CHAPTER VII

CONSTRUCTION QUALITY CONTROL INSPECTION PROGRAM [1]

[1] This Chapter of the FERC Engineering Guidelines has been prepared under contract with R & H Thomas, Inc.

Chapter VII
Construction Quality Control Inspection Program

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Chapter VII

Construction Quality Control Inspection Program

7-1 Purpose and Scope

7-1.1 General

The guidelines presented in this chapter provide staff engineers and geologists with recommended procedures and criteria to be used in reviewing and evaluating construction quality control inspection programs for FERC jurisdictional projects. These guidelines are based on the FERC Regulations, FERC Operating Manual for Inspection of Projects and Supervision of Licenses for Water Power Projects, and selected Quality Control Inspection Programs (QCIPs) from each FERC Regional Office. The term "licensee" in the remainder of this chapter refers to licensee, exemptee or applicant as appropriate. The review performed by staff will be conducted to ensure that submitted QCIPs comply with the Commission's Regulations and provide accepted construction quality control inspection and documentation practices common to the hydroelectric industry. Quality control has been defined as measuring conformance with the requirements. [2] In addition it is deciding what will be measured and who will do the measuring and documentation.

As stated in Section 12.40 of the Commission's Regulations and Article 4 of the Standard L Forms for licensed projects, during any construction, repair or modification of project works the licensee must maintain any quality control program that may be required by the appropriate Regional Director, commensurate with the scope of work and meeting any requirements or standards set by the Regional Director. Construction may not begin until the QCIP has been approved by the Regional Director.[3] The Regional Director may decide not to require such a program for relatively minor renovation work; however other conditions may be required upon review of the design and construction plans and specifications.

The intent of Section 12.40 is to ensure quality construction. The regulations require that quality control inspections must be conducted by the licensee, the design engineer or an independent firm accountable to the licensee, and must not be performed by a construction contractor or firm accountable to the construction contractor. The

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[2] Reference 1

[3] Reference: 18 CFR, Part 12, Subpart E, Section 12.40

regulations recognize that construction contractors have interests in quality construction work that lead them to establish their own quality control programs. The construction contractor is not precluded from performing his own quality control inspections for his own purposes. As stated in the preamble to Order 122, experience shows that construction contractors may also have conflicting interests that may lead to neglect of the quality of work. Because of the potential for conflict of interest, it is important to provide for independent quality control inspections. [4] The desire for independent quality control inspections is also evident in the requirement that, if the licensee's personnel are performing the construction work, the licensee must provide for separation of authority between construction personnel and quality control personnel.

Because of the varying types and complexities of projects under construction, considerable engineering judgement must be used in evaluating QCIPs. Projects under construction vary from new dams with surface or underground powerhouses, extensive tunnels and spillways to projects with minor modifications such as tailrace scour repairs and training wall modifications. The various types of construction have been grouped into three categories and each category has been divided into three types of QCIPs. In the following sections the categories are defined and examples of acceptable QCIPs for each category are discussed.

7-1.2 Review of QCIP

The review of a QCIP by staff is to evaluate the adequacy of the QCIP relative to the complexity of construction. Appendix VII-A contains required contents and a proposed outline for a QCIP. The contents and outline should be considered when reviewing a QCIP submitted for approval, keeping in mind the complexity of construction. The contents of Appendix VII-A are discussed in this and subsequent sections. Regardless of the complexity of construction, the QCIP should be clear on the qualification, independence, responsibility, authority, number and specialty of personnel responsible for quality control inspection. All QCIP reviews must include an evaluation of the adequacy of erosion control and other measures to protect the environmental quality of streams and other areas affected by construction. All QCIPs should have a Materials Testing Schedule that specifies the types and number of tests for adequate coverage for all materials included in the construction. On the larger and more complex construction projects that extend over a period of years, the training and periodic evaluation of quality control inspection staff should be reviewed.

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[4] Reference: FERC Order 122, Final Rule, Regulations Governing Safety of Water Power Projects and Project Works, Issued January 21, 1981

The necessary qualifications for quality control inspection personnel should be established in the QCIP and resumes for personnel assigned to a specific function included in the initial QCIP. At a minimum, resumes should be included for QCIP personnel who have authority to stop work and personnel who have authority to recommend stop work to the contractor and their supervisor. Emphasis should be placed on previous experience, including type of construction and levels of responsibility. This information should be supplemented on a continuing basis by submittal of qualifications of personnel actually employed. The qualification standard for each position can be established from existing standards, such as the ASCE Professional Grade Descriptions, [5] and the ACI Concrete Certification, [6]. The qualification standard of education and relative experience can also be specified in the QCIP.

It is important that personnel responsible for quality control inspection be independent from personnel responsible for construction, and the responsibility and authority of the quality control inspection personnel must be clear and specific. This independence must be maintained for all types of construction, including turnkey design-build construction and construction where the licensee is not only the designer and constructor, but also is responsible for the quality control inspection. There must be a separation of authority between construction personnel and quality control inspection personnel. The responsibility and authority of the quality control inspection personnel, e.g. the authority to require changes in construction or stop work, should be specifically stated in the text and illustrated in the organization chart of the QCIP.

The QCIP should describe the number and specialities of proposed quality control inspectors. Also, the number of inspectors proposed for each feature of construction, including coverage of shift work, should be specified. Where full time inspection is not proposed, the schedule for part time inspection should be described.

It is important that the contractor have an adequate erosion and sediment control program to prevent environmental degradation of streams during construction. The program should provide for the necessary inspection and monitoring to ensure that required protective measures are implemented. If during construction, it is determined that additional protective measures must be taken, the quality control inspection must have adequate procedures for instituting the measures. The erosion control plan is required by a license article and must be included in the QCIP, along with its inspection requirements, to ensure that adequate reporting is in place.

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[5] Reference 2

[6] Reference 3

The QCIP should contain a Materials Testing Schedule that specifies the test method, standard and frequency of tests for all materials. The Materials Testing Schedule will be based on the testing requirements, standards and codes that are specified in the contract plans and specifications.

A training and periodic evaluation program should be established as appropriate for quality control inspectors in the QCIP. This program is especially important for the larger and more complex construction projects that extend over a period of years and where there is a turnover and reassignment of inspection personnel. For less complex and short duration construction projects, an established training program may not be required; however, the qualifications of any new or reassigned personnel should be reviewed.

7-2 Quality Control Inspection Program Content

The QCIP should provide for an adequate and qualified construction inspection force and should contain detailed information including, but not limited to, the information contained in Appendix VII-A. In addition to the contents of Appendix VII-A, consideration should be given to including a construction inspection checklist which covers specific aspects of construction.

All of the items of the QCIP content in Appendix VII-A are discussed under the various categories of construction in Section 7-3. The items are discussed in detail in the suggested outline, with comments on items to be covered and pertinent issues to be considered, for each category of construction and the QCIP. The following paragraphs contain a brief discussion on each item listed in Appendix VII-A that pertains to all QCIPs, regardless of the construction category.

7-2.1 Introduction

The introduction should describe the project and the purpose of the proposed construction. Background information on the various construction contracts should be discussed. The general goals of the QCIP should be discussed. The names of the licensee, designer, construction contractor and organization(s) responsible for QCIP should be stated.

7-2.2 Organization Chart For QCIP Staff

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. Appendix VII-B contains sample organization charts that are discussed in Section 7-3.

7-2.3 Number and Specialties of QCIP Staff

The number and specialties of inspectors proposed for each feature of construction should be included. 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.

7-2.4 Duties, Responsibilities, Qualifications and Authority

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. As stated in Section 7-1.2, at a minimum, resumes should be included for QCIP personnel who have authority to stop work or authority to recommend stop work due to adverse quality conditions. The qualification standard can be based on existing standards established by professional organizations such as ASCE and ACI or the qualification standard can be specified in the QCIP. The information should be supplemented on a continuing basis by submittal of qualifications of personnel actually employed.

The responsibilities of the various organizations involved with the construction, such as the licensee, designer, construction management organization, QCIP staff, testing laboratory and construction contractor, should be addressed to provide an understanding of the necessary coordination and relationship for construction of the project. The services to be provided by each organization should be clearly delineated and discussed.

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 principal QCIP supervisor in the field should have limited or no involvement with contractor negotiations, scheduling of construction and cost justification, except as described for Category 3 construction.

7-2.5 Field Tests and Frequency of Testing

The contract plans and specifications delineate testing requirements for the project and the standards and codes to which the work will conform. The tests should be conducted at a frequency which will ensure that elements of the work are in compliance with the specified standards. In addition to the specifications, the type of testing required should be addressed in the QCIP. One such example is hydrostatic testing of penstocks. The FERC requires that hydrostatic or non-destructive testing be conducted on all pipelines whose failure would result in a hazard to life, property or the environment. The amount of testing, both hydrostatic and weld testing, should relate to the head and physical size of the project facilities.

A Materials Testing Schedule and Referenced Documents (relative to the testing) should be presented in a format similar to Appendix VII-D.

7-2.6 Field Laboratory or Commercial Testing Facilities

The supervision, equipment and location of the materials testing laboratory should be described. For large construction projects it is common for a fully-equipped materials testing laboratory to be maintained at the project site. The type of testing to be performed at the laboratory should be described. If tests requiring special equipment are to be performed by outside laboratories, the tests and laboratories should be described.

For small construction projects, there may not be a field laboratory at the project site. Therefore, an independent commercial laboratory may be used for material testing provided the licensee retains this service under a separate contract with the laboratory. If an off-site laboratory is used, adequate on-site storage should be provided on an as needed basis for such items as concrete cylinder molds and curing boxes, and other required equipment. The names and qualifications of all off-site laboratories should be provided in the QCIP.

7-2.7 Inspection Plan Including Documentation and Reporting

The Inspection Plan should be specific in providing guidance to QCIP staff and in establishing inspection, reporting and documentation procedures. The essential elements of an inspection plan are inspection criteria, contractor operations, QCIP operations and documentation. A training program for field engineers and inspectors may also be included in the inspection plan.

The criteria for inspection of contract work is in the executed contract between the contractor and the licensee.

Normally, the contractor operates independently from the licensee and is responsible for providing quality and schedule controls over materials, workmanship and methods to assure meeting contract requirements.

QCIP staff are responsible for verifying that all contract work is performed in conformance to contract documents and project procedures.

The purpose of reporting is to document the observation, investigation and analysis of inspection work. There are numerous types of reports and each project should use the inspection reporting that is appropriate for the type of construction and the construction contract. The daily inspection, nonconformance, and environmental deficiency reports are required for all QCIPs. The daily inspection report provides a means of recording contractor daily operations. The nonconformance and deficiency reports are used to identify, report and document all observed nonconformances and their disposition. Appendix VII-C contains samples of nonconformance and environmental deficiency reports.

For large and complex construction projects, there should be an established training and periodic evaluation program for QCIP field engineers and inspectors. For less complex and short duration construction projects, an established training program may not be required; however, the qualifications of any new or reassigned personnel should be reviewed to assure that the individual is fully qualified to oversee this assigned area of responsibility.

7-2.8 Planned Use of Consultants During Construction

Depending on the size and complexity of construction and the downstream hazard potential the licensee may be required to retain a Board of Consultants to review the design, plans and specifications and construction of the project for safety and adequacy.

The Board should also review the initial QCIP and comment on any changes that are considered necessary.

Also, certain projects may require special consultants such as grouting, instrumentation and blasting experts. The qualifications and scope of work of the special consultants should be included in the QCIP.

7-2.9 Schedule of All Major Features of Construction

The preliminary construction schedule should be included in the QCIP submitted for approval. The schedule should contain milestone dates established for the construction contractor. Modifications to the milestone dates should be included in the licensee's monthly construction progress report, which is a separate item from the QCIP.

7-2.10 Erosion Control and Environmental Compliance

An Environmental Compliance Plan should be developed for all projects under construction. The plan should include an approved erosion and sediment control plan to prevent environmental degradation of streams during construction. The plan should also include a listing of all permit and license requirements, and plans and programs that require oversight by the licensee to ensure adherence to the documents.

