SECTION 014100 – QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 PURPOSE

A. The purpose of the Construction Quality Management Program is to provide principles to encourage a mutual effort on the part of the Subcontractors and the Fermilab Projects to produce a quality project, on time and in accordance with the requirements of the contract, specifications and drawings. The complete Construction Management Program is composed of the Subcontractor's Quality Control Programs, and the Fermilab QA Plan, supplemented by the principles stated herein.

1.2 REFERENCES

A. The publications listed below form a part of this subcontract to the extent referenced.
   1. 010010 General Requirements
   2. 013100 Environment, Safety, and Health Requirements

1.3 THE QUALITY CONTROL PROGRAM

The Subcontractor's QC Program shall consist of several components:

- a QC Organization
- a documented QC Plan that incorporates "Three Phases of Control",
- a series of meetings, including an initial Coordination and Mutual Understanding Meeting,
- production and submittal of contractually required documents, i.e., "submittals,"
- review and approval of sub-subcontractors' submittals,
- testing,
- completion inspections,
- and the QC certifications and documentation necessary to verify that all contracted work complies with the requirements of the Contract, including materials, equipment, workmanship, fabrication, construction and operations.

Subcontractors shall maintain an adequate inspection system and perform such inspections as will ensure that the work called for by the contract conforms to contract requirements. The Subcontractors shall maintain complete inspection records and make them available to the LBNF Project for review.

The Subcontractors' staff will be held responsible for the quality of work on the job and are subject to removal by the LBNF Procurement Manager for noncompliance with quality requirements specified in the contract.

1.4 REQUIREMENTS

A. QC Plan:

1. The Subcontractors are required to provide the LBNF Procurement Manager a tailored QC Plan document that meets the specific project quality control requirements. This plan shall detail the procedures, instructions, and reports Subcontractors will use during the project. The QC Plan shall contain the following elements, as applicable:

   - Table of Contents
   - QC Organization Chart
   - Names and Qualifications
   - Duties and Responsibilities
   - Outside Organizations
   - Submittal Procedures
   - Testing Lab information
   - Testing Plan and Log
   - Rework Procedure
   - Documentation procedures
   - List of Definable Features of Work
   - Performing the three phases of control
   - Completion Inspection Procedures

   The plan shall be submitted within a specified number of calendar days after receipt of the notice of award.

2. The LBNF Project must approve the QC Plan before the Subcontractor starts work. The plan outlines and describes the process that the Subcontractors will use and the roles personnel will take on to satisfy the requirements of the QC Program, and identifies the Definable Features of Work (DFOW) for the contracted scope of work.

3. In general, construction work will not be allowed at the site prior to the approval of the QC Plan. Any exceptions must be authorized in writing by the LBNF QA Manager. Recognizing that it is not always practical to delay the start of construction until a complete QC Plan is submitted and approved, exceptions may be made for mobilization work, which includes surveying for location of Subcontractor's offices, laydown areas and temporary utilities, and installation of temporary utilities. The only other possible exception is work approved under an "Approved As Noted" submittal of the QC Plan, which may be appropriate under any of the following three (3) circumstances.

- First 90 Days: In the case that the QC Plan is a preliminary submittal and lists the definable features of work to cover the first ninety (90) days of construction, the LBNF QA Manager may approve this QC Plan as “Approved as Noted” to allow the Subcontractors to start these and only these initial activities. Upon completion of the authorized work, unless an acceptable follow-up QC plan has been submitted and approved, the FSCF-PM and NSCF-PM must stop the work.
- Phased Project: It is permissible to allow the Subcontractors to proceed with a series of acceptable QC Plans, one for each phase of the contract.
- Minor Changes: It is permissible to approve the QC Plan with minor changes or additions. The FSCF-PM and NSCF-PM may use an “Approved as Noted” approval to grant permission to start work if the Subcontractor agrees in writing to correct the plan by a specified date. The FSCF-PM and NSCF-PM must not allow the Subcontractors to continue work beyond the specified date if a corrected plan has not been approved.

