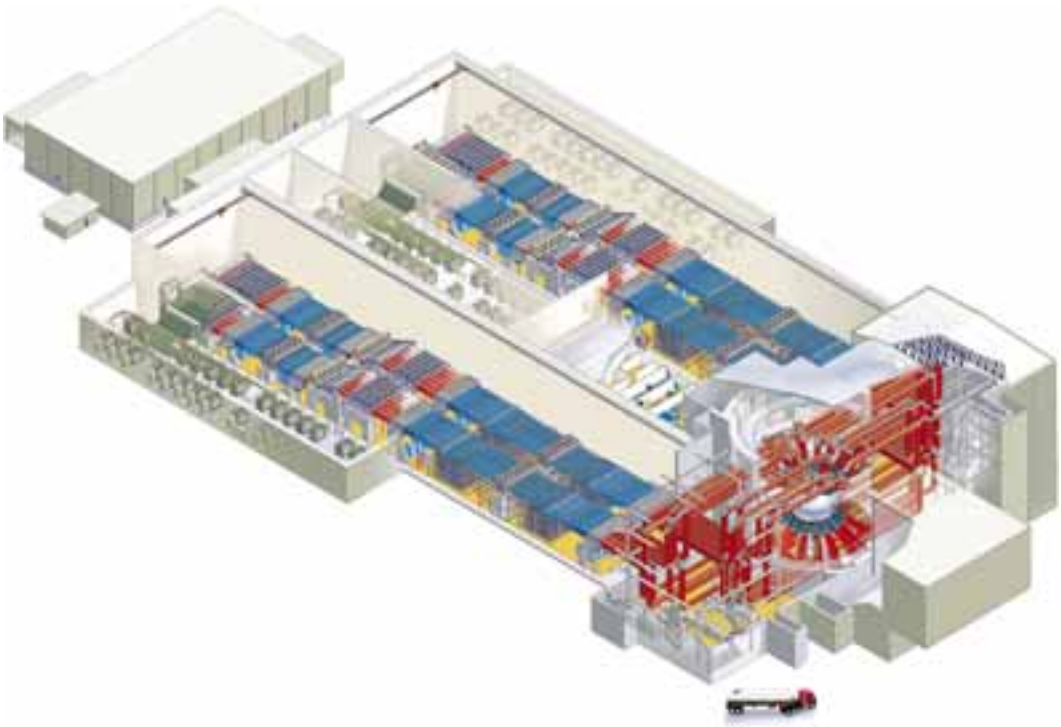
UCRL-ID-125435 Rev. 1
NIF-0000618

National Ignition Facility Quality Assurance Program Plan

Revison 1
September 1996



Lawrence Livermore National Laboratory
University of California • Livermore, CA • 94550

This report has been reproduced
directly from the best available copy.

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information
P.O. Box 62, Oak Ridge, TN 37831
Prices available from (615) 576-8401, FTS 626-8401

Available to the public from the
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd.,
Springfield, VA 22161

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract no. W-7405-Eng-48.

NIF Project Quality Assurance Program Plan

Submitted By:

C. Robert Wolfe Date
NIF Project Quality Assurance Manager

Jon Yatabe Date
NIF Project Assurance Manager

Concurred By:

Charles A. Taylor Date
NIF DOE ES&H Manager

NIF Project Quality Assurance Program Plan

Concurred:

John D. Boyes Date
SNL NIF Deputy Project Manager

John Soures Date
UR/LLE NIF Deputy Project Manager

W. Howard Lowdermilk Date
LLNL NIF Deputy Project Manager

Michael S. Sorem Date
LANL NIF Deputy Project Manager

Approved:

Jeffrey A. Paisner Date
NIF Laboratory Project Manager

Concurred:

Scott Samuelson Date
NIF DOE Field Manager

Contents

NIF Quality Assurance Policy

NIF Project activities will be conducted in a manner consistent with the guidance and direction of the DOE Order on Quality Assurance (5700.6C), the LLNL QA Program, and the Laser Directorate QA Plan. Quality assurance criteria will be applied in a graded manner to achieve a balance between the rigor of application of QA measures and the scale, cost, and complexity of the work involved.

Accountability for quality is everyone's, extending from the Project Manager through established lines of authority to all Project personnel, who are responsible for the requisite quality of their own work.

The NIF QA Program will be implemented by personnel conducting their activities to meet requirements and expectations, according to established plans and procedures that reflect the way business is to be conducted on the Project.

Jeffrey A. Paisner
NIF Laboratory Project Manager

INTRODUCTION

The National Ignition Facility (NIF) is a key constituent of the Department of Energy's Stockpile Stewardship Program. The NIF will use inertial confinement fusion (ICF) to produce ignition and energy gain in ICF targets, and will perform weapons physics and high-energy-density experiments in support of national security and civilian objectives.

The NIF Project is a national facility involving the collaboration of several DOE laboratories and subcontractors, including Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and the University of Rochester Laboratory for Laser Energetics (UR/LLE).

The primary mission of the NIF Project is the construction and start-up operation of laser-based facilities that will demonstrate fusion ignition in the laboratory to provide nuclear-weapons-related physics data, and secondarily, to propagate fusion burn aimed at developing a potential source of civilian energy.

To support the accomplishment of this very important mission, the LLNL Laser Directorate created the NIF Project Office to organize and bring about the Project. The NIF Project Office has established this Quality Assurance Program to ensure its success. This issue of the Quality Assurance Program Plan (QAPP) adds the requirements for the conduct of Title II design, construction, procurement, and Title III engineering. This QAPP defines and describes the program—the management system—for specifying, achieving, and assuring the quality of all NIF Project work consistent with the policies of the Laboratory and the Laser Directorate.

LLNL Quality Assurance Policy

All research, development, and operational activities will be conducted in accordance with our customers' needs and expectations, and with a commitment to excellence, innovation, and continuous quality improvement.

The LLNL QA Program provides guidance and direction for:

- Complying with applicable requirements.
- Using a graded approach to optimize the benefits of the program.
- Emphasizing continuous performance improvement.
- Using periodic independent and self assessment of quality.

