

## QAM 12060: Quality Assurance Guidelines for Scientific Research

### Revision History

<b>Author</b>	<b>Description of Change</b>	<b>Revision Date</b>
T.J. Sarlina	Removed Procedures For Experimenters (PFX) references Added references in Section 6.0 Added Experiment Operations Plan information	July 2018
Kathy Zappia	Initial release of QAM 12060 that replaces guideline OQBP 4200 rev.0 and cancels the OQBP procedure.	November 2013

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## 1.0 INTRODUCTION

This is the implementation guide for scientific research of Fermilab's Quality Assurance Program. This guideline does not apply to efforts that have specific quality assurance plans/programs approved separately by the Department of Energy, such as Fermilab projects with specific project QA plans as required by DOE Order 413.3 Program and Project Management for the Acquisition of Capital Assets. Quality assurance for construction projects associated with research is covered in the broader Fermilab Quality Assurance program and is not addressed in this document. It is recognized that there are research efforts that are at the edges of what is described here and are handled on a case-by-case basis, typically by those responsible for managing the resources needed for the research. All research at Fermilab complies with the policies and guidelines established by the Director, host Divisions/Sections, and Management Systems. This Fermilab implementation follows the American National Standard Institute "Quality Guidelines for Research" ANSI/ASQ Z1.13-1999. This document follows the topics and ordering in the standard.

As with other integrated management systems at Fermilab, the QA program for scientific research depends on the active commitment of all participants in the research and their professional judgment. Fermilab's implementation of QA for scientific research follows the "graded approach". The authority level and formality of the implementation of the QA elements for scientific research are tied directly to the scale and needs of each research effort as determined by the line management for that effort.

The requirements of this chapter apply to activities at Fermilab in Batavia, Illinois and any Fermilab leased spaces.

## 2.0 DEFINITIONS & ACRONYMS

AAC- Accelerator Advisory Committee  
ES&H – Environment, Safety, & Health  
EOP – Experiment Operations Plan  
FRA - Fermi Research Alliance  
QA - Quality Assurance  
LDRD – Laboratory Directed Research and Development  
NSF - National Science Foundation  
PAC - Physics Advisory Committee  
PI - Principal Investigator  
POC - Point of Contact  
SAC – Scientist Advisory Council  
SOW – Statement of Work  
UEC - Users Executive Committee

## 3.0 RESPONSIBILITIES

### 3.1 Chief Research Officer

- Executes the scientific strategy for the laboratory in support of the laboratory's mission.
- Engages the particle physics community in the strategic planning process and communicates the strategy with the scientific community.

- Provides oversight and management of all aspects of the research program at Fermilab

### **3.2 Accelerator Division Head**

- Ensures that the Accelerator Programs are well aligned with the ongoing scientific mission of the laboratory and are effectively organized and managed in support of this mission.

### **3.3 Chief Information Officer**

- Ensures that the Computing Divisions are well aligned with the ongoing scientific mission of the laboratory and is effectively organized and managed in support of this mission.

### **3.4 Chief Technology Officer**

- Ensures that the Accelerator-based technology development programs are well aligned with the ongoing scientific mission of the laboratory and is effectively organized and managed in support of this mission.

### **3.5 Chief Project Officer**

- Ensures that the portfolio of projects is advancing to support and enhance the laboratory's scientific capabilities.
- Advises on impacts and resource-balancing.

### **3.6 Principal Investigator (PI) or Spokesperson**

- Primary contact between the research collaboration and Fermilab.

## **4.0 PROGRAM**

Scientific research at Fermilab contains four elements: theoretical investigations, experiments, tests, and supporting-technology R&D. These four elements generally follow the same steps as they develop and move toward publication of results.

Scientific research efforts have a PI or spokesperson (sometimes co-PI's, co-spokespersons) to share the work and to help ensure availability for operational issues. These leaders are identified when the research is proposed, and there are orderly processes for changes to these leaders when the research will continue for extended periods of time. Normally, the Fermilab Directorate is informed of such changes at the time they occur.

These leaders are the primary contact between the Laboratory and the research, and these leaders have responsibility for the quality of the research, the safety of people and equipment in the research, as well as for reporting on the progress, status, and any relevant issues involving the research. This latter function is essential for determining, assuring, and improving the quality of the research.

Aspects of these responsibilities may be delegated as appropriate to facilitate effectiveness and communication. The Fermilab Directorate is notified at the time of any such delegation of responsibility.

Independent of which of the four research processes being considered (theoretical investigations, experiments, tests, and supporting-technology R&D), the steps in the research process are nearly the same, although the inputs and controls vary with the research type and the scale of the effort.