4. If Subcontractor elects to make any changes to its QC Plan, including any personnel changes, the Subcontractor shall submit the revised QC Plan to LBNF for approval. The LBNF Project reserves the right to make changes to the QC Plan, including interviewing QC Personnel to verify submitted qualifications and if necessary, to have personnel replaced.

B. Quality Control Organization

The personnel involved in Quality Control range from the laborers and mechanics performing the work, through the on-site supervision and up to the management of the Subcontractors’ firms. Examples of roles with specific Quality Control responsibilities would be:

- Quality Control (QC) Manager
- Submittal Reviewer(s)
- QC Specialist(s)
- Manufacturer or Factory Representative

Collectively, these individuals are responsible for carrying out the requirements of the QC System. As needed, some or all the positions and their qualifications, duties and responsibilities will be included in the contract requirements. The positions needed would depend on the work scope.

1. The QC Manager implements and manages the QC System, and is directly responsible to Subcontractor’s project manager management. The QC Manager shall work through the LBNF QA Representative assigned to the project for quality related matters.

   Responsibilities of the QC Manager include:

- Attend QC Plan meeting;
- Attend Coordination and Mutual Understanding Meeting;
- Conduct periodic QC meetings;
- Manage, coordinate and document performance of Three Phases of Control;
- Manage, coordinate and document work by designated Testing Laboratory personnel and any other inspection and testing personnel required by the Contract;
- Coordinate changes or substitution requests made by the Subcontractor to the the LBNF Project Manager;
- Inspect all work for compliance and maintain a Rework Items List on all nonconforming work;
- Coordinate all testing required in such a way as to maintain the schedule;
- Provide required QC certifications and documentation;
- Ensure that As-Built Drawings and As-Built Record of Materials are kept current and onsite.

The QC Manager has specific responsibilities regarding submittals (this includes submittals from Subcontractor, the sub-subcontractors, vendors, etc.):

- Coordinate all submittal actions in a timely manner so as to avoid project delays
- Maintain necessary submittal records in an organized fashion
- Review and certify all submittals for compliance
- Approve all submittals except those designated to be approved by the LBNF Project
- Check all material and equipment delivered to the project for compliance with the contract.

Constructing a quality facility requires proper planning of all Definable Features of Work (DFOW) to prevent deficiencies with costly tear out and replacement. The QC Manager should focus on the preparatory and initial phases of control to minimize or prevent rework. The QC Manager is required to obtain assistance from the QC staff or an outside consultant for any discipline(s) where he or she lacks proficiency. The QC Manager must have the authority to correct any deficiency even though it might result in stopping work on a segment of the project.

The QC Manager is always responsible for observing the work and monitoring safe work practices during the normal course of his or her jobsite duties, but as a rule is not assigned as the safety competent person.

2. A Subcontractors may be required to designate a QC specialist at the work site for each of the specific areas of responsibility that include particularly complex or demanding work. These specialists shall assist and report to the QC Manager. QC specialists may perform production-related duties as long as they are allowed sufficient time to perform their assigned QC duties; or they may be assigned only quality control duties. QC specialists are required to:
    - Attend the Coordination and Mutual Understanding Meeting,
    - Attend QC meetings,
    - Be present at the construction site to perform the Three Phases of Control,
    - Prepare documentation for each DFOW in their area of responsibility at the frequency specified in the contract,
    - Prepare specific sections of the Subcontractor's QC reports specifically covering the work in their area of responsibility performed by the sub-subcontractor/vendors.
3. Some submittals, typically on large, complex projects, may require review by a registered professional, qualified in the appropriate discipline. The Subcontractor would provide one or more Submittal Reviewers, separate from the QC Manager, in these cases. This Submittal Reviewer will be required to certify that the submittal(s) meet(s) the requirements of the Contract prior to certification or approval by the QC Manager. Subcontractors cannot retain the FermiForward's own A/E to accomplish this work.
4. Depending on the technical specifications, a contract may require the presence of technical representative(s) from a manufacturer or factory to be on-site during certain periods of the work to ensure compliance with installation recommendations, etc. The representative(s) shall be considered an extension of the QC Program during their presence on-site.

