



Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

DUNE Quality Assurance

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26 June 2018

Agenda

- DUNE Quality Assurance Plan Overview
- Quality Assurance Responsibilities
- Quality Assurance Value to DUNE
- Lesson Learned

DUNE Management Plan

- DUNE Technical Coordination monitors the technical contributions from the different agencies and **provides the necessary centralized project coordination functions**, such as: maintaining the detailed WBS dictionary; maintaining the overall schedule; change control; interface documentation; **standardized quality control/quality assurance practices** and global risk management.
- Assisting the consortia in defining and implementing quality assurance/quality control plans that maintain a uniform, high-level standard across the entire detector construction effort.

Quality Assurance and Quality Control

- Quality Assurance is an integral part of the design, fabrication, construction and installation of the DUNE Project.
- All work performed on LBNF and DUNE will draw on the guidelines and criteria set out in the LBNF/DUNE Quality Assurance Plan and all established quality policies within associated laboratories/institutions.

Quality Assurance and Quality Control

- These criteria include:
 - Management criteria related to organizational structure, responsibilities, planning, scheduling, and cost control
 - Training and qualifications of personnel
 - Quality improvement
 - Documentation and records
 - Work processes
 - Engineering and design
 - Procurement
 - Inspection and acceptance testing

LBNF/DUNE QA Plan

- Quality assurance and quality control (QA/QC) systems are designed, as part of the LBNF/DUNE Quality Assurance Plan, to ensure that the components of the LBNF Project meet the design specifications and operate within the parameters mandated by the requirements.
- QA Plan outlines the QA requirements for all LBNF/DUNE collaborators and subcontractors, henceforth referred to as Project Partners, and describes how the requirements shall be met
- Plan is implemented by the development of quality plans, procedures and guides to accommodate those specific quality requirements

Responsibility for Project Management

- The DUNE Consortia Leaders manage their Projects and are responsible for achieving performance goals.
- The LBNF/DUNE QAM is responsible for ensuring that a quality system is established, implemented, and maintained in accordance with requirements
- The LBNF/DUNE QAM reports to the LBNF Project Manager and DUNE Technical Coordinator and provides oversight and support to the Project Partners to ensure a consistent quality program.

Personnel Training And Qualification

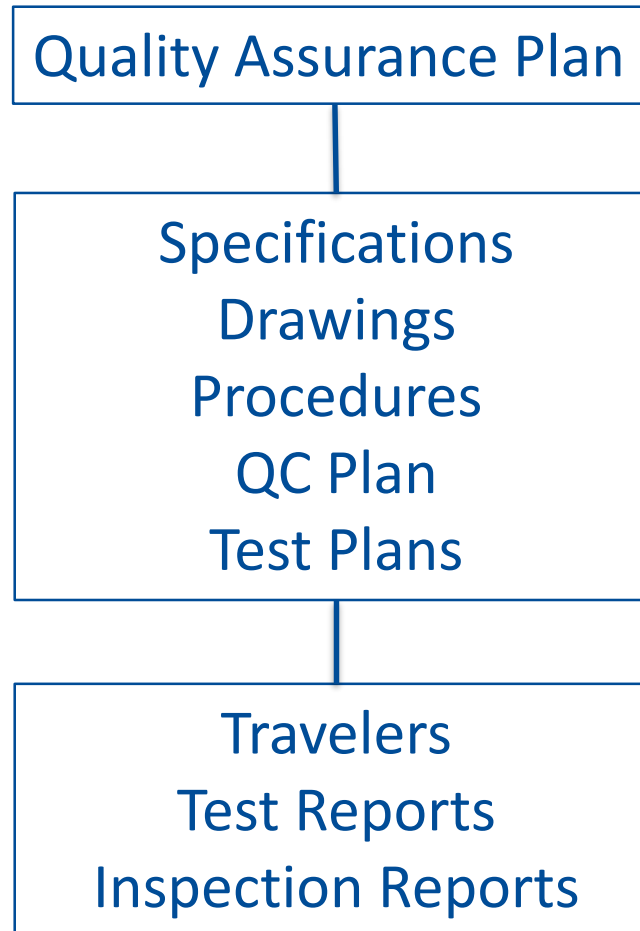
- The DUNE Technical Coordinator and Consortia Leaders, are responsible for providing the resources needed to conduct the Project successfully, including those required to manage, perform and verify work that affects quality.
- The DUNE Consortia Leaders are responsible for identifying the resources to ensure that their team members are adequately trained and qualified to perform their assigned work.

Quality Improvement

- All LBNF and DUNE Project Partners participate in quality improvement activities that identify opportunities for improvement.
- This quality-improvement process requires that any failures and non-conformances be identified and reported to the appropriate Sub-Project Manager or Consortia Leader; and, that root causes be identified and corrected.
- Items, services, and processes that do not conform to specified requirements shall be identified and controlled to prevent their unintended use.

Documents and Records

Quality Documentation Hierarchy:



Documents and Records

- Before these documents are put into effect they are reviewed and signed by the LBNF Sub-Project Manager, DUNE Consortia Leader or designee.
- The LBNF and DUNE Project Offices manage all documents under a document control system as identified in the LBNF/DUNE Configuration Management Plan (CMP).
- The system to control document preparation, approval, issuance to users, and revision is described in the CMP.

Work Processes

- DUNE team members are responsible for the quality of their work, and Project Partners are responsible for procuring the resources and support systems to enable their staff to complete their work with high quality.
- All DUNE work will be performed:
 - using methods that promote successful completion of tasks,
 - conformance to DUNE requirements, and
 - compliance with the LBNF/DUNE Integrated ESH Plan.