Laser Programs Directorate Quality Assurance Policy

All work conducted for the Department of Energy will be conducted in observance of the LLNL policy on quality assurance and the requirements of applicable DOE Orders (for QA, 5700.6C). The Laser Directorate is committed to identifying and correcting deficiencies associated with its program activities.

The Laser Directorate will promote the acquisition of scientific and technical knowledge while assuring management accountability, sufficient controls, and appropriate documentation. Each person shall be trained and qualified for assigned responsibilities, maintain a quality awareness, observe QA plan and procedure requirements, and be proactive in improving work practices.

Purpose and Scope of the QA Program Plan

This QAPP delineates and defines the QA requirements governing quality-affecting activities of the NIF Project team participants, and its subcontractors. It also describes the program implemented by the Project to comply with these requirements, which are applicable to the activities associated with Project functions, such as management, design, procurement, fabrication, handling, construction, installation, inspection, testing, and start-up of all structures, systems, and components for the NIF Project.

This QA Plan incorporates and supplements applicable QA Program requirements of DOE Order 5700.6C and LLNL QA Plan M-078, and the Laser Directorate QA Plan L-18724.

Through the issuance of this QAPP document, the NIF Project Manager has established the following:

- The responsibility and authority for developing and implementing a quality program for the Project.
- The requirement that its quality program meet applicable federal codes, standards, and regulations.
- The requirement that effective QA activities be implemented by the Project and its subcontractors, commensurate with importance of the work involved.
- The requirement that work be evaluated, issues adverse to quality be identified, and that effective corrective actions be taken when necessary, by responsible personnel.

This QAPP is based on the following fundamental principles:

- Achievement of quality is a line responsibility wherein each employee and supervisor is accountable for the quality of work assigned.
- The NIF Project Quality Assurance Manager maintains an overview of the work to provide additional assurance that specified requirements are met. This is

accomplished through oversight activities, such as surveillance, audits, and other assessments.

- The degree of application of quality assurance criteria is dependent upon the magnitude of risk or hazard associated with the potential failure of the component or system involved. This is accomplished through the use of graded assurance measures.
- A no-fault attitude is fostered by management to encourage the identification of nonconformances, so that processes can be improved to prevent the recurrence of problems.

The quality program implemented in this QAPP is expressed in the following hierarchy of documents:

- *DOE Order 5700.6C, Quality Assurance*—establishes QA requirements for the wide spectrum of work performed by the Department of Energy and its contractors.
- *LLNL Quality Assurance Program* (QAP)—identifies QA requirements applicable to all Laboratory activities (document number M-078).
- *LLNL Laser Programs Directorate QA Plan* (DQAP)—provides guidance and requirements applicable to all work performed within and for the Laser Directorate (document number L-19798-1).
- *NIF QA Program Plan* (QAPP)—defines the NIF Laboratory Project Manager's policy and direction for implementing a quality assurance program; interprets the provisions of DOE Order 5700.6C, the LLNL QAP, and the Laser Directorate DQAP, and applies them to NIF Project activities, adding specificity to the requirements; and broadly describes how the NIF Project conducts its business.
- Ancillary or Subcontractor QA Plans—establish QA requirements for an individual organization within the Project or a subcontractor doing business with the Project. Such plans address the management of activities limited to the organizations' assignments.
- Implementing Procedures and Instructions—provide direction and specific instructions for workers to accomplish tasks within the framework of a management program.
  - — Project-wide procedures established in the NIF Project Control Manual (PCM) flowing down from this QAPP are usually generic, with widespread application across NIF Project organizations.
  - — Project organization procedures resulting from this QAPP or the PCM are specific to activities involved in the organizations' work. Subcontractor procedures generated to cover their workscope must also comply with this hierarchy of documents.

Arrangement of This Document

The basic requirements of this QAPP are presented in three categories that include the ten QA criteria established for a total management system in DOE Order 5700.6C:

- Management
  1 – Program
  2 – Pesonnel Training and Qualification
  3 – Quality Improvement
  4 – Documents and Records
- Performance
  5 – Work Processes
  6 – Design
  7 – Procurement
  8 – Inspection and Acceptance Tersting
- Assessment
  9 – Management Assessment
  10 – Independent Assessment

Section 1.0 of this document provides a narrative description of the QA Program structure and the roles and responsibilities of individuals in the NIF Project organization who implement the program.

In Sections 2.0 through 10.0, the remaining nine QA criteria of the three major categories are briefly stated, then followed by a description of the Project's methodology for complying with them, including a reference to subtier implementation documents, such as procedures or instructions.

Finally, Appendix A presents the Project Organization Chart, Appendix B provides a Glossary of Terms and Acronyms, and Appendix C summarizes requirements of the ten QA criteria and the documents established by the NIF Project to implement QA requirements. Appendix C provides a useful "at-a-glance" reference for identifying subtier Project documents that implement this QA Program.

MANAGEMENT

1.0 Program

Criterion 1 of DOE Order 5700.6C, Quality Assurance, requires the following:

- Develop, implement, and maintain a written QA program, applied with rigor commensurate with importance of the work.
- Describe the organization responsible for managing, performing, and assessing the work.
- Describe the management system, including cost and schedule control.

1.1 QA Program Structure—the Graded Approach

This QAPP complies with the requirements of DOE Order on quality assurance, LLNL QAP M-078, and Laser Programs DQAP L-18724. It establishes specific responsibilities for implementing the NIF Project's quality program in a graded manner, according to three quality assurance levels (Q-Levels) in the following table:

Q-Level	Degree of quality assurance activities
1	Full formal QA documentation, verification, and audit activities for the work involved.
2	Formal QA documentation, verification, and audit for some aspects of the work.
3	Documentation and verification that meets national consensus standards specified for the work.

Q-Level 1—Project structures, systems, components and activities whose failure could cause undue risk to the health and safety of employees or the public; could have significant potential for damage to the environment; or could cause an unacceptable program interruption, monetary loss, or schedule delay. The consequences of failure are of such a nature as to be unacceptable, and the probability of failure significant or unknown.

Structures, systems, components, and activities classified as Q-Level 1 shall adhere to the highest level of QA requirements as established by the table above and described in this document.

