

RIG Revision Mid-Scale Section

REVISED Section 1.4.4 Mid-scale Research Infrastructure

Per Section 109 of AICA, a Mid-scale Research Infrastructure (RI) project means research instrumentation, equipment, and upgrades to Major Facilities (Major Multi-user Research Facilities) or other research infrastructure investments that exceed the maximum funded by the Major Research Instrumentation (MRI) Program and are below that of a Major Facility project. Like Major Facilities, NSF interprets the above to mean the Total Project Cost (TPC) as defined by the investment in implementation (construction acquisition, or other means) under a single award. Neither the cumulative sum of such investments, nor the investments related to design, operations, or associated science program costs are considered. Except for upgrades to Major Facilities, if the implementation TPC for a research infrastructure is within the Mid-scale project range, as defined by statute, it is considered Mid-scale Research Infrastructure throughout its full life cycle. Refer to Section 2.9 of this Guide (Mid-scale Research Infrastructure Guidance) for planning and oversight requirements throughout the Mid-scale RI lifecycle.



Section 2.9 - Mid-scale Research Infrastructure

A. Introduction:

In Section 1.4.4 of this Guide, Mid-scale RI projects are defined as Research Infrastructure having a cost to construct, acquire, or otherwise implement, between the upper limit of NSF's Major Research Instrumentation (MRI) program¹ and the lower threshold for what constitutes a Major Facility. Mid-scale RI can be stand-alone projects or associated with an NSF-funded Major Facility.

This section should not be interpreted as standalone, comprehensive guidance for Mid-scale RI. Rather, it should be viewed as a complement to all other relevant sections of this Guide. A central theme throughout is the expectation that proposers will scale and tailor proposed management methodologies to the technical nature, complexity and risk profile of the project or science support program.

NSF's investments in Mid-scale RI may also support development and design activities as well as operations. NSF funds these investments through multiple funding accounts and programs, some of which are managed exclusively by the Program Offices and others

¹ The current upper limit of an NSF award under the MRI program is \$4M, which does not consider cost share.

centralized at the agency level.² In all cases, the intent of Mid-scale RI investments is to meet the RI needs of the science community on shorter timescales than typically seen for Major Facility investments.

Although Mid-scale RI go through all life-cycle stages from development through eventual disposition, they do not fall under the five life-cycle Stages for NSF oversight of Major Facilities as described in Section 2.X of this Guide. In addition, NSF may only be engaged in some of the life-cycle stages. NSF typically funds the design and implementation of Mid-scale RI. Operations and maintenance (O&M) may be funded by NSF, in part or in whole, based on the Concept of Operations described in the proposal and as negotiated at award. If a Mid-scale RI project is an upgrade to an existing Major Facility, it is expected that the O&M costs will become part of the Operations Stage award for that Major Facility. Under financial assistance, NSF's conditional interest in property funded under a Mid-scale RI award is generally less than is typically seen with Major Facilities.

NSF Programmatic Oversight: At the appropriate point in award formation, each Mid-scale RI award is assigned to an NSF Program Officer with the responsibility for award oversight as determined by the award instrument utilized. NSF uses the Integrated Project Team (IPT) approach for oversight of Mid-scale RI awards (See Section 2 of this Guide), but the IPT need only consists of the Program Officer, the Awarding Official, and the RIO Liaison. Mid-scale projects consisting of upgrades to existing NSF Major Facilities are coordinated through the NSF Integrated Project Team (IPT) for that facility.

In accordance with NSF policy on financial assistance, the PO (or POs) creates a Management Plan documenting the planned oversight approach for the funding program, elements of which may be included in the funding announcement along with any deviations or additions to the guidance presented in this section. Therefore, an Internal Management Plan (IMP) is not required for an individual Mid-scale RI project. POs assigned to Major Facilities must be permanent NSF employees per statute, but NSF has broader discretion on employment status when assigning POs to oversee Mid-scale RI awards.

