The Antarctic Infrastructure Recapitalization (AIR) Program: An Enduring Approach to Maintaining and Modernizing Antarctic Stations

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**Information Paper Submitted by the United States**

***Summary***

The National Science Foundation (NSF) is responsible for managing research infrastructure that advances science at the frontiers of many disciplines. The U.S. Antarctic Program (USAP) infrastructure portfolio includes a wide range of research and related facilities, utilities, equipment, and vehicles, spanning three permanent stations, seasonal field camps, and three gateway/port locations, all of which supports science ranging from astronomy to biology. Most of this infrastructure operates year-round in one of the harshest environments on Earth. NSF has initiated the Antarctic Infrastructure Recapitalization (AIR) Program as a strategic approach to ensure that critical science needs are met through an enduring and dedicated effort to recapitalize our stations.

***Background***

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. High priority research that is best, or only, achieved in Antarctica relies on USAP infrastructure and logistics. The table below illustrates this interconnectedness; it shows the current U.S. research priorities as recommended by the National Academies and their associated infrastructure and logistics support components.

*Table 1 - Current U.S. research priorities as recommended by the National Academies and their associated infrastructure and logistics support components.*

| **U.S. Research Priorities** | **Why Antarctica?** | **Supported Science** | **Infrastructure and Logistics** |
| --- | --- | --- | --- |
| How much and how fast will sea level rise? | Two of the planet’s three remaining large ice sheets are in Antarctica; understanding their stability in a warming world is critical for predicting global sea level rise | * Thwaites Glacier International Collaboration * Hercules Dome * McMurdo Dry Valleys Glacial Geomorphology | * Airlift and flight operations * Deep field camp support * Transits through McMurdo and South Pole * Communications and data links * Science traverse * Inter-continental and intra-continental cargo transportation * Ice-breaking research vessels |
| How do Antarctic biota evolve and adapt to changing environmental conditions? | Antarctica and the Southern Ocean contain unique organisms and ecosystems that provide early warning signals for climate change impacts on the biosphere | * Palmer and Dry Valleys Long-Term Ecological Research projects * Studies on Southern Ocean productivity, fish ecology and adaptation, carbon cycling and biogeochemistry; freshwater and soil microbial ecology | * Airlift and flight operations * Field camp support * Transits through McMurdo and Palmer Stations * Communications and data links * Inter-continental and intra-continental cargo transportation * Ice-strengthened research vessels * Small boat operations |
| How did the universe begin, and what are the underlying physical laws that govern its evolution and ultimate fate? | Dry and stable atmospheric conditions, uniformity of weather, and thick ice sheets provide a critical platform for astrophysics research | * South Pole Telescope * Ice Cube Neutrino Observatory * Cosmic Microwave Background * Long Duration Balloon projects | * Airlift and flight operations * Transits through McMurdo * Long Duration Balloon field site on the Ross Ice Shelf * In-Residence at South Pole station * Communications and data links * South Pole Operations Traverse * Inter-continental and intra-continental cargo transportation |

A key objective of the AIR Program is to not only support current infrastructure, but also take advantage of opportunities where advancements in infrastructure can open new doors for science capabilities. Improved data connectivity, as one example, can facilitate discovery at greater speed and scale and broaden participation in Antarctic science. As another example, expanded traverse capabilities can dramatically reduce risk and cost for science teams accessing deep field locations. The AIR program will include technical support for needs assessments, cost-benefit analyses, and preliminary designs, to define transformative solutions to Antarctica’s unique challenges as an integral part of infrastructure renewal.

NSF has been working towards a dedicated capital plan and budget for USAP for many years, and the Antarctic Infrastructure Modernization for Science (AIMS) project begun in 2019 was an important first step for infrastructure renewal. The AIMS project successfully completed demolition of the old warehouses and began demolishing an old lodging building to make way for new structures; however, progress was halted in March 2020 by deployment restrictions resulting from the COVID-19 pandemic. The extended on-ice work stoppage that followed, as well as disruptions to workforce and supply chains, forced NSF to re-plan the AIMS project and to develop a new approach to revitalization of USAP infrastructure. Two of the five original components of AIMS are moving forward – the Vehicle Equipment and Operations Center and a new Lodging Building. Construction on those buildings resumed during the 2022-2023 field season; remaining scope elements will form the foundation of the AIR Program.

***AIR Program***

The AIR Program is a portfolio of investments in facilities and infrastructure across USAP stations and gateways that will assure safety, enhance efficiency, increase resilience, and support USAP’s continued leadership on the continent. The AIR program is managed as a portfolio of investments guided by [Station Master Plans](https://future.usap.gov/)that have been developed with robust engagement from across the science community (South Pole Master Planning is underway). The Station Master Plans define the future of each station, and the AIR portfolio is the prioritized and time-phased set of individual activities – e.g., construction projects, renovations, acquisitions – that are required to achieve that future.

The AIR program encompasses improvements to core infrastructure, which includes general-purpose facilities, utilities, equipment, and fleet used across USAP or for general station operations rather than for a single research activity. Work scope includes construction and renovation of facilities and utilities, purchase of equipment and fleet, and demolition/removal of obsolete infrastructure. Activities are prioritized and regularly assessed across all USAP locations by a Capital Investment Review Board as conditions and requirements change, allowing the program to be responsive to the research community, proactive in mitigating risks, and well-positioned to take advantage of opportunities.

***Path Forward***

AIR funds were first approved by the U.S. Congress in 2022, and the first project to be initiated was the construction of a new, permanent barge pier for resupply activities at McMurdo Station, slated to be delivered in 2025. Among the remaining near-term priorities are remediating degrading infrastructure at South Pole Station and lifting the buildings out of the accumulating snow, refreshing and expanding overland traverse equipment, investing in upgrades to flight-support equipment and facilities, and improving communications and power generation. As work is further planned, EIAs will be conducted for scope beyond the boundaries of what has already been assessed under current environmental documentation.