NSF Operations and Maintenance (O&M) Oversight for Major Research Facilities

Matt Hawkins, Head, Large Facilities Office
Linnea Avallone, Chief Officer for Research Facilities

January 24, 2022

Presentation Topics

- NSF's mission & legislative framework
- Award instruments and oversight for Major Facilities
- Recent NSF authorization legislation (AICA)
- Appropriations for NSF's Major Facilities
- NSF's balancing act for Operations & Maintenance (O&M)

NSF Organic Act (as amended)

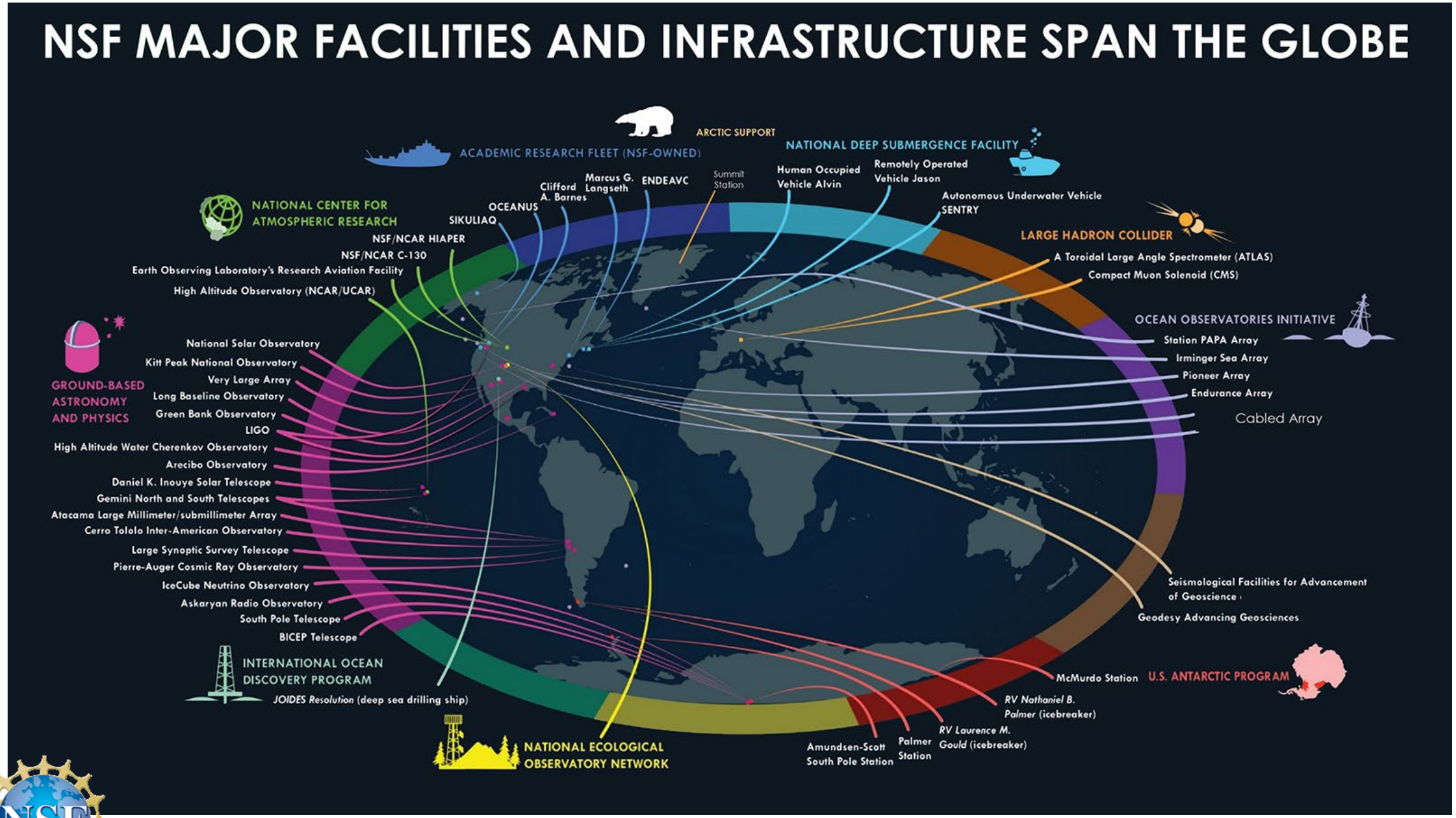
Functions of the Foundation:

"(2) to initiate and support basic scientific research and programs … in the ***mathematical, physical, medical, biological, social, and other sciences****, and to … strengthen engineering research potential and engineering education programs at all levels* ***in the various fields of engineering****, by making contracts or other arrangements (including grants, loans, and other forms of assistance) …"*

Research Infrastructure (RI):

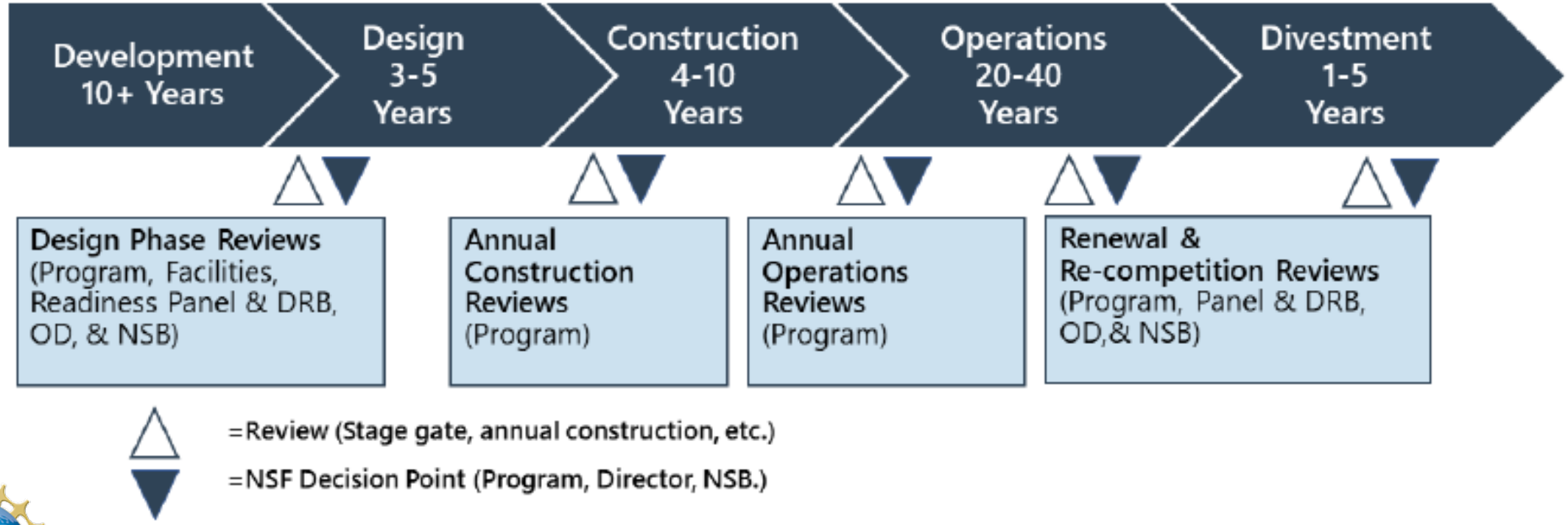
"The Foundation shall not, itself, operate any laboratories or pilot plants."