Q-Level 2—Project structures, systems, components, and activities whose failure could risk health and safety of employees or have minor impact on the environment, or could degrade the performance or reliability of operations, data acquisition, or deliverables. The consequences of failure are of such a nature as to be severe, but tolerable, and the probability of failure moderate.

Structures, systems, components, and activities classified as Q-Level 2 shall, as a minimum, adhere to the augmented level of QA requirements as established by the table above and described in this document.

Q-Level 3—Project structures, systems, components, and activities whose failure would not result in any significant health, environment, or safety risk, or loss or impairment of data generation; and the applicable codes, standards, or specifications do not require any special acceptance verifications or other QA measures. The consequences of failure are of such a nature as to be negligible or acceptable, and/or the probability of failure insignificant.

Structures, systems, components, and activities classified as Q-Level 3 shall, as a minimum, adhere to the lowest level of QA requirements as established by the table above and described in this document.

1.2 QA Program Application

The NIF Laboratory Project Manager retains the responsibility for implementing this QAPP, in which line managers, supervisors, and employees are responsible for ensuring that quality and performance objectives are effectively and efficiently achieved. The QAPP describes the way the NIF Project does business, and applies, according to the graded approach described in 1.1, to all activities described by the Project Work Breakdown Structure (WBS), NIF-0000386.

All Project personnel receive an orientation in the principles and provisions of the Project QA Program—the *project management system*. Personnel performing quality-affecting or verification activities receive additional training as described in Section 2.0.

The Q-Levels are “confidence levels” or degrees of assurance, rather than “graduated levels of quality” and are applied as appropriate to all structures, systems, and components, and the activities associated with them. The extent of controls applied for each Q-Level is based on fundamental considerations, such as the consequences of failure, complexity of design and fabrication, degree to which function can be demonstrated by test or inspection, past performance, impact on schedule, and economic considerations.

The responsible system engineers (the Project's technical authority) are accountable for performing evaluations to determine or revise the Q-Levels appropriate for the structures, systems, and components within their purview, according to NIF Procedure 1.6, Assignment of Quality Assurance Levels, and for documenting the necessary controls intended for ensuring the quality of the work.

1.3 Organization

The organizational units comprising the Project are illustrated in the chart in Appendix A, NIF Project Organization. The organization described herein includes personnel responsible for achieving quality and those responsible for verifying its achievement, normally those who did not perform the activities.

Verification personnel, whether in the line or organizationally independent, have sufficient freedom, authority, access, and responsibility to:

- Identify quality problems, deficiencies in hardware and documentation, and noncompliance with performance objectives.
- Initiate, recommend, or provide solutions through designated channels.
- Verify implementation of the solutions.
- Assure that deficient work is stopped or is proceeding under controlled conditions until proper disposition of the unsatisfactory condition is accomplished.

The quality-related responsibilities for the management positions of the Project's organizational units depicted in Appendix A are briefly described in the paragraphs below. Where titles are used to designate responsibility, the named position has the authority to designate another qualified position within the organization to perform an assigned task. The incumbent, however, retains the responsibility (is accountable) for implementing the requirements.

Subtier organizations may be described in subtier or ancillary QA plans that deal with organization-specific activities. Otherwise, the Project organizations operate directly in accordance with this QAPP and the *Project Control Manual*, CD 027, which contains management system procedures that implement this QAPP.

1.3.1 NIF Laboratory Project Manager

The Project Manager reports to the Associate Director for Laser Programs, and interfaces with the NIF DOE Field Office. The Project Manager has the overall responsibility and authority for the Project in accordance with the NIF Project Execution Plan, *CD 079*. To carry out this responsibility, the Project Manager relies on the assistance of the Project Engineer and Project Scientist, the support of four National Laboratory Deputies, and the administrative and technical performance of a project staff. The QA Program responsibilities for these management positions, including the senior managers of the project staff, are provided in succeeding sections.

The Project Manager's responsibilities include but are not limited to the following:

- Interfacing with the DOE on project management issues.
- Working with the Project staff to establish the technical, cost, and schedule baselines for the Project.
- Establishing and chairing the Level 3 Baseline Change Control Board.
- Establishing and implementing the QA Program for the NIF Project.
- Establishing, through appropriate contract language, the QA requirements for all Project subcontractors.
- Assessing Project work to ensure achievement of the Project mission, objectives, and quality requirements.

1.3.2 Project Engineer

The NIF Project Engineer reports to the Project Manager and holds the "chief engineer" position in the Project Office. The Project Engineer shares responsibility with the Project Scientist for the technical integrity of the Project, executing this responsibility by actions, such as the following:

- Advising the Project Manager on engineering issues.
- Establishing and maintaining the Project technical baseline.
- Implementing a review process to assure the integrity of the design.
- Ensuring that engineered systems meet cost performance goals.
- Analyzing designs to assure their manufacturing feasibility.

1.3.3 Project Scientist

The NIF Project Scientist reports to the Project Manager and holds the primary technical position in the Project Office. The Project Scientist shares responsibility with the Project Engineer for the technical integrity of the Project, executing this responsibility by actions, such as the following:

- Establishing primary criteria and functional requirements for the Project technical baseline.
- Ensuring resolution of science and technology issues.
- Interfacing with the National ICF Program.
- Conducting reviews to assure the Project's technical performance.

1.3.4 National Laboratory Deputy Project Managers

National Laboratory Deputies representing each of the four laboratories involved (LLNL, LANL, SNL, UR/LLE) are responsible for directing their laboratories' technical participatory effort in support of the NIF, according to the Project Manager's requests and established NIF Project requirements.

1.3.5 Associate Project Engineers/Leaders

Three NIF Associate Project Engineers (APEs) and one Associate Project Leader (APL) report to the Project Manager: APE for Special Equipment, APE for Conventional Facilities, APE for Activation and Start-up, and APL for Laser Materials and Optics Technology. These individuals are responsible for planning and acquisition and/or activation of structures, systems, and components that comprise the NIF. To carry out these responsibilities, the APEs/APL are assisted by Deputy APEs, System Engineers, and their staffs of discipline engineers and other technical personnel. Their responsibilities include but are not limited to the following:

- Developing design requirements to implement the Project's primary criteria and functional requirements for systems within their purview.
- Interfacing with the Systems Integration Manager to control design requirements and interfaces.
- Directing the activities of system engineers, technical personnel, and subcontractors in implementing the Project technical baseline.
- Designing, procuring, fabricating, installing, constructing, inspecting, and testing the Project structures, systems, and components within their purview.