Fabrication Work Processes

- Fabrication work on the DUNE Project shall be performed to established technical standards and administrative controls using approved instructions and procedures.
- Fabrication work processes with QA inspections and tests shall be documented on Travelers that are retained with the hardware item.
- Items, including consumables, shall be identified and controlled to ensure their proper use and prevent the use of incorrect, unaccepted, or unidentified items.

Fabrication Work Processes

- The Projects will define a system of controls to ensure that items are:
 - handled,
 - stored,
 - shipped,
 - cleaned, and
 - preserved to prevent them from deteriorating, being damaged, or becoming lost.
- Equipment used for process monitoring or data collection shall be calibrated and maintained.

Design

- The LBNF/DUNE design process provides appropriate control of design inputs and design products.
- The primary design inputs are the scientific/engineering requirements (physics requirements, detector requirements, specifications, drawings, engineering reports, etc.).
- The basis of the design process requires sound engineering judgment and practices, adherence to scientific principles, and use of applicable orders, codes and standards.
- This basis of the design process naturally incorporates environment, health and safety concerns.

Design

- Work groups will begin preliminary design of DUNE by breaking their work down into sets of engineering drawings, specifications and reports.
- Throughout the design process, engineers and designers work with LBNF/DUNE Sub-Project Managers, Consortia Leaders and the LBNF/DUNE QAM to determine QA inspection criteria of fabricated products and installations.

Design

- Close coordination must be made with LBNF/DUNE scientists to assure the engineering satisfies the scientific requirements of the experiment.
- Final Design work sets the final Quality Assurance parameters for the parts, assemblies and installations.
- Design during Final Design and production is confined to Change-Controlled changes,; and, minor changes necessary to facilitate production, drawing error correction, material substitutions and similar functional areas.

Procurement

- When procuring material or items, the following factors will be considered for review and approval of this documentation:
 - Inclusion of technical performance requirements
 - Identification of required codes and standards, laws and regulations
 - Inclusion of acceptance criteria, including requirements for receiving inspection and/or source inspection
 - DUNE requirements for vendor qualifications and certifications
 - DUNE intention to perform acceptance sampling in lieu of full inspection and test item acceptance

Inspection and Acceptance Testing

- Inspections and tests are performed in order to verify that the physical and functional aspects of items, services, and processes meet requirements and are fit for use.
- The performance expectations, inspections, and tests are considered during the design phase and, where appropriate, are specified in the design output and/or procurement documents.
- Consortia Design Authority is responsible for specifying when/what type of inspection is required and for ensuring that adequate inspections are performed.

Inspection and Acceptance Testing

- Inspection and acceptance testing plans identify item characteristics and processes to be inspected/acceptance tested, inspection techniques, acceptance criteria, hold points, and the organization responsible for performing the inspection.
- Appropriate corrective actions shall be taken where deficiencies are identified accompanied by the appropriate follow-up to ensure effectiveness.
- The measuring and test equipment used for inspection and acceptance tests are identified, calibrated, maintained, and controlled commensurate with their intended use.

LBNF/DUNE Quality Assurance Responsibilities

- Performs assessments of the Project's, Partner's and Contractor's Quality Assurance Plans
- Ensures that LBNF/DUNE QA program is established, implemented and maintained
- Participate in Design, Production Readiness and Production Progress Reviews
- Assist Partners and Contractors to establish, implement and maintain quality inspections and acceptance tests
- Report progress of LBNF/DUNE QA program implementation to Project Management
- Report QA/QC issues and progress of resolution to Project Management

Quality Assurance Value to DUNE

- Providing QA input and support to DUNE Consortia:
 - Provide guidance in the development of fabrication, inspection and testing procedures
 - Assist in the development of QC Plans, Travelers, Inspection and Test Reports, as applicable
 - Assist in the resolution on quality issues
 - Perform the Production Readiness Review
 - Perform Production Progress Reviews

LESSON LEARNED

Background:

- A cryomodule had been shipped between two facilities.
- Receipt inspection revealed that the vacuum pressure measured at atmosphere. All tests (e.g. leak tests) performed on this cryomodule prior to shipping were noted to be successful.
- Further inspection identified that one of the bolts on the bottom flange of the cryomodule was missing and another was found to be loosened. The BPM feedthrough washers were also missing. Other hardware was found to be loose inside the cryomodule as well.

Lesson Learned

Project Goals/Expectations/Processes

- The production of the cryomodules was split between two institutions. Each institution is tasked to produce 19 or 21 cryomodules, respectively, using the single design. The processes between the two institutions were to be equivalent.
- Production Readiness Reviews were held to review the needs for production as well as the procedural differences.
- No formalized changes made to procedures that reflected the variations between the processes
- One fabrication facility decided to use different fasteners therefore needed a different torque

Lesson Learned

- It was identified that there was no design review conducted on the transport fixture. There was neither a formalized review of the terrain on the routes that the cryomodule would travel.
- Design of the cryomodule had been updated and the fabrication facilities were not made aware of the design updates

Lesson Learned

Recommendations:

- It is recommended that the project teams formalize any shared documentation and communication between the two teams; such as the use of a shared document repository for the project and formal meeting minutes. This could include the creation of a system interface document between the two teams.
- It is recommended that the project team (based on roles/responsibilities) establishes a framework and set explicit expectations for what are deemed as equivalent processes being executed at the two institutions, including thresholds for variances.

Lesson Learned

- It is recommended that the project team conducts an analysis of the terrain and route future cryomodules will take.
- It is recommended that there is a design review held on the transport fixture.
- It is recommended that major modifications of project-related procedures is formally discussed and documented (i.e. required project reviews)