The germination of ideas for scientific research has inputs from individual discussions, reading of scientific and technical papers, and presentations and discussions in venues such as seminars, workshops, and conferences. A proposal is prepared once an idea has generated sufficient interest and adequate number of starting collaborators. The decision to proceed with the research gets input from further discussions and reviews, and the approval authority level varies with the research category and the scale of the effort.

The criteria for approval are that:

1. The research is a well-defined goal and remains relevant to the Fermilab mission.
2. There has been adequate progress during the approved phase and there is a plan for proceeding with the research (including resources and ES&H concerns).
3. There is a reasonable prospect for the required support to be available to complete the research.

## 5.0 PROCEDURES

### 5.1 Planning the Research

Research efforts are defined initially in a proposal with detailed specifics of the collaborative activities spelled out in project documentation such as a Purchase Order, a Cooperative Research and Development Agreement (CRADA), Experiment Operations Plan, Strategic Partnership Project (SPP), Non-Proprietary User Agreement (NUPA), International CRADA, etc. These documents include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule.

Proposals and draft collaborative research documents are reviewed by the relevant management at the Laboratory for appropriateness for the Laboratory mission, feasibility, and how the research fits into the broader research program at the Laboratory and around the world. For major research, such reviews are often performed with the advice of internal or external review committees (e.g., standing committees such as the Director's Physics Advisory Committee and Accelerator Advisory Committee) or ad hoc committees appointed by and reporting to the Directorate or Division/Section Heads. The level of such review depends on the nature of the research and the scale of resources needed. Laboratory approvals both influence national and international advisory and review committees and take cognizance of recommendations from them. For large efforts, a Stage I approval may be granted once the goals of the research and techniques intended for use are accepted, with full (Stage II) approval awaiting more definitive plans and understanding of the availability of resources.

Proposed and draft project and contractual documents may also be used between experiments or programs and subsets of collaborators as an aid to planning, and to delineate the same elements as the documents above. Statement of Work may be developed between Fermilab and anyone performing work with the Laboratory.

## 5.2 Experimental Operations Plan

The Experimental Operations Plan should include:

- An outline of the Science goals,
- A description of operations tasks and how they will be covered,
- ES&H activities and how they will be managed,
- organization charts showing the management structure for the experiment and how it interfaces with the laboratory,
- Fermilab resources and roles as they pertain to each Division,
- The model for data processing and analysis including the computing budget and effort required,
- A list of the identified resources available, and
- A description of the roles and responsibilities of each institution together with a list of support required by each institution from funding agencies.

Contact the [Office of Program Planning](#) for more detailed information.

## 5.3 Performing and Documenting the Research

All research is performed in conformance with the policies and guidelines established by the Director, the host Division/Section, and relevant Management System policies.

In addition, research is performed with the highest regard for the scientific method, with the anticipation that results may be checked by independent researchers, and implications of the research results may lead to additional research efforts in the future whose utility and viability depend on the more current results.

Research groups have established various forms of internal review, sometimes multi-stage arrangements given the strong impetus for publishing research results in recognized journals, and interest in them. These reviews may include working early-on in analysis groups, assignment of “godparents” -individuals or groups to mentor and monitor the research- when the work reaches a certain level of maturity, formal review of first and second drafts of papers by assigned reviewers and open to the full research collaboration – all this before the work is submitted for publication. Less formal release of preliminary results for conference and other presentation may occur before formal submission of results for publication. In addition, submission to journals is accompanied by submission to the Fermilab Publications Office, which reviews for intellectual property rights and adds an additional level of quality assurance. Finally, there is the peer review of the most important results by the editors and referees before acceptance for publication in referee journals – and scrutiny by the broader research community, often in parallel through the mechanism of public preprint archives.

## 5.4 Assessing the Performance of the Research

Indications of the quality of scientific research include:

- Peer review of individual projects by committees, referees, peer reactions to seminars and conference talks
- Assessment of impact by citation counts; e.g., using the SPIRES database, counts and prestige of awards and recognition, etc.
- Overall assessment of group quality by agency reviews; e.g., Triennial DOE reviews
- Performance in job market and recruitment

At the most general level, there are regular Laboratory and agency reviews of the research output of the Fermilab program. As part of preparations for these reviews, statistics are accumulated about the numbers of publications and the numbers of citations for each publication using the facilities of public archival services, some of which the Laboratory contributes directly to its maintenance. Progress during pre-publication parts of the research effort is monitored through various meetings. These meetings provide a forum for monitoring progress as data is accumulated and analyzed in the ongoing scientific research.

