

BALFOUR BEATTY

QUALITY CONTROL PLAN

UNCW Dobo Hall

Proprietary Property of Balfour Beatty
QUALITY CONTROL PLAN
(QC PLAN)

PROJECT INFORMATION			
Project Name:	Dobo Hall Renovation	Date Issued:	01/28/2019
Client:	UNCW	Project Manager:	M. Reynolds

REVISION LOG

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Any reference to “Contractor” in this Quality Control Plan or attached documents refers to Balfour Beatty.

1.0 INTRODUCTION

a. Overview

Delivering a quality project is part of Balfour Beatty’s “Signature Experience”. As a part of our commitment to quality, we work together with people throughout our company and those we do business with to ensure that

quality is incorporated into every aspect of the project from design through turnover. When quality control begins in design and follows through to the work in the field and project turnover, it results in the continuity of the entire team, leading to the success of the integrated approach and ultimately, a project that exceeds expectations.

Quality management is a critical role in the overall success of the project during both the design and construction phases. The Quality Control (QC) Plan flows through to all Subcontracts. Subcontractors are held accountable for maintaining a QC Plan consistent with Balfour Beatty's QC Plan and for confirming that they are in compliance with the contract documents.

The nature and content of the QC Plan varies depending on contract requirements, contract delivery approach, and the risks associated with the specific type of work. The QC Plan is tailored to meet the specified requirements of each project, building code requirements, and Americans with Disabilities Act.

Balfour Beatty Construction will leverage technology to enhance the speed and organization with which our QC Plan will be executed. Through the use of BIM 360, Constructware, and owner-defined systems, which are custom tailored to meet the needs of our QC Plan, and handheld tablet computers, information will be made available in the field for the speed and convenience of the trades' personnel. Quick and convenient access to the most current information is an essential part of our QC program.

b. Goals and Objective

As in safety, quality is everyone's job and requires people to function as a team in order to achieve the best possible results. Balfour Beatty's entire team will take a proactive approach to quality on every project, preventing and identifying defects, focusing on maintaining a uniform, high quality level of workmanship throughout all phases of procurement, fabrication, construction, start-up, and testing.

Attention to detail will be taken at every level to ensure that requirements are met for projects that are designed to specific LEED standards.

Quality construction represents an opportunity to improve the way we do business on a continuous basis and our goal is to deliver the exceptional experience, a quality project, and exceed our clients' expectations.

c. Roles and Responsibilities

QC Manager - Based on the specific contract requirements, the role of the QC Manager may vary. The specific roles will be identified for each team member and submitted for owner's approval.

The Quality Assurance/Quality Control (QC) Team is led by Balfour Beatty's QC Manager, who develops the QC Plan and ensures that quality assurance and control is strictly implemented and monitored throughout the duration of the project.

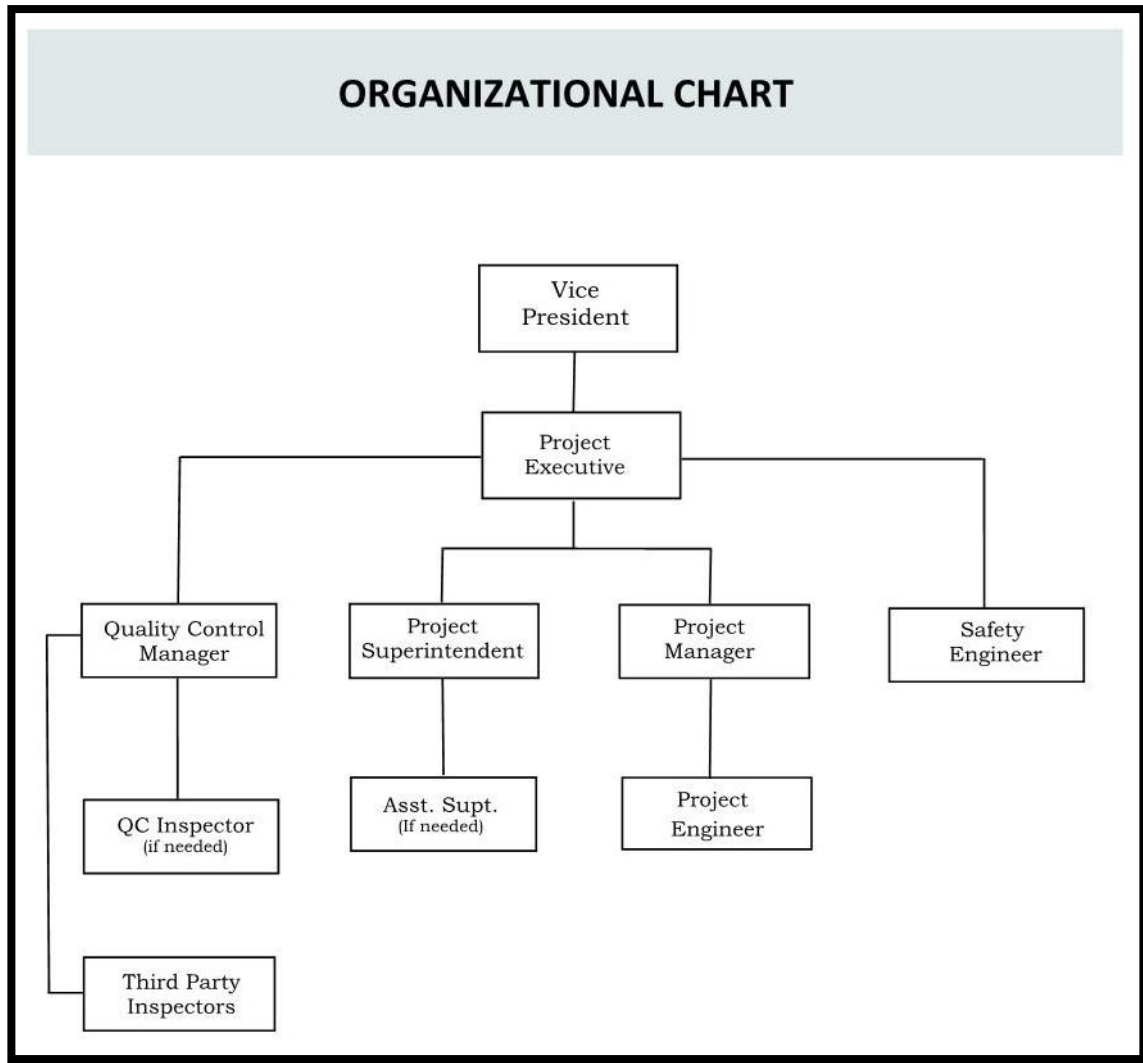
Administrative QC - Based on the specific Contract requirements, the role of the Administrative QC may vary (i.e.; the Corps of Engineers has a QMS System they utilize to manage the documentation dealing with the Quality Control Program for each project.)