1.3.6 System Engineers

NIF System Engineers report to their respective APE/APL, and are generally responsible for direction of the technical staffs and management of the technical details associated with the procurement, installation, and acceptance of their systems. These responsibilities include but are not limited to the following:

- Preparing System Design Requirements (SDRs), Subsystem Design Requirements (SSDRs), and Interface Control Documents (ICDs).
- Establishing interfaces with other Project systems.
- Designing the system or process and performing engineering analyses to support the system or process design.
- Assigning and revising Q-levels, establishing quality requirements and implementing QC measures to assure that the systems meet specified quality requirements, including preparing QA/QC plans procedures where needed.
- Providing safety input to the Project's Environment, Safety, and Health (ES&H) documents.
- Estimating and scheduling the work involved in the design, procurement, installation, inspection, and testing of the system.

1.3.7 Systems Integration Manager

The NIF Systems Integration Manager reports to the Project Manager through the Project Engineer, and is responsible for ensuring an integrated systems approach to the design and construction of the NIF. The Systems Integration Manager is responsible for activities such as the following:

- Coordinating design requirements and criteria for Project systems to assure proper flowdown from the primary criteria and functional requirements.
- Assessing overall Project risk and advising the Project Manager on risk management.
- Establishing interface controls to document key interfaces among Project systems, such as interference prevention and vibration-control budgeting.
- Evaluating NIF performance through operational analyses.

1.3.8 Project Assurance Manager

The Project Assurance Manager reports to the Project Manager and is responsible for environmental, safety, health, quality, and security aspects of the Project and interfaces with DOE on Assurance issues. The Project Assurance Manager is responsible for activities such as the following:

- Evaluating environmental impacts of the Project, including NEPA documentation, permits, and monitoring.
- Performing and reporting safety analyses of Project construction and operation.
- Ensuring the establishment and implementation of an ES&H management plan and an ALARA program.
- Interfacing with DOE and the public on ES&H and other issues.
- Ensuring the establishment and implementation of a Project quality program, including project controls and recordkeeping.
- Establishing and implementing a security plan.

1.3.9 Quality Assurance Manager

The Project QA Manager reports to the Project Manager through the Project Assurance Manager, and is responsible for developing and issuing this QAPP document, and for reviewing and concurring in management plans, subtier and ancillary QA plans, and implementing procedures. The QA Manager is responsible for activities such as the following:

- Advising management of quality achievements and recommending means of improving quality performance.
- Developing a project management/quality assurance orientation program for Project personnel.
- Establishing generic project management/quality assurance procedures and instructions.
- Verifying the quality of work by assessment or surveillance.
- Investigating quality issues.
- Furnishing quality assurance expertise to support Project assessments.

1.3.10 Engineering Services Manager

The NIF Engineering Services Manager reports to the Project Manager through the Project Engineer and is responsible for managing design services for the Project's

special equipment, and for configuration management. The Engineering Services Manager is responsible for activities such as the following:

- Establishing a design service organization (electrical, electronic, and mechanical) to support the Project's special equipment system engineers.
- Establishing a configuration-control / data-management program for the Project and ensuring preparation of a Configuration Management Plan and implementing documents.
- Implementing a NIF computer-aided-design and -drafting system.
- Linking the engineering data management system with financial and procurement controls (Project and institutional) to establish production controls for special equipment systems.

1.3.11 Project Control Manager

The NIF Project Control Manager reports to the Project Manager and is responsible for cost and schedule control and reporting for the Project. The Project Control Manager is responsible for activities such as the following:

- Developing and maintaining the Project Summary Work Breakdown Structure and Dictionary.
- Coordinating development of the Project Execution Plan for issue by the Project Manager.
- Establishing and implementing a cost and schedule control and reporting system, including cost-account planning and documentation.
- Establishing and implementing baseline change controls, including the tracking and trending of effects of changes to Project baselines.
- Advising the Project Manager on cost, schedule, and financial matters.
- Interfacing with DOE and participating laboratories on the Project's financial matters.

1.3.12 Project Administrator

The NIF Project Administrator reports to the Project Manager and is responsible for managing the administrative personnel and support functions of the Project. The Project Administrator is responsible for activities such as the following:

- Managing Project documents and records; maintaining QA files.
- Implementing a Project action tracking system.
- Supervising the administrative staff and managing the administrative affairs of the Project, including human-resources-related processes.

1.3.13 Procurement Manager

The NIF Procurement Manager reports to the Project Manager and is responsible for all Project procurement and subcontract actions. The Procurement Manager is responsible for activities such as the following:

- Developing and maintaining a Procurement Plan and acquisition strategy, by interaction with the Project's senior managers; maintaining a qualified vendor base.
- Managing a staff of procurement specialists to place and manage procurements for the Project, including major subcontracts for architect-engineers, engineering service contractors, optics facilitization vendors, master task agreements, and a construction manager.
- Resolving procurement issues regarding compliance with specifications, inspections, nonconformance reporting, etc.
- Advising the Project Manager on procurement issues and contractual matters.
- Interfacing with DOE and participating laboratories on procurement issues and contractual matters.

1.3.14 All NIF Project Personnel

Each individual in the NIF Project organization, whether matrixed, directly employed, or subcontracted by the Project, is responsible for receiving Project training specified by his/her manager, and is accountable for achieving quality in his/her own work.

All personnel are responsible for executing their work and ensuring that quality-affecting activities within their purview are performed in conformance with this QA Program and the applicable approved plans and procedures, such as those cited in this QAPP.

1.4 Delegation of Responsibility for Quality

When responsibility for attaining quality is assigned to other Laboratory personnel, subcontract personnel, consultants, suppliers, or vendors, quality assurance requirements and work controls are documented in contracts, statements of work, task records, or similar documents. These documents include, as applicable, the assigned responsibilities, lines of communication, criteria defining acceptable work, and a listing of deliverables.

