Quality Assurance Plan
for
Lattice QCD Research Program Extension III

Unique Project (Investment) Identifier: 019-20-01-21-02-1032-00

Operated at
Brookhaven National Laboratory
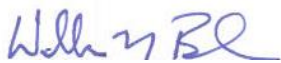Fermi National Accelerator Laboratory

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LQCD-ext III Quality Assurance Plan
Change Log

Version No.	Description	Effective Date
1.0	Updated to reflect LQCD-ext III operations model.	June 5, 2019

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1 Purpose and Scope

This document describes the Quality Assurance (QA) Program and related methodologies to be followed while executing the Lattice Quantum Chromodynamics Computing Research Program Extension III (LQCD-ext III) for the period FY2020 through FY2024.

The LQCD research program (hereafter LQCD) is an extension of the LQCD-ext II project, which is funded through FY2019. It will support the continued acquisition and operation of institutional computing hardware at existing facilities located at Brookhaven National Laboratory (BNL) and Fermi National Accelerator Laboratory (FNAL). BNL and FNAL will provide facilities and infrastructure that deliver the mid-scale computing required by the LQCD program. They will also provide computing professionals to plan, design, deploy, and operate the computing systems.

Since any software development, scientific or otherwise, is out of scope for LQCD-ext III, software quality assurance is not addressed in this document. Also, this document does not address quality assurance for scientific research.

This QA program (QAP) is based on the following DOE orders:
- DOE Order 414.1D, *Quality Assurance*
- DOE Order O413.3B, *Program and Project Management for the Acquisition of Capital Assets*
- DOE Guidance G 413.3-14, *Information Technology Project Guide* (dated 9-12-08).

2 Quality Assurance Program

Quality assurance applies to all work associated with LQCD. The QAP is implemented using a graded approach based on the analysis of risks identified in areas where work is to be performed. Although general QA principles apply to all aspects of the work, specific requirements are identified, as necessary, to consistently meet the obligations defined in the Program Execution Plan (PEP). Following the distributed nature of the project, whenever appropriate, site-specific activities adhere to the specific QA program documents for each host laboratory. Each hosting laboratory is responsible for ensuring that all work is performed following applicable safety, health, quality, physical security, cyber-security, environmental, and facilities/infrastructure policies and procedures.

Quality assurance runs through every phase of the project, with QA implementation guided by the LQCD-ext III Risk Management Plan[i]. As the research program progresses, designs and procedures may evolve, and the QA process will be revised as appropriate to remain an integral part of the program. This synthesis of QA with the program activities ensures the level of product and performance quality necessary to accomplish technical and scientific objectives.

3 QAP Elements and Implementation Strategy

Based on DOE Order 414.1D, Quality Assurance, the major elements applicable to LQCD are management, performance, and assessment. The key QA management elements for the program are the QAP itself, the qualification and training of personnel, the quality improvement process, and documentation. Performance elements include work processes, design, procurement, inspection and acceptance testing. Assessment elements include management assessments and independent assessments. Implementations of each of these QA elements are described in the following sections.

3.1 Management

3.1.1 Criterion 1 - Quality Assurance Program

This Quality Assurance Program has been developed by the LQCD Integrated Project Team (IPT). It is approved by the LQCD-ext III Contract Project Manager (CPM) and is implemented through the policies set forth in the PEP[ii] for the project.

The CPM is responsible for implementing the quality assurance program. Because of the distributed nature of the project, Site Managers are responsible for day-to-day quality assurance at their respective sites. Each Site Manager follows the comprehensive quality assurance program established at their home institution. For BNL, details are prescribed in the BNL Graded Approach to Quality Requirements[iii] and the BNL Quality Activity Guide[iv]. The quality assurance program for Fermilab is described in the Integrated Quality Assurance (IQA) document[v].

Each site uses a graded approach when implementing the QAP. Since the LQCD program office is located at Fermilab, the Fermilab IQA program is followed for overall project-related quality assurance activities.

The QAP is reviewed at least annually by the Site Managers and LQCD Program Office and revised with the approval of the LQCD CPM.

3.1.2 Criterion 2 - Personnel Training and Qualification

The PEP contains the current organization charts for LQCD. The qualification of project personnel begins with the IPT. The roles and responsibilities of the IPT, as well as the responsibility for assigning personnel to team positions, are described in the PEP. The Federal Project Director (FPD) and CPM are DOE Level-1 Qualified IT Project Managers in accordance with DOE Office of the CIO (OCIO) PM guidance. The experience and qualification of the scientific and technical staff are validated according to the policies maintained at each hosting institution. Hosting institutions are responsible for hiring qualified staff members and providing opportunities for personnel learning, training and professional growth to its staff members.

