APPENDIX

TECHNICAL PROPOSAL

****** APPLICABLE TO WATER AMERICAS ONLY ******

AP-7.10 QUALITY MANAGEMENT SYSTEM

1.0 PURPOSE AND APPLICABILITY

Black & Veatch Water Americas provides planning, design, engineering, procurement, construction, startup, and consulting services. The Quality Management System (QMS) directs the processes that affect the quality of services and deliverables of the Division. The implementation of the QMS is facilitated by the use of this documented QMS manual and is supported by policies, procedures, standards, guides, and other forms of documented processes. The system defines requirements and responsibilities of the Division professionals and the activities and processes they perform. The QMS is applicable to all Water Americas projects and operating processes.

2.0 DEFINITIONS

Product – Result of the design, procurement, construction, or other process, including, reports, drawings, specifications, calculations, procured equipment and materials, and constructed facilities.

Quality Management System (QMS) - A quality management system is a set of interrelated or interacting elements that the organization uses to direct and control how quality policies are implemented and quality objectives are achieved.

3.0 QUALITY MANAGEMENTSYSTEM

3.1 General

The purpose of the Water Americas QMS is to define, control, monitor, and continually improve the processes that affect the quality of services and products provided to clients and Water Americas business operations.

3.1.1 QMS Scope

The Water Americas QMS scope is defined within this and other supporting QMS documents. This manual and supporting documents address the following QMS scope elements:

- The organizational structure, responsibilities and authorities
- The QMS documentation management system

- Resource management: human, information, and infrastructure
- Provision of services and products
- Consistent operating processes and methods
- Methods for collecting and monitoring data to ensure conformance to requirements and continual improvement
- Continuous improvement of internal operations and client deliverables through business process management
- Records management

3.1.2 Quality Policy

Water Americas will not compromise on the quality of its services and products and will execute projects and supporting Division processes in accordance with Black & Veatch's (B&V) governing corporate code of conduct, business practices, corporate policies, corporate instructions, Water America's QMS, and statutory, regulatory, and client requirements. Water Americas shall continually improve the effectiveness of the QMS and the execution of its projects through periodic review and correction of its standards and processes and by encouraging feedback regarding the results of their use. It is the goal of Water Division management to communicate this quality policy so it is understood by all professionals.

3.1.3 Quality Objectives

Water Americas' quality objectives include:

- Understanding and adjusting to current and future client and market needs
- Meeting contractual requirements
- Meeting or exceeding client expectations
- Delivering excellent projects, free of claims
- Providing value creation
- Complying with regulatory, statutory, and agency requirements
- Upholding the B&V Code of Conduct, Corporate Policies, Business Practices and Corporate Instructions
- Ensuring that each professional is actively engaged in quality improvement by providing feedback as process users
- Ensuring supplier performance

3.1.4 Quality Management System Compliance

The Water Americas Quality Management System complies with Black & Veatch Business Practice BP.14.02 Quality Systems as well as AP-10.14.02, Water Business Compliance to BP.14.02 Quality Systems. To comply with the business practice, the system is based on the principles of the ISO 9001:2008 edition.

This standard and supporting policies, procedures, standards, and guidelines define Water Americas QMS. The initial sections define the management of the system; subsequent sections define the requirements and processes that govern the services provided and the division operating processes.

3.1.5 Quality Management System Planning

Documented quality planning covers such items as process planning, project planning, and quality system improvements. Planning involves identification of the required controls, processes, equipment, tools, techniques, and resources consistent with the existing QMS and Water Americas' operations. Project quality planning is addressed by AP-7.11 Project QA/QC Plan and C&P quality manuals. Quality planning is discussed during the Management Review Meeting, in accordance with paragraph 3.4.1.

3.1.6 B&V Organization: Responsibility, Authority, and Communication

The firm's leadership is committed to the development and implementation of a quality management system directed at three basic levels: corporate, division, and project.

3.1.6.1 Corporate

The Black & Veatch organization is shown on Figure 1. The Board of Directors provides oversight for the firm's overall governance.