The individual or organization delegating the work retains the responsibility for establishing and implementing management controls to assure that the delegated work meets quality requirements.

1.5 Stop Work Authority

Each person has the authority and responsibility to stop his/her own work when continuation will produce or conceal results that are not in accordance with prescribed requirements, and the responsibility to report such conditions to line management. Further, each person has the responsibility to advise others to stop work that is creating

an unsafe condition, and to report that unsafe condition to the appropriate safety officer.

In all cases, stop work orders are issued and lifted according to *NIF Procedure 3.3, Stop Work Action*.

1.6 Cost and Schedule Control

Each person has the obligation to be cognizant of the financial and schedule significance of his/her work. When making decisions, managers consider the cost and schedule effects of alternatives, and are accountable for maintaining cost and schedule baselines, as well as the technical and quality elements of the Project.

Project estimates are prepared according to *NIF Procedure 1.2, Cost Estimating,* and schedules for the work are prepared according to *NIF Procedure 1.3, Project Scheduling.*

2.0 Personnel Training and Qualifications

Criterion 2 of DOE Order 5700.6C requires the following:

- Personnel shall be trained and qualified for their assigned work.
- Continuing training shall be provided to ensure proficiency.

The qualifications of NIF Project personnel who are assigned to manage, perform, or verify activities that affect quality are established and recorded according to *NIF Procedure 2.1, Personnel Qualification Approval and Records Retention*. Further, these personnel receive appropriate Project-specific orientation and training prior to performing assigned work. The training required is determined by organization managers in accordance with *NIF Procedure 2.2, Personnel Training and Qualification*. Personnel who participate in independent QA Program assessments are qualified according to the requirements in *NIF Procedure 2.3, Qualification of QA Program Auditors*.

Training of subcontractor personnel is verified by examination of personnel qualification records, surveillance of work in progress, and assessment of output products through the testing and inspection activity discussed in Sections 7.0 and 8.0 of this QAPP.

3.0 Quality Improvement

Criterion 3 of DOE Order 5700.6C requires that processes be implemented to:

- Detect and prevent quality problems to ensure improvement.
- Identify, control, and correct items and processes that do not meet requirements.

- Identify causes of problems to prevent their recurrence.
- Analyze quality results information to identify areas needing improvement.

3.1 Control of Nonconformances

Each person has the authority to identify conditions adverse to quality, and the responsibility to report them to appropriate management by means of a Nonconformance Report (NCR), according to *NIF Procedure 3.2, Nonconformance Reporting,* or its approved subcontractor equivalent. Deficient conditions are investigated and dispositions are determined by the appropriate technical authority.

Deficiencies identified by inspections, assessments, or other reviews of completed work (other than in-process inspections) are also reported on NCRs, which are periodically analyzed by the Project QA Manager for possible trends to identify opportunities for improvement.

3.2 Corrective Action

As part of the nonconformance control process, consideration is given to root causes and generic implications, and corrective action is taken according to the methods established by the technical authority who dispositions the NCR. When necessary, further action may be taken to prevent recurrence of significant conditions adverse to quality. To maintain management visibility, significant issues are tracked according to the process described in *NIF Procedure 1.8, Project Action Tracking.*

3.3 Performance Measurement

Performance standards for individual activities are established in the drawings, specifications, procedures, and test instructions that govern the work. Information on compliance with individual-task quality performance requirements is collected and analyzed through the nonconformance/corrective action process described above. This process provides the feedback information necessary for NIF Project technical personnel to address problems commensurate with their Q-Level, degree of importance, and occurrence.

4.0 Documents and Records

Criterion 4 of DOE Order 5700.6C requires the following:

- Documents that describe processes, specify requirements, or establish designs shall be prepared, reviewed, controlled, and maintained.

- Records that provide evidence of quality shall be specified, reviewed, controlled, and maintained.

4.1 Technical Documents

Documents such as criteria, interface controls, drawings, calculations, computer codes, specifications, procedures, data sheets, vendor data, program plans, work instructions, etc., are either locally controlled by engineering organizations according to their internal procedures, or controlled at the Project Document Control Center (DCC) in accordance with *NIF Procedures 4.1, Document and Records Control and 4.2, Control of Project Correspondence.*

Subcontractors are required by procurement documents to supply plans and procedures that describe their control of documents and records created as a result of subcontract work.

4.2 Procurement Documents

Procurement documents, such as requisitions, purchase orders, statements of work, supplier evaluations, etc., are locally controlled at the Project's Procurement Office until procurements are completed, or controlled at the Project DCC in accordance with NIF Procedure 4.1, cited above. Procurement controls are discussed in Section 7.0.

4.3 Quality Records

Records that provide evidence of the quality of structures, systems, components, and activities are maintained during active use by each responsible organization or subcontractor. When records have been completed, they are validated (Q-Level 1 only) and transmitted to the DCC where they are retained according to NIF Procedure 4.1. Reviews of technical records performed by Project Office personnel are accomplished according to *NIF Procedure 4.3, Review of Technical Records.*

PERFORMANCE

5.0 Work Processes

Criterion 5 of DOE Order 5700.6C requires the following:

- Work shall be peformed under controlled conditions according to established technical standards and approved administrative controls.
- Items shall be identified and controlled to ensure their proper use, and maintained to prevent their loss or deterioration.
- Equipment used for monitoring or data collection shall be calibrated and maintained.

5.1 Procedures and Other Instructive Documents

Project activities are prescribed by and accomplished in accordance with instructions, procedures, drawings, specifications, or checklists, and with nationally recognized codes and standards appropriate to the assigned tasks. These documents contain appropriate performance standards for the work, such as quantitative and qualitative acceptance criteria for determining that the prescribed activities have been satisfactorily accomplished.

Project activities are also governed by the procedures established in the Project Control Manual. The procedures in this manual are generated according to a standard format designed to present all the information needed by a user, which is prescribed in *NIF Procedure 1.1, Preparation of PCM Procedures.*

Subcontractor activities are governed by Project-approved procedures and instructions prepared according to their QA Plans unless otherwise noted (see Section 7.1).

