

Quality Control Inspection Program Counterstone of a High-Performance Project Organization

Jose E. Reyes

Panamanian Association of Project
Management, Panama
e-mail: jreyes@apgp-ipma.org

DOI 10.5592/otmcj.2012.1.2
Research paper

IN ORDER TO ENSURE THE QUALITY OF THE WORKS DURING CONSTRUCTION STAGES, consistent with the overall project objectives, the Project Team shall prepare a document that established the scope and criteria that regulate the actions of professionals and companies involved in the project, following a well known and proven criteria for quality control and quality assurance. These are commonly included in Quality Control Inspection Programs (QCIP).

Keywords

Project Management,
Quality Inspections,
Construction,
Non Conformance
Management

In this paper is a viewpoint and identifies the recommended activities to be implemented to ensure quality during the stages of design and inspection processes during the construction phase to ensure that objectives are met. It is also important to mention that this paper explicitly point out the importance of roles and responsibilities of the parties involved and that those mechanisms for reviewing and monitoring the project should be precise and easily understood to avoid misinterpretation. The tasks defined in a Quality Control Inspection Program (QCIP) should aim to meet basic a preventive rather than corrective actions.

The qcip organization

an organization chart should be prepared for each QCIP. The organization chart should show the details of the relationships of the licensee, designer, QCIP personnel, construction management personnel (if applicable), and the

construction contractor. The organization chart should contain the titles and names of all key personnel known at the time of submittal. Personnel who have the authority to stop work due to adverse quality conditions should be identified. Also personnel who have the authority to recommend stop work to the contractor and to their supervisor should be identified.

The number of QCIP staff and the number of various specialties should be determined by the type of construction and the construction schedule. There should be adequate inspection whenever there is construction activity. Where full time inspection is not proposed for certain personnel, the schedule and approximate percentage of part time inspection should be described. If a qualified inspector is proposed to cover more than one area of expertise, it should be demonstrated that there will not be a conflict in scheduling the construction inspections.

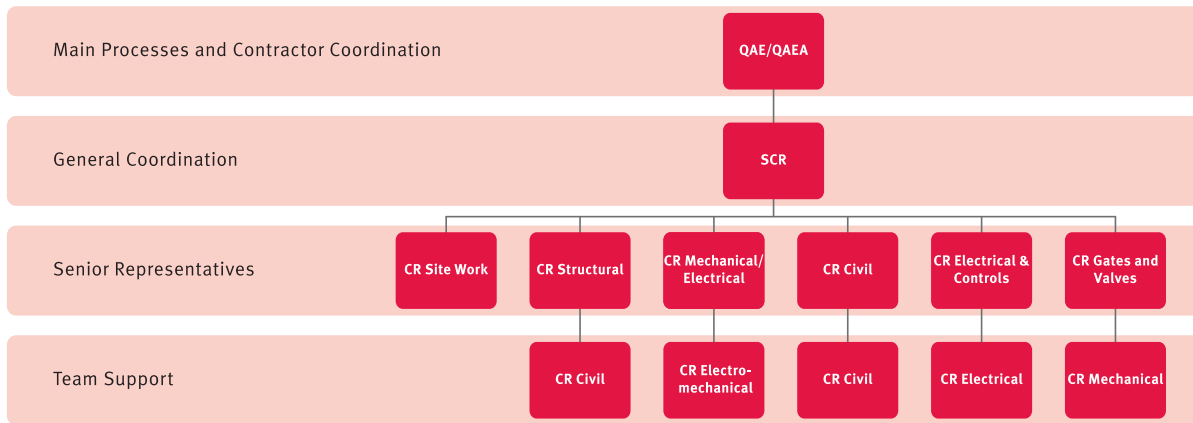


Figure 1: Typical QCIP Organization in support of a Construction Project

The necessary qualifications for QCIP staff should be established in the QCIP and resumes for QCIP personnel assigned to specific functions included in the initial submittal of the QCIP. The qualification standard can be based on existing standards established by professional organizations or the qualification standard can be specified in the QCIP.

The responsibilities, duties and authority of key QCIP staff should be clear and definitive, and should correlate with the organization chart. The position description should contain such items as the job title; complete description of all duties and responsibilities; authority, such as, authority to initiate a nonconformance report, authority to stop work and authority to recommend stop work; responsibility relative to contractor negotiations

and scheduling of construction; and reporting authority. During construction, there should be someone in the field at all times who has the authority to stop work. There should be a separation of authority between the QCIP staff and construction personnel.