NSF MAJOR FACILITIES AND INFRASTRUCTURE SPAN THE GLOBE



Major Facility Lifecycle Stages
(defined in NSF Research Infrastructure Guide)

Figure 2.1.3-1 **Progressive steps in the facility life cycle, showing the high-level review and decision points for exit and entry into each stage. The Design Stage is further broken down into phases.**



Award Instruments

The Federal Grant and Cooperative Agreement Act of 1977:

- **Acquisition**: to acquire property or services **for the direct benefit or use of the federal government → Contracts**
- **Assistance Awards:** to transfer a "thing of value" (money, property or services) to the non-federal entity **to accomplish a public purpose of support or stimulation authorized by federal law → Cooperative Agreements**

What is the **principal purpose** of the transaction?

Who benefits from the transaction?

NSF Major Facility Awards

- Designed, constructed and operated **BY** the science community, **FOR** the science community
- Recipient managed; no NSF staff on-site
- NSF oversight to assess **progress** and decisions on **continued financial support**
- Not beneficial for NSF to unilaterally change or redirect work
- “Substantial Government Involvement”
- Synergistic relationship with the science community

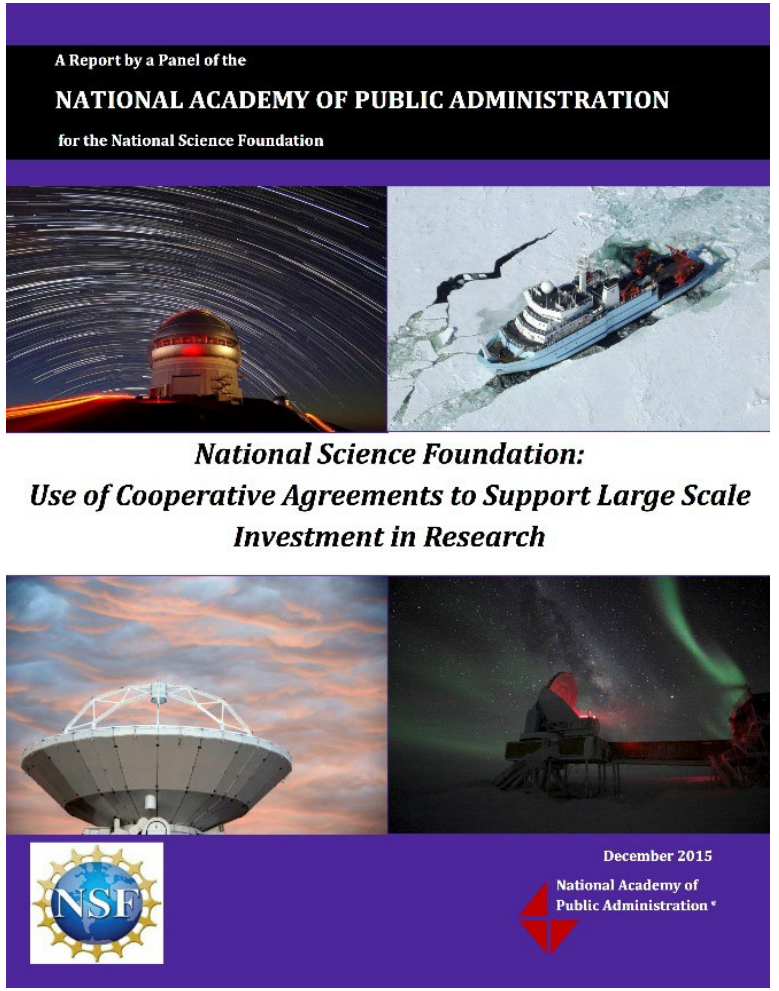
Science Community Benefits
Cooperative Agreements (CA)

*Except Antarctic and Arctic Logistics (FAR-based contracts)

NAPA Report – December 2015

- Requested by NSF & NSB – Use of CAs under external scrutiny
- NSF's current use of CAs and effectiveness of current policy
- Compare the CA mechanism with other award instruments
- Compare how other scientific agencies manage similar projects
- Identify potential improvements to the NSF's processes