C. Required Meetings

1. The *Preconstruction Conference* is an important meeting required on all construction contracts for discussion of the administrative procedures for the contract. During the conference, which takes place before starting work, ground rules are established and understandings reached that will establish positive relationships at the start of the contract.

   This is also an opportunity to emphasize the importance of the QC organization to the Subcontractor. Discussion of the QC System requirements and their due dates should be included. An extensive discussion of the CQM Program, however, is best reserved for the QC Plan and Coordination and Mutual Understanding meetings. Where practical, the Preconstruction Conference and QC Plan Meeting (if required) may be scheduled for the same day, provided the two agendas are properly separated.
2. The first meeting specifically relating to CQM is the *QC Plan Meeting*. This meeting is an excellent communication forum to ensure the QC Plan and

Program are quickly and efficiently instituted. The purpose for meeting is to develop a mutual understanding of the QC Plan requirements. All QC requirements from the contract and the specifications should be discussed.

3. After the QC Plan is submitted and prior to the start of construction, the Subcontractor and the LBNF CF teams shall meet to discuss the basic philosophy of the CQM Program and QC requirements. The purpose of this meeting is to establish a mutual understanding of the QC and QA requirements for the contract. The LBNF CF Team thoroughly reviews the proposed QC Plan before the meeting.

   The Project Engineer sets the time and place and prepares the agenda. The Subcontractor is required to present the QC Program in its entirety. Every detail of the contractual requirements relative to QC should be discussed. The relationships of the QC Manager to the superintendent and to the LBNF Project representatives should be discussed. The agenda and length of this meeting depends upon the Subcontractor's familiarity with the QC requirements.

   At a minimum, the Subcontractor's QC Manager, Project Manager, Superintendent and the LBNF FS/NS CF Project Manager and the QA Representative attend this meeting. Each sub-subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting.

   Subcontractors are required to explain in detail how the three phases of control (Section 4) will be implemented for each definable feature of work. Minutes of the meeting will be prepared by the QC Manager and signed by the Subcontractor and LBNF Procurement. Subcontractors shall provide a copy of the signed minutes to all attendees.

   The *Coordination and Mutual Understanding* meeting must be repeated when a new QC Manager is appointed.

4. *QC Meetings* meetings shall be held on a regular basis, e.g., weekly. The frequency and scheduling should be agreed to during the Coordination and Mutual Understanding meeting. The QC Manager develops the agenda, conducts the meeting, and prepares the minutes. All problems or questions should be directed to him or her.

   These meetings should be used to reinforce the philosophy of the CQM Program. Submittal status should be the lead off agenda item of each QC Meeting.

   Sub-Subcontractor QC personnel should attend the meetings to discuss approaches to upcoming phases of work and correction of any deficiencies. Agendas for these meetings include items such as:

   - Status of submittals;
   - Review of test reports for deficiencies and results;
   - Review of Construction Schedules to see which phases of control, tests or inspections are scheduled for upcoming DFOWs; and
   - Review of outstanding problems from previous meeting.

The QC Manager shall be required to address how the Subcontractors intend to correct any problems. As part of the project documentation, the QC Manager must keep minutes of the meeting and distribute them to attendees. These minutes become part of the official contract file.

D. Testing

Tests shall be identified as individual activities in the specifications. The LBNF CF Team shall identify critical tests (e.g., for fire protection, elevators, high voltage electrical) that must be included as construction schedule activities. Subcontractors are required to perform any sampling and testing required under the contract.

1. Subcontractors shall provide an independent construction-materials testing laboratory, or in some cases establish such a laboratory, accredited by an acceptable laboratory accreditation authority, to perform sampling and tests required by the contract.

   Testing laboratories that have obtained accreditation by an acceptable laboratory accreditation authority (Section 3.6.2) shall submit to LBNF Procurement a copy of the Certificate of Accreditation and Scope of Accreditation. The scope of the laboratory's accreditation must include the test methods required by the contract. Testing laboratories that have not yet obtained accreditation by an acceptable laboratory accreditation authority must submit an acknowledgment letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started. Certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory meets or conforms to the ASTM standards listed in the contract must be submitted to LBNF Project for approval.