7-2.11 Construction Inspection Checklist

Although not required, consideration should be given to providing the QCIP inspectors with checklists to aid them in reviewing and inspecting the construction work. The checklists could be generic or prepared for the specific construction project. The checklists will help the inspectors plan their inspections and serve as a reminder in review of work plans and inspection of installed work. Appendix VII-E contains three sample civil inspection checklists for excavation, earthwork and concrete placement. The checklists are prepared to indicate types of items to be covered and format and are not intended to be complete for the categories discussed. Depending on the type of construction, checklists for other categories, such as, mechanical, electrical and welding, should be included.

7-3 Types of Quality Control Inspection Programs

The type of QCIP adopted will depend on the complexity of construction, ownership of the project and contractual arrangements. Each program must be evaluated on its ability to meet the FERC Regulations and its ability to provide for an adequate

inspection force. The primary goal is safety and not cost minimization. Cost is always important; however, quality cannot be sacrificed for cost. The QCIP should assure that the specified work is constructed in accordance with approved plans and specifications. Included in this section is a discussion of the various types of QCIPs encountered under the FERC's jurisdiction and what is considered to be an acceptable standard for each type.

The various types of construction have been divided into three categories and each category has been divided into three types of QCIPs. Each category and its attendant QC arrangement are defined as follows:

- Category 1 - Construction of a major new hydroelectric project that includes a new dam, powerhouse, spillway, tunnels and appurtenant facilities.

  1A - QCIP by the licensee, design engineer or independent firm other than the construction contractor.

  1B - QCIP by the licensee who is also the designer and construction contractor. This could also be a labor-broker construction contract.

  1C - Turnkey design-build construction. The same firm designs and constructs the project with some quality control inspection included in the contract. QCIP by licensee or independent firm other than the design-build firm.

- Category 2 - Construction not as large and complex as Category 1. A typical example would be an addition to an existing structure such as construction of a powerhouse at an existing dam. QCIPs A, B and C are as described under Category 1. It is recognized that there have been and will be very large and complex projects that only involve the construction of a powerhouse at an existing dam.

- Category 3 - Construction not as large and complex as Category 2. A typical example would be the modification of an existing structure, such as the installation of post-tensioned rock anchors in a concrete gravity dam or major maintenance such as replacing gates or resurfacing a spillway section. QCIPs A, B and C are as described under Category 1; however, it should be noted that QCIPs 3A and 3B are more common than 3C.

Routine maintenance that does not affect project safety would not normally require a QCIP. If a licensee is unsure whether a QCIP is required, the Regional Director or Director, Division of Dam Safety and Inspections should be contacted for further guidance.

7-3.1 Category 1A

The construction of a new major hydroelectric project requires the most comprehensive QCIP for hydroelectric projects under FERC jurisdiction. The QCIP must contain all of the items in Appendix VII-A and be discussed in sufficient detail and clarity for the document to be self contained. Described below is a suggested outline with comments on items to be covered and pertinent issues to be considered for a Category 1 construction where the QCIP is performed by the licensee, design engineer or independent firm other than the construction contractor.

7-3.1.1 Introduction

The introduction should describe the project and the proposed construction. The organization responsible for QCIP should be stated as well as the licensee, designer and construction contractor. The general goals of the QCIP should be discussed. Specialized construction techniques and equipment should be described.

7-3.1.2 Responsibilities

The responsibilities of the various organizations involved with the construction, such as the licensee, designer, quality control inspection organization, testing laboratory and construction contractor should be discussed. The services to be provided by each organization should be itemized and briefly discussed.

7-3.1.3 Organization and Staffing

This section pertains primarily to the organization and staffing of the quality control inspection personnel. However, personnel involved in construction management should also be included to provide a better understanding of the necessary coordination and relationship between personnel.

The responsibilities and duties of key QCIP staff should be clear and definitive. Resumes for personnel assigned to specific functions should be included in the initial QCIP and should be concise and specific on education and experience. Emphasis should be placed on previous experience and involvement in the type of construction and the level of responsibility. This information should be supplemented on a continuing basis by submittal of qualifications of personnel actually employed. As stated in Appendix VII-A, the QCIP should contain an organization chart of the construction inspection force. It is helpful to relate the key personnel responsibilities and duties to an organization chart. Appendix VII-B contains descriptions of duties and responsibilities

of some key personnel and sample construction management organization charts with emphasis placed on the QCIP. The charts are identified by fictitious FERC project numbers. Sample organization charts for Category 1A QCIPs are represented by FERC Project Numbers 24,995 and 24,996.

Other Recommended Practices

In general there are other recommended practices to those discussed in Appendix VII-B, relative to the organization and staffing of a QCIP, that should be encouraged or required in some situations. These practices are as follows:

- In an effort to achieve a separation of authority for the QCIP, it is preferable to place the quality control inspection personnel under a separate and equivalent level of supervision, such as the Resident Engineer. However, if this organization is not feasible, the principal QCIP supervisor in the field should have limited or no involvement with contractor negotiations, scheduling of construction and cost justification.

- It should be stated in the QCIP that all QCIP positions shown are intended to be full time except where part time is specified. For part time positions, the estimated time on the job should be specified and related to the construction activity.

- In addition to the descriptions of personnel duties and responsibilities in the QCIP text, consideration should be given to making a Key Project Personnel Summary Table. The table would have the name, title with name of company, primary work location, percent of time spent on site and a brief statement of responsibilities for key project personnel. The key personnel should be both on-site and off-site personnel of the QCIP and pertinent personnel from the licensee such as the Project Manager. The table would provide, at a glance, a summary of the key personnel involved in the construction along with a brief statement of their responsibilities.

- In situations where the Design Engineer is not stationed at the project construction site, there should be a statement in the QCIP establishing the frequency of required field inspections of the ongoing construction and his involvement in reviewing QCIP reports and test results. The field inspections should also be correlated with critical stages of construction. For fast moving construction projects such as a RCC dam, the inspections should be scheduled early and made frequently.

7-3.1.4 Inspection Plan or Field Inspection Guidelines

Some large and complex construction projects have an inspection plan and others have field inspection guidelines for the QCIP personnel. The purpose of the plan or the guidelines is to provide guidance for the QCIP personnel and establish inspection, reporting and documentation procedures. The contents can be varied between a plan and guidelines or varied within either, depending on the licensee, design engineer or contractor. The essential elements of an inspection plan or field inspection guidelines are inspection criteria, contractor operations, QCIP operations, and documentation. A training program for field engineers and inspectors may also be included in an inspection plan. A construction inspection checklist covering specific aspects of construction may also be included with the plan or guidelines, which is discussed in more detail in Section 7-2. A discussion of the essential elements described above are as follows:

7-3.1.4.1 Inspection Criteria

The criteria for inspection of contract work is the executed contract between the contractor and the licensee and any amendments or change orders executed during the work. The contract incorporates drawings, specifications, codes, standards and laws, which are the basis of contract enforcement and must be available to inspection personnel. The contract documents should be reviewed periodically to ensure that current documents are being used and that all requirements are being met.

7-3.1.4.2 Contractor Operations

Normally, the contractor operates independently from the licensee and the QCIP personnel and retains responsibility for satisfactory performance and site safety. This allows the contractor, within the limitations of the contract, to choose his own methods, schedules, materials and equipment. It is the contractor's responsibility to provide quality and schedule controls over materials, workmanship and methods to assure meeting contract requirements. It is the responsibility of the licensee, construction management firm and QCIP personnel to verify that the contractor meets all contract obligations and QCIP personnel inspect and verify, rather than direct or control, the contractor's field construction operations.

7-3.1.4.3 QCIP Operations

The QCIP personnel are responsible for verifying that all contract work conforms to contract documents and project procedures. Contractors should be advised

immediately upon detection of nonconforming work so that the work can be corrected. General inspection duties should be listed, such as, becoming familiar with the contract documents, when to contact the supervisor and guidance on when to stop work. Procedures should be established for communications between QCIP personnel, the contractor and construction management personnel.

7-3.1.4.4 Documentation

The purpose of reporting is to document the observation, investigation and analysis of inspection work. There are numerous types of reports such as the daily inspection report, nonconformance report, environmental deficiency report, field directive and clarification report, concrete placement and test cylinder report, cadweld inspection report, compacted fill density test report, field weld inspection form, pipe and components field inspection form and shotcrete report, to name a few. Each project should use the inspection reporting method that is appropriate for the type of construction and the construction contract. A discussion of the proposed inspection reporting should be presented in the QCIP along with sample report forms. The QCIP should define the review levels for all reports. The daily inspection report, nonconformance report and environmental deficiency report are required for all QCIPs. Discussions of the daily inspection and nonconformance reports are contained in the following paragraphs. The environmental deficiency report is discussed in Section 7-3.1.6.

7-3.1.4.4.1 Daily Inspection Report

The daily inspection report is prepared by the QCIP Inspectors and provides a means of recording the contractor's daily operations. Daily reports are written when there is construction activity. If there is no construction, there should be no daily reports. For documentation, a daily report will note when construction stopped and another daily report will note when construction began. The report should cover all important factors affecting job conditions and progress of the work and can be used later as a basic reference to determine the exact history of work at any given time. The daily report should include such items as weather conditions, description of activities performed, types of equipment used, materials incorporated into the work, description of any problems requiring correction and corrective action taken, detailed description of any instructions given to the contractor and any other information necessary to document the contractor's activity and progress during the shift. For QCIPs structured similar to Project 24,995, the original report would be filed with the Office Engineer and copies retained by the Senior Civil Engineer and the inspector.

7-3.1.4.4.2 Nonconformance Report

The nonconformance report is used to identify, report and document all observed nonconformances 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. Failure to meet compaction criteria that results in the immediate reworking or removal and replacement is an example of noncomforming work that is addressed on the spot. This could be handled by the inspector and his supervisor and would not necessarily require input, other than review, from the Design Engineer or the Resident Engineer. Low strength concrete and inadequate foundation preparation are examples of nonconforming work that require review and study. Such situations would require input from the inspector's supervisor, Design Engineer, engineering or geological specialists and the Resident Engineer and may require studies and follow-up reports. A sample nonconformance report form is contained in Appendix VII-C. The disposition for QCIPs structured similar to Project 24,995 would have the Senior Civil Engineer or the Materials Engineer signing as QC supervisor in the description/affected area box and the Resident Engineer signing as QC supervisor in the disposition box on the sample form. To track action on all work observed to be deficient by the QCIP staff, a quality tracking and reporting system should be developed and maintained. The system should contain such information as, report number for tracking, date of issue, originator, description of deficient work, disposition, technical basis for disposition, date of closure, party responsible for closure and pertinent references.

7-3.1.4.5 Training

A project-specific training program for all incoming field engineers and inspectors should be established. The Resident Engineer should assure that each engineer and inspector has training in the area of expertise and quality control procedures for the inspections that they will perform. Formal classroom training should be conducted by a designated representative for the applicable category or discipline. Personnel such as batch plant inspectors and field technicians with little or no experience should be given on-the-job training and be required to pass a series of written tests on quality control procedures, laboratory procedures, and test methods for either soils or concrete. They should be supervised by an experienced lead engineer. Experienced supervisors, engineers and inspectors should be required to have a specified number of years of construction experience or be required to pass a series of written examinations relating to the area of inspection, the contract documents and quality control procedures.

7-3.1.5 Field Testing Requirements

The contract plans and specifications have been developed to establish testing requirements for the project and the standards and codes to which the work will conform. The QCIP staff will use the specified tests to verify that the work is performed in accordance with the contract. The sampling will be done and the tests will be conducted at a frequency that will ensure that elements of the work are in compliance with the specified standards.

Appendix VII-D is a Sample Materials Testing Schedule and Referenced Documents. The number of tests are not intended to be representative of the quantity of tests required but rather an example of a preferred format for presenting the materials testing schedule and frequency. The Referenced Documents provide a full description of the tests referred to in the Sample Materials Testing Schedule.

7-3.1.6 Environmental Compliance

A detailed Environmental Compliance Plan should be developed for all projects under construction. The plan should include a listing of all permit and license requirements, and plans and programs which require oversight by the licensee to ensure adherence to these documents. The listing could be presented in tabular form as construction related environmental requirements. It is important that the plan contain an adequate erosion and sediment control plan to prevent environmental degradation of lands and streams during construction.