5.2 Identification and Control of Items

Processes for the identification and control of documents generated by the NIF Project are prescribed in procedures established in the Project Control Manual. Q-Level 1 hardware and software items (and Q-Level 2 and 3 items specified by the technical authority) produced by the Project are identified and controlled according to plans, procedures, or instructions prepared by the organizations responsible for the hardware or software. Identification of these items is maintained on the items or in documents traceable to them.

Processes for the identification and control of items produced by subcontractors are prescribed in Project-approved procedures that describe methods for ensuring their traceability and for assuring only correct materials are used, including consumables with limited shelf-lives.

5.3 Handling, Storage, and Shipping

Handling, storage, labeling, shipping, cleaning, and preservation of Q-Level 1 components (and Q-Level 2 and 3 items specified by the technical authority) are accomplished according to plans, procedures, or instructions prepared by the organizations responsible for the items. These procedures are designed to prevent damage, loss, or deterioration until installed in the NIF.

5.4 Control and Calibration of Measuring and Test Equipment

Control of monitoring, data-collection, and test equipment is accomplished according to Project-approved procedures or instructions prepared by the organizations responsible for the items, or according to applicable codes and standards. The instructions or standards describe methods by which guages, tools, instruments, and other equipment used for activities affecting quality are to be calibrated, adjusted, and maintained at specified intervals, and controlled to ensure their accuracy. Equipment of this type that does not require formal calibration is only checked periodically for proper function.

6.0 Design

Criterion 6 of DOE Order 5700.6C requires the following:

- Items and processes shall be designed using sound engineering and scientific principles, and appropriate standards.
- Design work and design changes shall incorporate applicable requirements and design bases.
- Design interfaces shall be identified and controlled.
- Design adequacy shall be verified and validated by qualified individuals who did not perform the work.
- Verification and validation shall be completed before the design is approved and implemented.

Technical activities of the NIF Project are controlled to a degree commensurate with their Q-Level. Design process controls used by organizations that perform engineering services cover the range of activities from documenting design requirements and calculations through design development, output, changes, records, interfaces, verification, and approval.

6.1 Design Preparation and Control

The control processes for design and engineering performed by the NIF Project are prescribed by *NIF Procedures 6.1, System Design Requirements, 6.2, Interface Control Documents*, and *6.3, Engineering Drawing Standards and Controls*. Organization-specific procedures or instructions may also be used to address individual activity details.

Subcontractors performing design and engineering services are required by procurement documents to provide plans and procedures that describe their design control processes, for acceptance by the Project.

6.2 Design Verification

Designs of Project structures, systems, and components are verified by qualified personnel implementing the processes described *NIF Procedure 5.1, Design Review*. Technical records are reviewed by qualified personnel according to *NIF Procedure 4.3, Review of Technical Records.*

6.3 Configuration Management

Project system configurations are controlled by the technical and administrative processes described in the *NIF Configuration Management Plan*, L-21635-1, NIF-LLNL-96-070. The Plan invokes a number of interrelated procedures of the PCM, which are operative in managing the Project configuration, particularly *NIF Procedure 1.7 Project Change Control and 6.4, Engineering Change Requests*.

7.0 Procurement

Criterion 7 of DOE Order 5700.6C requires the following:

- Suppliers shall be evaluated and selected on the basis of specified criteria.
- The Project shall ensure that procured items and services meet established requirements and perform as specified, and that approved suppliers continue to provide acceptable items and services.

All procurement activities for the NIF Project are accomplished according to the University of California Laboratory procurement Policies and Standard Practices. However, certain procurements may be controlled to a greater degree, depending on the assigned Q-Level.

7.1 Supplier Use of NIF Project Office QA Program

In cases where the procurement scope or schedule constraints cannot justify subcontractor/supplier development or maintenance of a QA program, the NIF Project organization may permit some or all of the supplier's activities to be performed under the jurisdiction of this document. Under circumstances in which this condition is anticipated, the responsible Project APE/L ensures that procurement documents (including the RFP) specify those portions of this QAPP that apply to the subcontractor's work.

7.2 Supplier Qualification

Suppliers of items and services for the Project are evaluated and qualified through the process described in *NIF Procedure 7.1, Supplier Qualification.*

7.3 Standard Procurement Practice

The *NIF Procurement Plan*, NIF-0000TBD, addresses the scope, schedule, and selection of suppliers for the Projects major procurements. All procurement activities are accomplished in accordance with *NIF Procedure 7.2, Standard Procurement Policies and Practices,* which addresses the application of University of California requirements for Project procurements of all types.

7.4 Vendor Surveillance

Verification of supplier compliance with quality requirements of Q-Levels 1 and 2 items and services is performed by qualified personnel in accordance with *NIF Procedure 7.3, Vendor Surveillance.* This activity includes source inspections and reviews of suppliers' production and inspection records and other documentation verifying the achievement of quality at the source. Verification of compliance with quality requirements for selected Q-Level 3 components during production may be obtained by vendor certification or other means.

8.0 Inspection and Acceptance Testing

Criterion 8 of DOE Order 5700.6C requires the following:

- Inspections and tests shall be conducted using established acceptance and performance criteria.
- Equipment used in inspections and tests shall be calibrated and maintained.

8.1 Inspection

In-process and acceptance inspections are performed by qualified subcontractor personnel in accordance with Project-approved procedures prepared by the designer or the organization responsible for inspection, or according to the codes and standards that apply to structures, systems, and components inspected. Project personnel witness critical inspections of Q-Level 1 items and selected Q-Level 2 and 3 items when appropriate. NIF QA personnel periodically witness inspections (or may perform inspections) as a part of the surveillance and assessment processes discussed in Sections 7.0 and 10.0.

Optical components to be used in NIF laser systems receive special inspections as indicated in the *QA Plan for Laser Materials and Optical Technology*, L-21796-1, NIF-LLNL-96-276, and its references. Computer software to be used in the control and diagnostics of NIF laser systems receive special inspections as indicated in the *Software QA Plan*, L-16880, NIF-LLNL-94-073, and its references.

Receiving inspections at the jobsite for Q-Level 1 and selected Q-Level 2 and 3 materials and equipment components are performed by either NIF Project personnel or subcontractor personnel according to Project-approved procedures prepared by the designer or the organization responsible for inspection.