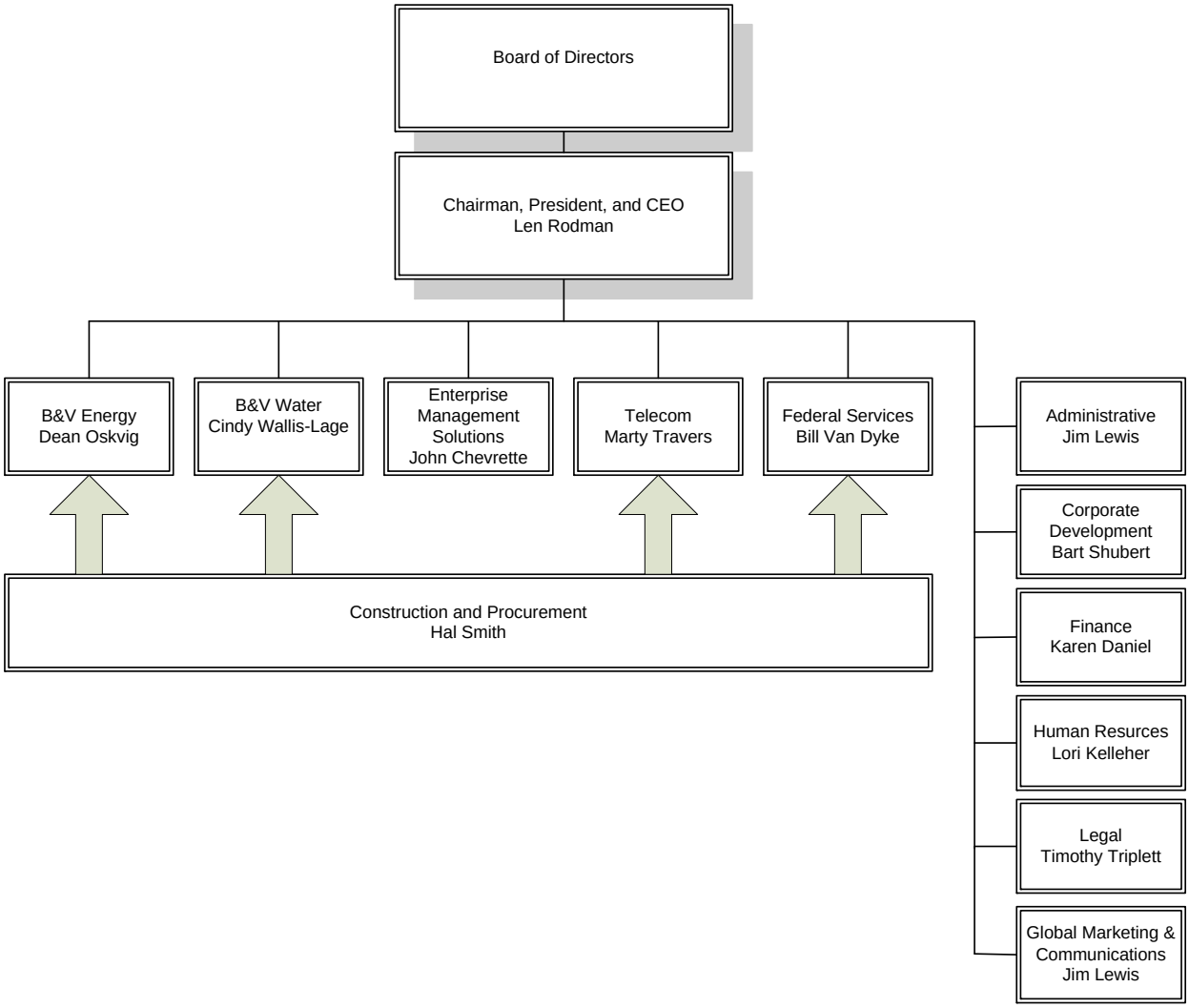

Figure 1 – Black & Veatch Organization

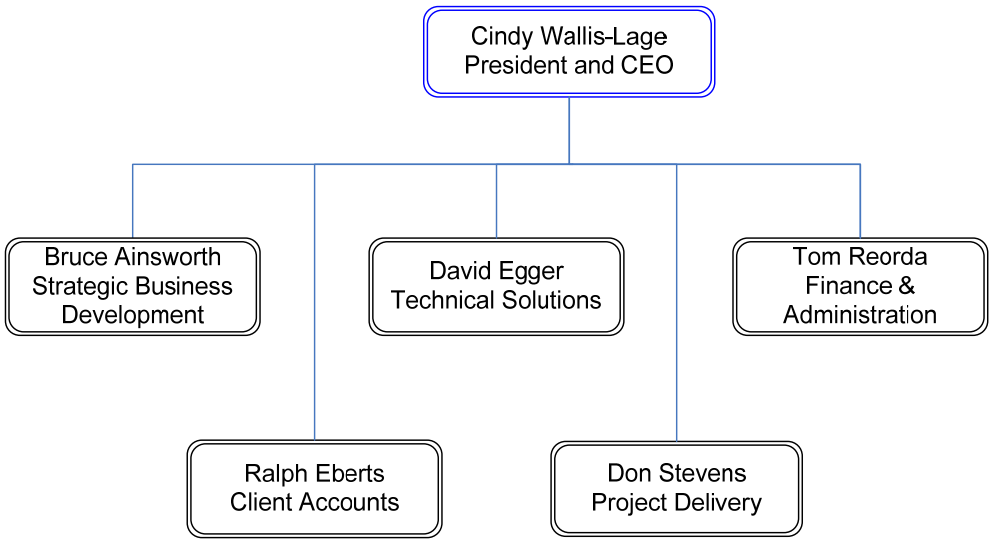

Figure 2 – Black & Veatch Water Americas Organization

3.1.6.2 Water Americas

The Water Division President and CEO has responsibility and authority for establishing and approving the Water Americas QMS and is the owner of this QMS document. The President and CEO is responsible for ensuring the development, maintenance, implementation, and communication of the QMS and other supporting documentation to all Water Americas employees whose work affects the quality of our services and the results of business processes. It is with this authority and the commitment to Client satisfaction and business excellence that the President and CEO of Water expects all Water Americas professionals to understand their responsibility, authority, and accountability for the implementation of this system. The President and CEO has the authority and responsibility to ensure that the monitoring and reporting of QMS implementation occurs, and that resources are available to meet project and division quality related operation process commitments

Under the direction of the President and CEO, Water's executive and administrative officers have the responsibility and authority for administering and implementing the Water Americas' QMS, overall coordination and direction of Safety, Quality, Division Services, Planning & Finance, Legal, Engineering, Procurement, Construction, Startup, and other related services provided by Water Americas', and the quality of such services and supporting processes. The Division's executive management team is shown on Figure 2.

Executive management's specific responsibilities for quality are as follows:

- To establish and fulfill Water Americas quality policy

- To approve the division's quality objectives and determine they are met
- To monitor progress toward achievement of quality objectives
- To review the organizational structure as it affects quality and modify the structure as necessary to promote quality
- To ensure that the division's quality strategy and objectives are adequate and communicated throughout the organization

Executive management's commitment is to provide Water Americas professionals with the information, tools, resources, responsibility, and authority to contribute to the achievement of Water Americas' quality objectives. Executive management is responsible for ensuring access to, and training for, the QMS and applicable supporting policies and standards. All Water Americas employees are responsible for becoming familiar with the overall structure and content of the QMS and complying with the applicable requirements defined in the QMS. To support that responsibility, every employee is given access to the QMS manual and all supporting policies and standards in the Water document management system.