Lead Inspector - The lead Inspector will assume the role of performing and providing status for overall field inspections and testing. On a large project the Lead Inspector can have numerous Specialty Inspectors reporting to them. The Lead Inspector will have the responsibility to manage personnel and subcontractors

Specialty Inspector - A Specialty Inspector will hold a level of expertise in a specific field such as Mechanical, Electrical, Commissioning and or any variety of disciplines where the contract may call for special inspections (i.e. Curtain Wall Systems, NACE Certified Painting, etc...).

d. Organizational Chart

The organizational structure on the project depends on the size of the project, the contract requirements, and the project staffing. The project organization should reflect the quality tasks and responsibilities as outlined within the plan as well as traditional project responsibilities.



e. Program Tools and Document Control

Software Tools

Balfour Beatty utilizes many program tools to aid in accuracy, compliance, speed, reporting, and reduction of waste. BIM 360, Constructware, and Owner defined software systems, are custom tailored to meet the needs of our QC Plan. Handheld tablet computers are used in the field for various QC functions such as recording test and inspection

results, performing checklist inspections, and performing Punchlist procedures. The following are just a few tools that can be used, depending on the type of project.

Document Control

Document Control will be managed on each project based on Owner defined requirements. During the Design Phase, Bid Packages will be distributed through email blasts and the associated documents will be available on the defined software system for that project. Available documents can be viewed on line and printing is at the discretion of the subcontractor.

During the Construction Phase, “Issue for Construction” documents will be available in the same manner, and subcontractors will have access to view documents and print at their discretion. Revisions will be managed through email blasts from the Project Engineer on site, and the related documents will be available on the software program, which will have all of the current information for RFIs, ASIs, etc. The most current version of all drawing sheets and specifications will be posted and available. A master Drawing Revision Log will be available in the software program for reference.

SmartBox

Many projects provide a “SmartBox” in the field, in which the latest information including the latest plan sheet version, is made available in the field for the speed and convenience of the trades’ personnel. This includes RFIs, ASIs, etc.

Concrete Strength

The Concrete Break Log tracks the design strength trend of each concrete mix design as well as placement locations. The log is useful for using the trends for planning purposes, future work, and is a resource for verifying concrete mix designs used for each type of placement and in quickly identifying the location should additional testing become necessary. *(see forms for sample)*

Waste Tracking

Waste management can be captured through a Concrete Waste Log, which tracks concrete yardage from ordering through the placement stage. This aids in follow on placements as well as estimating future work, while producing less waste. *(see forms for sample)*

2.0 QUALITY CONTROL PROCESS

Balfour Beatty’s Quality Process utilizes basic fundamental steps throughout the project with a focus on doing the work right the first time through planning, mock-ups and on-going construction verification. These steps are the Buyout/Purchasing Meeting, Pre-Mobilization Meeting, Preparatory Meeting, Initial Inspection, Follow-Up Inspections and Final Inspection. Used in conjunction with one another, these meetings and inspections will ensure quality control coverage from start to finish for each definable work feature.

In preparation, the QC Manager shall complete the following tasks at various steps in the Preconstruction and Construction phases:

1. Review the applicable Owner’s contract and Subcontract Agreement for inclusions, exclusions and standard paragraphs related to this work.
2. Review all applicable and up-to-date construction drawings and specification sections.
3. Review all applicable industry standards (i.e., ASTM, ANSI, etc.) referenced by the Contract documents.

4. Check to verify that all materials and/or equipment have been submitted, reviewed and approved. Material and equipment submittals should be reviewed and approved prior to beginning the Preparatory Meeting.
5. Complete a full review of the approved submittals, coordination drawings and/or shop drawings, request for information and Contract changes as well as manufacturer recommendations.
6. Identify and review LEED requirements for the work and how the requirements will be met.
7. Identify specific testing requirements associated with the work.
8. Check to ensure that provisions have been made to provide required control, testing and inspection and the safe practices that will support these activities.
9. Identify mock-up requirements associated with the work.
10. Review the associated schedule with the Superintendent and Project Manager.
11. Develop the Preparatory Meeting Agenda.

a. **Design Phase**

i. **Design Phase / Coordination for QC on Design Build Projects**

During the planning and design phases, Balfour Beatty provides on-going review of design documents and specifications to uncover potential coordination issues, clarify details, and eliminate specification conflicts. Active design management, third party peer reviews, Navisworks clash detection, and integral subcontractor involvement in design are some of the measures the Balfour Beatty Team will undertake to provide a quality design on the project. This proactive approach allows us to achieve quality design documents and a quality product in the field.