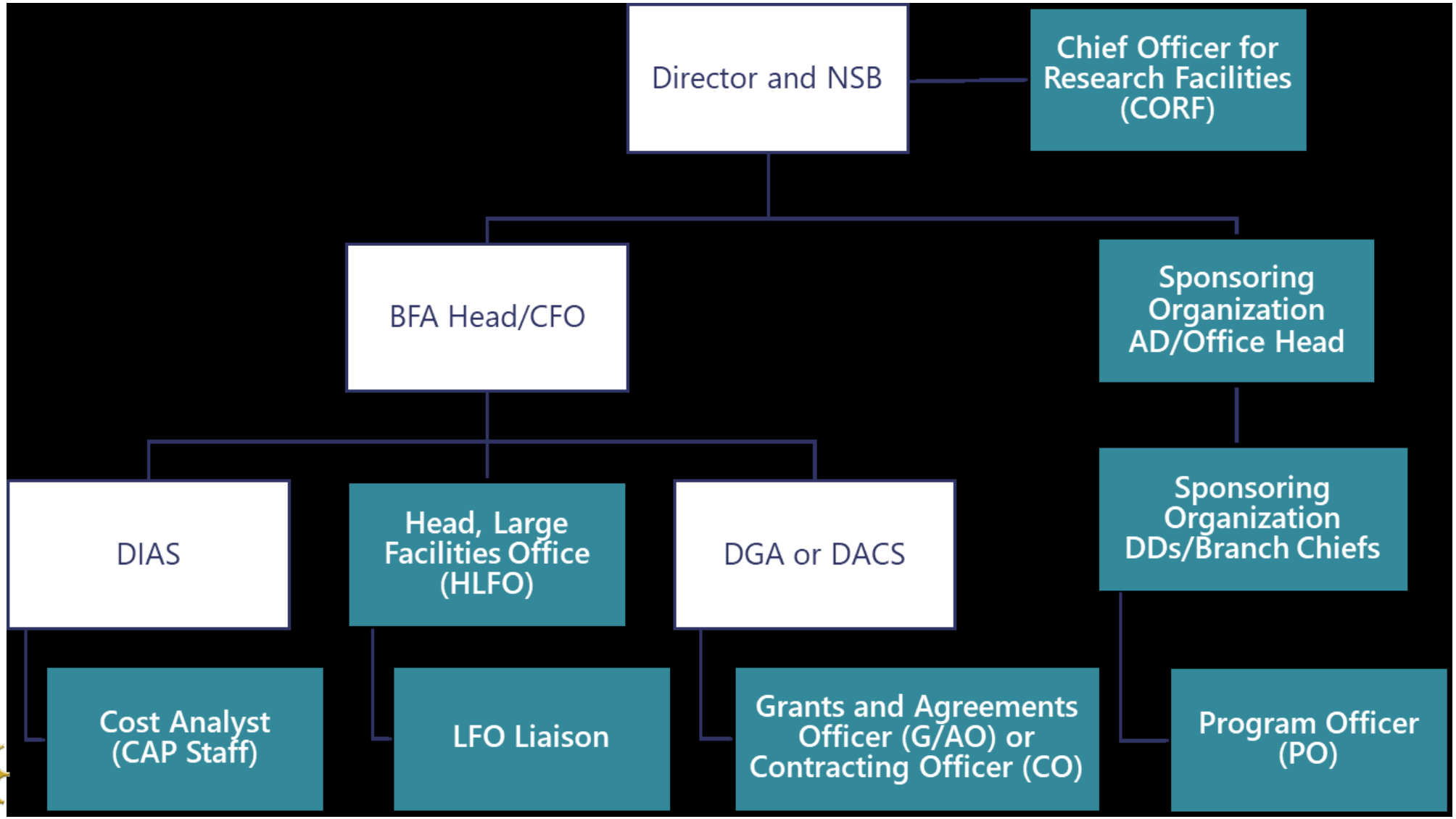
"Overall, the Academy Panel found that cooperative agreements are an appropriate mechanism to support the development of large-scale research facilities."



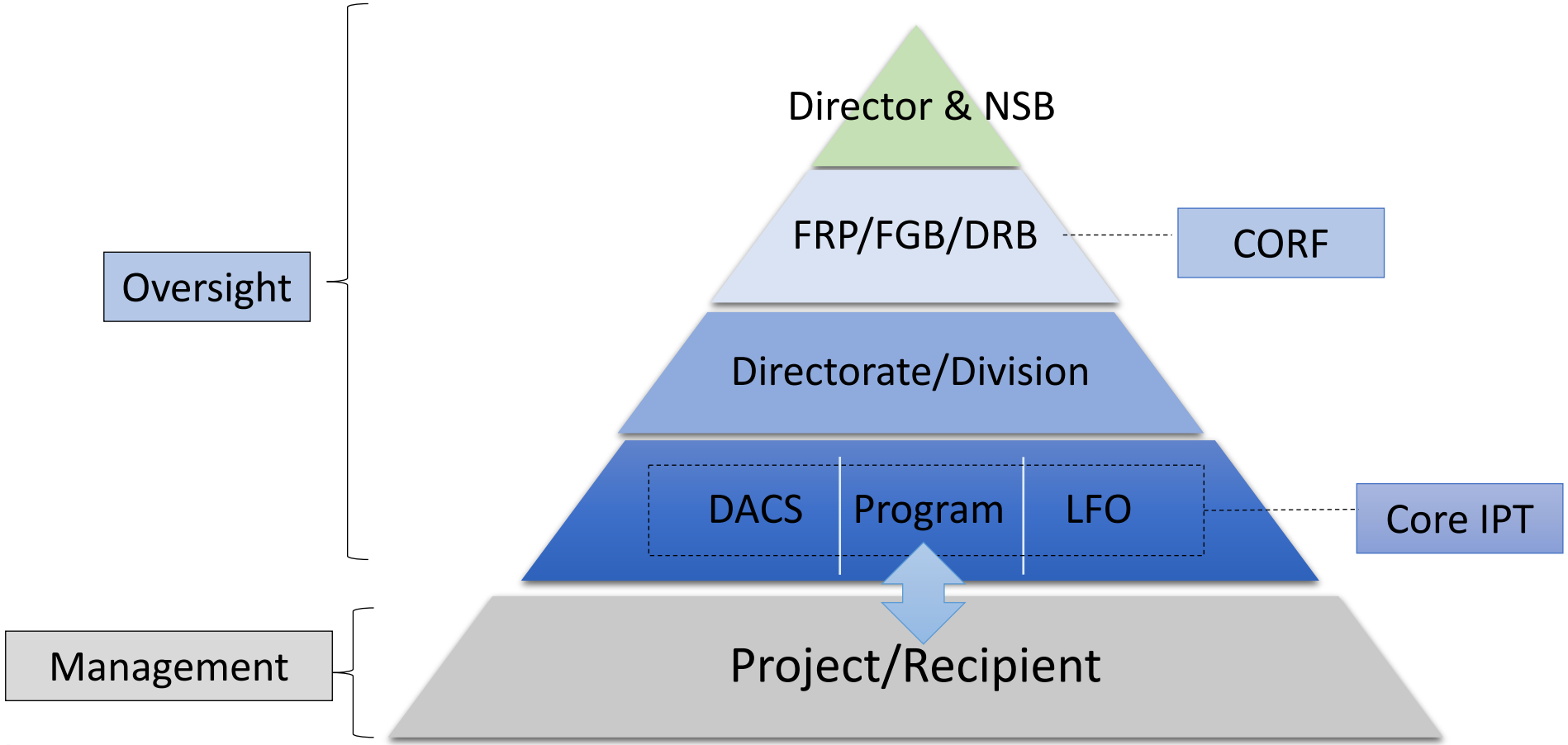
Science/Technical  Business Practices

Many recommendations of NAPA report on NSF's processes were incorporated into AICA Section 110 (described later)