3.1.3 Criterion 3 - Quality Improvement

The CPM has the overall responsibility for effecting quality improvement throughout the project and is supported in this effort by the IPT. At the project level, the IPT takes steps to detect and prevent quality problems, identify root causes, correct quality issues, and implement improvement measures. At the site management level, these responsibilities are carried out by the site managers following the site-specific QA program documents. Site managers are responsible for developing and documenting processes, preparing technical specifications for QA related elements and carrying out QA procedures to ensure that products and procured items conform to these specifications.

The CPM and ACPM consolidate overall project performance measures and review them with the FPD to identify any quality issues. Performance measures defined in the PEP are tracked monthly and reviewed with the FPD to understand root causes of process-related concerns and necessary mitigation strategies. To assess performance and identify potential areas for improvement, LQCD conducts annual user satisfaction surveys. The project team also monitors and tracks key performance measures on a monthly basis.

3.1.4 Criterion 4 - Documents and Records

Documentation and records are maintained for LQCD-ext III at an appropriate level.

3.1.4.1 Documents

Controlled documents are defined in the PEP; the full set of controlled documents is listed in Appendix D of the PEP. Controlled documents are maintained in the Fermilab Computing organization's DocDB document database[vi]. The DocDB database supports automated versioning of documents and extensive report generation. DocDB was developed at Fermilab and is supported by the Fermilab Core Computing Division. The Core Computing Division maintains the software, administers the computing platforms and performs backups of the database.

DocDB is accessible online, with access protected as needed. Depending on their sensitivity, documents may or may not be accessible to the public and may even have restricted access within the program. LQCD controlled documents are retained under a protected topic area. Other uncontrolled LQCD documents are also maintained in this document database as appropriate. Access to and support for DocDB is negotiated in a Memorandum of Understanding (MOU) between LQCD and Fermilab.[vii]

The CPM and ACPM oversee the document control process. Through the use of the DocDB database, each project document is assigned a unique identification number and versions are tracked by date and submitter, along with a record of the changes made. Early versions remain accessible in the database.

In addition to documents stored in DocDB, other LQCD documents are maintained on the LQCD web site, which is access controlled. These include review documents, presentations, reports, findings, and the implementation status of review recommendations or corrective actions

3.1.4.2   Records

LQCD records are maintained by the LQCD Program Office, which is located at Fermilab. Documents that meet the criteria for a record are managed following policies and procedures defined in the Fermilab Records Management Handbook.

3.2   Performance

3.2.1   Criterion 5 - Work Processes

The CPM, with the support of the IPT, coordinates work on the program to ensure that the work is performed to these specifications. As defined in DOE O413.3, the execution of a project is associated with various work processes that may or may not be applicable to the LQCD-ext III. In this section, applicability of these work processes is discussed. Specific execution procedures are discussed in other relevant documents.

3.2.1.1   Design Definition

The site managers, with support from the program office, identify the appropriate technical standards to be applied to the system and prepare a schedule and budget for producing it. With input and advice from the USQCD Executive Committee and the USQCD Scientific Program Committee, which includes scientists and software engineers, the Site Managers work with their computing organizations to select and deploy appropriate hardware and associated software including proper configuration for their sites.

3.2.1.2   Building and Infrastructure

This work process is not applicable to LQCD, since hosting institutions are responsible for providing space and infrastructure to install the hardware procured for the project. This arrangement is defined in the MOUs with the hosting laboratories.

3.2.1.3   Hazard Analysis

This work process is not applicable to LQCD, since hardware is fully installed by the supplier. This work process is governed by the rules and regulations imposed by the hosting institution. Hosting institutions are responsible for overseeing associated work processes.

3.2.1.4   Integrated Safeguard and Security Management

Site mangers, with the help of the safety and security coordinators of the host laboratories, are responsible for making sure that employees perform the work in the site computing facilities according to the Integrated Safeguard and Security Management system in place. Computer security is a key concern for the project. Each participating laboratory must possess accredited DOE Authority to Operate (ATO) authorization, or equivalent approvals.

As necessary, environment, safety and health (ES&H) related work processes associated with the computing facilities are reviewed as a part of internal ES&H reviews and management assessments at each host laboratory.

Work performed by collaborating institutions is specified in formal MOUs between the project and each hosting institution.