The erosion and sediment control plan is required as a license article and the approved plan should be included in the QCIP to ensure that adequate inspection and reporting is in place. The plan should address the protection of existing vegetation, grading of slopes, control of surface drainage, sediment containment measures, temporary topsoil stockpiling, storage and disposal of excess excavation and debris, construction and upgrading of access roads, and clearing and construction of the transmission line rights-of-way. Approved disposal sites should be indicated. The plan should also outline a schedule for implementation of any mitigation measures proposed and the monitoring and maintenance of the measures. The environmental requirements should be outlined in the Technical Specifications.

For QCIPs structured similar to Project 24,995 (Appendix VII-B), the Resident Engineer has overall responsibility for environmental compliance and the duties are carried out by the Environmental Coordinator. The Environmental Coordinator monitors the project under construction on a daily basis to assure compliance. The Environmental Coordinator briefs the Resident Engineer and other key staff on environmental concerns. In the event that environmental concerns arise from the Environmental Coordinator or other QCIP staff, the Resident Engineer will take the appropriate action to notify the contractor of his responsibilities and to correct any noncompliance. A sample Environmental Deficiency Report is contained in Appendix VII-C. The deficiency report should reference the requirement, the nature of the deficiency, the type of correction required, and the time frame to complete the correction. If the deficiency violates a license requirement, that should also be noted. The Resident Engineer or Environmental Coordinator should make the required notification to outside concerns, such as resource

agencies, to comply with special permit requirements.

7-3.1.7 Construction Schedule

The preliminary construction schedule, based on the understanding of the project at that time and the FERC license conditions, should be included in the QCIP submitted for approval. The schedule should contain milestone dates established for the construction contractor(s). After award of the construction contract, the contractor will submit detailed construction schedules, which in some cases, will be updated monthly. Modifications to milestone dates should be included in the licensee's monthly construction progress report, which is a separate item from the QCIP.

The construction schedule in the QCIP should be presented in either tabular or graphic form.

7-3.1.8 Planned Use of Consultants

In the order issuing license for most large and complex construction projects, the FERC requires the licensee to retain a Board of Consultants to review the design, plans and specifications and construction of the project for safety and adequacy. The Board should also review the initial QCIP and comment on any changes that are considered necessary.

Major areas of concern for certain projects may require special consultants such as experts for blasting and vibration control to advise on the monitoring of shock and vibration from blasting and pre/post blasting surveys; instrumentation specialists to advise on various types of instruments and to interpret results and lake tap experts to provide advice and experience on this highly specialized work. The special consultant's qualifications and scope of work should be included in the QCIP. The need for special consultants may be evaluated based on the actual conditions encountered during construction. Immediately after selection of the consultant, his qualifications and scope of work should be added to the QCIP.

7-3.2 Category 1B

The Category 1B QCIP also involves the construction of a new major hydroelectric project; however, in Category 1B the licensee is the designer, construction contractor and also provides the quality control inspection. The suggested outline, comments and pertinent issues (as discussed in Section 7-3.1 and Category 1A of Appendix VII-B) will apply in this section except where noted otherwise.

7-3.2.1 Responsibilities

Since the design, construction and quality control inspection will be done by the licensee, it is important that the responsibilities of the various departments within the licensee's organization be described. These will primarily be departments involved in the design, construction and operation of the project. Of particular concern is the separation of authority and the level of reporting. It is important that there be a separation of reporting authority between construction staff and QCIP staff at the field level and that the reporting comes together at as high a level as possible in corporate headquarters.

7-3.2.2 Organization and Staffing

This section is similar to the Organization and Staffing Section for Category 1A; however, the primary difference is in the separation of authority between the QCIP staff and the construction personnel. A sample organization chart and descriptions of duties and responsibilities of some key personnel for Category 1B is presented as Project 24,997 in Appendix VII-B. The organization chart delineates the independent relationship between the construction personnel and the quality control inspection personnel. There are certainly other arrangements that could be considered; however, the important item is the separation of authority.

7-3.3 Category 1C

As with Categories 1A and 1B, Category 1C also involves the construction of a new major hydroelectric project. In Category 1C the project is constructed under a turnkey contract by a design-build contractor. Frequently there is a built-in quality control function by the design-build contractor that is required for proper production controls. To comply with the FERC Regulations, there must be a separate QCIP by the licensee or a separate engineering design firm under contract to the licensee. The licensee's overall QCIP should integrate all available testing results developed during the project by the QCIP staff, the design-build contractor's quality control activities and any third party testing. An example of such a coordinated approach would be that the design-build contractor must run tests to characterize potential concrete aggregate sources and to identify the suitable portions of the given source. Based on the resulting data and information, the licensee's QCIP staff would run selected tests to confirm that the selected materials meet all requirements. In this manner, the contractor's production control testing results would develop a base of quality control information that would allow the licensee's QCIP testing program to be reduced in the number of tests and still be specific and representative of the materials selected for construction.

The suggested outline, comments and pertinent issues to be considered (as discussed in Section 7-3.1 and Category 1A of Appendix VII-B) will apply in this section except where otherwise noted.

7-3.3.1 Responsibilities

The responsibilities of the various organizations involved with the construction, such as the licensee, design-build contractor and the quality control inspection organization should be discussed. The services to be provided by each organization should be itemized and discussed. An example would be that the coordination of the testing laboratories, if more than one laboratory is used, should be discussed, such as the sharing of test results and the QCIP inspector's authority to direct the type, location and frequency of tests that the inspector deems necessary.

7-3.3.2 Organization and Staffing

This section pertains primarily to the organization and staffing of the quality control inspection personnel. Since the licensee has a separate QCIP from the design-build contractor, there should be communication with the design and construction personnel of the design-build firm.

The statement on responsibilities, duties and resumes of key QCIP staff (as presented in Section 7-3.1.3 and Category 1A of Appendix VII-B) apply to this category.

7-3.3.3 Field Testing Requirements

The Field Testing Requirements, as discussed in Section 7-3.1.5, are valid for the Category 1C QCIP; however, the coordination of testing between the design-build contractor and the QCIP testing (as discussed in Sections 7-3.3, 7-3.3.1 and in Category 1B of Appendix VII-B) should be taken into consideration for Category 1C construction.

Testing for foundations and materials during the advanced engineering and design stage that would normally be done by the designer under Category 1A construction and available to QCIP personnel prior to and during construction would normally be done by the design-build contractor for Category 1C construction. Therefore, it is important that this information be coordinated between the QCIP staff and the design-build contractor and considered when designing the QCIP testing requirements.

7-3.4 Categories 2A, 2B and 2C

As stated in Section 7-3, Category 2 construction is not as large and complex as Category 1. A typical example would be an addition to an existing structure such as construction of a powerhouse at an existing dam. This could also include a private or municipal powerhouse at an existing Federal dam.

The boundary line between one construction category and another is not always distinct and it is not important that it should be. The purpose of establishing construction categories is to provide a vehicle for discussing the relative magnitude of QCIPs necessary for the project under construction. The QCIP policy statements, suggested format and procedures discussed for Categories 1A, 1B and 1C also apply to Categories 2A, 2B and 2C.

The construction of a new powerhouse at an existing dam requires a comprehensive QCIP. The QCIP must contain all of the items in Appendix VII-A and be discussed in sufficient detail and clarity for the document to be self-contained.

The number of QCIP personnel and variation of QCIP disciplines in the sample organization chart for Category 2C should be similar to that required for Categories 2A and 2B. However, the number of QCIP personnel for any Category 2 construction will probably be smaller than for Category 1 construction. Normally, a Category 2 construction such as construction of a new powerhouse at an existing dam is contained in a smaller area than Category 1 construction, where a dam, powerhouse and spillway can be spread out over a relatively large area, requiring more QCIP staff to inspect concurrent construction activities. Also, fewer disciplines may be required for Category 2 construction. An example would be construction of a new powerhouse at an existing dam, which may have little or no earthwork.

The suggested outline, comments and pertinent issues to be considered (as discussed in Sections 7-3.1, 7-3.2 and 7-3.3 and in Categories 1A, 1B and 1C of Appendix VII-B) will apply to Categories 2A, 2B and 2C except where otherwise noted.

The three Category 2 QCIPs will be discussed as one unit except for the Organization and Staffing Section where a sample organization chart has been prepared for a Category 2C QCIP.

7-3.4.1 Responsibilities

The responsibilities of the various organizations involved with construction (as

described in Sections 7-3.1.2, 7-3.2.1 and 7-3.3.1) are applicable to Category 2 and should be used depending on the type of QCIP. If the project involves construction of a new powerhouse at a Federal dam, the responsibilities of the Federal Agency that operates the dam should be discussed. The FERC has Memoranda-of-Understanding (MOU) with Federal Agencies, such as the Army Corps of Engineers and the Bureau of Reclamation, relative to construction. The appropriate policy and procedures contained in the MOUs should be considered in the discussion of responsibility.

7-3.4.2 Organization and Staffing

This section pertains primarily to the organization and staffing of the quality control inspection personnel. The statement on responsibilities, duties and resumes of key QCIP staff, as presented in Section 7-3.1.3, applies to this category.

Only one sample organization chart was prepared for Category 2. The organization chart and the role of the principal QCIP supervisor in the field, for Project 24,999, are discussed in Appendix VII-B. Project 24,999 is considered to be a representative QCIP for Category 2C.

7-3.4.3 Inspection Plan or Field Inspection Guidelines

The Inspection Plan or Field Inspection Guidelines discussed in Section 7-3.1.4 are also applicable to Category 2 construction.

For Category 2 projects, the training may need to be revised. Due to their probable shorter construction time, formal classroom training may not be appropriate.

The Quality Control Engineer may rely on experience and on-the-job training to assure that each engineer and inspector is trained in the area of expertise and quality control procedures for the inspections that they will perform.

7-3.4.4 Field Testing Requirements

The Field Testing Requirements as discussed in Sections 7-3.1.5 are valid for Category 2 construction. The coordination of testing between the design-build contractor and the QCIP testing (as discussed in Sections 7-3.3, 7-3.3.1, 7-3.3.3 and in Category 1C of Appendix VII-B) should be taken into consideration for the Category 2C construction.

Depending on the size of construction, a field laboratory facility may not be

established at the project site and an independent commercial laboratory may be used for material testing. Adequate on-site storage should be provided on an as needed basis for such items as concrete cylinder molds, concrete cylinder curing box, and other required equipment.

7-3.4.5 Planned Use of Consultants

Depending on the complexity of construction, uniqueness of design, downstream hazard potential and other considerations, a Board of Consultants may not be required in the license. There may be areas of concern for certain projects that will require special consultants such as is discussed in Section 7-3.1.8.

7-3.5 Categories 3A, 3B and 3C

As stated in Section 7-3, construction for Category 3 is not as large and complex as Category 2. Two examples of Category 3 construction would be the modification of an existing structure such as the installation of post-tensioned rock anchors in a concrete gravity dam or major maintenance of an existing hydroelectric project such as replacing gates or resurfacing a spillway section. The post-tensioned rock anchor construction will be used as an example in this discussion.

The installation of post-tensioned rock anchors in an existing concrete gravity dam requires a QCIP that contains all of the items in Appendix VII-A. The QCIP should be discussed in sufficient detail and clarity to be self-contained. The suggested outline, comments and pertinent issues to be considered, (as discussed in Sections 7-3.1, 7-3.2, 7-3.3, 7-3.4 and Categories 1A, 1B and 1C of Appendix VII-B) will apply to Categories 3A, 3B and 3C except where noted otherwise. Because of the single item, short duration, and less complex type construction for Category 3 construction, the QCIP will be a scaled down version of that required for Categories 1 and 2. There will be fewer QCIP personnel and disciplines.

Category 3 will be discussed as one unit except for the Organization and Staffing Section where a sample organization chart has been prepared for a Category 3A QCIP. The number of QCIP personnel in the sample organization chart should be similar to that required for Categories 3B and 3C.

7-3.5.1 Organization and Staffing

This section pertains primarily to the organization and staffing of the quality

control inspection personnel. The statement on responsibilities, duties and resumes of key QCIP staff, as presented in Section 7-3.1.3 applies to all QCIP personnel in this category.

Only one organization chart was prepared for Category 3. The sample organization chart and the duties and responsibilities of the Project Manager and the Resident Engineer, for Project 25,000, are discussed in Appendix VII-B. Project 25,000 is considered to be a representative QCIP for Category 3A.