NSF Oversight Organizational Structure



NSF Major Facility Oversight Structure



Roles and Responsibilities – Section 2.1.6 of the RIG

- **Recipient (Awardee)** > Manages the project or O&M program
- **Core IPT** responsible for day-to-day oversight:
  - Program Officer
  - Grants/Agreements Officer or Contracting Officer
  - LFO Liaison
- **Directorate/Division –** Proposes future projects and endorses/supports long-term O&M commitments.

Roles and Responsibilities – Section 2.1.6 of the RIG

- **Facilities Readiness Panel (FRP)** - Confirms technical readiness during the Design Stage and recommends advancement (Chaired by the CORF)
- **Facilities Governance Board (FGB)** – Makes recommendations on strategic issues and approves policies/procedures (Chaired by CORF)
- **Directors Review Board (DRB)** – Reviews information and action packages going to the NSB
- **NSF Director –** Approves advancement and makes recommendations for new projects and programs to the NSB, OMB and Congress
- **National Science Board (NSB)** – Establishes strategic agency policies, authorizes inclusion of new project in future budget requests, and authorizes large awards above certain thresholds (Construction and O&M)

Large Facilities Office (LFO) – History & Purpose

- 2001 & 2002 Congress and OIG concerns over mixing MREFC and R&RA funds
- 2003 Deputy Director for Large Facilities Projects (DDLFP; now Head, LFO) appointed and LFO formed to strengthen oversight:
  - Part of the Office of Budget, Finance and Award Management (BFA)
  - Head, LFO reports to CFO
- Provides:
  - "Assistance" to Recipients and NSF staff on good practices & lesson learned
  - "Assurance" that NSF oversight practices are followed
- *Research Infrastructure Guide* (RIG)
- *Business Systems Review Guide* (BSR Guide)
- Internal Standard Operating Guidance

Large Facilities Office (LFO) – Cont'd

- Responsible for implementation of the Program Management Improvement and Accountability Act (PMIAA) – *Workforce Development*
- Leads NSF's Research Infrastructure *Knowledge Management Program*:
  - PO Forum (NSF Staff)
  - Annual RI Workshop (NSF Staff and MF community)
  - Quarterly RI Webinars (NSF Staff and MF community)
- Independent bi-monthly reports (Design, Construction and O&M) to CORF and CFO:
  - EVM metrics
  - Project Status
  - Oversight Activities
  - Project Risks

American Innovation and Competitiveness Act (AICA)
(PL 114-329, 2017 as amended)

- NSF's most recent authorizing legislation
- Many requirements on how NSF oversees RI
- **Section 109:** "*Mid-scale Projects*" (Total Project Cost $6M to $100M)
- **Section 110:** "*Oversight of NSF Major Multi-user Research Facility [Major Facility] Projects*":
  - Total Project Cost for Construction > $100M
  - Use of GAO best practices for cost and schedule
  - Duties of Large Facilities Office (headed by Matt)
  - Senior agency official with responsibility for full-lifecycle oversight (Linnea)
  - Cost analyses; construction oversight; use of contingency

Large Facilities Office (LFO) – AICA 2017

"*Continue to maintain a Large Facilities Office*":

- NSF's primary resource for all policy or processes related to the development, implementation, and oversight of major facilities
- NSF-wide resource on project management, including expert assistance on nonscientific and nontechnical aspects of project planning, budgeting, implementation, management, and oversight
- Coordinating and collaborating with research directorates to share best management practices and lessons learned from prior projects
- Assessing each major multi-user research facility project for cost and schedule risk

Senior Agency Official – AICA 2017

- *"Appoint a senior agency official whose responsibility is oversight of the development, construction, and operations of major multi-user research facilities across the Foundation;"*

- Chief Officer for Research Facilities (CORF) position created in 2018
  - Within Office of the Director; member of agency executive leadership team
  - Coordinates/integrates all aspects of major (and mid-scale) facilities across NSF
  - Responsible for developing/implementing strategies to deliver cutting-edge research infrastructure
  - Together with Head, LFO, ensures technical, scientific and financial excellence for all major facilities

Appropriations for Major Facilities

NSF has six accounts; four related to Major Facilities funding:

- **Major Research Equipment and Facilities Construction (MREFC) -** Funds the Construction Stage (since 1993)
- **Research and Related Activities (R&RA) -** Funds the Development, Design, Operations, and Divestment Stages
- **National Science Board (NSB) -** "Co-manages" NSF with the Director and authorizes all Major Facility awards
- **Office of Inspector General (OIG) -** Close attention to Major Facility oversight

Why are Appropriations Accounts Important?