No Cost Overrun Policy (NCOP): Although substantial rigor is required in establishing the TPC for a Mid-scale RI implementation award, these projects are not subject to the "No-Cost Overrun Policy" used for Major Facilities, as defined in Section 1.4.6 of this Guide. This is because the NCOP is based on having a risk-adjusted TPC that is developed at the Preliminary Design Review (PDR) to support a potential budget request to Congress on a project-specific basis. Since Mid-scale RI projects do not go through the formal stage-gate review process, there is no PDR. In addition, Mid-scale RI projects are often funded under a broader program and not articulated in NSF's budget request by specific projects. However, any potential cost increases that could impact the award amount (i.e., that cannot be

² Centralized funding programs include Mid-scale RI Tracks 1 and 2, with Track 1 funded from the Research and Related Activities account and Track 2 from the Major Research Equipment and Facilities Construction account.

addressed through re-planning, use of budget contingency, or de-scoping) should be discussed with the PO and Awarding Official as early as possible and be addressed per Federal regulation and NSF's policy based on the award instrument used.

B. Expectations for Mid-scale RI Proposers and Awardees:

1. Mid-scale RI Management Team:

Given the expectation to deliver a certain scope within cost and schedule, or to provide an on-going science support program to the community, NSF has different expectations for Mid-scale RI awards compared to research awards which are often standard grants. The Awardee for a Mid-scale RI should form a Management Team capable of executing the activities funded under the award. The expectations for personnel (Section 4.6.6 of this Guide) while not required for Mid-scale RI, may be used to inform the subject matter expertise of individuals on the Management Team based on whether the award activities are for design, implementation, or operations; each of which having its own set of challenges and risks. For example, projects consisting of simple acquisitions of commercially available components generally have very low risk. For these the Management Team may only be the Principal Investigator and their institution's contracting office.

For more complex Mid-scale RI projects, the Project Manager (PM) should be identified and consulted early in the process, ideally prior to initial proposal submission (either design or implementation depending on the program), to assist with interpretation of the RIG. Some professional organizations³ provide general guidance on the size and formation of the Management Team but a qualified PM can also help ensure adequate, competent staffing is proposed and hired. Proposing organizations may also be able to leverage available in-house resources, such as business management, architectural, or engineering departments, or project management staff in the facilities (non-academic) arm of the institution. It is also advisable to have discussions with peer organizations in the respective field of research and with project management consultants, to help ensure adequate staffing. Experienced Project Managers can be an asset when considering the scaling and tailoring flexibility allowed by NSF on Mid-scale RI projects, and help avoid over-implementation during proposal submission and post-award.

- 2. Concept of Operations:** When NSF is considering an investment in the design or implementation of a Mid-scale RI, it is essential that the agency understands any long-term commitments as part of the proposal review process. As a result, Mid-scale RI proposals must include a Concept of Operations (ConOps) Plan that is aligned with the technical maturity of the RI. For a design proposal, the ConOps Plan should be presented as currently envisioned, with the operations cost estimates and funding strategy refined with maturation of the Project Execution Plan (See Section 3.5 of this Guide). If implementation is eventually funded, the ConOps Plan would then be further

³ e.g., Project Management Institute (PMI)

refined as the infrastructure moves toward delivery. If NSF commits to supporting long-term operations, a proposal that includes a detailed Annual Work Plan (AWP) would eventually be submitted based on the refined ConOps Plan developed during implementation. See Section 3.6 Operations Planning of this Guide for more information on AWP.

3. Project Management

- a. **Scaling and Tailoring the Project Management Approach:** Awardees should execute Mid-scale RI projects using well-established project management methodologies. However, NSF allows flexibility in scaling and tailoring the methodology used based on the size, complexity, technical nature of the project, and identified projects risks. Project management practices include reliable cost estimating and schedule development, risk identification and risk mitigation, consideration of needed contingencies, and the ability to monitor progress against plan so that corrective actions can be taken. The level of project management effort and resources employed should be carefully considered such that the benefit does not outweigh the cost.
- b. **Cost Estimating:** Budget estimates for Mid-scale RI investments in design, implementation, and operations need to be supported by a well-documented Basis of Estimates (BoE) developed in accordance with the four characteristics and the twelve steps of the GAO Cost Guide, as described in Section 4.2 Cost Estimating and Analysis of this Guide. However, the primary focus should be on generally meeting the four characteristics of a reliable estimate (well-documented, comprehensive, accurate, and credible) to support NSF's assessment of cost reasonableness. The twelve steps should be considered when deemed advantageous to the Awardee's estimating process for the given life-cycle stage and NSF will review accordingly as part of the agency's cost analysis process. At minimum, the estimate should be easily understood, describe the methodology, and show calculations traceable to supporting documentation (well-documented), follow a work breakdown structure (comprehensive), be validated to be an error free representation of most likely costs (accurate), and consider risks and uncertainties (credible).
- c. **Schedule Development:** Schedules should be tailored to the technical nature and complexity of the project and the needs of the Project Management Team to monitor progress against plan. Schedules can be as simple as a time sequenced list of major milestones, or, when using EVM, as complex as a fully developed Integrated Master Schedule (IMS). No matter how simple or complex, the schedule proposed should meet GAO's four characteristics of a reliable schedule (comprehensive, well-constructed, credible, and controlled). The ten best practices should be considered when deemed advantageous to the Awardee's scheduling process for the given life-cycle stage, and NSF will review accordingly. At minimum, the schedule should establish milestones for all key events at reasonable durations (comprehensive), be logically sequenced (well-constructed), consider risks and inclusion of adequate float