The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved. These reviews try to identify and anticipate problems and make recommendations for corrective action.

In some cases, there are ad hoc internal and/or external reviews of potential and identified research problems organized within the research effort itself and reporting directly to that research effort organization – again with the goal of defining methods of preventing or correcting problems.

### **5.5 Transferring the Results of the Research**

While archival publication of research results remains the primary record of research, additional transfer of the results occurs in multiple forums. Relevant regular and major conferences and workshops are keen on hearing the results of Fermilab research. Some of these meetings are sponsored by Fermilab, but all such relevant meetings include major presentations of Fermilab based research results in their programs, both as invited presentations and by accepting submitted papers, etc. Assurance of this broad dissemination of the results of research is aided by the participation of Fermilab staff members and users as conveners and on the organizing and/or international advisory committees of nearly all major conferences.

Major collaborations have dedicated, standing speaker committees to facilitate the inclusion of research results from their collaboration in conferences and workshops. When no such mechanism exists, PI's and PM's are contacted directly to fulfill this function.

### **5.6 Planning**

In planning the Laboratory program, in addition to the various Laboratory advisory committees that review the research, the Laboratory obtains input from the funding agencies and the user community. From the agencies, this input comes directly from frequent and regular communication, and as an output of agency reviews. From the users of the facilities, the Laboratory obtains input from individual contacts with colleagues, and more formally through the Users Organization and its Users Executive Committee (UEC). See links to the Users Organization constitution and other relevant information at [http://www.fnal.gov/orgs/fermilab\\_users\\_org/index.html](http://www.fnal.gov/orgs/fermilab_users_org/index.html).

The UEC is supported by the Fermi Research Alliance. The UEC meets monthly, and meetings include direct discussions with Laboratory management. The UEC also organizes an annual Users meeting, which further enhances the input from these stakeholders.

## 5.7 Support for Performing the Research

### 5.7.1 Human and Material Resources

As discussed above, resources are identified as part of the proposal processes, and included directly in budget and staff planning processes. In the case of major programs, resources are also included in additional program planning documents.

Individual scientists receive informal training as a part of doing research at the Laboratory and collaborating with other scientists and engineers. Informal training also occurs as part of the research environment at the Laboratory. The typical degree of earlier training of the laboratory scientists who have responsibility for directing research is generally a Ph.D., 6 years of postdoctoral experience, and a graded sequence of assignments at the lab.

Mentoring is necessary to assure the longer-term quality of the research effort at the Laboratory and beyond. For Fermilab employees, such mentoring is a part of the annual goal setting and performance review processes. For users, mentoring is performed by the home institution, assisted by efforts internal to individual research efforts where they exist (e.g., in large experiments).

### 5.7.2 Research Environment

Special attention is paid to the quality and number of seminars, colloquia, workshops, and training sessions available at Fermilab. Public calendars and daily e-mailed reminders of such events are available to all. An atmosphere that encourages exchanges between speakers and audience at such events is a recognized goal.

The laboratory maintains document repository services through its Publications Office, Archives, and Documents Management & Control Policy.

### 5.7.3 Assessment

In scientific research where the collection of data occurs, the quality of that data is continuously monitored as it is taken. This quality assurance is typically built into the data acquisition process itself, with follow-up monitoring in near-real time and later off-line analysis, separate from the research-goal analysis itself.

Reviews of research quality are held regularly and ad hoc, both by internal reviews (e.g., via Director's Reviews and those organized within Divisions/Sections) and by external reviews (e.g., by DOE, PAC, and AAC).

Annual assessments of the performance of Fermilab staff members are part of the standard procedure at the Laboratory. This process includes annual goal setting, self-assessment of achievements, and review by supervisors.

## 5.8 Quality Improvement Goals

Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., workshops, seminars, and weekly All Experimenters/Lab Status Meetings).

## 5.9 Training

Training for quality assurance in research is a built-in part of the scientific process, with students learning from mentors and researchers regularly needing to present and defend their work internally to their collaborators and externally to the larger community. In addition, scientists are constantly participating in workshops, seminars, and physics studies and going to various schools and technology training to keep current.

## 6.0 REFERENCES

ANSI/ASQ Z1.13-1999, Quality Guidelines for Research

[DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets,](#)

[Experiment Operations Plan](#)

[Accelerator Advisory Committee website](#)

[Physics Advisory Committee website](#)

[Users Executive Committee Webpage](#)

[Program Planning Office](#)

[Scientific Research Misconduct Procedure](#)