- Separate MREFC and R&RA accounts prevents construction funding from “rolling over” into Operations and Maintenance (O&M):
  - **Proper segregation of scope and funding**

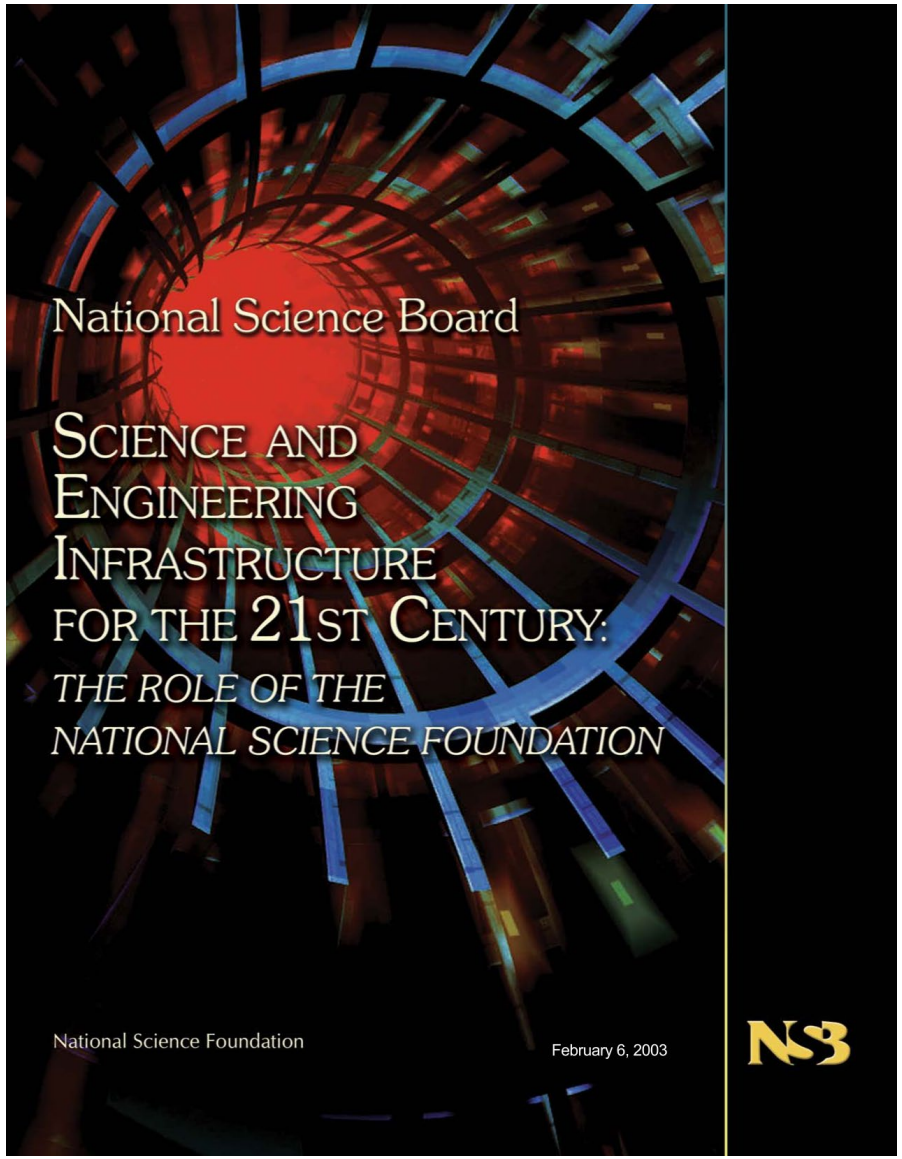
- R&RA account also funds the single investigator research:
  - Directorates/divisions must **balance Major Facility O&M against all the other needs** of their communities
  - Scientific scope determined by negotiation of annual O&M work plans for facilities

NSF’s Operations and Maintenance (O&M) Approach

NSB-02-190 (2003)

Recommendation 1: *"Increase the share of the NSF budget devoted to S&E infrastructure …"*

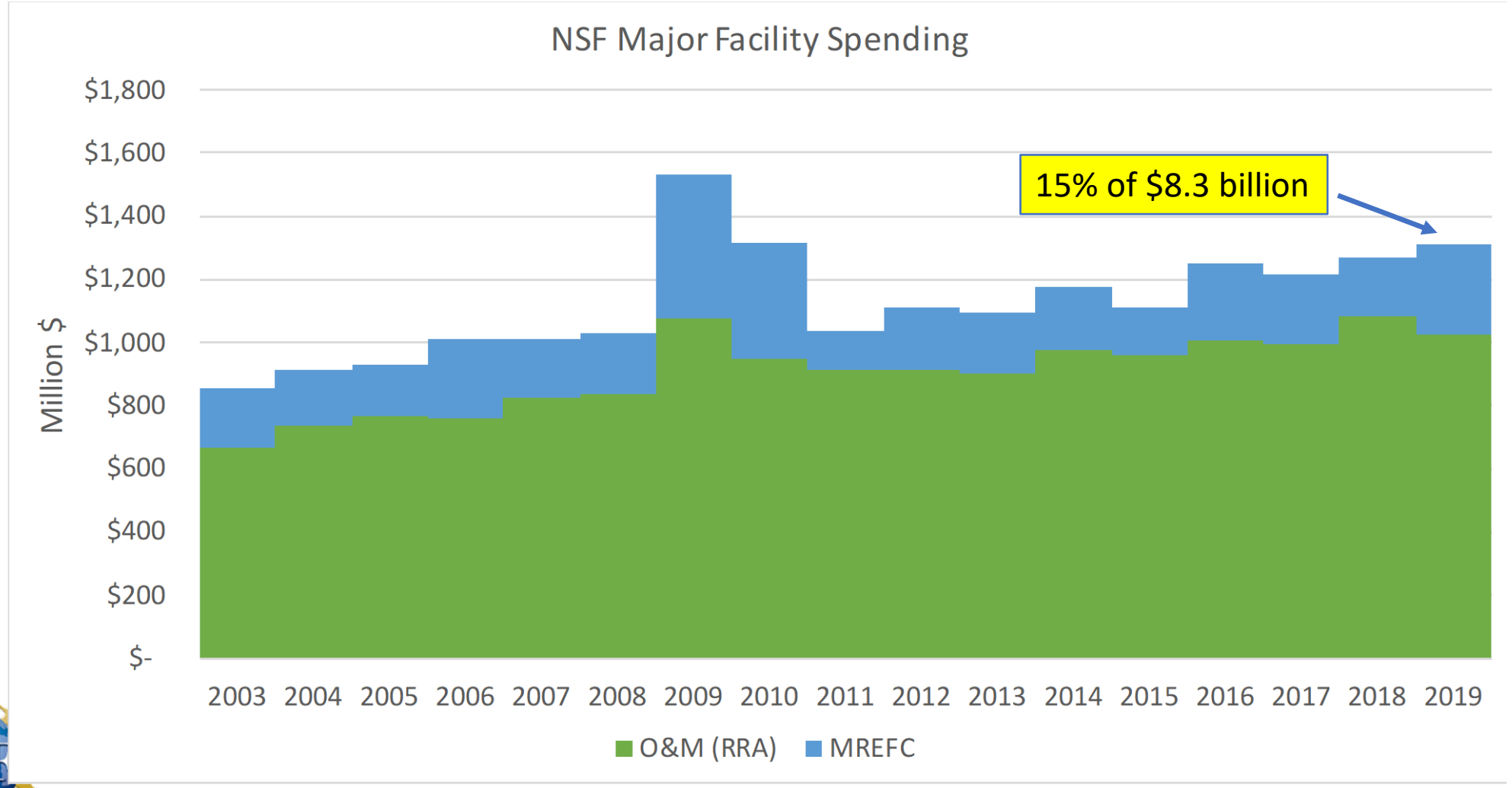
> *"A share closer to the higher end of the historic range (22-27 percent) is desirable."*