The construction and installation quality plans

A project QMS should cover both Quality Assurance (QA) and Quality Control (QC) of the works. The organizational structures responsible for QA/QC should be separate and independent from the functions responsible performing the works subject to the quality surveillance.

Following best Practices of Construction and Project Management as part of the QMS, the project team should develop Construction and Installation Quality Plans (CIQP) for all work packages which are key to the project deliverables.

For the implementation and operation of each CIQP, Inspection and Test Plans (ITP) should be prepared. Each ITP must define the list of successive inspection operations for a particular activity or work package, identifying who carries out the inspections and the follow-up document on which the inspections are reported.

The inspection main task is to ensure, in each instance the construction process that overall expectations and requirements of the owner are met, and in particular, shall ensure that both the construction methods, materials and labor used to achieve the objectives of the project. The functions of the inspection of the work should include: continued monitoring of compliance with the work program, review of construction dimensional protocols used in the works, ongoing review of the work instructions or release for construction documents, continuously verification of the quality of building materials, technical competence of labor used in the works, provide input to define extents of payments, finding safety measures during construction and control file and contract documents and test reports.

Inspection as the basis of a quality control methodology

The overall Quality Control Method applicable to contributing parties should contain three rings or levels, on the following principles:

- ▶ “Internal” inspections by the Production Team. In each production team, it is the duty of those executing the work to check systematically the compliance of their work with the project requirements. Inspections are formally recorded on

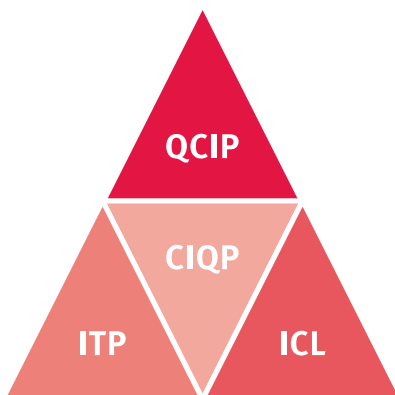


Figure 2: Document Structure

Execution Follow-up Documents prepared simultaneous with the applicable work procedure. Those in charge of executing the work are also required to check services and works provided by subcontractors.

► **“External” (or independent) inspections to the Production Team.** The Quality Control personnel carries out independent inspections on the project team’s own work and that of its subcontractors. They have no direct responsibility with regard to commercial and program requirements, and therefore act with the desired degree of independence. The independent inspection “validates” or confirms the producing (or “internal”) inspections, and will control the quality of materials and workmanship and ensure and verify that the works are designed to perform as required and are constructed as designed. These “external” inspections are also recorded on Execution Follow up Documents.

► **“Outside” inspection by the Owner.** The executing organization and its subcontractors are subject to outside inspection by the Owner or any organization appointed to act on its behalf. These inspections take place at the Owner’s discretion at previously defined “witness” or “hold” points, identified on the relevant Inspection and Test Plan (ITP). Similarly, each subcontractor should ex-

ercise inspection on its own suppliers and subcontractors.

In order to maintain a collaborative approach in the execution of the quality plan, witness point requires the requester to be informed in advance. The general rule is that request are made, when work has progressed to such an extent that inspection is possible, however if the requesting party does not attend the inspection, work may nevertheless continue and be fully documented. In the other hand, since they are set by both the owner and the executioner in advance because of their criticality, at a hold point it is forbidden to continue work until the requesting party has carried out, or waive, and formally recorded its inspection on the Execution Follow-up Documents.

Third party manufacturing inspections

Shipment is one of the final steps of overseas sourcing and likely the most important. Everyone wants to avoid nasty surprises when they receive their goods so it is important to have some way to inspect them before they are shipped. There are different ways to do this. However, in most situations, a third party quality inspection is the best course of action.

The project Team should never underestimate the importance of proper in-

spection before a component or equipment is shipped to the project site. The chance for error is always present when making any kind of procurement. With overseas sourcing, the distances as well as shipping times, different legal systems and other factors complicate the process of replacing any defective products. Furthermore, payments are often made in advance and some suppliers may be reluctant to replace goods after they are shipped. Finally, sometimes improper loading or defective containers can ruin products that were manufactured to specifications. Therefore, the Inspection during this phases of the works is essential to guarantee the deliverables and achieve the project goals.