The Balfour Beatty Team will ensure that Quality Objectives, which are required to meet the requirements of the Contract, are well established and clearly communicated to all relevant participants within the Project Team. The primary objectives are as follows:

1. Validate that the products and services satisfy the Base Contract and approved changes.
2. Provide verified, accurate, and traceable processes and documentation.
3. Eliminate discretionary modifications.
4. Drive to eliminate nonconformance and assure appropriate, accurate, validated and verified corrections when required.
5. Comply with all applicable Federal standards, regulations, and requirements.
6. Meet project security requirements and Federal safety standards, requirements, and procedures.
7. Foster an environment of excellence in quality through open, clear, and concise communications.
8. Assure coordination between the different disciplines.

ii. **Preconstruction Phase**

a. Purchasing / Buyout Meeting

The Buyout/Purchasing Meeting is the first step of the Quality Process. The four primary objectives of this meeting are to:

1. Procure and document the complete scope of work to be included in the subcontract
2. Evaluate the Subcontractor's ability and commitment to completing the scope in accordance with the Contract documents and project schedule.
3. Communicate the Balfour Beatty Quality Process to the Subcontractor and obtain a commitment to following it.
4. Obtain and document commitments to:

- a. Submittal dates
 - Allowing ample time for a thorough Balfour Beatty and designer review
 - Having all of the submittals available, allowing for better coordination between related trades
 - Flushing out design and procurement errors sooner
- b. Material fabrication lead times
- c. Participation in Preparatory Meetings and Initial Inspections
- d. Mock-ups
- e. Special testing and responsibility for conducting required testing
- f. LEED requirements and how they will be met

Additional objectives of the Buyout/Purchasing Meeting include:

- ✓ Review project, and review specifications and drawings.
- ✓ Estimate expectations / standards
- ✓ Understand chain of command for each subcontractor.
- ✓ Clarify if work is subcontracted out to tier subcontractors.
- ✓ Produce schedule for subcontract work, including crew size and production.
- ✓ Gain references of similar work performed.
- ✓ Review subcontractor/ supplier's company structure and ability to perform work in such a manner to meet our expectations

Meeting Attendees:

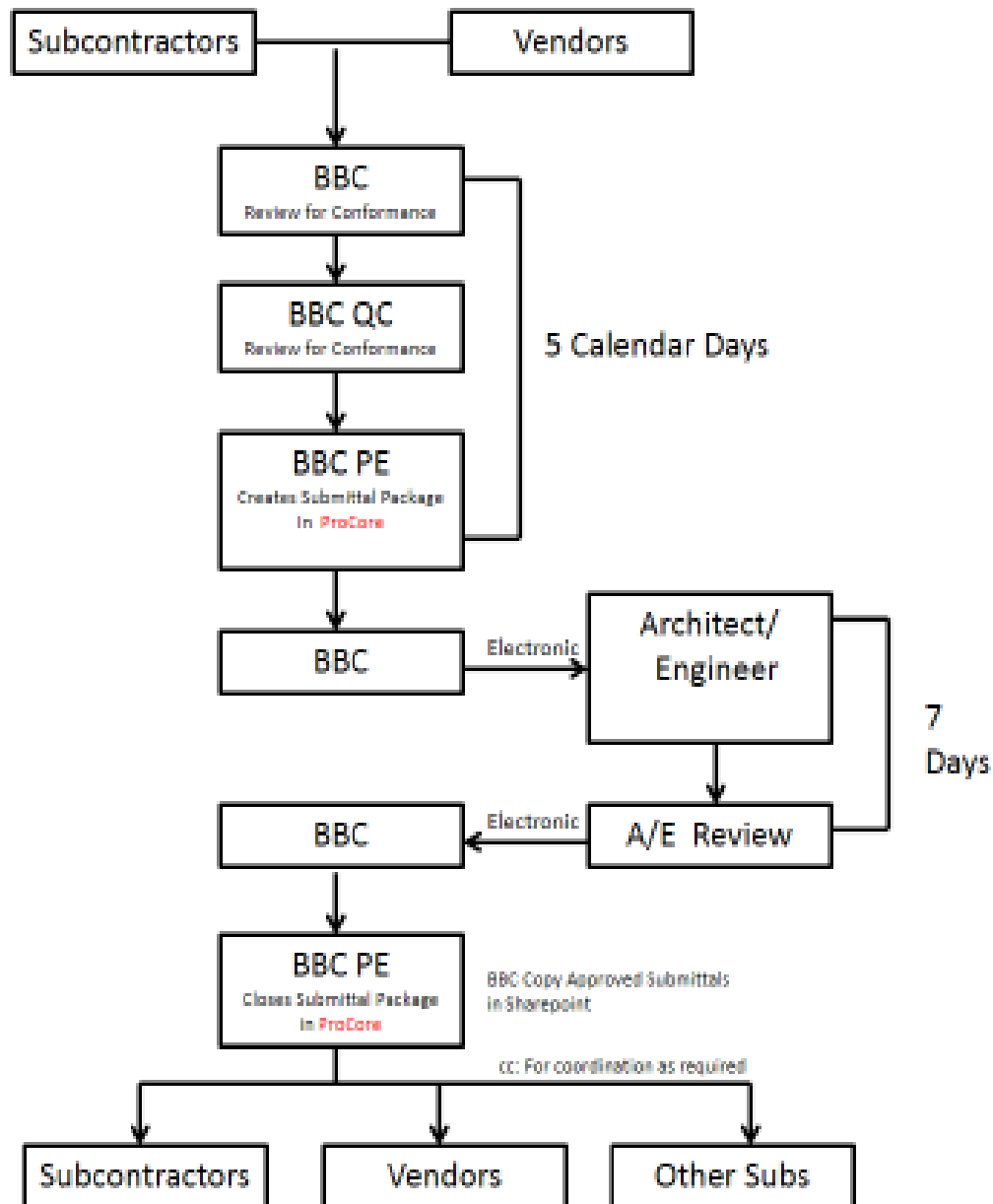
<u>Balfour Beatty</u>	<u>Subcontractors</u>
<ul style="list-style-type: none">• Estimator• Project Executive• Superintendent (When possible)• Project Manager• Quality Control Manager	<ul style="list-style-type: none">• Principle (contract signer)• Estimator