7-3.5.2 Inspection Plan or Field Inspection Guidelines

The elements of the Inspection Plan or Field Inspection Guidelines as discussed in Section 7-3.1.4 are applicable to Category 3 construction.

For Category 3 projects, the training section should be revised. Due to the short construction time, the small number of QCIP personnel involved and the relatively fast pace of construction, formal classroom training may not be appropriate. The practicality of on-the-job training is also questionable.

It is important that qualified personnel with the appropriate experience be used to staff the QCIP. If replacement personnel are required, they should also be qualified and have appropriate experience.

7-3.5.3 Field Testing Requirements

The Field Testing Requirements as discussed in Section 7-3.1.5 are valid for Category 3 construction. The coordination of testing between the design-build contractor and the QCIP testing (as discussed in Sections 7-3.3, 7-3.3.1, 7-3.3.3, 7-3.4.4 and Categories 1A, 1B and 1C of Appendix VII-B) should be taken into consideration for the Category 3C construction.

Normally, a field laboratory facility will not be established at the project site for a Category 3 construction and an independent commercial laboratory will be used for material testing.

7-3.5.4 Planned Use of Consultants

Normally, the FERC license will not require a Board of Consultants for a Category 3 construction. There may be areas of concern for certain projects that will require special consultants such as drilling and grouting consultants for rock tendons.

7-3.6 Small Construction Not Requiring a QCIP

As stated in Section 7-1.1, the Regional Director may decide not to require a QCIP for relatively minor work. An example would be a low hazard project where the construction consists of replacing an existing powerhouse, that is not a water impounding structure, with a new powerhouse that would be constructed on the existing concrete foundation. The design has been done by the owner and partially by the manufacturer of the turbine and generator. Thus the owner is the partial designer, contractor and operator. The owner and his associates would provide the quality control during construction.

It is important that the design for such a project be reviewed in detail by a professional engineer, in addition to the FERC staff. It should be stressed that the project be constructed in accordance with approved plans and specifications. The FERC will provide additional guidance when the Regional Office staff makes field inspections during construction to verify that good construction practices are followed.

7-4 Summary

As stated in Section 12.40 of the Regulations and Article 4 of the Standard L forms for licensed projects, during any construction, repair or modification of project works, the licensee must maintain any quality control program that may be required by the appropriate Regional Director, commensurate with the scope of work and meeting any requirements or standards set by the Regional Director. The guidelines presented in this chapter provide staff engineers and geologists with recommended procedures, criteria and examples, to be used in reviewing and evaluating the licensee's QCIPs.

All QCIPs should provide for an adequate and qualified construction inspection force and should contain detailed information including, but not limited to, the information contained in Appendix VII-A and discussed in Sections 7-2 and 7-3. In addition to the staffing responsibilities and authority described below, the QCIPs should have an inspection plan, adequate documentation, training, materials testing schedule, environmental compliance plan and construction schedule. Sample organization charts, abbreviated descriptions of duties and responsibilities for some key QCIP personnel, report forms, material testing schedules and referenced documents and inspection checklists are found in the appendices.

QCIP staff must be independent from personnel responsible for construction. The responsibility and authority of QCIP staff must be clear and specific. This independence must be maintained for all types of construction. The principal QCIP supervisor in the

field should have limited involvement with contractor negotiations, scheduling of construction and cost justification. Key QCIP staff should have the authority to stop work due to adverse quality conditions. There should be someone in the field at all times who has "stop-work" authority. QCIP personnel, such as the inspectors, should have authority to recommend stop work to the contractor and to their supervisor.

There are numerous types of QCIPs depending on the complexity of construction, ownership of the project and contractual arrangements. Each type of program must be evaluated on its ability to meet the FERC Regulations and its ability to provide for an adequate and qualified force for inspection of construction of the project works. In this chapter, the various types of construction are grouped into three categories and each category is divided into three types of QCIPs. The categories are defined and typical QCIPs discussed with illustrations, such as the sample organization charts and descriptions of duties and responsibilities of some key personnel in Appendix VII-B.

Where the licensee is the designer, construction contractor and also provides the quality control inspection, it is important that there be a separation of reporting authority between the construction staff and the QCIP staff at the field level. The reporting should come together at as high a level as possible in the corporate headquarters and supervisory structure.

For turnkey design-build construction, there is frequently a built-in quality control function by the design-build contractor for production control. However, to comply with the FERC Regulations, there must be a separate QCIP by the licensee or a separate engineering design firm under contract to the licensee.

7-5 References

1. Fairweather, V., "The Pursuit of Quality: QA/QC", Civil Engineering, February 1985, pp. 62-64.

2. American Society of Civil Engineers, "ASCE Professional Grade Descriptions", ASCE Guide to Employment Conditions for Civil Engineers, ASCE - Manuals and Reports on Engineering Practice, 2nd Edition, 1980, pp. 5-7.

3. American Concrete Institute, "Qualifications of Personnel for Inspection and Testing Duties", Guide for Concrete Inspection, ACI 311.4R-88, Manual of Concrete Practice, 1988, pp. C-12 and C-13.

7-6 APPENDICES

APPENDIX VII-A

CONSTRUCTION QUALITY CONTROL INSPECTION PROGRAM CONTENT

AND

PROPOSED OUTLINE FOR QCIP

CONSTRUCTION QUALITY CONTROL INSPECTION PROGRAM CONTENT

The construction quality control inspection program should provide for an adequate and qualified force for inspection of the construction of the project works. The program description should contain detailed information including, but not limited to, the following:

a. Introduction describing the project and proposed construction.

b. Organization chart of the construction inspection force.

c. Number and specialties of inspectors proposed. Information submitted with this item, or item above, should include the number of inspectors proposed for each feature of construction. Where full time inspection is not proposed, the schedule for part time inspection should be described.

d. Description of duties, responsibilities, necessary qualifications, and scope of authority of the QCIP staff. This information should be supplemented on a continuing basis by submittal of qualifications of the personnel actually employed.

e. Field tests to be performed and frequency of testing.

f. Field laboratory facilities or commercial testing services to be provided.

g. Description of Inspection Plan including documentation and reporting procedures.

h. Planned use of consultants during construction.

i. Schedule of all major features of construction.

j. Description of erosion control and other environmental measures.

The QCIP should cover such items as: (1) water diversion during construction, (2) underground and surface excavation, (3) production and placement of earth and concrete, (4) powerhouse construction, (5) installation of penstocks and (6) installation of major mechanical and electrical equipment. The information provided should be in sufficient detail for the reviewer to determine that the proposed QCIP provides adequate construction quality control.

Some items, such as safety requirements and special construction techniques, may be included in the contract specifications. If not, these items, especially those that may involve the safety of personnel working in deep excavations, or in the vicinity of water impounding structures (cofferdams), should be detailed in the QCIP or the temporary Emergency Action Plan.

PROPOSED OUTLINE FOR THE

QUALITY CONTROL INSPECTION PROGRAM[1]

A. Introduction
- o Purpose
- o Background
- o Description of structures and types of construction
- o Specialized construction techniques and equipment

B. Organization and Staffing Responsibilities
- o Responsibilities of various organizations
- o Number of staff and availability required
- o Titles, duties and responsibilities of staff
- o Specialty inspectors
- o Lines of communication and authority
- o Approval and rejection of work
- o Authority to stop work
- o Statement of independence
- o Resumes

C. Inspection Plan and Field Practices
- o Inspection criteria
- o Knowledge of contract plans and specifications
- o Inspection equipment and resources
- o Contractor operations
- o Coordination with contractor's schedule
- o QCIP operations
- o Frequency of inspections
- o Documentation and follow-up action
- o Training

D. Documentation
- o Daily inspection reports
- o Nonconformance reports

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[1] Bullet items are minimum suggested topics. Additional topics should be included to fully describe the QCIP. A statement of "not applicable" is required for outline items not needed in a particular QCIP.

- Other periodic reports
- Maintenance of records
- Photographs

E. Training
- Study materials
- Classroom instruction
- On-the-job-training and supervision
- Proficiency testing and certification
- Resume update

F. Material Testing
- Testing schedule
- Testing standards
- Testing organization
- Adequacy of on-site laboratory
- Adequacy of off-site laboratory
- Evaluation of testing data and actions required
- Documentation

G. Erosion Control and Environmental Compliance
- Environmental compliance plan
- Erosion and sediment control plan
- License requirements
- Specialized plans, permits and approvals
- Frequency of inspections
- Documentation and corrective actions
- Environmental deficiency report

H. Schedule
- Start and finish dates
- Anticipated construction sequence
- Staged and phased construction

I. Planned Use of Consultants
- Areas of inspection and review
- Consultants names and resumes

J. Appendices
- Organizational chart

- Descriptions of duties and responsibilities of QCIP staff
- QCIP personnel resumes
- Project layout
- List of contract documents
- Materials testing schedule and referenced documents
- Example of reports to be used, e.g. nonconformance report
- Flow chart for tracking construction deficiency
- Contractor's schedule
- Record keeping procedures

APPENDIX VII-B

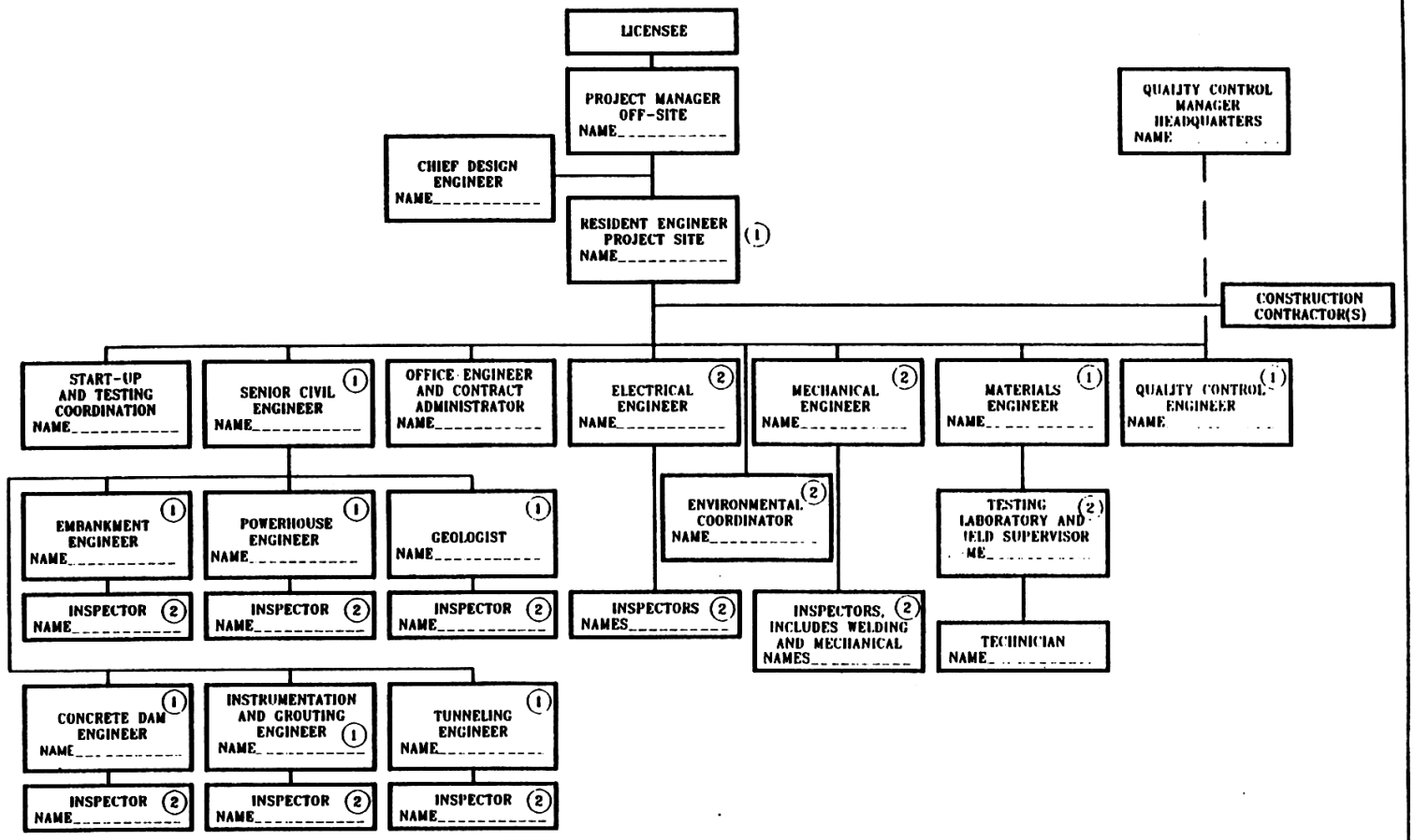
SAMPLE ORGANIZATION CHARTS

AND

DESCRIPTIONS OF DUTIES AND RESPONSIBILITIES

OF SOME KEY PERSONNEL

NONAME HYDROELECTRIC PROJECT
FERC PROJECT NO. 24,995
CONSTRUCTION MANAGEMENT ORGANIZATION CHART (SAMPLE)
(EMPHASIS PLACED ON QUALITY CONTROL INSPECTION PROGRAM)



TYPE OF CONSTRUCTION: CATEGORY 1A

CONSTRUCTION OF NEW DAM, POWERHOUSE, TUNNELS, SPILLWAY AND APPURTENANT STRUCTURES.