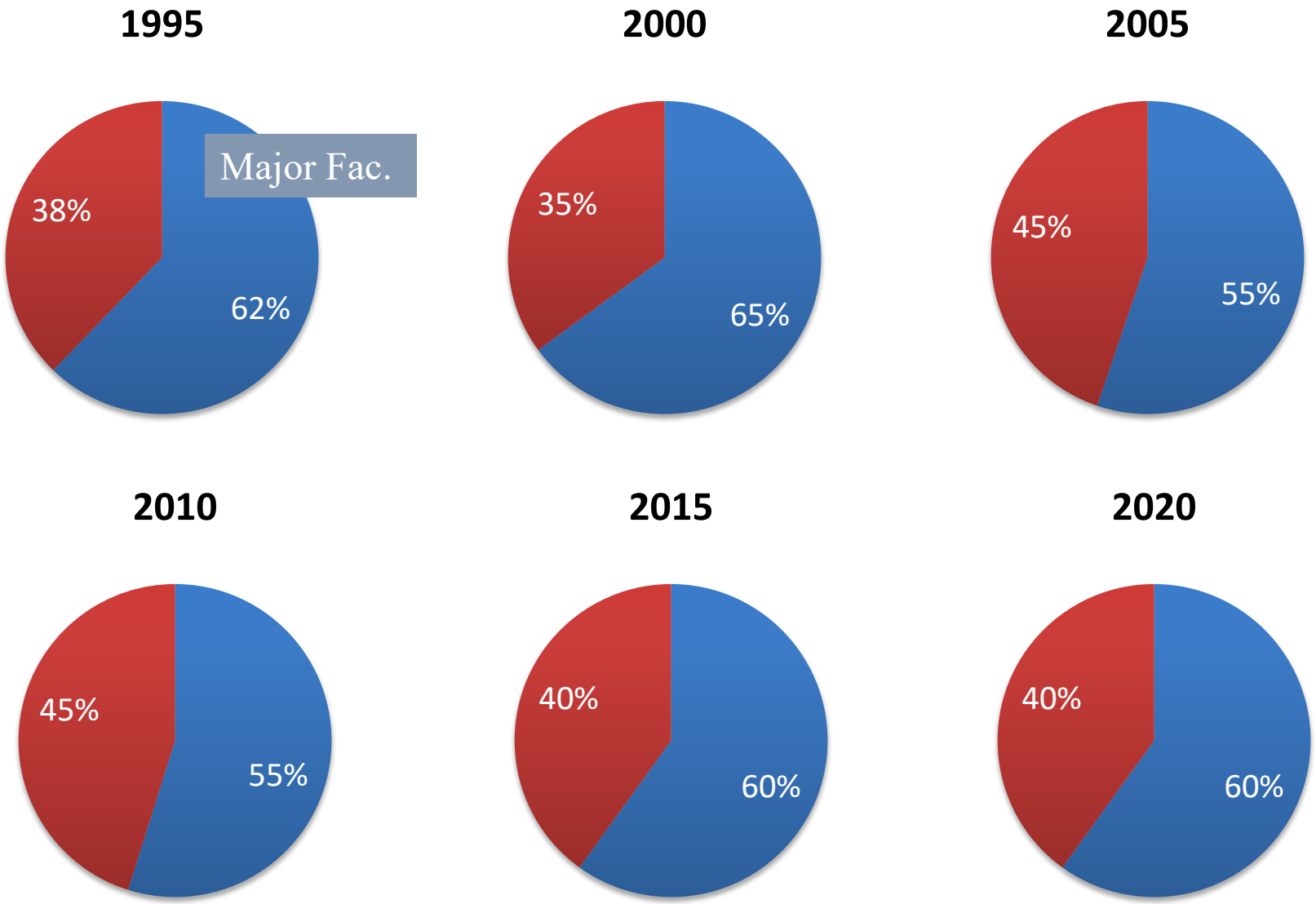
Research Infrastructure Spending Breakdown

- Percent not mandated “top down”
- Typically about 15% of NSF budget on Major Facilities
- Not consistent across directorates/divisions
- **Facility Heavy:** Astronomy, ocean sciences, polar programs, physics, atmospheric & geospace sciences