iii. Source / Factory Inspections & Testing ([see e.5.a](#))

b. Submittal Procedures & Flow Chart

The requirements for submittal review may vary from project to project; such as A/E review time, and number of submitted copies. The flow chart below shows the Submittal process. It is crucial to coordinate approved submittal information with subcontractors with adjacent work. (i.e.; blocking details, roofing materials, specialties).

Submittal Flow Chart



c. Third Party QC Agencies

i. Third Party Testing and Inspection Management

The role of the qualified Third Party Testing and Inspection Agency is to perform all testing that requires ICBO, AWS, or other Code Official certified inspectors. This agency will be responsible for assuring all “frequency” field or source inspections and tests within their scope are done in accordance with the contract requirements. This agency will also be responsible for providing status on each area of required testing and inspection in order to aid the project team with understanding the progress of the scope of work and to provide assurance that the proper frequency is being achieved. Examples of this is Soil Density Tests (quantity required for each area specified), or Welding (Percentage of welds visually inspected or tested per the structural design requirements).

This agency will be trained to adapt to and use the quality control system/database required for use on the specific project they are working on. (see f.3 for Third Party management and process)

d. Definable Feature of Work

i. Inspection Profile

The Inspection Profile is a document that is created at the start of the project (and ideally in the pre-construction phase) that defines all potential and likely Definable Features of Work (DFOW). A Definable Feature of Work is a task distinct and separate from other tasks of work, that results in a product, that has control requirements and crew work that is unique to that task.

This document will be designed to coordinate and follow the work as planned and scheduled by the Project Superintendent. The Quality Control (QC) Manager will implement the use of the Inspection Profile to identify upcoming features of work for planning and to manage and monitor each definable feature of work as it progresses through the Quality Process. Early ‘Buy in’ from the owners and subcontractors, and input from these parties, is extremely valuable.

This document may change over the course of the project, but is a starting point for the number of Preparatory meetings that will be required.

The Inspection Profile is coordinated with the CPM and WBS (work breakdown structure)

e. Phased Inspection Process

- i. Preparatory Meeting
- ii. Initial Inspection
- iii. Follow-Up Inspections
- iv. Close-In Inspections
- v. Supplemental Quality Inspections
- vi. Final inspections

Preparatory Meeting (Recommend 5-7 days prior to commencing work)

The Preparatory Meeting is the most important of the phased inspection process and **must** be held prior to starting each definable feature of work. The purpose of this meeting is to ensure that the subcontractor's **Foreman and crew** understand all contractual requirements. Construction standards and contract interpretation issues should be discussed and settled in advance of construction. At the conclusion of this meeting, the scope of the Initial Inspection is defined and scheduled. A Preparatory Meeting should occur prior to each definable feature of work on the project. This meeting is the last opportunity to clear up issues, concerns and conflicts with a scope of work before the tradespersons arrive to put the work in place.

In preparation for this meeting, the QC Team should complete the following tasks:

- Check to ensure subcontract is signed and bonds and insurance are in place
- Review the applicable Owner's contract and Subcontract Agreement for inclusions, exclusions.
- Review Warranties to allow Balfour Beatty and its' subcontractors time to identify and resolve issues before the warranty has expired.
- Review all applicable and up-to-date construction drawings and specification sections.
- Review all applicable industry standards (i.e., ASTM, ANSI, etc.) referenced by the contract documents. A copy of each standard should be provided by the subcontractor with the submittals.
- Check submittal status. Submittals for the feature of work should be approved *prior* to the Preparatory meeting.
- Complete a full review of the approved submittals, coordination drawings and/or shop drawings, RFIs and contract changes, as well as manufacturer recommendations.
- Review adjacent work for coordination and material compatibility.
- Review specific testing requirements associated with the work and ensure that provisions have been made to provide required control, testing and inspection. Foremen must understand expectations and what their management has committed to.
- Review LEED requirements and subcontractor's plan for meeting them from the Pre-Mobilization meeting.
- Identify mock-up requirements associated with the work.
- Review the associated schedule with the Superintendent.
- Develop the Preparatory Meeting Agenda.

It is critical that the agenda is sent to the attending parties *ahead* of the meeting date to allow all parties time to review, contribute and prepare for this very important meeting. The meeting needs to focus primarily on means and methods that will be used to meet tolerances and accomplish the work. It's important to understand what items may be pre-fabricated or if any source inspections are required as well as the type of equipment, materials, tools and crews will be used to accomplish the work.

Meeting Agenda: *(See Forms Section for Sample Agenda)*

1. Safety & JHA Review
2. Quality Expectations
 - a. Review/Understand Specifications
 - b. Submittal Review (Any substitutions, variances)
 - c. Change Orders and RFIs
 - d. Testing Criteria & Frequency
 - e. Document Control – Current Documents
 - f. Means and Methods – Equipment, Materials, Tools and Crews

- g. Review LEED requirements
 - h. Sequence of Operation/Coordination with Other Trades
 - i. Initial Inspection
3. Initial Inspection Defined and Scheduled
 4. Schedule (To include subcontractors' meetings)
 5. Special Conditions/Job Walk

Meeting Attendees:

Balfour Beatty

- Superintendent
- QC Personnel
- Office Engineer
- Safety Engineer
- Testing Lab (if required)

Subcontractors:

- Superintendent
- Foreman (required)
- Manufacturers' Representative(s) (if needed)
- 2nd Tier Subcontractors and Foremen
- QC Representative (As designated)

Owner and A/E Representative(s)

Initial Inspection

A representative sample should be completed for each definable feature of work. The Initial Inspection is performed on the representative sample of work as soon as it is completed. The approved mock up may be incorporated into the contract work if approved by contract requirements. This inspection is designed as a follow-up to the Preparatory Meeting. The primary function of this inspection is to verify that the contractor starts the work in full compliance with the contract requirements and to establish an acceptable level of workmanship.

