 Request	ESTIMATES ¹				
					FY 2025	FY 2026	FY 2027	FY 2028	FY 2029
<i>R&RA:</i>									
Development & Design	\$42.46	-	-	-	-	-	-	-	-
Subtotal, R&RA	\$42.46	-	-	-	-	-	-	-	-
<i>MREFC:</i>									
AIMS Implementation ²	272.19	2.81	-	-	-	-	-	-	-
AIR Implementation	-	87.19	60.00	60.00	60.00	60.00	60.00	60.00	60.00
Subtotal, MREFC	\$272.19	\$90.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00
TOTAL REQUIREMENTS	\$314.65	\$90.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00

¹ Outyear estimates are for planning purposes only.

² Includes \$150.65 million carried forward into FY 2023 for continued construction of the AIMS project. Any residual funds not needed for AIMS will be carried over into the AIR program to potentially support unfunded components of AIMS or other recapitalization priorities.

Major Research Equipment and Facilities Construction



Note: The AIR program will include future development and design activities within MREFC appropriations.

Construction of the Vehicle Equipment and Operations Center and Lodging facility resumed in the FY 2023 field season under the newly revised AIMS baseline schedule. Unfunded components of the original AIMS project will be evaluated and considered for inclusion in the AIR program. As noted above, the AIR program is being managed as a portfolio of investments guided by station master plans developed with robust engagement from across the science community and with inter-agency partners. Activities are prioritized by the CIRB as conditions and requirements change, which allows the program to be responsive to the research community, proactive in mitigating risks, and well-positioned to take advantage of opportunities as they arise. The table below shows active and near-term planned investments, not in any implied order of importance.⁵ These investments are multi-year projects that are in different stages of implementation. The projects and their respective stage of implementation will be updated in future budget narratives as appropriate. Scheduling of these investments will be dynamic, depending on a combination of CIRB prioritization and complex logistical considerations.

McMurdo Pier Project, \$55M	Status: Execution
<p><u>Mission Need:</u> McMurdo, South Pole Station, and field camps are all reliant on resupply vessels that bring food, fuel, equipment, and materials each January. Vessels have historically offloaded at McMurdo via an ice pier in Winter Quarters Bay where materials are then trucked, traversed, or flown to their destination. The ice pier has failed three times in the past 12 years, requiring the last-minute deployment of temporary offload solutions that are costly and inefficient.</p>	
<p><u>Project Scope:</u> This project will construct and deploy a barge-type structure that will be moored off McMurdo and can be used reliably and efficiently year after year, significantly reducing program risk.</p>	

⁵ Total project cost information is included when no longer procurement-sensitive, which is typically when the activity has been awarded for construction.

<u>Project Status:</u> The pier and associated bridge and mooring structures are under design, and the project is on track for completion in FY 2026.	
McMurdo Power Plant Switchgear Controls Upgrade	Status: Planning
<u>Mission Need:</u> Control systems manage eight generators and three wind turbines that provide power for McMurdo Station as well as New Zealand’s Scott Base. The system has no redundancy, is unreliable, and has frequent outages.	
<u>Project Scope:</u> New software will eliminate outages related to control errors and support future generator replacements. The upgrade will enable an increase in monitoring and remote diagnostics, and will resolve information technology security vulnerabilities.	
Future USAP Data Center	Status: Planning
<u>Mission Need:</u> The USAP Data Center is currently housed in its own facility, which limits NSF’s ability to take advantage of the efficiency and security available in the cloud environment.	
<u>Project Scope:</u> This project will identify a cost-effective cloud provider and migrate the USAP data center to the new service.	
South Pole Blue Building Lifting System and ARO Raise	Status: Planning
<u>Mission Need:</u> South Pole Station’s Blue Buildings (the IceCube Lab, the Dark Sector Lab that houses the South Pole telescope, Martin A. Pomerantz Observatory (MAPO) with its attached BICEP array, and the Atmospheric Research Observatory (ARO)) are being buried in snow and without action, will become unusable.	
<u>Project Scope:</u> This project will lift the ARO and provide a “proof of principle” for the remaining structures. Lifting the buildings will extend their useful lifespan by 20 years and drastically reduce annual snow management workload.	
Traverse Improvements and Expansion	Status: Planning
<u>Mission Need:</u> The South Pole Traverse (SPoT)-2 delivers approximately 100,000 gallons of fuel to the South Pole Station each year at a fraction of the cost of airlifting the fuel. SPoT-2 modules, such as the mobile kitchen and crew quarters, were acquired in 2003, have traveled over 60,000 miles, and are failing structurally and electrically.	
<u>Project Scope:</u> This project refreshes the operational traverse equipment to ensure continued fuel and cargo delivery to South Pole Station and adds light duty vehicles to expand support to near-field science.	