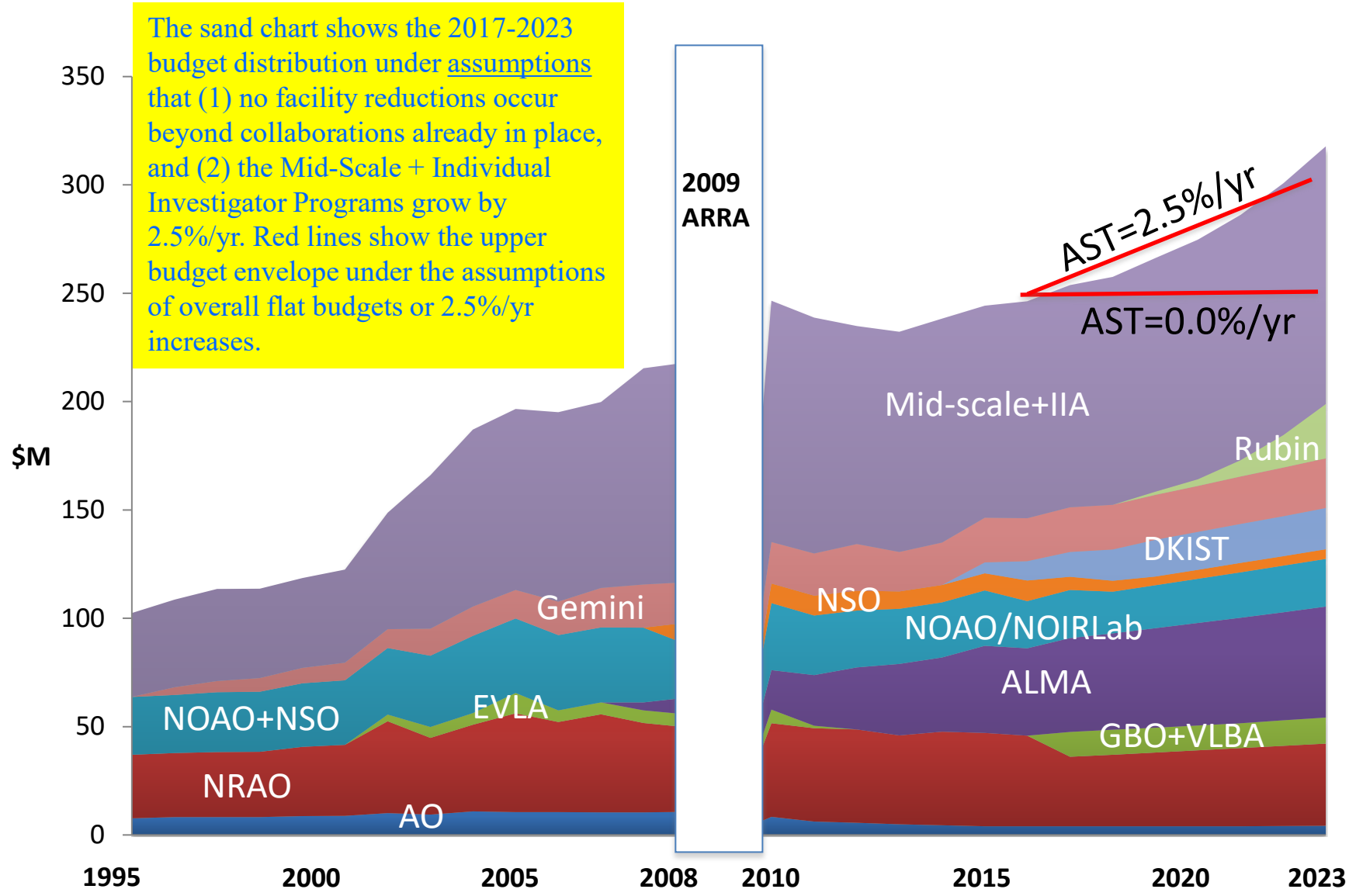
Spending Trend on Major Facilities



Astronomy Major Facilities O&M Fraction over the Years



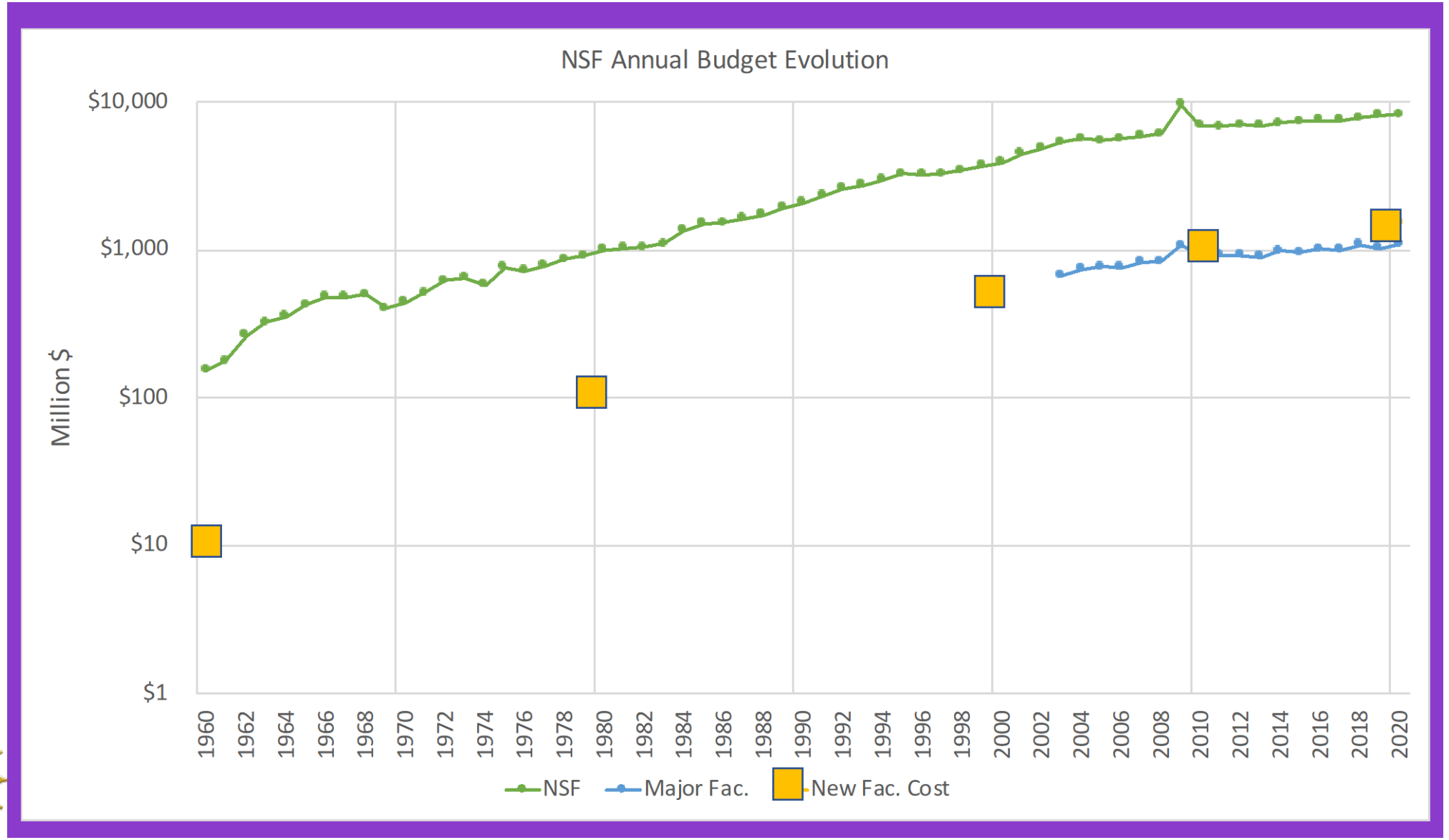
Facility-Heavy Division: AST (Plot from Oct. 2016)