Notification requirements to the Owner and/or A/E will vary depending on the project, but a minimum of 48 hours' notice should be given. The following personnel should be in attendance:

- Balfour Beatty QC Manager
- Owner QA representative
- Subcontractor Foreman

For special applications, such as waterproofing or special coatings, the manufacturer's representative may want to be in attendance. (In some cases, it is required)

The Initial Inspection consists of the following tasks:

1. Make a physical examination and/or test of the required materials, equipment, and sample work to ensure that they are on hand, have been properly stored, and conform to the approved shop drawings and/or submitted product data.
2. Verify that the mock-up installation meets all contract documents if applicable for the representative sample.
3. Examine the initial workmanship to determine if it is acceptable. Immediately identify and correct problems prior to continuing work. This mock-up will establish the workmanship standards.

The completed mock-up must be approved in writing by the QC Representative, the Architect and/or the Owner's QC Representative prior to continuing with the installation of the work. The subcontractor's foreman or

superintendent must attend this initial inspection of their work. Mock-up/ Initial Inspection approvals are to be documented in the QC Daily Report and/or Project Log and the Inspection Profile by utilizing the Initial Inspection Report. (*See forms section*). Results of the Initial Inspection should immediately be communicated to the Balfour Beatty superintendent and the rest of the project team.

This phase may be repeated for each new crew to work on-site or whenever acceptable quality standards are not being met.

Follow-up Inspection

The Follow-up Inspections are done periodically as general inspections for the major work activities that are currently happening. These inspections can be noted on the CQC Daily Report and they can be formally documented if warranted or if work may be concealed.

- Verify that all required control testing is being performed, and the results are within tolerances.
- Make a physical examination of recently delivered materials and equipment to verify that they are approved and properly stored pursuant to manufacturer recommendations, LEED requirements, and applicable specifications.
 - Review the current level of workmanship. Compare this workmanship to the mock-up to verify that it meets acceptable standards.
 - Review applicable drawings to verify that other trades' work has been incorporated and coordinated.
 - Document that a Follow-Up Inspection was performed on the QC Daily Report and/or Project Log.

This type of inspection also applies to work that *must* be completed prior to being concealed or closed off from view. (*see Close-In Inspections*)

Close-In Inspections

1. It is a *code requirement* that all concealed work be inspected/tested, and signed off prior to concealment. Balfour Beatty's Close-In Inspection process is designed to hold subcontractors accountable for their work being complete and ready for concealment and all RFIs, ASIs, etc., have been incorporated into their work.
2. When an area of work is nearing the scheduled concealment date, a Close-In Inspection Report for the appropriate type of concealment (wall, ceiling, floor) is made available for subcontractors to review, check, and sign off their work. (*see Close-In Inspection in forms section*)
3. Each subcontractor whose work will be concealed *must* sign off on the form in the appropriate section. (Close-Ins and outstanding items should be covered in the weekly Subcontractor Meetings)
4. When all subcontractors have signed off, and the required inspections / testing have been completed, accepted, and signed off, the responsible QC team member reviews and verifies the completed work. (Involve subs if necessary and verify against plans, etc.) When the work has been verified, the QC personnel schedules the "close-in" inspection with the AHJ.
5. Be ready for the AHJ! The QC team member will have copies of accepted/ signed test reports for plumbing, fire piping, mechanical, electrical, steel inspection, etc., for the AHJ to review prior to walking out for the

inspection. This saves valuable time and builds trust with the AHJ. Permitted sets of drawings need to be readily available.

6. Upon successful completion of the Close-In Inspection, the AHJ generally will provide either a signed copy of the jurisdiction's form or ticket, sign the plans, or sign the Close-In Inspection Report.
7. The successful Close-In is communicated to team members, and appropriate subcontractors.
8. The Close-In Inspection Report is filed in the appropriate QC file location.

Supplemental Quality Inspections

Source/Material Inspections

Source Inspections are typically called out, if required, in the contract specifications or general notes. Many times the General Contractor will opt to perform a source inspection on a product or special fabrication process that is a high risk item, regardless of the contract requirements. *(see forms section for source inspection template).*

Sequence Inspections

Sequence Inspections are inspections that require a specific level of certification to perform the inspection. Examples of this may be NACE level inspection for special coatings or NETA Inspections for electrical gear. In addition, specialty inspections can be an inspection required by Regulatory Agencies such as: Fire Marshall, Elevator, ADA, Roofing, Lightning Protection, Owner Insurance Company, Building Department, Health Department, etc.

Final Inspections

Final Inspections for Definable Features of Work are performed with the Owner's QC Representative (if applicable) and/or Architect. These are intended to illustrate that work is complete and ready for acceptance.