or schedule contingency (credible), and updated routinely by authorized individuals with actual progress to provide a current forecast for comparison to the planned schedule (controlled). See Section 4.3 Schedule Development and Estimating of this Guide for details.

- d. **Contingencies:** Budget, schedule, and scope contingencies are highly encouraged on Mid-scale RI implementation awards and may be considered on design and operations awards. Budget and schedule contingencies give credibility to their respective estimates. Scope contingency provides pre-vetted options to further manage risk if budget contingency becomes inadequate during implementation or add capabilities if the risk impact aren't fully realized. In other words, all three contingencies can work in concert to provide the flexibility to cover risk exposure and deliver the full scientific scope within the authorized total project cost.

If proposed, the budget contingency estimate must be developed using a rigorous risk management approach as described in Section XX of this Guide. NSF is under no obligation to award budget contingency and may choose to handle risk realization in other ways per Sections XX and YY of this Guide. If awarded, NSF may hold up to 100% of the budget contingency until needed.

Since the schedule for a Mid-scale RI project can range in complexity, proposers should assess the benefit of schedule contingency to their project. If a simple milestone schedule is used, use of schedule contingency may add no practical value. The Awardee and NSF may simply be monitoring milestones and extending the award duration as needed to complete the project, provided that sufficient funding remains. If EVM and a full IMS is employed, then schedule contingencies may be added to each major work package in accordance with project management good practices and following formal change control procedures. See Section 4.3 of this Guide for additional details.

A Scope Management Plan is a valuable risk management tool. Scope contingency should be proposed at a level appropriate to the project and acceptable to the Program Office. **It does not need to have a value equivalent to at least 10% of the baseline budget as with Major Facilities projects.** If proposed, de-scope options (as well as scope opportunities) should be well-documented, be time-phased, prioritized to minimize scientific impact, and have appropriate threshold for NSF approval in the PEP.

Use of contingencies is always managed through the formal change control process as described in the PEP or AWP. Thresholds for NSF approval are then codified in the terms and conditions of the award.

- e. **Monitoring Progress Against Plan:** All Major Facilities are required to use Earned Value Management (EVM) during the Construction Stage. **In contrast, Mid-scale RI**

projects are only required to use an objective method of monitoring progress against plan that is considered sufficient for the Project Management Team to manage the project. If the method used is deemed sufficient to manage the project during the NSF review process, it should be considered sufficient for NSF oversight of the award. Any adjustments to the method will be made during award negotiation. If EVM is used, both scaling and tailoring are encouraged to balance administrative burden with sufficient project management insight. Refer to Section 6.8.4 of this Guide for more information on scaling EVM and Section X.X.X for other means of monitoring progress against plan.

E. The Mid-scale RI Life-cycle Stages (Types of Awards):

1. Mid-scale RI Development

Development of Mid-scale RI projects generally happens on significantly shorter time scales compared to Major Facilities. A vision for a time sensitive solution enabling scientific advances might lead directly to submission of a proposal for design of a Mid-scale RI and subsequent award. NSF may also fund activities such as community workshops to develop ideas and build consensus around the needed infrastructure. At the appropriate time this could lead to submission of a formal proposal for design either through a formal program or via an unsolicited proposal. If the proposed RI is an acquisition, submission of an implementation proposal (bypassing development and design) may be appropriate. If the project is an upgrade to an existing Major Facility, the development may happen as part of the Operations Stage award with approval of NSF Program Officer. In all cases communication with the appropriate NSF Program Officer is essential to successfully advance the vision beyond an initial idea to a formal design activity or a potential implementation project.