ADVANCED ENGINEERING AND DESIGN AND CONSTRUCTION MANAGEMENT BY ENGINEERING DESIGN FIRM UNDER CONTRACT TO LICENSEE. DESIGN FIRM DOES QCIP UNDER SUPERVISION OF SENIOR CIVIL ENGINEER.

LICENSEE COULD SUBSTITUTE FOR ANY COMBINATION OF THE DESIGN FIRM'S DUTIES.

CONSTRUCTION CONTRACTOR(S) UNDER SEPARATE CONTRACT WITH LICENSEE.

(1) AUTHORITY TO STOP WORK DUE TO ADVERSE QUALITY CONDITIONS.

(2) AUTHORITY TO RECOMMEND STOP WORK TO CONTRACTOR AND SUPERVISOR.

Category 1A

Project 24,995

Project 24,995 has the construction management and QCIP being performed by an engineering design firm under contract to the licensee and the construction contractor under separate contract to the licensee.

As stated in Section 7-2.3, the number and specialities of inspectors proposed for each feature of construction should be included and should be determined by the type of construction and the construction schedule. This organization chart is for Category 1 construction, which requires the most comprehensive QCIP for projects under FERC jurisdiction. Thus there are numerous QCIP engineers and inspectors shown on the chart. When a qualified QCIP individual is proposed to cover more than one area of expertise, it should be demonstrated that there will not be a conflict in supervision and scheduling of construction inspections.

In this arrangement, the Senior Civil Engineer and the Materials Engineer (who is in charge of the field and laboratory testing) are the principal QCIP supervisors in the field and must coordinate activities with others such as the Environmental Coordinator and the Quality Control Engineer, all of whom report to the Resident Engineer. Sample abbreviated descriptions of duties and responsibilities for some key personnel are as follows:

Resident Engineer

The Resident Engineer is responsible for the management and general direction of the firm's site construction management organization. Will supervise the field inspection and testing activities and engineering staff functions. Also will recommend progress payment estimates, change order control, evaluation of claims and cost and scheduling of construction activities. Has authority to stop work for nonconformance or potentially unsafe work practices. Reports to the Project Manager, located off-site.

Senior Civil Engineer

The Senior Civil Engineer is responsible for the overall surveillance and inspection of construction activities and any related testing required to confirm compliance with the specifications. Through subordinates, prepares daily field inspection reports and directives. First individual with line responsibility for requiring the correction of any work by the contractor that does not conform to the specifications.

Has authority to issue nonconformance reports and notifies the Resident Engineer and Quality Control Engineer for resolution. Reports to the Resident Engineer and communicates to the Design Engineer any situation where the plans and specifications do not appear to be appropriate for the conditions encountered. Has authority to stop work. Is notified of any recommendation to stop work by QCIP personnel who have the authority to recommend stop work to the contractor and their supervisor. Has limited or no responsibility or involvement with contractor negotiations, scheduling of construction and cost justification. Reports to the Resident Engineer.

Materials Engineer

The Materials Engineer is responsible for the operation of the materials laboratory and for the inspection of production in the concrete batch plant. Supervises both laboratory and field sampling and testing of concrete, embankment materials, penstocks, conduits and other major facilities. Responsible for quality control inspection of the batch plant and transportation to the point of placement. The first individual with line responsibility for requiring the correction of any work, under his control, by the contractor that does not conform to the specifications. Is notified of any recommendation to stop work by QCIP personnel who have the authority to recommend stop work to the contractor and their supervisor. Has authority to stop work and reports to the Resident Engineer.

Quality Control Engineer

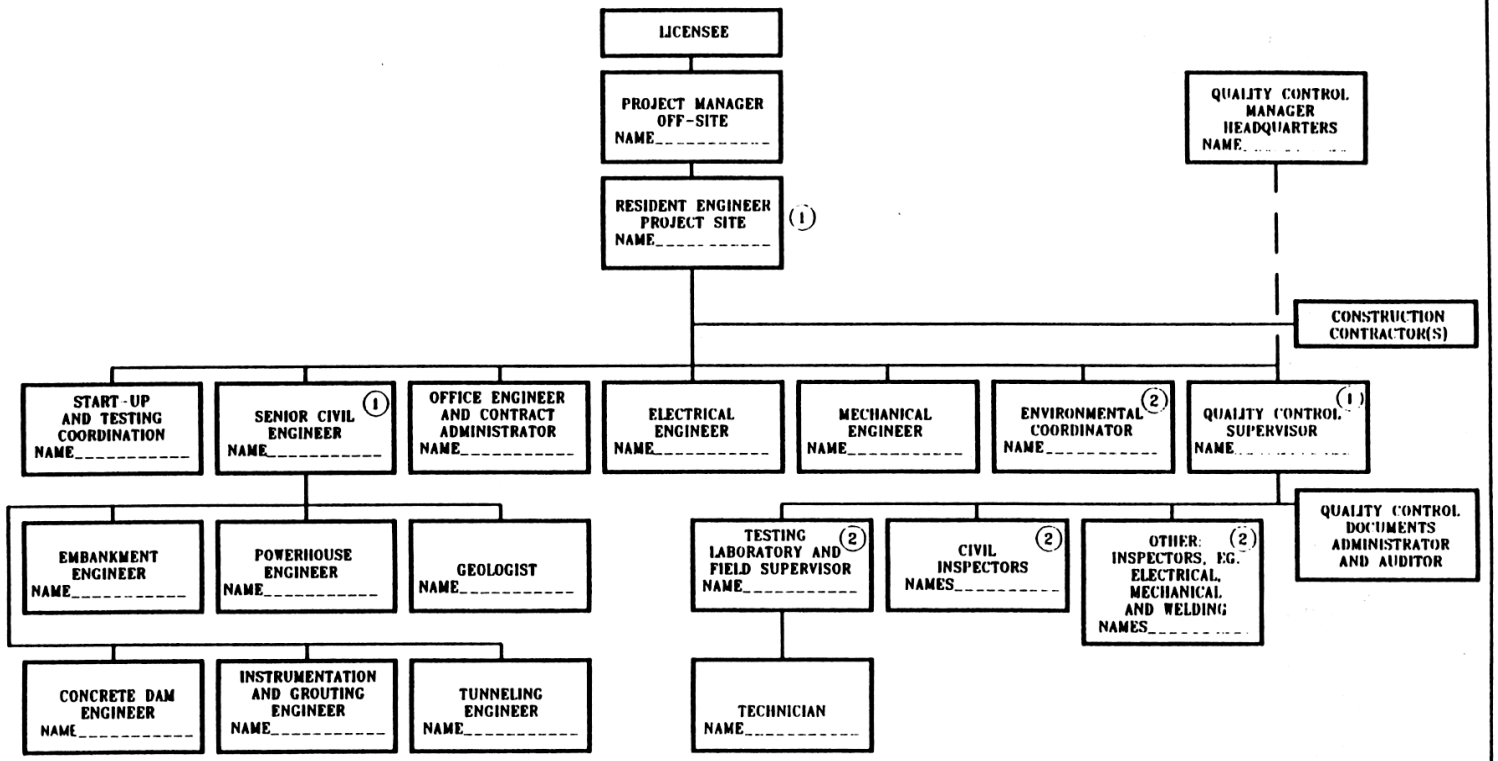
The Quality Control Engineer is responsible for assuring that all site activities for field inspection and materials quality control testing conform to the QCIP requirements. Reviews and audits the activities of the Materials Laboratory as well as the overall activities of the field inspection staff. Has authority to stop work. Is notified of any recommendation to stop work from QCIP personnel who have the authority to recommend stop work to the contractor and their supervisor. Reports to the Resident Engineer and communicates directly with the Quality Control Manager in Headquarters.

Environmental Coordinator

The Environmental Coordinator is responsible for reviewing and monitoring project construction on a daily basis to assure environmental compliance. Reviews contractor's environmental plans for compliance with approved license and permits. Documents environmental compliance with erosion and sedimentation control techniques, archeological monitoring, blasting and instream rock excavation techniques, reservoir clearing activities and permit specifications for special concern areas. Provides

environmental training to field inspectors and conducts environmental briefing course for construction personnel. Coordinates with field inspectors on construction activity relative to environmental compliance. Recommends modification of environmental plans that are determined to be unsatisfactory during construction. Collects quality control water samples on an as needed basis to verify the accuracy of the contractor's water quality results. Provides input to the monthly report concerning environmental and mitigation activities. Responsible for liaison with resource agencies on environmental issues and takes measures to avoid permit violations. Has authority to recommend stop work to the contractor and his supervisor and advises the Senior Civil Engineer, Materials Engineer and the Quality Control Engineer of the action. Reports to the Resident Engineer.

NONAME HYDROELECTRIC PROJECT
FERC PROJECT NO. 24,996
CONSTRUCTION MANAGEMENT ORGANIZATION CHART (SAMPLE)
(EMPHASIS PLACED ON QUALITY CONTROL INSPECTION PROGRAM)



TYPE OF CONSTRUCTION: CATEGORY 1A

CONSTRUCTION OF NEW DAM, POWERHOUSE, TUNNELS, SPILLWAY AND APPURTENANT STRUCTURES.

ADVANCED ENGINEERING AND DESIGN AND CONSTRUCTION MANAGEMENT BY ENGINEERING DESIGN FIRM UNDER CONTRACT TO LICENSEE. DESIGN FIRM DOES QCIP UNDER SUPERVISION OF QC SUPERVISOR. LICENSEE COULD SUBSTITUTE FOR ANY COMBINATION OF THE DESIGN FIRM'S DUTIES.

CONSTRUCTION CONTRACTOR(S) UNDER SEPARATE CONTRACT WITH LICENSEE.

(1) AUTHORITY TO STOP WORK DUE TO ADVERSE QUALITY CONDITIONS.

(2) AUTHORITY TO RECOMMEND STOP WORK TO CONTRACTOR AND SUPERVISOR.

Project 24,996

Project 24,996 is similar to Project 24,995 in that the construction management and QCIP is being performed by an engineering design firm under contract to the licensee and the construction contractor is under separate contract to the licensee. However, the QCIP differs from Project 24,995 in that the QCIP field staff for Project 24,996 are under the supervision of the Quality Control Supervisor since the Senior Civil Engineer's primary function is as the Design Engineer. The Senior Civil Engineer and his staff will coordinate the design with construction activities and provide the necessary engineering support. Sample abbreviated descriptions of duties and responsibilities for some key personnel are described in the following paragraphs.

Quality Control Supervisor

For Project 24,996, the Quality Control Supervisor is the principal QCIP supervisor in the field and must coordinate activities with others such as the Senior Civil Engineer, the Electrical and Mechanical Engineers and the Environmental Coordinator. The Quality Control Supervisor is the first individual with line responsibility for requiring the correction of any work by the contractor that does not conform to the specifications. The testing laboratory and QCIP field inspectors are supervised by the Quality Control Supervisor. Through subordinates, prepares daily field inspection reports and directives. Reports to the Resident Engineer and communicates to the Senior Civil Engineer any situation where the plans and specifications do not appear to be appropriate for the conditions encountered. The Quality Control Supervisor, Senior Civil Engineer and Resident Engineer have authority to stop work. Is notified of any recommendations to stop work by QCIP personnel who have the authority to recommend stop work to the contractor and their supervisor. The Quality Control Supervisor has limited or no responsibility or involvement with contractor negotiations, scheduling of construction and cost justification. Reports to the Resident Engineer and communicates directly with the Quality Control Manager in Headquarters.