- The Feature of Work shall be reviewed with the Subcontractor for conformity to plans, specifications, quality, workmanship, and completeness. Once it is determined that the work is complete and acceptable, the Owner's QC representative / Architect will be notified of the request for Final Inspection
- Contractor's QC Representative will then walk with the Owner's QC representative (if applicable) and/or Architect with the intent that the Feature of Work will be signed off and acknowledged as completed. *(see Final Inspections in forms section)*

f. Testing

i. Codes and Standards

Quality Control testing and inspection will be in accordance with the technical provisions of the contract documents or the Contractor's testing requirements, whichever is more stringent. The performance of all tests shall be recorded on the QC Daily Report and/or Project Log and on the Master Test Register. The QC Representative shall keep documentation of all tests. Work that results in a failing test shall be

immediately corrected, if possible, and re-tested. Re-testing must be documented. A QC Discrepancy will be issued if immediate correction is not achievable.

ii. **Master Test Register**

The Test Register is a document created at the start of the project, ideally in the pre-construction phase, which identifies all the required testing for the project. Throughout the project, the test register will provide the current status of testing.

After a thorough review of the specifications and other pertinent information by the QC Representative, and prior to commencement of work, the detailed Master Test Register covering each section, area, or system will be prepared that will include at least the following:

- Specification Section defining test requirement
- Description of activity, system, or area of work
- Test frequency criteria
- Test description, standards used and test method (In cases that no published method is available, or an integrated system is being functionally tested, the requirement for submittal of customized written procedures will be noted.)
- Company or agency responsible to perform test
- Location of test (on-site or off-site)
- Identification of consultants or specialists as appropriate for review, inspection and testing
- Documentation of test results. Pass/Fail/Retest
- Location of file where documentation will be kept.

(see Attachments section for sample)

iii. **Frequency Field Testing**

a. Independent Testing Agency; Qualifications, Duties, and Coordination

- Qualifications of the Testing Agency

The specified party shall employ the services of an independent testing agency to perform material testing activities as specified in the contract. The laboratory actually performing the work will be accredited or certified as required by the contract documents. These testing agencies will be mutually acceptable to the Owner, the Design Team (if applicable) and the General Contractor. During buyout, ensure that they are obligated to prove compliance.

- Duties of the Testing Agency

The independent testing agency engaged to perform sampling, testing and inspection of materials will cooperate with the Contractor and the Owner's Representative in the performance of its duties, and shall provide qualified personnel to perform required inspections and tests. The testing agency will notify the Contractor's QC Representative promptly of irregularities or deficiencies observed in the work during performance of its services. It is the responsibility of the testing agency to furnish a handwritten report *prior* to leaving the job site. This report is to be followed by a typed and certified report within one week. Concrete breaks results are typically forwarded the day cylinders are tested. The testing agency's inspector will attend all relevant Quality Meetings and process sessions. The testing agency shall be responsible for providing overall status of compliance for all third party testing per the contract requirements. For

"frequency testing" (i.e. Civil/Structural) it will be the responsibility of the testing agency to provide status reporting proving testing quantities are being met and testing results comply with the requirements.

- Coordination

The Contractor and the testing agency engaged to perform inspections, tests and similar services shall coordinate the sequence of all activities to accommodate required services with a minimum of delay. The Contractor and the testing agency shall coordinate activities to avoid the necessity of removing and replacing work to facilitate inspections and tests. The Contractor is responsible for scheduling inspections, tests, taking samples and similar activities.

g. Commissioning (Cx) / Start Up

Cx Overview

Commissioning is the orderly process of advancing an installation from the state of completion (construction) to a functioning facility (operations) in accordance with the design intent.

The main function of Commissioning is to verify and document that all systems function as designed prior to turnover. Balfour Beatty utilizes a fully integrated, project specific Commissioning plan, and provides oversight to assure a fully operational facility that meets all design requirements.

Equipment and systems with logic are included in Commissioning. At a minimum, the following systems typically get commissioned:

- Electrical
- HVAC
- Life Safety
- Fire Protection
- Elevators / Escalators
- BAS / EMCS
- Security
- Emergency Generators & UPS

Cx Process

Commissioning is a quality control process that provides an opportunity to test and document the proper installation and functionality of a facility's systems and components as designed and specified. Commissioning ensures the facility meets the Owner's project requirements, the Basis of Design and operational needs for the owner's intended usage. The commissioning process is broken into 7 levels listed below;

Level 0 – Design Review

Level 1 – Factory Witness Tests / Inspections

Level 2 – Receiving / Submittal Verification

Level 3 – Startup & Prefunctional Testing (Installation Verification)

Level 4 – Functional Performance Testing

Level 5 – Integrated Systems Testing

Level 6 – Training & Turnover

The overall purpose of the commissioning process is as listed below and is the responsibility of the Balfour Beatty team, however, requires the full participation and constant communication from the entire project team, including the owner, design team, subcontractors and vendors.

- To ensure building systems perform interactively according to the owner's project requirements, Project Charter, Basis of Design and the Commissioning Plan. The specific objectives include but are not limited to the following:
 - Verify that no mechanical and electrical coordination and design issues are present, as well as identify any Single Points of Failures (SPOF), through a careful review of the construction drawings, specifications, and submittals.
 - Ensure that applicable equipment and systems are installed properly and receive adequate quality checkout through careful site observation and verification of contractor's quality control documentation.
- The purpose of commissioning is to provide the owner with a high level of assurance that the building systems are installed and operating in the appropriate manner, and is in compliance with the design intent, contract documents and Commissioning Plan.
- This process is not to diminish the responsibility of the system designers or installing contractors, nor is it intended to be a redundant testing or inspection function. Commissioning is performed to document and validate the efforts of the designers and contractors, ensuring that the quality of the systems meets the owner's project requirements as documented by the basis of design.
- Verify and document the mechanical, electrical, security and fire systems and sub systems function and interact as intended. This will be accomplished through witnessing and documenting both Level 4 Functional Testing and Level 5 Integrated Systems Test (IST). The IST will be conducted after all factory and field component/system quality control, start-up, and test procedures have been completed. The goal of this testing is to verify the operation, proper interdependencies, redundancies, and fail-safe operation of all critical systems. Both the Level 4 & Level 5 test will typically be developed and administered by a third party Commissioning Authority (CxA) and performed by the subcontractors and/or vendors.
- Deliver a comprehensive systems manual to the owner. This electronic manual will provide the owner with a searchable reference of all as-built drawings, specifications, O&M manuals, final commissioning reports, and other important documentation.