The Project Team should ensure that the selected Factory Inspection provider is a reputable company with good personal near the factory. It is also important to make sure the inspection company does not have any relation with the manufacturer that would represent a conflict of interest. The Scope of the works should follow the proper CIQP defined for the work package but it is advisable the teams should have verified in advance the following documentation from the prospected supplier: Manufacturer’s ‘type’ test certificates or recent test results carried out on similar items. For in-plant testing purpose, the Supplier should submit a coordinated fabrication/inspection schedule in advance to the team establishing the dates on and the places where each part of the equipments will be prepared for inspection and testing. The team can then easily manage with the Factory Inspection Provider the witnessing of such tests.

In-Plant Inspection and Testing. During the manufacturing of equipment or component for the works, it is important to remember that the Supplier is solely responsible of the quality of this works, and the role of the third party quality inspectors is basically Quality Assurance, then the witnessed tests



will only occur after the Supplier has carried out its own tests and corrected identified faults or shortcomings.

The tests/inspections may include the following verification, as applicable:

- ▶ Material/Equipment compliance to the Specification,
- ▶ Supplier/Manufacturer Certificates to prove the quality of the materials,
- ▶ Material/Equipment Integrity (visual inspection),
- ▶ Certificates proving the successful execution of the required factory tests,

The material shipment to site will have the certification by the Factory Inspection Provider that the components are in compliance with the process and specifications set forth.

Quality in handling and storing

The efficient handling and storing of materials are vital to the project. In addition to raw materials, these operations provide a continuous flow of parts and assemblies through the project site and ensure that materials are available when needed. Unfortunately, the improper handling and storing of materials and components often result in costly delays.

Receiving Inspection and Testing. Materials, products and components to be incorporated into the works should be inspected upon receipt either by the Store man, for those to be kept in the stores, or by a Section Foreman, or other nominated person, for those delivered directly on site. The inspection process must involve identifying the delivery and checking it complies with the stipulations of the order in terms of quantity (count, weight) and in terms of quality (type, trade mark, marking and documentation required by the Order). Any other inspection requirements must be indicated in specific reception documents. Special attention should be made for handling, storage and preservation require-

ments in order to guarantee the integrity of the component until is incorporated in the work. Material Safety Data Sheet (MSDS) serves the purpose to establish the health and safety consideration in the used and should be incorporated in the work instruction of the productions crews.

Executing the work under a qcip

On completion of a particular activity, an inspection document should be established and filed to provide evidence of compliance with specified requirements. The file, comprising Execution Tracing File (ETF), Inspection Checklists (ICL) and other follow up forms, must be compiled. The ICL is specific to an activity or segment, and must be used to give documentary evidence of the different levels of inspection. Compliance of results to the specifications must be certified by the presence of the signature of the service provider's qualified representative, with job title, name and the date of inspection on the Inspection Checklist. If inspection is unsatisfactory, this should be mentioned on the ETF.

- ▶ Final Inspection and Testing. When required, services or activities should be inspected or tested on completion according to an established work schedule. The inspection or test should be documented. Operation and Maintenance Manuals should then be established and handed over to the Owner upon completion of the Contract. For these inspections and testing, Commissioning, Completion, and Taking-Over Quality Plans should be prepared by the project team and submitted to the Owner.

NON-CONFORMANCE MANAGEMENT

Non conformances are unexpected observation or event on a non fulfillment of a requirement. The QCIP should determine what nonconformance level (dimensional or functionality threshold)

is reasonable for specific contractor products or facilities as a basis for seeking consideration on nonconforming material. The intent is not to condone some level of contractor deficiency, but to determine where limited Owner and contractor resources can be used most effectively.

The nonconformance report is used to identify, report and document all observed non conformances and their disposition. A nonconformance is any observed deviation from the intent of the construction contract documents. The report identifies the condition and required action, and leaves space for future entry of the time and manner of correction. The report is initiated by the quality control inspector. The inspector's supervisor is responsible for seeing that disposition of the nonconformance is defined, that corrective action is taken and the correction is documented. There is a distinction between nonconforming work that is addressed on the spot and nonconforming work that requires review and study. The first is address by immediate, which is "action taken to eliminate a detected non-conformance. These actions may involve process or product changes, (e.g., rework or repair). Corrections are fixes that correct the act that caused the non-conformance to exist; the second type is addressed by which implies, "action taken to eliminate the causes of a non-conformance, defect, or other undesirable occurrence and prevent recurrence". The distinction between a Correction and Corrective Action is that the former relates to the elimination of an existing non-conformance, whereas a Corrective Action relates to the elimination of its cause. In a project site non conformance management involves:

Control of Non Conformance Product. Completed work or materials identified as not conforming to specified requirements are classified and dealt with. A deficiency will be deemed to have occurred when it cannot be corrected by

reworking at time of identification, or when it cannot be solved immediately by applying standard rules or an existing repair procedure. Nevertheless it will be recorded in the respective follow-up document.