3.2.2 Criterion 6 - Design

New systems are planned and designed following engineering best practices. Requirements are gathered and several alternatives are considered in the process of developing a final system design or specification. Design considerations are documented in Alternative Analysis (AA) documents that are prepared and as necessary revised by teams generally consisting of the LQCD site managers, site architects, and other subject matter experts directly associated with the research program. Each team is led by an individual appointed by the CPM. In most cases, design teams are led by one of the Site Managers. Once the alternatives analysis is complete and a preferred design identified, a recommendation on how to proceed is prepared and included in the AA document. The AA document, with recommendation, is formally transmitted to the USQCD Executive Committee for review and concurrence, and to the CPM for final approval.

3.2.3 Criterion 7 - Procurement

Site specific procurements are made in accordance with the procurement policies and procedures of the respective hosting laboratories. Procurement offices at hosting laboratories are governed by DOE rules and regulations. These offices perform annual self-assessments, regulatory compliance reviews, supplier surveillance and cost efficiency optimization.

3.2.4 Criterion 8   Inspection and Acceptance

Establishment of acceptance criteria and inspection procedures are important elements of QA. Site Managers assume the principal role in this process, which includes the following elements.

3.2.4.1 Establishment of Acceptance Criteria

For new hardware procurements, the Site Manager for the host site, with support by the IPT with appropriate experience and expertise, develops the acceptance criteria for new system hardware using a technically and scientifically defensible methodology. This includes running a prescribed set of codes on a stand-alone system, running code on multimode systems at the supplier site, running benchmark codes on the newly installed system at the host site, etc.

The hosting Site Manager establishes acceptance criteria for all other items that are procured from suppliers or fabricated and used to achieve the objectives of the program.

3.2.4.2   Test and Acceptance Procedures

Acceptance test designs are defined during the hardware acquisition process. The responsible Site Manager develops testing procedures for all newly procured items at an appropriate level. Systems are typically fully installed by the suppliers and once the project team has completed the initial set of system acceptance tests, the new system is released to expert users for initial user testing. Once the system is validated by expert users, it is released for production use by the USQCD user community.

3.3   Assessment

LQCD undergoes a comprehensive set of assessments and the outcomes of these assessments are used by the project for continuous quality improvement.

3.3.1   Criterion 9 Management Assessment

On a monthly basis, each Site Manager submits to the LQCD Program Office a detailed performance report for their institution. The ACPM consolidates these financial and technical performance reports and submits them to the CPM for review.

On a monthly basis, the CPM and ACPM prepare and present a report summarizing status and performance against goals to the FPD. This report, along with any issues related to the performance, is reviewed and discussed with the FPD.

During the annual All-hands Meeting organized by the USQCD collaboration, the CPM presents a summary of performance to the collaboration.

As a part of routine management assessment schedules of the hosting laboratories, each individual site is assessed for computer security, physical security, quality assurance and ES&H.

3.3.2   Criterion 10   Independent Assessment

Every year, LQCD undergoes an annual progress review organized by the DOE HEP office. During these comprehensive reviews, an independent, external body of assessors reviews the progress of the project from various points of view. These reviews focus on science proposed and delivered, computing facility performance, and financial and technical delivery performance. A formal review agenda is prepared, and review results are summarized in a written report that is made publicly available.

As a part of the national laboratory system, each hosting site also undergoes various independent reviews in the areas of security and safeguards, ES&H, and performance management.

4 List of Acronyms

Acronym	Definition
ACPM	Associate Contractor Project Manager
BNL	Brookhaven National Laboratory
C&A	Certification and Accreditation (computer security)
CCB	Change Control Board
CPM	Contractor Project Manager
DOE	Department of Energy
ES&H	Environment, Safety & Health
FNAL	Fermi National Accelerator Laboratory (a.k.a. Fermilab)
FPD	Federal Project Director
IPT	Integrated Project Team
LQCD	Lattice Quantum Chromodynamics
MOU	Memorandum of Understanding
NCSA	National Center for Supercomputing Applications
QA	Quality Assurance
QAP	Quality Assurance Program
QCD	Quantum Chromodynamics
SC	Office of Science
Tflop/s	Teraflops per second. 1 teraflop = 10^12 floating point operations
Tflop/s-yr	Computing delivered by 1 TFlop/s sustained for one year

5   References

[i] LQCD-ext III Risk Management Plan

[ii] LQCD-ext III Project Execution Plan

[iii] BNL Graded Approach to Quality Requirements
https://sbms.bnl.gov/sbmsearch/subjarea/73/73_SA.cfm

[iv] BNL Quality Activity Guide
https://sbms.bnl.gov/sbmsearch/subjarea/73/73_Exh1.cfm?ExhibitID=6494

[v] Fermilab Integrated Quality Assurance Program

[vi] Fermilab Computing Division Document Database Design and Interface

[vii] Memorandum of Understanding between the LQCD-ext III Project and the Fermilab Computing Division