Fleet and Equipment Refresh	Status: Planning
<p><u>Mission Need:</u> More than two-thirds of the USAP fleet, which includes cargo and passenger transport vehicles, snowmobiles, loaders, light tracked utility vehicles, and light trucks, is beyond end-of-life, in some cases by decades. Air Traffic Control and mobile communications equipment is also aging and at increasing risk of failure.</p>	
<p><u>Project Scope:</u> This investment returns the fleet to a safe, sustainable state, allowing USAP to transition to more fuel efficient and environmentally friendly vehicles, and refreshes aging communications equipment.</p>	
Environmental Satellite Ground System	Status: Planning
<p><u>Mission Need:</u> Environmental satellite ground systems are crucial for weather forecasting and flight planning. They are also essential for safe aviation, station operations, and science support. The current McMurdo and Palmer Station systems, Tera Scan, are at or beyond end-of-life.</p>	
<p><u>Project Status:</u> This project will replace the McMurdo and Palmer systems, providing modern weather forecasting tools that ensure compatibility with new and future weather satellites.</p>	
Doppler Weather Radar	Status: Planning
<p><u>Mission Need:</u> Successful and safe flight operations rely on accurate and timely weather information. McMurdo does not have any Doppler weather radar capabilities.</p>	
<p><u>Project Scope:</u> This project will deploy Doppler weather radar to McMurdo, greatly enhancing weather forecasting capabilities which, in turn, improve the level of science support possible with USAP flight operations.</p>	
Tactical Air Navigation Upgrade	Status: Planning
<p><u>Mission Need:</u> Tactical Air Navigation (TACAN) systems are critical for providing bearing and distance guidance and non-precision landing approach capability at McMurdo. The current TACAN is beyond end-of-life, and parts are no longer available, so refurbishment is not possible.</p>	
<p><u>Project Scope:</u> This project will replace the McMurdo TACAN with a new, modern system.</p>	

South Pole Critical Infrastructure Remediation	Status: Planning
<u>Mission Need:</u> Ice shelf movement and snow accumulation are crushing utilities supporting the vehicle maintenance facility and the safety escape hatches in the long underground utility tunnel at the South Pole Station. In addition, the fresh water well is coming to the end of its useful life.	
<u>Project Scope:</u> Remediates garage arches and utility tunnels being crushed by weight of snow and installs a new rodwell and outfall required for water production and waste storage, respectively.	
McMurdo Airfield Power System	Status: Planning
<u>Mission Need:</u> More efficient airfield equipment and facilities have lowered power demand, making the existing generators oversized, inefficient, and obsolete.	
<u>Project Scope:</u> This project replaces generators with more efficient units that are easier to maintain, and for which spare parts are readily available.	
Heavy Science Traverse Platform	Status: Planning
<u>Mission Need:</u> The existing Heavy Science Traverse, used to haul scientific drilling equipment to remote areas of Antarctica, is aging and difficult to maintain.	
<u>Project Scope:</u> This project will deploy new, more efficient and reliable traverse equipment in the field with expanded geographic reach, reducing reliance on costly airlift.	
McMurdo Station Utility Modernization	Status: Planning
<u>Mission Need:</u> Existing McMurdo Station outside plant infrastructure (e.g. potable and fire protection water requirements, electrical, heat loop, sewer, fuel services, IT communications cable and conduits) is degraded, prone to failure, costly to maintain, and will not support future facilities.	
<u>Project Scope:</u> This project upgrades outside plant utilities, builds a new water storage tank, and installs a fire-water booster pump.	
South Pole Satellite Communications Upgrade	Status: Planning
<u>Mission Need:</u> The mainland link to South Pole Station satellite communication has restricted access to the currently available and future satellites.	
<u>Project Scope:</u> This project replaces that ground station with a new antenna, tripling bandwidth.	
Station and Field Communication Improvements	Status: Planning
<u>Mission Need:</u> USAP uses a combination of mobile radios and HF radios for on-station and station-to-field communication including emergency and flight operations.	
<u>Project Scope:</u> This project replaces these systems to better support science and operations.	

Reviews

Conceptual Design and Preliminary Design Reviews for AIMS were passed successfully in FY 2015 and FY 2017, respectively, resulting in a National Science Board (NSB) resolution (NSB-2017-20) authorizing NSF to include AIMS in a future budget request. The AIMS Final Design Review (FDR) was conducted in October 2018. The external panel found that the project execution plan was well-developed for the FDR and recommended that the project proceed to the Construction Stage.

In addition to daily and weekly communications with the Antarctic Support Contractor's (Leidos) AIMS project management, NSF conducts a formal monthly project management review. This review covers progress described in the monthly project management report produced by Leidos. Also planned are annual Construction Reviews conducted by OPP, the Large Facilities Office, and an external panel, with the first one having occurred in November 2020. The next Construction Review is planned for the second quarter of FY 2023.

The CIRB meets on a quarterly basis to prioritize activities within the AIR Program. In FY 2023, readiness reviews for AIR activities will be conducted based on the scale and complexity of individual projects.

Risks

If the infrastructure that enables Antarctic science is not kept robust and efficient, USAP is at risk of losing science capabilities year over year as facilities, utilities, equipment, and vehicle fleet degrade.

As described above, ongoing and planned near-term activities in the AIR program will mitigate critical risks facing USAP, including some that represent single points of failure to the mission. In executing the projects, NSF has implemented a rigorous risk management approach that includes the identification of risks and mitigation strategies. Robust risk management will also be required of contractors and awardees. In all cases, NSF holds the risk of cost and schedule increases that are beyond the control of the contractor or awardee, including events such as pandemics, unpredictably severe weather, icebreaker and supply vessel availability, and macroeconomic changes.

COVID-19 and inflation impact on the construction market, labor force, supply chains, travel restrictions, and safety protocols present the greatest near-term risks to AIMS and AIR due to the size and complexity of these programs.