A deficiency will be addressed by a Nonconformance Report (NCR), raised by the QCIP staff that identified or has been informed of the deficiency. Non-conforming product may be: modified to meet the requirements of the Contract, repaired to achieve a technically acceptable condition, accepted as it stands by concession, rejected, scrapped or demolished.

Once completed, NCR forms should be included in the Execution Follow up Documents. The principle by which non conformances are identified and resolved applies to all contributing parties for activities taking place on the jobsite.

Service providers supplying factory products may use their own procedure to deal with non conformances on condition the procedure has been accepted by QCIP Team and the supplies delivered to the jobsite comply with specifications after dealing with the non conformances.

Other elements of the qcip Identification and Traceability. When traceability is mandatory or is considered necessary, the materials, parts and components of sub-assemblies should be marked, preferably at the time of production, in the factory or on site, or by a batch number or part number indicated on the product, or by a reference indicated on marked-up documentation or on the Execution Follow-up Documents. The CIQP, or Order to the supplier, should specify which of these measures to adopt. These measures particularly apply to elements prefabricated on site or in factory. They will not apply to standard off-the-shelf materials or products stored in a warehouse. Products with a given shelf life shall be administered according to special rules

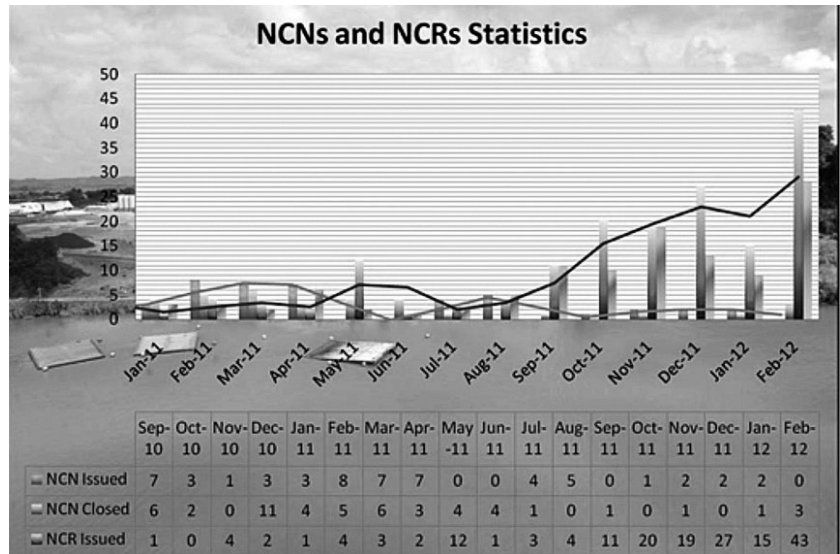


Figure 3. NCN & NCR Statistics evidence of QMS Maturity Level

(first in, first out) paying particular attention to ensure they are used before the expiry date.

Control of Monitoring and Measuring Equipments. Monitoring and Measuring Devices requiring calibration, or regular checking, shall be physically identified with its own individual reference and will be included on a calibration schedule recording the calibration status of each item and the date of recalibration or interim inspection. Each item of equipment shall be provided with:

- ▶ an individual data sheet, indicating the frequency and method of verification or calibration, and summarizing the results of each operation,
- ▶ a label identifying the instrument and indicating the dates of the last and the next operation.

Final comments

With the attention to conformance as the measure of quality during the construction process, the establishment of a Quality Control Inspection Program becomes extremely important. Quality requirements should be clear and verifiable, so that all parties in the project can understand the requirements for conformance

Quality control represents increasingly important concerns for project manag-

ers. Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the result. In the worst case

Good project managers try to ensure that the job is done right the first time and that no major Non Conformance occurs on the project. The only way to have full control on the process and learn how to manage it effectively is by recognizing the importance of a high performance Quality Control Inspection Organization.

References

FERC Engineering Guidelines, Chapter VII, Construction Quality Control, prepared under contract with R&H Thomas Inc, 1993

Vidile II, Robert T, "Non Conformance Management, Preventive and Corrective actions", Presentation Strykers Orthopaedic Corporation, February 2010

Rose, Kenneth, "Project Quality Management", J.Ross Publishing, 2005

Razzak,, Addul, "Quality Management in Construction Projects",CRC Pres. 2010

Graphics and Figures: Third Set of Locks Project, Panama Canal.

Note: The author is currently the Project Manager of the Third Set of Locks Construction Project at the Atlantic Site.