8.2 Acceptance Testing

Acceptance tests are performed by qualified NIF Project personnel or subcontractor personnel in accordance with Project-approved procedures prepared by the technical authority or the organization responsible for inspection as described in the *NIF Master Test Plan*, Doc no TBD. Tests are performed and documented according to the codes and standards that apply to structures, systems, and components tested. Project personnel witness acceptance tests of Q-Level 1 items and when appropriate, selected Q-Level 2 and 3 items. NIF QA personnel periodically witness tests as a part of the surveillance and assessment processes discussed in Sections 7.0 and 10.0.

8.3 Calibration of Measuring and Test Equipment

Control and calibration of monitoring, data-collection, and test equipment is accomplished as described in Section 5.0.

ASSESSMENT

9.0 Management Assessment

Criterion 9 of DOE Order 5700.6C requires that management at all levels:

- Periodically assess the performance of the integrated quality assurance program (project management system).
- Identify and correct problems that hinder the Project from achieving its objectives.

NIF Project organization managers and supervisors participate in periodic self-assessments conducted by the NIF Project Manager and/or the Associate Project Engineers/Leader, according to the guidance in *NIF Procedure 9.2, Management Self-Assessments.* Managers may independently determine the need to evaluate ongoing activities within their organizations, regardless of other Project assessments. When so determined, internal assessments are conducted using self-assessment plans prepared according to Procedure 9.2.

Further, a Project Scientist's Advisory Panel, established by the Project Manager in *NIF Procedure 9.1, Charter for the Project Scientist's Advisory Panel,* critically and systematically assesses proposed project changes that could impact achievement of mission objectives.

10.0 Independent Assessment

Criterion 10 of DOE Order 5700.6C requires the following:

- Planned, periodic, independent assessments shall be conducted to measure item quality, determine process effectiveness, and promote improvement.
- Independent assessors shall be free of the line organization and shall have sufficient authority to carry out their responsibilities.
- Independent assessors shall be technically qualified and knowledgeable in the areas assessed.

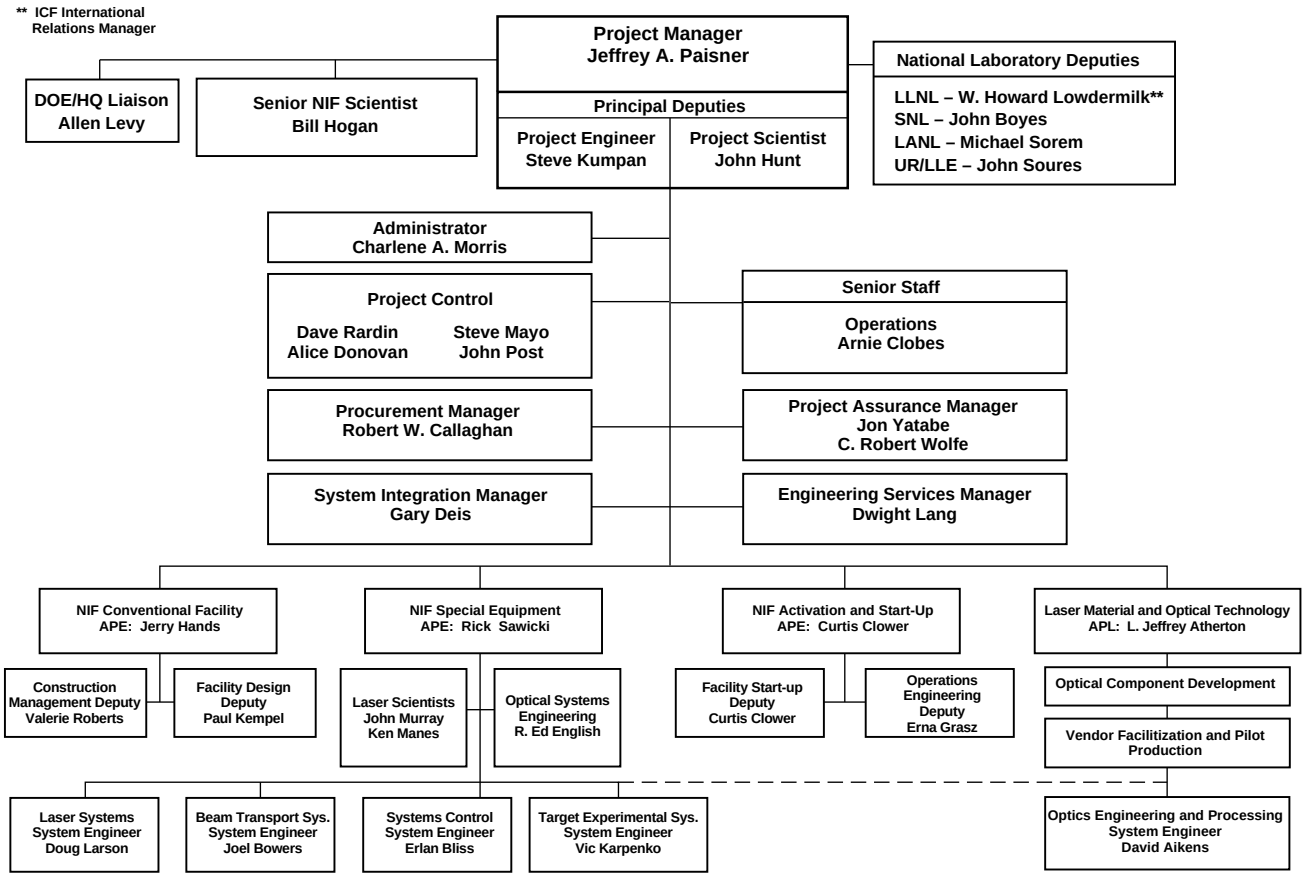
The NIF Project QA organization schedules, plans, and conducts periodic assessments, audits, and other reviews to evaluate the line organizations' achievement of requisite quality objectives. This system of QA oversight is designed to advise management of potential problems and makes use of technically knowledgeable advisors working with QA evaluators to focus on the effectiveness of the Project's QA Program, its performance, and its results.