The O&M "Problem"

- Expensive RI necessary to enable research in some fields
- Budgets grow sporadically/linearly, but the cost of the next-generation scientific capabilities tends to grow exponentially
- Requires a commitment to ~10% of the construction cost in annual O&M from appropriations 5-25 years in the future
- Priorities evolve with time and changing federal emphases

Cost Trend for a State-of-the-Art NSF Facility



…as Old as NSF

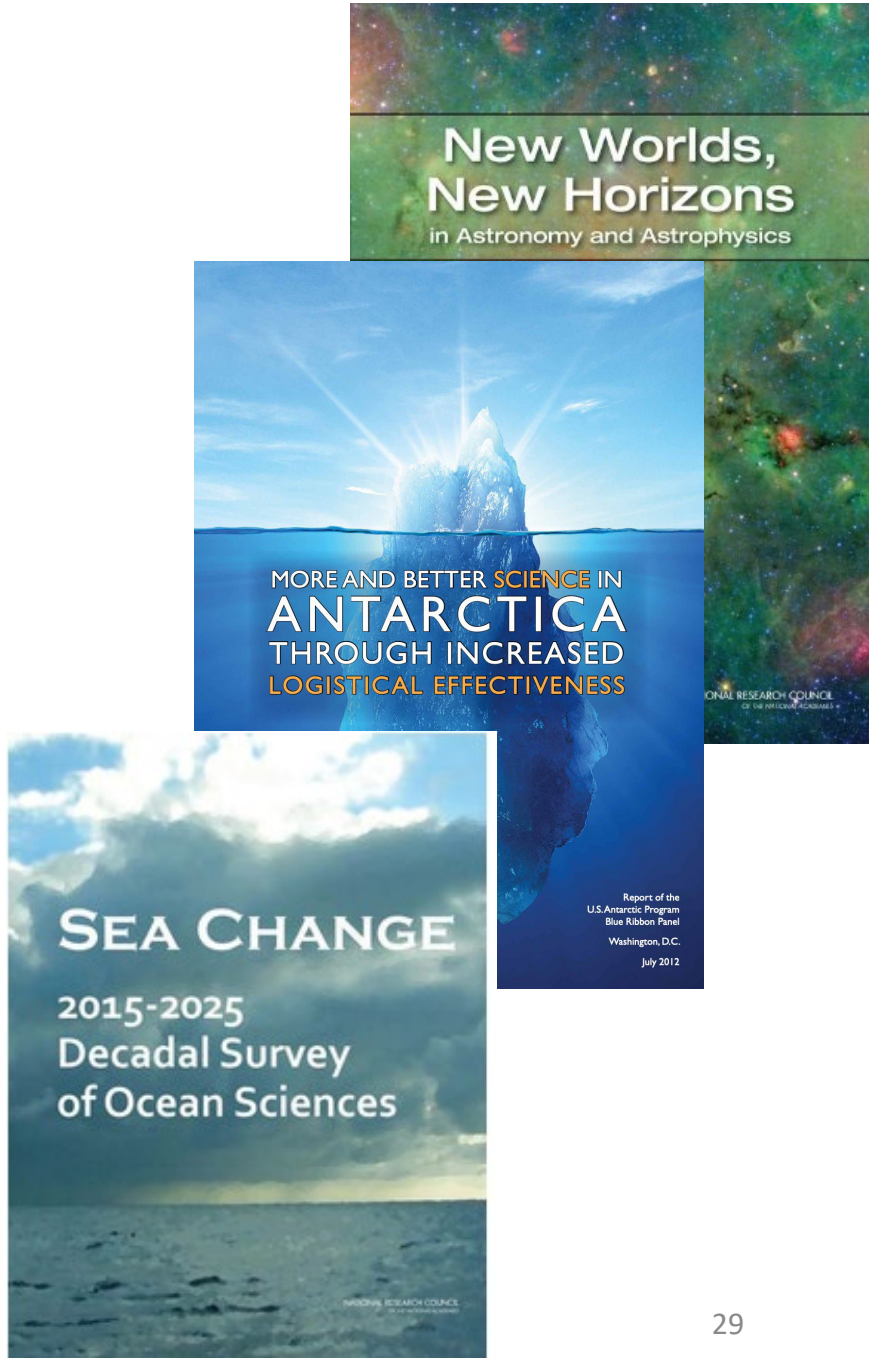
Alan Waterman (first NSF Director), *Basic Research: A National Resource* (1957):

> *"It is widely recognized that continuing costs for operations and maintenance of large research equipment raise more problems than original construction costs. Continuing Federal support threatens an indefinite financial burden, a first claim against future appropriations."*

Disciplinary Reviews of O&M Priorities

- **Astronomy: 2005 Senior Review, 2012 Portfolio Review, Decadal Surveys**
- **Polar Programs: 2012 Antarctic Logistics**
- **Ocean Sciences: 2014 Sea Change Report**
- **Geospace Facilities: 2016**

Ability to reduce O&M expenditures by divesting older facilities cannot pay for the O&M of new, more expensive facilities.



O&M Summary

- Cooperative agreements provide **flexibility** to manage O&M
- Construction **ALWAYS** leads to O&M commitment from unknowable future appropriations
- Directorates/divisions **can best manage science-RI** balance for their disciplines
  - **How to balance with strategic agency considerations?**
- "Solution" must not cause more problems than it solves