2. Laboratory Accreditation Authorities are:

   - The National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology
   - The American Association for Laboratory Accreditation (A2LA) program

3. When reporting on test results, the Subcontractor must cite applicable contract requirements, tests and the analytical procedures used. Actual results must be provided and include a statement that the item tested or analyzed conforms or fails to conform to specified requirement(s). Subcontractor must notify the LBNF Project immediately if the item fails to conform. An authorized testing laboratory representative shall certify test results by signing the test report. Subcontractors must furnish the reports, certifications, and other documentation to the QC Manager. A summary report of field tests is required at the end of each month.

   The QC Manager is required to furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the LBNF Project, and attach a copy of the summary report to the last Daily Report of each month.

E. Quality Control Certifications

1. Each QC Report signed by the QC Manager shall contain the following statement:

"On behalf of the Subcontractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

2. Upon completion of the work, or a specific portion thereof, the QC Manager shall furnish a completion certificate to the LBNF Project attesting that "the work has been completed, inspected, tested and is in compliance with the Contract."

F. Quality Control Completion Inspections

1. Near the completion of all work or any portion thereof, the QC Manager shall conduct an inspection of the work and develop a "punch list" of items that do not conform to the approved drawings and specifications. This is called a Punch-out inspection. The punch list shall include any remaining items on the "Rework Items List" that were not corrected prior to the Punch-Out Inspection and the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the LBNF Project. The QC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished Subcontractors shall notify the appropriate NS/FS LBNF Project Manager that the work is ready for the LBNF Project "Pre-Final Inspection."

2. The LBNF Project will perform a pre-final inspection to verify that the facility is complete and ready to be occupied. A LBNF "Pre-Final Punch List" may be developed as a result of this inspection. Each deficiency noted in the punch list shall reference the applicable specification paragraph, Drawing No., etc., from which the deficiency stems. Any items noted on the "Pre-Final" inspection shall be corrected in timely manner and shall be accomplished within the time slated for completion of the entire work, or any increment thereof if the project is divided into increments by separate completion dates. The QC Manager shall ensure that all items on this list are corrected prior to notifying the LBNF Project that a "Final" inspection can be scheduled.

3. Based upon results of the “Pre-Final” inspection, the LBNF Project will formally schedule the final acceptance inspection. The QC Manager, the QC Specialists, the superintendent or other primary Subcontractor management personnel, and LBNF Project representatives, and possible other LBNF Project personnel, will attend this inspection.

   At least 14 days prior to the final inspection, notice shall be given to LBNF Procurement stating that all items previously identified to the Subcontractor as being unacceptable, along with all the remaining work performed under the contract, will be complete and acceptable by the date of the final acceptance inspection.

G. Subcontractor Documentation

The CQM Program requires Subcontractors to control quality and document that control.

The Subcontractor’s reports in conjunction with the LBNF Project’s reports provide the written record of job progress, control inspections, and tests. It is therefore critical that the Subcontractor’s reports be correct and timely. These reports constitute the official record of work performance and compliance with drawings and specifications. The QA Representative must obtain and review the Subcontractor’s reports daily for accuracy and completeness. Any area(s) of disagreement must be resolved at the field level that day if

possible. The Fermilab CF Project Manager should review these reports and ensure the QC/QA process is working.

The documentation that is generated by the QC System must be maintained in the Web Based Project Management Software System.

1. Subcontractors are required to develop and provide daily Subcontractor Production and Quality Control Reports to the LBNF Project. These reports are the daily record of operations on the job site. This series of reports is intended to fully document the work, any test results, dimensional checks, equipment and material checks. Depending on the complexity of the work being performed and the duties of the QC Manager, the Subcontractor may combine these reports into one daily report. The QC portion of the report will include the reports from each sub-subcontractor working on the site. Entries on the report(s) must be tied to the schedule activities.