The commissioning process should be considered during of the project phases as outlined below;

Design Phase

The main objective in the design phase is to develop the Commissioning / Start Up requirements for the project. This is achieved by:

- Reviewing the design, if required, to ensure contractual performance requirements are met
- Reviewing the design, if required, to ensure that Owner and operators needs are met (giving particular attention to operation and maintenance issues)
- Developing the Commissioning / Start Up specifications
- Developing the Commissioning / Start Up plan for the project to establish and communicate the testing and documentation procedures

Construction Phase

The objective of the construction phase is to prepare and plan for the testing phases. It consists of the following elements:

- Submittals are reviewed for design conformity, and information is compiled for the development of the test procedures.
- Commissioning / Start Up checklists are developed for testing each individual component. (PCs)

- Test procedures are developed for the Functional Performance Tests (FPTs).
- A detailed Commissioning / Start Up schedule is developed. This schedule should be integrated or coordinated with the overall project CPM.
- Individual components that do NOT have logic, i.e.; door locks, overhead coiling doors, loading dock equipment, fuel tanks, are generally not part of Cx, and are tested separately, with results documented on the Master Test Register.
- Periodic inspections should be made of the work as it is being installed. Particular focus should be placed on operation and maintenance issues. The Owner's system operators should participate.
- Initial Operation and Maintenance Manuals should be submitted and reviewed for content and format.
- As-Built drawings should be reviewed monthly.
- Initial Owner training agendas should be submitted and reviewed.

Start Up & Functional Testing Phase

Component Level Testing

- Each component of a system is started up and tested individually (these tests are documented on the Master Test Register).
- The tests are performed and documented using the Commissioning / Start Up checklist.
- Once the Commissioning / Start Up checklist has been completed for each component of a system, the system is ready for the system verification phase.

System Verification Phase, which is also referred to as the Integrated Systems testing phase, consists of two steps:

Step 1 – Normal Operation System Level Testing – The entire system is started up and tested using the procedures developed in the construction phase.

After the proper operation of each system is verified and documented, the Integrated System Testing can begin.

Step 2 –System Maintenance and Failure Testing – All interfaces between systems must be tested, verified and documented.

Final Documentation Phase. Prior to final acceptance of the systems, the following documentation must be submitted and approved:

- Final Operation and Maintenance Manuals
- Final As-Built
- Owner training performed and documented
- Final Commissioning / Start Up report including copies of all completed testing checklists, and test and balance reports

h. Documentation

The QC Team will maintain complete and accurate records of all inspections and tests. These records will provide factual evidence that the inspections and tests have been performed and that the installation conforms to the contract documents. The Contractor's records will cover both conforming and non-conforming features.

i. **QC Daily Reports and/or Project Log**

The QC Daily Report and/or Project Log is (are) the primary vehicle(s) for documenting daily quality control efforts and issues. This report will be diligently completed and submitted on the following day. The report will include the following information:

- A description of major work activities occurring that day
- Preparatory Meetings, Initial Inspections, Follow-Up Inspections, Final Inspections, Material Inspections, Specialty Inspections and Off-Site Inspections will be noted on the report. The appropriate forms should be attached.
- Discrepancies identified and corrected will be noted on the report.
- Copies of all inspection and test reports, including data and calculation sheets, for both passing and failing tests will be submitted with the Daily Inspection Report.
- Test reports (i.e., pressure tests) will be included as they become available.
- A description of outside testing agency work and inspections performed by code authorities that day.
- Copies of subcontractors' QC Daily Reports (if required) that include a statement from the subcontractor certifying that all of the supplies and materials incorporated into the work are in full compliance with the terms of the contract.

ii. **Non-Conformance Reports (NCR)**

Non-Conformance Reports are utilized to document discrepancies in quality, workmanship, materials, and/or unauthorized deviations from the contract requirements so that the discrepancies and deviations can be called to the attention of the necessary parties and corrected as quickly as possible. A Non-Conformance Report is required for all significant non-conforming work that cannot be corrected within 48 hours of identification. It is not, however, meant to document minor or Punchlist type items generated in the inspection phases.

****It must be noted that on Federal projects, deficient work cannot be included in the monthly billing. (Per the FAR) A value must be assigned to the deficient work, and that amount deducted from the billing until it has been verified as corrected and signed off by the owner's representative or authorized party.**

The Non-Conformance Report procedures are as follows:

1. When materials or workmanship do not conform to the contract drawings or specifications, they will be rejected. If the defective work is significant and cannot be corrected within 48 hours, the QC Representative will initiate a Non-Conformance Report and immediately furnish copies to the Contractor's Project Manager, Superintendent, and subcontractor's QC representative as well as to the appropriate Owner's representative.
2. Non-conformances will be recorded on the Non-Conformance Report. Each non-conformance will be assigned a number and entered on the DR Log, and the Contractor's QC Representative will list a concise statement providing a location and description of the non-conformance on the Non-Conformance Report.

3. Upon correction of the non-conformance, the QC Representative will re-inspect the item(s) relative to the original requirement, plus the rework information noted on the Non-Conformance Report. When it is found acceptable, the Non-Conformance Report will be signed off as corrected. If the item is still not acceptable to the QC Representative, the non-conformance will remain open and will be resubmitted for inspection only after further rework. Some projects i.e.; USACE, require the Owner's QA representative to approve and sign off Non-Conformance Reports when the work is corrected and acceptable.

