Quality Assurance Plan
for the
SC Lattice QCD Computing Project Extension II
(LQCD-ext II)

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Fermi National Accelerator Laboratory
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LQCD-ext II Quality Assurance Plan
Change Log

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1.0	Adopt this document for LQCD-ext II from LQCD-ext	February 12, 2014
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1 Purpose and Scope

This document describes the Quality Assurance Program and related methodologies to be followed while executing the SC Lattice Quantum Chromodynamics Computing Extension II (LQCD-ext II) project for the period FY2015 through FY2019.

The purpose of the LQCD-ext II project is the deployment and operation of a large scale dedicated computing facility for the study of Quantum Chromodynamics (QCD). This project plays an important role in expanding our understanding of the fundamental forces of nature and the basic building blocks of matter. The computing hardware is housed at Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory (FNAL) and Thomas Jefferson National Accelerator Facility (TJNAF), and is operated as a single distributed computing facility, which is available to lattice gauge theorists at national laboratories and universities throughout the United States.

The scope of this mixed life cycle project is restricted to the deployment and operation of the incrementally procured computing hardware. The Development, Modernization and Enhancement (DME) portion of the project covers the new deployment of computer hardware while the Steady State (SS) portion of the project addresses the operation of the year to year deployment of the newly procured hardware for the project and the operation of the hardware procured and operated for the LQCD-ext II project. Since any software development, scientific or otherwise, is out of scope for this project, software quality assurance will not be addressed in this document. Also, this document does not address quality assurance for scientific research.

The program 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*; and
- 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 the LQCD-ext II project. The LQCD-ext II QAP is implemented using a graded approach to the application of controls, 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 Project 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 tailored using a graded approach, mostly guided by the LQCD Risk Management Plan[i]. As the project progresses, designs and procedures may evolve and the QA process will be revised as appropriate to remain an integral part of the project. This synthesis of QA with the project ensures the level of product and performance quality necessary to accomplish the technical and scientific objectives of the LQCD-ext II project.

3 QAP Elements and Implementation Strategy

Based on DOE Order 414.1D, Quality Assurance, the major elements of the LQCD-ext II project are management, performance, and assessment. The key QA management elements of the project 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. The assessment elements include management assessments and independent assessments. Implementations of each of these QA elements are described in the following sections.

3.1 Management

This section describes the implementation of QA in the management of the LQCD-ext II project.

3.1.1 Criterion 1 - Quality Assurance Program

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

The IPT is responsible for implementing the project quality assurance program. Because of the distributed nature of the project, site managers at each of the three sites are responsible for day-to-day quality assurance at their sites. Each site manager follows the comprehensive quality assurance program instituted at their respective site. 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]. The TJNAF quality assurance program is described in the TJNAF Quality Assurance Plan[vi].

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

The LQCD-ext II QAP is reviewed at least annually by the LQCD-ext II site managers, and revised with the approval of the LQCD-ext II CPM.

3.1.2 Criterion 2 - Personnel Training and Qualification

The LQCD-ext II PEP contains the current organization charts for the LQCD-ext II project. 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 LQCD-ext II 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 the root cause, 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 LQCD-ext II CPM and ACPM consolidate overall project performance measures and review them with FPD to identify any quality issues. Performance measures defined in the LQCD-ext II business case 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, the LQCD-ext II project team 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 the LQCD-ext II project at an appropriate level.

3.1.4.1 Documents

Controlled documents are defined in the PEP and the full set of controlled documents is listed in Appendix D of the PEP. Controlled documents are maintained in the Fermilab Computing

Sector's DocDB document database[vii]. The DocDB database supports automated versioning of documents and extensive report generation. DocDB was developed for the BTeV Project 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 via the World-Wide Web, 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 project. LQCD-ext II controlled documents are retained under a protected topic area. Other uncontrolled LQCD-ext II project 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 the LQCD-ext II Project and Fermilab.[viii]

The LQCD-ext II 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 and drafts remain accessible in the database.

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

3.1.4.2 Records

LQCD-ext II project records are maintained by the LQCD-ext II Project Office, which is located at Fermilab. Project documents that meet the criteria for a record are managed following policies and procedures defined in the Fermilab Records Management Handbook.