2. Mid-scale RI Design

Proposed Mid-scale RI projects are not required to undergo the formal stage-gate reviews that are mandatory for Major Facilities. However, Mid-scale RI must demonstrate an appropriate level of design maturity before proceeding to implementation. This level of maturity is generally comparable to that of a Final Design Review (FDR) as described in Section 2.X *Final Design Phase* of this Guide.

Mid-scale RI design awards must have a Design Execution Plan (DEP) that leads to submission of the Project Execution Plan (PEP) as a final deliverable. To minimize technical risk, design activities may include prototyping that has its own PEP tailored and scaled to this level of activity embedded within the DEP. Section 3.2 *Design Stage Planning* describes suggested contents of a DEP. The expected deliverable at the end of design is a comprehensive PEP ready for consideration of an implementation award.

3. Mid-scale RI Implementation

The implementation activities proposed for a Mid-scale RI may include construction, acquisition, or a wide variety of other activities that are necessary to deliver the intended scope based on the technical nature of the project. Production level design activities and prototyping not accomplished during design may also take place during implementation. While the scope of most Major Facility projects typically have a mix of hardware, civil works, instrumentation, firmware and software, Mid-scale RI projects may be all instrumentation, all software or a mixture depending on the needs of the scientific community. This high degree of variability requires that the project management approach be aligned to the needs of the RI type.

Some Mid-scale RI projects approaching \$100M may use many of the project management methods typically used for Major Facilities. Smaller projects, particularly those at the lower end of the Mid-scale RI TPC range, are expected to implement project management methods **only to the extent necessary to effectively manage the project. If deemed suitable to manage the project during the NSF review process, they will generally be suitable for NSF oversight purposes.**

As with Major Facilities, the PEP establishes the project definition, documents how progress against plan will be monitored, establishes change control and contingency use procedures, describes the Concept of Operations, and other Plans as described in Section 3.4 of this Guide. All ten PEP components must be included and addressed, unless otherwise noted in the funding announcement. The sub-components within each PEP component may be omitted but, if included, they should be scaled and tailored to size, complexity, and technical nature of the project, as well as the associate project risks.

The final NSF-approved PEP is generally incorporated by reference into the terms and conditions of the implementation award. However, the PEP is considered a living document and, as such, periodic post-award PEP revisions are expected. The Awardee should submit revised PEP sections to the NSF Program Officer for approval as described in the terms and conditions of the award.

As with Major Facilities, both re-planning and re-baselining may occur during implementation. Budget, schedule, and scope contingencies, if proposed and awarded, are expected to be used in accordance with the change control processes described in the PEP and the award terms and conditions.

4. **Mid-scale RI Operations**

If NSF commits to long-term operation of a Mid-scale RI, then submission of an Annual Work Plans (AWP) is required, including the use of an operational Work Breakdown Structure (See Sections 3.5 and 4.X of this Guide). Reporting during operations is based on the terms and conditions of the award. If the Mid-scale RI science support program is associated with a Major Facility, then reporting is generally included as part of the

reporting requirements of that facility.⁴ At the Program Office’s discretion, periodic operations reviews may be used to inform award renewals or competition, assess Awardee’s performance, inform the need for upgrades to meet emerging science requirements, or other oversight needs. See Section 3.5 Operations Stage Planning of this Guide for more information.

5. Mid-scale RI Disposition

As stated above, NSF may not have any long-term operational investment in a Mid-scale RI and therefore play no part in disposition decisions. Whether the property is government owned, or whether NSF has conditional interest in the property funded under the award, depends on the award instrument utilized. Under contracts all property is federally owned, and eventual disposition would follow government-wide practices. Under financial assistance, government ownership and NSF’s conditional interest at the end of the award (if any), must be specifically stated in the award terms and conditions. In general, the expectation for a Mid-scale RI under financial assistance is that title to property would vest with the Awardee at the end of the award. Unlike Major Facilities, eventual disposition at the end of service life would be the sole responsibility of the Awardee. Disposition planning with NSF would only be necessary if the agency had ownership or conditional interest in specific property. For more information on disposition refer to Section 2.8 of this Guide.