4. The QC Team will review the Non-Conformance Report with the Project Manager and Superintendent periodically to formulate a disposition of each listed uncorrected non-conformance. They will establish timetables for final resolution of all non-conformances.

5. The Contractor's Project Manager or Superintendent will notify subcontractor(s) of any uncorrected discrepancies and direct subcontractor(s) to take immediate corrective action. The Non-Conformance Report will be reviewed at weekly subcontractor meetings.

6. A copy of the Non-Conformance Report with outstanding items shall be attached weekly to the QC Daily Report and/or Project Log.

i. Punchlist and Turnover

i. Punchlist Procedure

Final Punchlist Inspections are prepared with the Owner's QC Representative (if applicable) and Architect in attendance. These are intended to illustrate that work is complete and ready for acceptance. Balfour Beatty's QC Representative will develop the Final Punchlist with support from the Superintendent. The following steps shall be followed:

1. Work will be reviewed for conformity to plans, specifications, quality, workmanship, and completeness.
2. An itemized list (Punchlist) will be made of work not properly completed, damaged work, inferior workmanship, or work that is non-compliant. This Punchlist will be developed utilizing the project software and will be immediately available to subcontractors for ease of distribution and status updates. After Distribution of this list to applicable subcontractors, a timetable will be identified for completion.
3. Subcontractors will be instructed to document completion of the work items listed. Once complete, the subcontractor will walk the listed items with Balfour Beatty's QC Representative(s), who will sign off when listed work items have been satisfactorily completed.
4. Balfour Beatty's QC Representative will then walk with the Owner's QC representative (if applicable) and/or Architect with the intent that the listed items will be signed off and acknowledged as completed and accepted.

ii. Training

The specified training requirements should be captured in the Master Tracking and Deliverable Log and/or a Master Training Log. Notification to the Owner of various training sessions will vary due to project specifications. Sign in sheets for each training must be signed by all trainees and transmitted to the Owner along with required training materials to prove compliance with requirements. It is the Owner's responsibility to have the proper personnel at each training.

iii. O&M Manuals and Spare Parts/Tools

The Master Tracking Log will also capture the requirements for Operation and Maintenance Manuals, and spare parts and tools. There should be a designated place to store these as they are delivered by subcontractors to prevent damage and misplaced parts prior to turnover to Owner.

iv. **Warranty Phase**

In the instance of Warranty work, the Owner will notify the designated BBC contact of the specific item. A Warranty Work Order (WWO) will be initiated by BBC to document and track the item. BBC will forward the WWO to the responsible subcontractor(s). The WWO defines the item and expected date of completion along with other pertinent information and are tracked on a WWO log. When the Warranty work is completed, it will be verified as completed and acceptable, and the WWO will be closed and the Owner notified. The Owner should be provided a copy of the WWO log at periodic intervals for status updates during the Warranty period.

3.0 FORMS AND CHECKLIST

a. **Forms**

i. **Requests for Inspection and Tests**

ii. **Inspection**

- Inspection Profile – (See 7.0 Attachments section)
- Source Inspection
- Material Inspection
- Initial Inspection
- Follow-Up Inspection
- Concrete Pre-Placement Inspection
- Close-In Inspection
- Special Inspection
- Final Acceptance Inspection

iii. **Tests**

- Test Register – (See 7.0 Attachments section)
- Test Report

iv. **Discrepancy**

- Discrepancy Report

4.0 TERMS AND ABBREVIATIONS

CPM - Critical Path Method

The critical path method (CPM) is a step-by-step technique for planning that defines critical and non-critical tasks with the goal of preventing time-frame problems. The CPM is ideally suited to projects consisting of numerous activities that interact in a complex manner.

Definable Feature of Work - DFOW

DFOW is a task (work feature) that is separate and distinct from other tasks that results in a product, has a distinct set of quality control requirements/activities, & work crews unique to that task. (ex: structural steel erection, ceramic tile) There should be a minimum of one DFOW for each Specification Section, and more for complex Specification Sections. (ex: Mechanical, Electrical)

Deficiency / Discrepancy

- Out of Spec material (including Buy American Act) that cannot be replaced within 48 hours.
- Out of Spec installation procedure that cannot be replaced within 48 hours.
- Defective or damaged material that the contractor does not intend on replacing / repairing or that will be concealed prior to replacement.

Phased Inspection

One of the phases of inspection; Preparatory, Initial, Follow Up, Final Acceptance.

JHA – Job Hazard Analysis

A safety analysis breakdown of a specific task of work by defining the steps of a task, the hazards associated with each step, and, the measures that will be used to prevent the hazards from occurring. A JHA focuses on the relationship between the worker, the task, the tools, and the work environment. JHAs must be reviewed with the work crew prior to starting a feature of work or task.

Quality Control (QC) Plan

The QC Plan identifies the specific quality control requirements for the project based on the project's contract documents. The QC Plan also defines the proactive steps that will be taken to ensure quality at each step of the project from design to turnover.

Work Breakdown Structure

Based on the project schedule, the work breakdown structure shows how the major features of work will be put into place with relationship to other work.

Work in Progress or Means and Methods

- Any damaged work or defective material that the contractor intends on replacing / repairing prior to concealment is considered Work in Progress.
- Cleaning or preparation of surfaces that will receive other work (as long as surface is properly cleaned and prepped prior to follow on work) is considered Work in Progress.
- Remedial action that is awaiting an RFI or Design Response is a Work in Progress.
- Repair of work damaged by others is considered Work in Progress.
- Temporary installation procedure to achieve the correct final result is a Means and Methods.
- Omission of a feature of work that will be put into place at a later date without affecting structural integrity of the work is considered Means and Methods,

5.0 ATTACHMENTS