   These reports are to be delivered to the Quality Assurance Representative no later than 10:00 a.m. local time the following workday. It is important that the reports be current, factual and complete as they provide a complete record of the contract.

   The LBNF QA Representative and the LBNF FS/NS CF Project Manager shall obtain and review the Subcontractor's reports daily for accuracy and completeness, and to ensure the QC/QA process is working.

   - The Subcontractor Production Report, prepared by the Subcontractor's Project Manager, documents the efforts expended and the progress made on a daily basis; it is not specifically a Quality Control report. Each entry in the Subcontractor's Production Report must tie to an associated activity on the Subcontractor's schedule and clearly identify the on-site labor support for each sub-subcontractor.
   - The Subcontractor Quality Control Report, prepared by the QC Manager, is specifically intended to address the progress and issues with the Quality Control Program as it proceeds on the project site. Space is designated for documenting actions on all three phases of control, as well as rework. Entries shall be clearly tied to the activities on the Subcontractor's schedule. Documenting the controls for any "follow-up" phase work is of importance. Additional reports, discussed below, are available to provide detailed documentation of the "preparatory" and "initial" phases. The report must include a certification by the QC Manager that the work is in compliance with the contract, except as noted in the report.

2. There are several other records and schedules required of the Subcontractor, in addition to the daily reports. They are a critical part of the overall written record of the contract and shall be maintained in the Subcontractor's web-based document management system, accessible to the LBNF Project.

   - The preparatory phase of control for each DFOW concludes in a meeting at which all the required activities for this phase of the DFOW are reviewed and checked off. The Preparatory Phase Checklist is intended to aid the QC Manager in effectively accomplishing the preparatory phase of control for each DFOW, and conducting this termination meeting. It provides a simple means of documenting that the required meeting occurred for the DFOW and that the QC Manager may now proceed to the Initial Phase.

- Similar to the Preparatory Phase, the initial phase of control for each DFOW concludes in a meeting at which all the required activities for this phase of the DFOW are reviewed and checked off. The Initial Phase Checklist is intended to aid the QC Manager in effectively accomplishing the initial phase of control for each DFOW, and conducting this termination meeting. It provides a simple means of documenting that the required meeting occurred for the DFOW and that the QC Manager may now proceed to the follow-up phase. In this checklist, activities shall be clearly tied to the section and paragraph of the applicable specification, and the submittal being reviewed. It shall also identify any phasing or workmanship issues that must be followed, particularly addressing safety aspects of the installation.
- The submittal status log, prepared in the web-based construction management system, shows the status of all shop drawings, certifications, and other submittals. For each submittal, the log shall show the contract and/or specification paragraphs requiring the submittal, a description of the submittal, whether it is Subcontractor-approved or LBNF-approved, and actual submission and approval dates on all actions. This allows the QC Manager to track the status as well as pending or planned actions required by the Subcontractor or the LBNF Project.
- Subcontractors are required to prepare and maintain a Testing Plan and Log to document the specification requirements, DFOWs, test plan, test location, tester, and frequency of all required tests. With this information, the QC Manager and the QA Representative can monitor the plans and status of all required testing.
- Two full-size sets of drawings shall be maintained at the work site and updated on a daily basis, showing all deviations from the contract drawings, including buried or enclosed utilities and conditions revealed during construction. Upon completion of construction, the As-Built Drawings shall be certified as accurate by the QC Manager and submitted to the LBNF Project for record purposes. The QA Representative shall check the As-Builts each month.
- The QC Manager shall establish a list of items requiring rework, and an agenda item for the QC meetings to review the progress of corrective actions on these items. The list shall indicate the date identified, describe each deficiency, contract requirement, action taken, and resolution, and indicate the date corrected. Deficiencies corrected on the same day they are discovered are exempt from the rework list. The QC Manager should not allow the adding to, building upon or enclosing of, nonconforming work.

H. Non-Compliance

The primary focus of the QC System is prevention. When this fails and non-compliance is encountered, the QC organization shall identify, document, and correct the non-compliance. In a case where the Subcontractor’s QC Organization is not effective and/or an unacceptable number of non-compliance issues are identified, the QA Representative must take actions in accordance with the Quality Improvement section of the LBNF/DUNE QA Plan.