F. Summary of NSF Oversight for Major Facilities and Mid-scale RI

Given the wide range in implementation cost and the kinds of projects funded under Mid-scale RI programs, management by the Awardee and the oversight by NSF should be tailored and scaled to the unique characteristics of the RI, such as an assessment of the associated technical and programmatic risks, the technical scope, and the type and mix of work being performed. However, NSF is committed to the principle that this flexibility does not preclude a requirement for appropriate rigor on the part of NSF or the Awardee. The following table is provided to help clarify the factors influencing NSF oversight and illustrate the differences in the level of oversight for Mid-scale RI and Major Facilities based on statutory requirements and agency policy.

Table 2.9.1 – Summary of Oversight Requirements for Major Facility versus Mid-Scale RI

NSF Oversight Requirements for Major Facility versus Mid-scale		
	Major Facilities	Mid-scale RI
Statutory Oversight Requirements	YES AICA 2017; Section 110 (Construction and Operations)	NO AICA 2017; Section 109 speaks only to developing a strategy for Mid-scale RI. All oversight is based on NSF practice.

⁴ Larger Mid-scale RI upgrade projects are generally funded as a separate award with distinct reporting requirements.

Life-cycle Stages	YES (Development, Design, Construction, Operations, Disposition)	YES (Primarily focus on design, implementation, and operations)
Stage-gate Reviews	YES (CDR, PDR, FDR)	NO (Technical readiness assessed by the Program Office per funding announcement, or separate assessment if unsolicited)
NSF "No Cost Overrun" Policy	YES (Risk-adjusted TPC at PDR to support a potential budget request)	NO (Mid-scale RI do not undergo PDR)
Use of GAO Good Practices for Cost	YES AICA 2017; Section 110	YES Per NSF practice and as described in the associated funding announcement
Use of GAO Good Practices for Schedule	YES AICA 2017; Section 110	YES Per NSF practice and as described in the associated funding announcement
Budget Contingency	YES For Construction Stage, Monte Carlo (MC) simulation methods to demonstrate 70-90% confidence.	NO (Highly Recommended) Simplified algorithmic method to full Monte Carlo (MC) simulation, if proposed.
Schedule Contingency	YES	NO
Scope Contingency	YES At least 10% of baseline cost	NO (Recommended based on project complexity and risk profile)
Management Reserve	YES Authorized by NSF as part of the TPC for unforeseen events. Held by NSF and awarded as supplemental funding.	NO Standard NSF supplemental funding requests procedures; recommendation at Program Office discretion.
Design Execution Plan (DEP)	YES	YES
Project Execution Plan (PEP)	YES (All components and subcomponents)	YES (All components and subcomponents, unless specified otherwise in the funding announcement)
Annual Work Plan (AWP)	YES	YES (If operations is supported)
Work Breakdown Structure (WBS)	YES (Construction and Operations Stages)	YES (Implementation and operations)
Earned Value Management (EVM)	YES; Construction Stage Only (Scaled to the project)	NO (Only an objective means to monitor progress against plan. If EVM is used it should be scaled and tailored to the implementation project)

Periodic Construction Stage Reviews	YES (Joint PO and RIO)	NO (At Program Office discretion)
Periodic Operations Stage Reviews	YES	NO (At Program Office discretion)
NSF Integrated Project Team (IPT)	YES	YES (Core IPT members Only)
Awardee Core Competencies	YES (As described in Section 4.6.6 of Guide and required per the terms and conditions of the award)	YES (Matched to the technical nature of the project or program or as required per the terms and conditions of the award)
Disposition of Property	Either federally-owned or NSF has conditional interest, depending on the award instrument and the award terms and conditions. NSF is engaged in property disposition decisions throughout and at the end of award.	Generally, property title vests with the Awardee. Disposition would be the Awardee's sole responsibility. Disposition planning with NSF is only necessary if NSF has ownership or conditional interest.

G. Other Good Practices for Mid-scale RI.

1. Maintaining a recurring schedule for internal Project Team meetings and at least monthly with the NSF's core IPT to discuss project status against plan and risk management. A minimum requirement for meeting with NSF would be stated in the award terms and conditions, but establishing open communication and more frequent meetings when necessary is considered a good practice.
2. Review the information provided in the funding announcement before proposal submission.
3. Carefully review the award term and conditions with NSF as part of award negotiation and distribute to the Project Management Team for awareness during award execution.