Independent assessments of Optics Production Section activities are conducted in accordance with *NIF Procedure 10.1, Independent Assessments.* Personnel who lead

independent QA audit teams are certified and those who participate on the teams are qualified in accordance with *NIF Procedure 2.3, Qualification of QA Program Auditors.*

Appendix A

NIF Project Organization Chart



00-00-0195-0086pb04

Appendix B
Glossary of Terms and Acronyms

Acronyms

AE	Architecture Engineering Firm
APE	Associate Project Engineer
APL	Associate Program Leader
DOE	Department of Energy
ICD	interface control document
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
NCR	nonconformance report
NIF	National Ignition Facility
QA	quality assurance
QAP	Quality Assurance Plan
QAPP	Quality Assurance Program Plan
SSC	structures, systems, and components
SDR	System Design Requirement
SNL	Sandia National Laboratories
UR/LLE	University of Rochester Laboratory for Laser Energetics
WBS	Work Breakdown Structure

Definitions of Common Terms

Assessment/Verification—The act of reviewing, inspecting, testing, checking, conducting surveillances, auditing, or otherwise determining which items, process, or services meet specified requirements.

Configuration—The Project technical baseline as identified in documents formally designated and approved by the NIF Project Office and DOE. The physical and functional description of a facility, structure, system, or component.

Configuration Management—The systematic evaluation, coordination, approval, documentation, implementation, and verification of approved changes to the NIF Project configuration (technical baseline) after having formally identified the baseline.

Corrective Action—Measures taken to rectify conditions adverse to quality and, where necessary, to prevent recurrence.

Design Verification—The act of verifying the adequacy of design through the use of design review, alternate calculations, or qualification testing.

Document—Recorded information that describes, defines, specifies, reports, certifies, requires, or provides data or results. A document is not considered a record until it is complete.

Graded Approach—The method of allocating the rigor of quality assurance efforts to individual Project activities or elements. It is based on an assessment of the consequences associated with the potential failure of activities or elements.

Item—An all-inclusive term used in place of any of the following: appurtenance, facility, sample, assembly, component, equipment, material, module, part, structure, subassembly, subsystem, system, unit, documented concepts, or data.

Nonconformance—A deficiency in characteristic, documentation, or procedure that renders the quality of an item of hardware, software, or an activity unacceptable or indeterminate.

Quality—The degree to which an item or process meets or exceeds the end user's requirements and expectations.

Quality Assurance—Actions that provide confidence that quality is achieved.

Quality Assurance Level (Q-Level)—A designation applied to Project elements based on risks in the event of failure. It denotes the level of confidence necessary, and the amount of formal quality assurance action rewquired to substantiate the work performed.

Record—A completed document or other media that specifies requirements for or provides objective evidence of the quality of an item or process.

Work—Process of performing a defined task or activity, such as research and development, engineering design, component fabrication, operations, maintenance and repair, administration, software development and use, construction, inspection, data collection, analysis, etc.

Work Breakdown Structure (WBS)—A hierarchical organization of activities that describes and establishes relationships between the work elements of the project. The WBS assigns a number to each major category of work or component.

Appendix C
QA Program Implementing Documents

QA Program Criteria	NIF Project Implementing Documents
1.0 Program	
Program Management and Organization	NIF-LLNL-95-499, (this) Project QAPP
Grading (Q-Levels)	NIF 1.6, Assignment of Q-Levels
Organization	Project Execution Plan, CD 079 this QAPP (Appendix A)
Stop Work Authority	NIF 3.3, Stop Work Action
Cost & Schedule Control	NIF 1.2, Cost Estimating NIF 1.3, Project Scheduling
2.0 Train'g & Qualification	
Personnel Performing Work	NIF 2.1, Personnel Quals & Approval NIF 2.2, Orientation & Training
Personnel Verifying Work	NIF 2.3, Qualificat'n of QA Prog Auditors
3.0 Quality Improvement	
Nonconformance Control	NIF 3.2, Nonconformance Report'g
Corrective Action Tracking	NIF 1.8, Project Action Tracking
4.0 Documents & Records	
Technical Documents	NIF 4.1, Document & Records Control NIF 4.2, Correspondence Control
Procurement Documents	NIF 7.2, Std Procuremnt Policy & Practice
Quality Records	NIF 4.3, Review of Technical Records
5.0 Work Processes	
Instruction, Procedures, Dwgs	NIF Project Control Manual, CD 027 NIF 1.1, Preparation of Procedures
Identification & Control of Items	Project-approved procedures by sub-contractors or Project organizations; TBD
Handling, Storage & Shipping	Project-approved procedures by sub-contractors or Project organizations; TBD
Control of Measuring and Test Equipment	Project-approved procedures by sub-contractors or Project organizations; TBD

QA Program Criteria	NIF Project Implementing Documents
6.0 Design	
Design Preparation and Control	NIF 6.1, System Design Requirements NIF 6.2, Interface Control Documents
Design Verification	NIF 6.3, Engrg Drawing Stds & Controls NIF 4.3, Review of Technical Records
Configuration Management	NIF 5.1, Design Review NIF-LLNL-96-070, Configurat'n Mgt Plan
7.0 Procurement	
Supplier Use of NIF QAPP	NIF-0000618, (this) Project QAPP
Supplier Qualification	NIF 7.1, Supplier Qualification
Standard Procurement Practice	NIF 7.2, Standard Procurement Policies and Practices
Vendor Surveillance	NIF 7.3, Vendor Surveillance
8.0 Inspection & Testing	
Inspection	NIF-LLNL-96-276, Laser Mat'ls & Optical Technology QA Plan NIF-LLNL-94-073, Software QA Plan Project-approved procedures by subcontractors or Project organizations
Acceptance Testing	NIF Master Test Plan; Project-approved procedures by sub-contractors or Project organizations; TBD
Control of M & T E	Project-approved procedures by sub-contractors or Project organizations; TBD
9.0 Managem't Assessment	
Technical Objectives	NIF 9.1, Charter for Project Scientist's Advisory Panel
Project Organizations	NIF 9.2, Management Self-Assessments
10.0 Independent Assessment	
QA Oversight and Audits	NIF 10.1, Independent Assessments
Auditor Qualification	NIF 2.3, Qualification of QA Program Auditors