The subcontractor shall maintain a procedure for controlling, tracking and reporting construction deficiencies, nonconforming items from identification through acceptable corrective action. The procedure shall establish measures to identify, segregate (when possible), and remove from work operation the nonconforming items to prevent inadvertent use/incorporation into the subcontract, identify root cause and provide documented verification that the identified deficiencies have been corrected and approved by Fermilab if required.

I. Three Phases of Control

The Three Phases of Control process, which includes Preparatory, Initial and Follow-up phases, provides the backbone of the Subcontractors' Quality Control Program.

The Three Phases of Control process breaks down the scope of work into definable features of work (DFOW), and establishes required QC activities that apply to them in each phase. A DFOW is a task that is separate and distinct from other tasks, with its own distinct QC requirements. The Three Phases of Control process applies to both on-site and off-site work.

Each DFOW is distinguished by trade or discipline and appears as a distinct item or activity on the construction schedule. In some cases a single DFOW corresponds to a specification section in the contract, in other cases a specification section is more logically broken into multiple DFOWs.

1. The preparatory phase takes place prior to beginning work on each DFOW, and consists in large part in planning, procuring materials and discussions. The Subcontractor is required to notify LBNF FS/NS CF-PM prior to the start of the preparatory phase for each DFOW. This phase shall include a meeting conducted by the QC Manager and attended by the QC specialists, the superintendent, and the foreman responsible for the DFOW. The results of all preparatory phase actions must be documented in the daily QC Report and/or in the Preparatory Phase Checklist. The following functions must be performed during the QC Manager's meeting, prior to beginning work on each DFOW:
    - Review each paragraph of the applicable specification sections in the Contract;
    - Review the Contract drawings;
    - Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and certified by the QC Manager, and approved;
    - Verify receipt of approved factory test results, when required;
    - Review the testing plan and ensure that provisions have been made for the required QC testing;
    - Examine the work area to ensure that the required preliminary work has been completed;
    - Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

- Plan and identify potential problems for each DFOW, and discuss the approach to adopt in order to provide quality construction;
- Discuss construction methods, construction tolerances, workmanship standards;
- Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.

2. The Subcontractor is required to notify LBNF FS/NS CF-PM at least two workdays prior to the start of the Initial phase for each DFOW. The QC Manager conducts the initial phase with the QC Specialists, the superintendent, and the foreman responsible for that definable feature of work. The QC Manager observes the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. The results of all initial phase actions must be documented in the daily QC Report and/or in the Initial Phase Checklist. The following functions must be performed over the course of this phase for each DFOW:

   - Establish with the work crew the quality of workmanship;
   - Resolve conflicts;
   - Ensure that testing is performed [by the approved laboratory];
   - Check work procedures for compliance with the Safety Plan and the appropriate activity hazard analysis to ensure that applicable safety requirements are met.

   Prime and subcontractor foremen shall document all Initial Phase Checklists and include them with the QC Report.

3. Follow-up phase activities are performed daily, or more frequently as necessary, on each in-progress DFOW, according to the schedule until the DFOW is complete and documented as such in the daily QC Report. The following functions must be performed over the course of this phase for each DFOW:

   - Ensure the work for each activity is in compliance with Contract requirements;
   - Maintain the required quality of workmanship;
   - Ensure that testing is performed [by the approved laboratory];
   - Ensure that rework items are being corrected;

   Subcontractors and Sub-subcontractors document follow-up phase activities for each DFOW on the QC Report and the Production Report.

4. Additional Preparatory and Initial Phases shall be conducted on the same DFOW if:

   - The quality of on-going work is unacceptable;
   - There are changes in the applicable QC organization;
   - There are changes in the on-site production supervision or work crew;
   - Work on a DFOW is resumed after a substantial period of inactivity; or

- Other problems develop.

5. When the contract consists of off-site work, Subcontractors shall notify LBNF FS/NS CF-PM prior to the start of the preparatory and initial phases for the off-site work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

END OF SECTION