QCIP Inspectors

The QCIP Inspectors are responsible for performing the required verification of the correctness and adequacy of the construction contractor's work in accordance with applicable specification, drawing and procedural requirements. Inspectors will document the results of each inspected function on the designated reporting form and inform responsible personnel about unsatisfactory items, while ensuring that corrective actions are taken to resolve the conditions. For defective work the inspectors will initiate a nonconformance report and submit the report to the Quality Control Supervisor for

resolution and will verify that the defect has been corrected. The QCIP Inspectors have authority to recommend stop work to the contractor and their supervisor. The QCIP Inspectors report to the Quality Control Supervisor. The QCIP Inspectors are responsible for observing and reporting on construction activities in their specific areas of assignment. The principal areas of inspection are civil, mechanical, electrical and welding. Brief descriptions of the responsibilities, in addition to those described in this paragraph, and inspection functions for Civil and Mechanical Inspectors are contained in the following paragraphs.

Civil Inspector

The Civil Inspector is responsible for such items as observing and recording the results of all critical clearing operations; survey work; lines and grades; excavation; blasting operations; instrumentation; foundation and concrete placement acceptance; batching, mixing, testing, and transporting concrete; drilling and grouting operations; earthworks such as placing, compacting and testing of embankments; rockfill; and tunneling. The inspection functions are dependent on the type of construction.

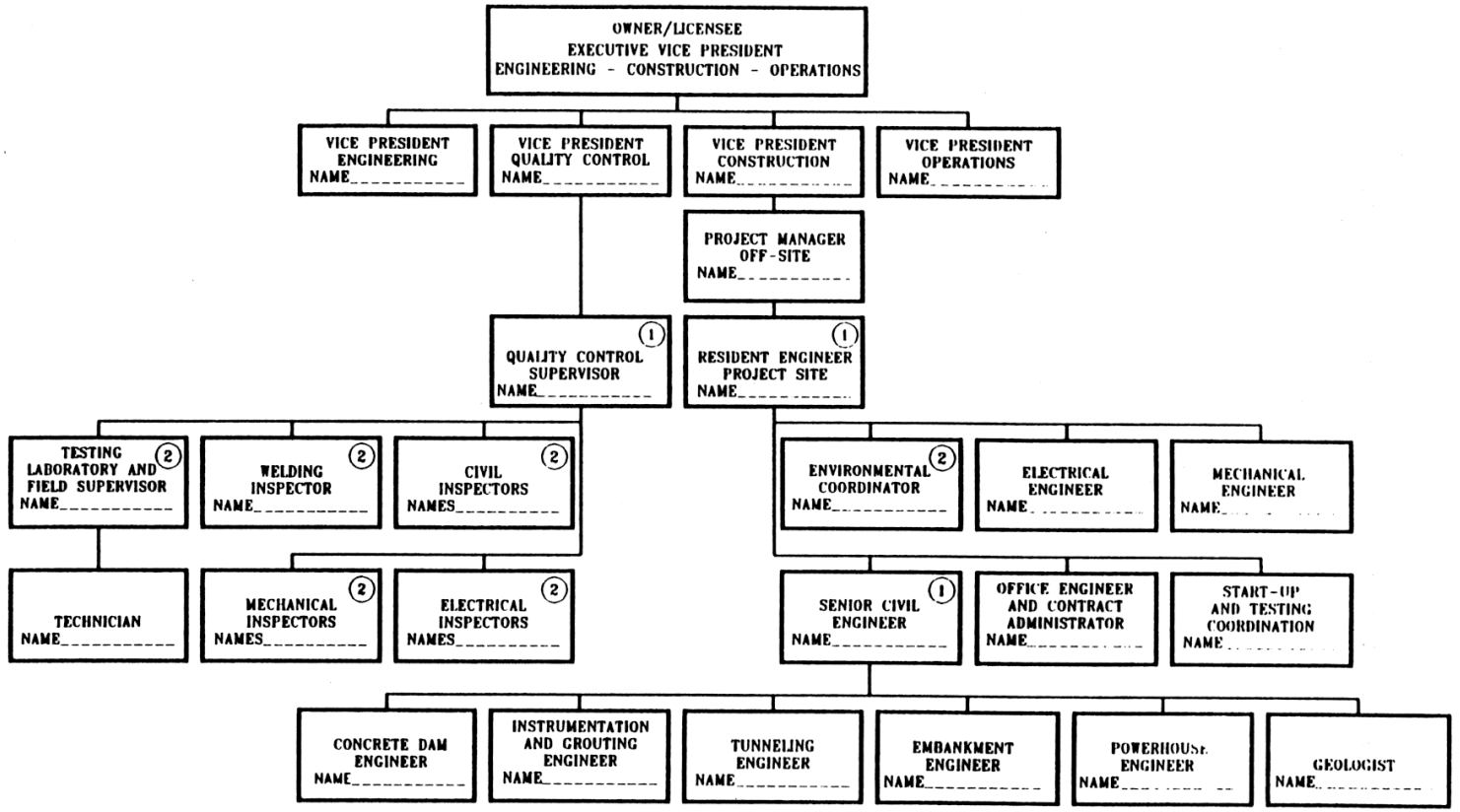
The Civil Inspector should observe and assure the adequacy of the field and laboratory tests. He should assure that the work is performed by qualified and, where specified, certified personnel.

Inspection for conventional concrete batching and placement is relatively straightforward and there is an abundance of information in the literature. Quality control inspection for roller compacted concrete (RCC) construction is substantially different than that of conventional concrete. RCC is discussed in Chapter 3 of the Engineering Guidelines. RCC construction involves placing and spreading no-slump concrete in horizontal layers and compacting with a smooth-drum, vibratory roller. Foundation preparation and concrete mix designs are very important for a RCC dam. Once construction starts, the rate is faster than conventional concrete or embankment construction. Therefore, it is necessary to construct a test fill (prior to construction of the RCC dam) to assess all of the required elements such as the mix design, speed of placement, compaction effort, workability suitable for compaction, joint cleanup requirement, segregation of coarse aggregates and contractor performance. As stated in Chapter 3, the test fill should be constructed outside of the footprint of the proposed structure. The test fill offers the QCIP staff an opportunity to gain useful experience in the operation of monitoring equipment that will be used on the actual fill. The Civil Inspector should be familiar with the results of the test fill and should use the design as a basis for his inspections. The Civil Inspector should also be familiar with restrictions during inclement weather.

Mechanical Inspector

The Mechanical Inspector is responsible for such items as observing and assuring the correctness of the fit, acceptable tolerances, alignment, embedment and mating of all critical parts of the field assembled turbine and generator. Assures that the contractor performs sufficient inspections on all mechanical components and material. Makes random and periodic inspections of the alignment, welding, flushing and hydrostatic testing of powerhouse piping. Verifies by inspection that the correct installation, alignment and final setting of mechanical components such as pumps, motors, pressure vessels, valves and air compressors. Participates in completion inspections of installed systems. Where appropriate, periodic site inspections should be made at fabrication shops.

NONAME HYDROELECTRIC PROJECT
FERC PROJECT NO. 24,997
CONSTRUCTION MANAGEMENT ORGANIZATION CHART (SAMPLE)
(EMPHASIS PLACED ON QUALITY CONTROL INSPECTION PROGRAM)



TYPE OF CONSTRUCTION: CATEGORY 1B

CONSTRUCTION OF NEW DAM, POWERHOUSE, TUNNELS, SPILLWAY AND APPURTENANT STRUCTURES.

LICENSEE IS DESIGNER, CONSTRUCTION CONTRACTOR AND PROVIDES QUALITY CONTROL INSPECTION.

(1) AUTHORITY TO STOP WORK DUE TO ADVERSE QUALITY CONDITIONS.

(2) AUTHORITY TO RECOMMEND STOP WORK TO CONTRACTOR AND SUPERVISOR.

Category 1B

Project 24,997

In Project 24,997, the licensee is the designer, construction contractor and also provides quality control inspection. In the field, the Resident Engineer supervises and is responsible for construction and the Quality Control Supervisor supervises and is responsible for the QCIP. It should be noted that there is a separation of authority in the field between the QCIP staff and construction personnel and the reporting authority comes together in the office of the Executive Vice President for Engineering, Construction and Operations, a high level in the corporate structure. Sample abbreviated descriptions of duties and responsibilities for some key personnel are described in the following paragraphs.

Resident Engineer

The Resident Engineer is responsible for project management, production, costs and overall quality of work. Responsible for the general direction of the discipline activities, material and equipment coordination and contract coordination. Has authority to stop work for nonconformance work or potentially unsafe work practices. Reports to the off-site Project Manager.

Quality Control Supervisor

The Quality Control Supervisor is responsible for the overall surveillance and inspection of construction activities and any related testing required to confirm compliance with the specifications. Through subordinates, prepares daily field inspection reports and directives. First individual with line responsibility for requiring the correction of any work performed by the construction personnel that does not conform to the specifications. Has authority to issue nonconformance reports and notifies the Resident Engineer and Senior Civil Engineer for resolution. Communicates to the Resident Engineer and Senior Civil Engineer any situation where the plans and specifications do not appear to be appropriate for the conditions encountered. The Quality Control Supervisor has authority to stop work. Is notified of any recommendation to stop work from construction management personnel who have the authority to recommend stop work. Has no responsibility or involvement with scheduling of construction and cost justification. Reports to the Vice President for Quality Control at the corporate level and communicates with the Resident Engineer and his staff at the project site.

Testing Laboratory and Field Supervisor

The Testing Laboratory and Field Supervisor is responsible for the operation of the materials laboratory and coordination with an outside laboratory, if appropriate, for the inspection of production in the concrete batch plant. Supervises both laboratory and field sampling and testing of concrete, embankment materials, penstocks, conduits and other major facilities. Responsible for quality control inspection of the batch plant and transportation to the point of placement. Has authority to recommend stop work to the contractor and to his supervisor and reports to the Quality Control Supervisor at the project site.

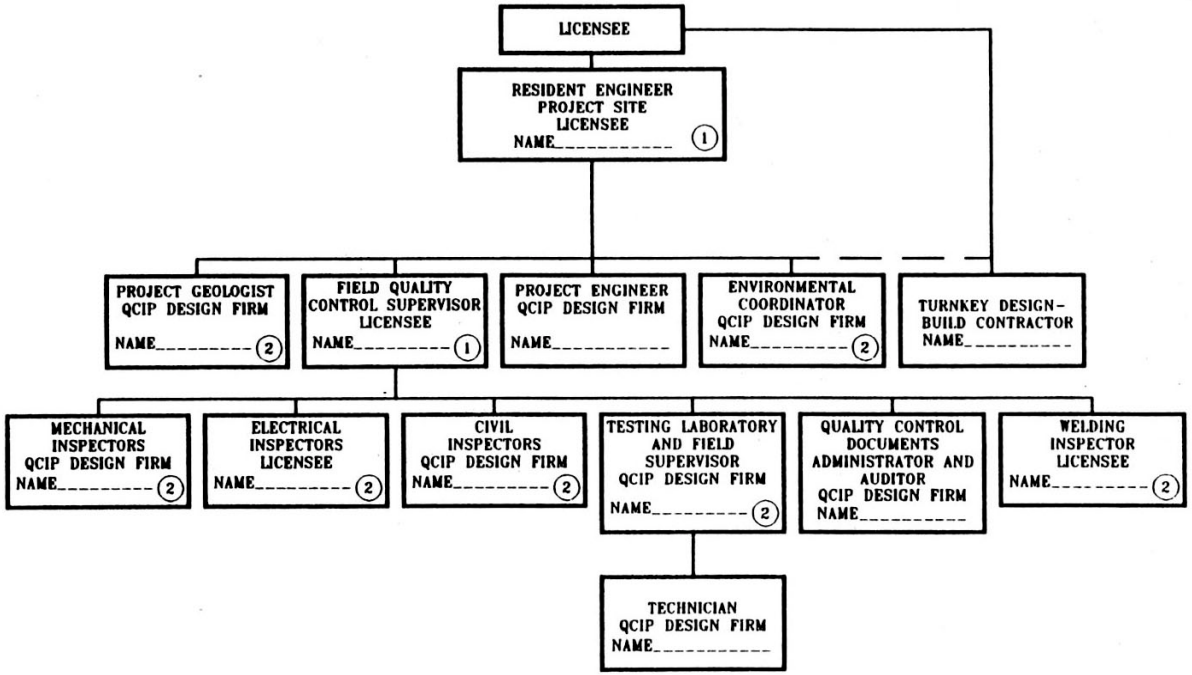
Civil Inspectors

The Civil Inspectors will verify that work in progress is being performed in accordance with applicable specification, drawing and procedural requirements. They will maintain an up-to-date status of construction progress and inform responsible personnel about unsatisfactory items, while ensuring that corrective actions are taken to resolve these conditions. For defective work, the Civil Inspectors will initiate a nonconformance report and submit it to the Quality Control Supervisor for resolution and will verify that the defect has been corrected. Have authority to recommend stop work to the contractor and their supervisor. Reports to the Quality Control Supervisor at the project site.