3.2 Performance

This section describes the implementation of QA in the performance of the LQCD-ext II project.

3.2.1 Criterion 5 - Work Processes

The ultimate goal of the LQCD-ext II project is to deploy and operate the special purpose computing facility distributed over three national laboratories. Details of the work to be done are specified in the LQCD-ext II System Description Document[ix]. The CPM, with the support of the IPT, coordinates work on the project to ensure that the work is performed to these specifications. As defined in the DOE O413.3 document, the execution of a project is associated with various work processes that may or may not be applicable to the LQCD-ext II project. 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 design documents are prepared and, if necessary, revised by the team of LQCD-ext II Site Managers. The Site Managers, with support from the project 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 LQCD-ext II Site Managers 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 the LQCD-ext II project, 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 the project, since the 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 hosting laboratories, are responsible for making sure that employees perform the work in the site computing facility 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 Authority to Operate (ATO) authorization, or equivalent approvals, to continue to be a part of the LQCD-ext II project.

As necessary, environment, safety and health (ES&H) related work processes associated with the computing facilities are reviewed as a part of the overall ES&H reviews for the laboratory.

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

3.2.2 Criterion 6 - Design

The technology of the computing facility design for the LQCD-ext II project is based on the designs used for the LQCD project and its predecessor, the SCIDAC prototype project. The

System Description Document provides an overview of the design and validation strategies. Each individual hardware system design is developed and reviewed by the team of site managers. Each system design is also reviewed by external reviewers during the Annual Progress Review of the project, at which the design is formally presented for review and concurrence. This process helps ensure that the LQCD-ext II computing facility achieves the specific technical and scientific objectives of the project.

3.2.3 Criterion 7 - Procurement

Site specific procurements are made in accordance with the procurement policies and procedures of the respective hosting laboratories. The LQCD-ext II project office keeps track of the procurement and associated documents. Procurement offices at hosting laboratories are governed by the same 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 LQCD-ext II QA. This applies both to items that are procured and those that are fabricated within the project. LQCD-ext II 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 extensive 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 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 as part of the project.

3.2.4.2 Test and Acceptance Procedures

Acceptance test designs are defined during the requisition process. The responsible Site Manager develops testing procedures for all newly procured items at an appropriate level. System 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

The LQCD-ext II project 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, the CPM and ACPM prepare a report summarizing the status of the project and performance against goals. Each Site Manager submits detailed performance reports. The ACPM consolidates these financial and technical performance reports and submits them to the CPM. This report, along with any issues related to the performance, is reviewed by the FPD and Project Monitor on a monthly basis.

During the annual All-hands Meeting organized by USQCD collaboration, the CPM presents a summary of the performance of the project 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, the LQCD-ext II project undergoes an annual progress review sponsored by the DOE HEP and NP offices. During these comprehensive reviews, an independent, external body of assessors reviews the progress of the project from various points of view. Over the years, the focus of these reviews included 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 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

ACPM .....Associate Contractor Project Manager
ASCR .....Advanced Scientific Computing Research
BNL.....Brookhaven National Laboratory
CPM .....Contractor Project Manager
DME.....Deployment, Modernization and Enhancement
EA .....Enterprise Architecture
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
LQCD-ext II...Lattice Quantum Chromodynamics Extension
MOU .....Memorandum of Understanding
QA.....Quality Assurance
QAP .....Quality Assurance Program
QCDOC .....QCD on a Chip
SC.....Office of Science
SciDAC.....Scientific Discovery through Advanced Computing
SS .....Steady State
TJNAF .....Thomas Jefferson National Accelerator Laboratory
WBS.....Work Breakdown Structure

5 References

[i] LQCD-ext II Risk Management Plan
[ii] LQCD-ext II 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] Thomas Jefferson Laboratory National Accelerator Facility Quality Assurance Plan
[vii] Fermilab Computing Division Document Database Design and Interface
[viii] Memorandum of Understanding between the LQCD-ext II Project and the Fermilab Computing Division
[ix] LQCD-ext II System Description Document