Senior Civil Engineer

The Senior Civil Engineer coordinates and approves project engineering design, manages the overall project to meet specifications and supervises a specialty staff of civil engineers and geologists. Approves engineering design and changes, resolves engineering design conflicts and interface problems within the project and has authority to stop construction if the work is deemed unsafe or in noncompliance with the specifications. Reports to the Resident Engineer.

NONAME HYDROELECTRIC PROJECT
FERC PROJECT NO. 24,998
QUALITY CONTROL INSPECTION PROGRAM
(SAMPLE)



TYPE OF CONSTRUCTION: CATEGORY 1C

CONSTRUCTION OF NEW DAM, POWERHOUSE, TUNNEL, SPILLWAY AND APPURTENANT STRUCTURES.

TURNKEY DESIGN-BUILD CONTRACTOR UNDER CONTRACT TO LICENSEE.

QCIP BY LICENSEE AND SEPARATE ENGINEERING DESIGN FIRM UNDER SEPARATE CONTRACT TO LICENSEE.

LICENSEE OR DESIGN FIRM COULD SUBSTITUTE FOR ANY COMBINATION OF QCIP DUTIES.

(1) AUTHORITY TO STOP WORK DUE TO ADVERSE QUALITY CONDITIONS.

(2) AUTHORITY TO RECOMMEND STOP WORK TO CONTRACTOR AND SUPERVISOR.

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Category 1C

Project 24,998

The organization chart for Project 24,998 in Appendix VII-B is considered representative of Category 1C.

Project 24,998 requires the construction of a new dam, powerhouse, tunnel, spillway and appurtenant structures. The QCIP is performed by a combination of licensee and separate engineering design firm personnel. The licensee has a contract with the design-build firm to design and construct the project and a separate contract with the engineering design firm for the QCIP. The QCIP could be staffed by all licensee or all design firm personnel and still accomplish the same purpose.

In this arrangement, the Field Quality Control Supervisor and the Testing Laboratory Supervisor are the principal QCIP supervisors in the field and report to the Resident Engineer, who is responsible for the QCIP. Sample abbreviated descriptions of duties and responsibilities for these personnel are contained in the following paragraphs.

Resident Engineer

The Resident Engineer is the licensee's senior project representative at the project site. Responsible for all interface and coordination between the licensee and the design-build contractor. Manages the activities of the QCIP staff and through the QCIP staff monitors the quality of the design-build contractor's work. Monitors the design-build contractor's engineering, construction reporting, quality control, progress and schedule. Reviews and assures resolution of all nonconformances. Reviews design changes and claims; however, normally, claims would be an internal matter with the design-build contractor. Assures compliance with the FERC licensing requirements. Has authority to stop work for nonconformance work or potentially unsafe work practices. Reports to the licensee's off-site Project Manager.

Field Quality Control Supervisor

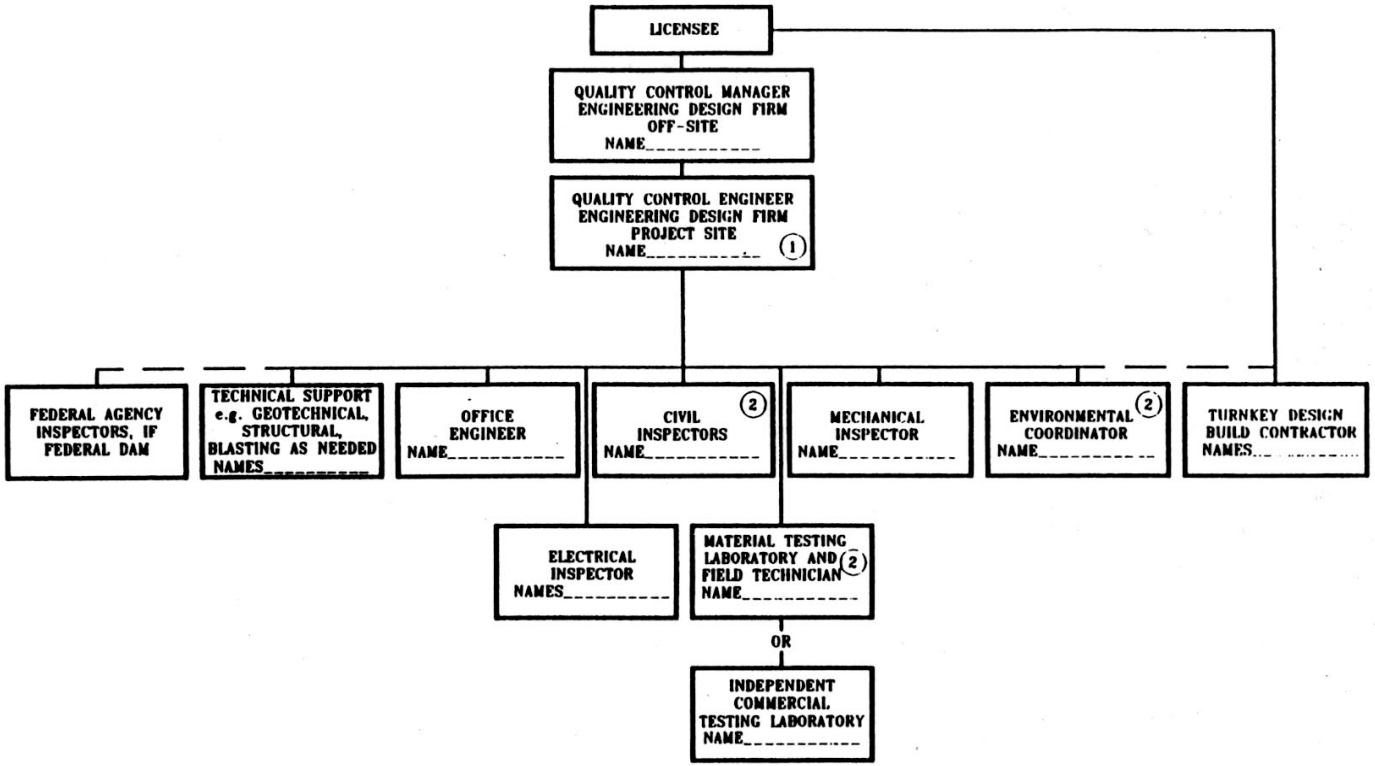
The Field Quality Control Supervisor is a licensee employee responsible for assuring that the design-build contractor's site activities are carried out according to the contract documents and the approved QCIP. He plans and directs the activities of a staff of inspection and testing personnel. He assures that records of satisfactory completion of site activities, equipment and material acceptability and qualifications of QCIP personnel are maintained. Through subordinates, prepares daily field inspection reports and

directives. Reviews the design-build contractor's construction inspection and test procedures and coordinates the results with the QCIP inspection and test results. Has the authority to issue nonconformance reports and notifies the Resident Engineer, Project Engineer, and Testing Laboratory Supervisor for resolution. Reports to Resident Engineer and communicates to the turnkey designer any situation where the plans and specifications do not appear to be appropriate for the conditions encountered. Has authority to stop work due to adverse quality conditions. Is notified of any recommendation to stop work from QCIP personnel who have the authority to recommend stop work to the contractor and their supervisor. Has no responsibility or involvement with contractor negotiations, scheduling of construction and cost justification. Reports to the Resident Engineer.

Testing Laboratory and Field Supervisor

The Testing Laboratory Supervisor is an employee of the engineering design firm. Responsible for the establishment of certified testing facilities, equipment and personnel. Develops test procedures and instructions to personnel for testing performance. Coordinates the QCIP testing with the design-construct contractor testing to obtain maximum use of the information. Responsible for the performance testing of soils, aggregate, concrete, rockbolts, soil and rock anchors, conduits, penstocks, field welds and other required testing. Has authority to recommend stop work to the contractor and to his supervisor and has no responsibility or involvement with contractor negotiations, scheduling of construction and cost justification. Reports to the Field Quality Control Supervisor.

NONAME HYDROELECTRIC PROJECT
FERC PROJECT NO. 24,999
QUALITY CONTROL INSPECTION PROGRAM
(SAMPLE)



TYPE OF CONSTRUCTION: CATEGORY 2C

CONSTRUCTION OF A NEW POWERHOUSE AT AN EXISTING DAM.

CONSTRUCTION MANAGEMENT BY TURNKEY DESIGN-BUILD CONTRACTOR UNDER CONTRACT TO LICENSEE.

QCIP BY ENGINEERING DESIGN FIRM UNDER SEPARATE CONTRACT TO LICENSEE; HOWEVER, THE LICENSEE COULD BE SUBSTITUTED FOR THE DESIGN FIRM.

(1) AUTHORITY TO STOP WORK DUE TO ADVERSE QUALITY CONDITIONS.

(2) AUTHORITY TO RECOMMEND STOP WORK TO CONTRACTOR AND SUPERVISOR.

Category 2C

Project 24,999

Project 24,999 requires the construction of a new powerhouse at an existing dam. There are numerous combinations of licensee/owner relationships relative to owner of the dam and owner of the powerhouse. For Project 24,999, the dam is operated by a Federal Agency and the licensee/owner of the new powerhouse is a non-public organization. The project is being constructed by a design-build contractor under contract to the licensee and the QCIP is being done by an engineering design firm under separate contract to the licensee.

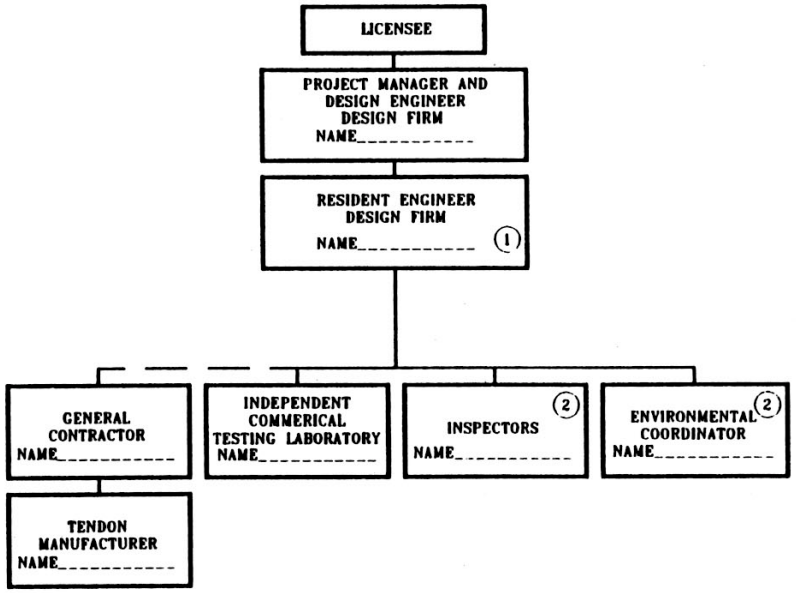
Quality Control Engineer

The Quality Control Engineer is the principal QCIP supervisor in the field and is responsible for the QCIP. As a representative of the licensee, he is responsible for all interface and coordination between the licensee and the design-build contractor at the project site. Is also responsible for all interface and coordination between the licensee and the Federal Agency inspectors. Reviews any design changes or claims involved with the design-build contractor and assures compliance with the FERC licensing requirements. Plans and directs the activities of a staff of inspection and testing personnel. Communicates to the turnkey designer any situation where the plans and specifications do not appear to be appropriate for the conditions encountered. Through subordinates, prepares daily field inspection reports and directives. Has authority to issue nonconformance reports and to stop work due to adverse quality conditions or potentially unsafe work practices. Has limited responsibility and involvement with contractor negotiations, scheduling of construction and cost justification. Reports to the off-site Quality Control Manager.

The Federal Agency inspector will provide inspection of those items that affect the structural integrity or operation of the Federal project and will report to the Quality Control Engineer for verification of any discrepancy or correction.

Normally, technical support for disciplines such as geotechnical, structural engineering and blasting would be supplied from an off-site location on an as needed basis for construction of this type. These personnel would report to the Quality Control Engineer.

NONAME HYDROELECTRIC PROJECT
FERC PROJECT NO. 25,000
CONSTRUCTION MANAGEMENT ORGANIZATION CHART (SAMPLE)
(EMPHASIS PLACED ON QUALITY CONTROL INSPECTION PROGRAM)



TYPE OF CONSTRUCTION: CATEGORY 3A

MODIFICATION TO EXISTING PROJECT STRUCTURE(S), e.g. INSTALLATION OF POST-TENSIONED ROCK ANCHORS IN A CONCRETE GRAVITY DAM.

LICENSEE HAS SEPARATE CONTRACTS WITH A GENERAL CONTRACTOR AND AN ENGINEERING DESIGN FIRM, DESIGN FIRM RESPONSIBLE FOR DESIGN AND THE QCIP; HOWEVER, THE LICENSEE COULD SUBSTITUTE FOR ANY COMBINATION OF THE DESIGN FIRM'S DUTIES.

(1) AUTHORITY TO STOP WORK DUE TO ADVERSE QUALITY CONDITIONS.

(2) AUTHORITY TO RECOMMEND STOP WORK TO CONTRACTOR AND SUPERVISOR.

Category 3A

Project 25,000

The sample Construction Management Organization Chart for Project 25,000 is for the installation of post-tensioned rock anchors in concrete gravity dam. The licensee has separate contracts with a general contractor and an engineering design firm. The design firm is also responsible for the QCIP.

Project Manager

The Project Manager, who is also the Design Engineer for the engineering design firm, is located off-site. It should be stated in the QCIP that the Design Engineer will inspect anchor tests to verify that load increments, for performance and proof tests, conform to the design. For other types of Category 3 construction, it is important for the Design Engineer to inspect the construction frequently and at critical stages. Normally, for smaller jobs, the Design Engineer is located off-site.

Resident Engineer

The Resident Engineer, who is employed by the engineering design firm, is the principal QCIP supervisor in the field and is responsible for the QCIP. All site project activities are under the direction of the Resident Engineer. Has responsibility for the complete project including the construction, installation, coordination of testing, cost and schedule control, safety and material flow. Assures compliance with FERC requirements. Plans and directs the activities of a small staff of inspectors. Coordinates the necessary testing with a commercial laboratory, located off-site. In conjunction with his staff prepares daily field inspection reports and directives. Reports to the Project Manager any situation where the plans and specifications do not appear to be appropriate for the conditions encountered. Has authority to issue nonconformance reports and to stop work due to adverse quality conditions or potentially unsafe work practices. Reviews any design changes or claims involved with the contractor. Involved in contractor negotiations, scheduling of construction and cost justification. It may not be practical, on a small job such as this, for the principal QCIP supervisor in the field to have limited or no involvement with contractor negotiations, scheduling and cost justification. The Resident Engineer reports to the Project Manager, who is located off-site.

Due to the small QCIP staff the Resident Engineer and/or Inspectors will monitor and inspect such procedures as drilling, watertightness testing, grouting and bolt tension

tests, check for proper alignment of drill holes, proper materials and placement procedures for grout and compliance with anchor load test procedures.

APPENDIX VII-C

SAMPLE REPORT FORMS

NONCONFORMANCE REPORT

AND

ENVIRONMENTAL DEFICIENCY REPORT

NONCONFORMANCE REPORT SAMPLE

NCR NO.:

Subject: CONTRACTOR:

DESCRIPTION/AFFECTED AREA:

REFERENCE DOCUMENTS:

Contract No./Section:

Construction Drawing:

QC Inspector *Date*

QC Supervisor *Date*

DISPOSITION:

☐ REWORK ☐ REPAIR

☐ USE AS IS ☐ REJECT

ACTION TAKEN TO CONTROL NONCONFORMANCE:

QC Supervisor *Date*

STATEMENT OF COMPLETED ACTION:

ACTION COMPLETED:

QC Inspector *Date*

NONAME HYDROELECTRIC PROJECT

921130-FERC0011

DISTRIBUTION:

SAMPLE

VALUE YOUR BUSINESS ENGINEERING CO.

ENVIRONMENTAL DEFICIENCY REPORT

To: _____ Date: _____ Time: _____

Please correct the following ENVIRONMENTAL DEFICIENCY by _____

Reference: _____

Please sign and return when corrected.

_____ _____
Signature Date

Distribution:

1. _____
2. _____
3. _____
4. _____
5. _____

Sketch

_____
VALUE YOUR BUSINESS ENGINEERING CO.

921130-FERC07T1

APPENDIX VII-D

SAMPLE

MATERIALS TESTING SCHEDULE

AND

REFERENCED DOCUMENTS

SAMPLE
Noname Hydroelectric Project
Materials Testing Schedule
Field Testing

Material	Test	Test Method and/or Standard	Test Frequency and/or Certification
River banks and run off areas	Compliance with erosion Control plan and effectiveness of erosion control measures	Visual/Daily turbidity	Daily
Rock anchors	Fabrication and installation	PTI Manual, ASTM A416 and A421	As directed by the Quality Control Engineer
Fresh concrete	Temperature	ASTM C172, metal dial type thermometers	First batch produced each day and every 50 cubic yards
	Air content	ASTM C231	First batch produced each day and every 50 cubic yards
	Slump	ASTM C143	First batch produced each day and every 50 cubic yards
Hardened concrete	Compressive strength	ASTM C31, C39 and C172 (7 and 28 day) amd ACI 214	Six test cylinders from first 100 cubic yards, four cylinders from each 150 cubic yards thereafter for each class of concrete in any one day

SAMPLE
Noname Hydroelectric Project
Materials Testing Schedule
Field Testing

Material	Test	Test Method and/or Standard	Test Frequency and/or Certification
Concrete Aggregate	Gradation, Fineness modulus, Abrasion, Specific gravity and absorption	ASTM C33, C127, C131, C136 and C289	Prior to delivery to batch plant. To be done by testing laboratory
Grout holes	Pressure test	As directed by contract specifications	Prior to pressure grouting
Random fill	Moisture content	ASTM D1557	At time of placing
	Density	ASTM D1557	Before use
	In-place density	ASTM D1556, and D2216	A minimum of one test for every three lifts or three tests for every 200 cubic yards
Structural steel	Field-welded connections	AWS D1.1	At completion and as directed by the Quality Control Engineer
Rock core	Direct shear strength	RTH 203-80	Minimum of three test specimens for each rock type to determine cohesion and the angle of internal friction. As directed by the Quality Control Engineer.

SAMPLE
NONAME HYDROELECTRIC PROJECT
REFERENCED DOCUMENTS

American Concrete Institute (ACI)

ACI 214-77	1983	Recommended Practice for Evaluation of Strength Test Results of Concrete

American Society for Testing and Materials

ASTM C 31	1985	Making and Curing Concrete Test Specimens in the Field
ASTM C 33	1986	Concrete Aggregates
ASTM C 39	1986	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 127	1984	Test for Specific Gravity and Absorption of Concrete Aggregate
ASTM C 136	1984	Method for Sieve Analysis of Fine and Coarse Aggregate
ASTM C 143	1978	Slump of Portland Cement Concrete
ASTM C 172	1982	Sampling Freshly Mixed Concrete
ASTM C 231	1982	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 289		Test Method for Potential Reactivity of Aggregate (Chemical Method)
ASTM D 1556	1982	Density of Soil In Place by the Sand Cone Method
ASTM D 1557	1978	Moisture Density Relations of Soil and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2216	1978	Method for Laboratory Determination of Water (Moisture)

Content of Soil, Rock, and Soil-Aggregate Mixtures

American Welding Society (AWS)

AWS D1.1	1988	Structural Welding Code

U.S. Army Corps of Engineers

RTH 203.80	1980	Direct Shear Strength of Rock Core Specimens, Rock Testing Handbook (RTH), Geotechnical Laboratory, Waterways Experiment Station

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GC Spec.	1990	Specifications for General Construction Contract, Noname Hydroelectric Project (Engineer's Specification No. 23456-GC001)

APPENDIX VII-E

SAMPLE

CIVIL INSPECTION CHECKLISTS

SAMPLE
INSPECTION CHECKLIST
EXCAVATION

The following characteristics of excavation should be reviewed:

1. Perform a thorough review of all site exploratory reports made during design and during construction.

2. Peview site plans to note any underground structures to be avoided, such as pipes and utilities.

3. Prior to commencing excavation, clearing, grubbing and stripping operations should be completed to the areas shown on the site excavation drawings. Provisions should be provided for dust abatement.

4. For mass excavation remove soil, boulders, coal and any other unclassified materials to the lines and grades shown on the drawings.

5. For structural excavation remove in-situ materials for structures, underground utilities, pipes, culverts, drains or diversion channels to the lines, grades, elevations and dimensions shown on the drawings.

6. Sumps and wellpoints should be constructed and adequate pumps should be provided to prevent groundwater accumulation in the excavation.

7. Random sampling and testing should be performed on excavated material to note changes in soil classification or physical properties.

8. Borrow areas should be properly maintained to provide effective drainage and erosion control.

9. Excavation should be made to the lines, grades, elevations and dimensions as shown on the drawings or as directed by the foundation engineer or geologist to obtain a suitable foundation.

10. Completed excavation should be inspected, tested and accepted prior to placement of mud mats, slabs, pipes or structural backfill.

SAMPLE
INSPECTION CHECKLIST
EARTHWORK (BACKFILL)

The following characteristics of earthwork should be reviewed:

1. Determine the material requirements for the different types of earthwork on the construction project.

2. Check that material sources have been approved.

3. If method specifications are used, determine the compaction requirements. Determine what degree of compaction is needed to satisfy design criteria. Determine the type and weight of compaction equipment required and the number of equipment passes at a specified lift thickness necessary to meet density requirements.

4. Check that provisions are adequate for dust abatement.

5. Foundation should be inspected, tested and accepted prior to start of fill operations.

6. Provisions should be adequate for control and disposal of surface and subsurface water.

7. Fill and borrow areas should be maintained to provide effective drainage and are protected against erosion.

8. Field and laboratory tests should be conducted at the frequency specified to verify physical requirements of the fill material.

9. Fill material should meet moisture, compaction and density requirements and be placed in the specified lift thickness.

10. Moisture and density tests should be performed at random locations and at specified frequency.

11. Fill material should be brought to final grade and inspected, tested and accepted, if acceptable.

SAMPLE
INSPECTION CHECKLIST
CONCRETE PLACEMENT

The following characteristics of concrete placement should be reviewed:

1. Placing equipment is clean and free of loose concrete, mud, and other debris that could jeopardize the quality of the structure.

2. Reinforcing steel and embeds are clean and free of loose rust, grease or other matter that may adversely affect concrete bond.

3. Embedded piping has been tested as specified.

4. Joints and surfaces to receive concrete are free of deleterious materials.

5. Forms are clean and free of foreign material.

6. Provisions for hot or cold weather concrete protection are provided.

7. Concrete is placed in a manner to prevent segregation.

8. Placement of concrete is made in lift thickness as specified and within time restrictions between lifts for high lift placements.

9. Concrete is properly vibrated.

10. Placement is made to avoid excessive drying of fresh concrete before next lift is placed.

11. Concrete is sampled and tested at specified frequency for strength, slump, temperature and unit weight.

12. Concrete is brought to final grade and finished as specified.