The Executive Vice President, Project Delivery, who reports directly to the President and CEO, has the responsibility and authority to maintain, implement, and improve the QMS. He shall also verify and report to the President and CEO and other executive and administrative management whether and how the requirements of the QMS are being implemented and maintained. The Division President and CEO is the final authority on all quality matters.

3.1.6.3 Project

Project teams are created as required for each project and remain active for the duration of the project. Project Directors, Project Managers, and Engineering Managers have the responsibility, authority, and accountability for implementing the Quality Management System for their projects.

A typical project organizational structure for design services is shown on Figure 3. The level of effort required to satisfy project requirements varies depending on the scope and complexity of the project. Positions may, therefore, be either expanded or consolidated as appropriate for each project and as determined by the Project Director and the Project Manager. Responsibilities of the Project Director, Project Manager, Engineering Manager, and Facilitator are identified in the Water document management system. The organization, key positions, and responsibilities established for each project are typically included in the project procedures memorandum (or similar document).

As appropriate for the assigned task, project personnel have the responsibility, authority, and organizational freedom to do the following:

- Initiate action to ensure conformity with Water Americas standards and to prevent nonconformance issues

- Identify and record any quality problems
- Initiate, recommend, or provide solutions through designated channels
- Verify correction of quality problems and the implementation of preventive measures
- Control the use of nonconforming product until the deficiency has been corrected
- Provide improvement feedback to the custodians of various standards

Project expectations are communicated to the project team through the following documents:

- Project Procedures Memorandum (Administrative – Professional Services Projects) or Project Execution Plan (Administrative – Expanded Scope Projects)
- QA/QC Plan (Quality)
- Basis of Design Memorandum (Technical)
- Project Work Flow (Work Process)

Each project is required to have a project site in the Water document management system (Cygnet or ProjectWise) and the documents shall be filed on the project site for access by all project team members.

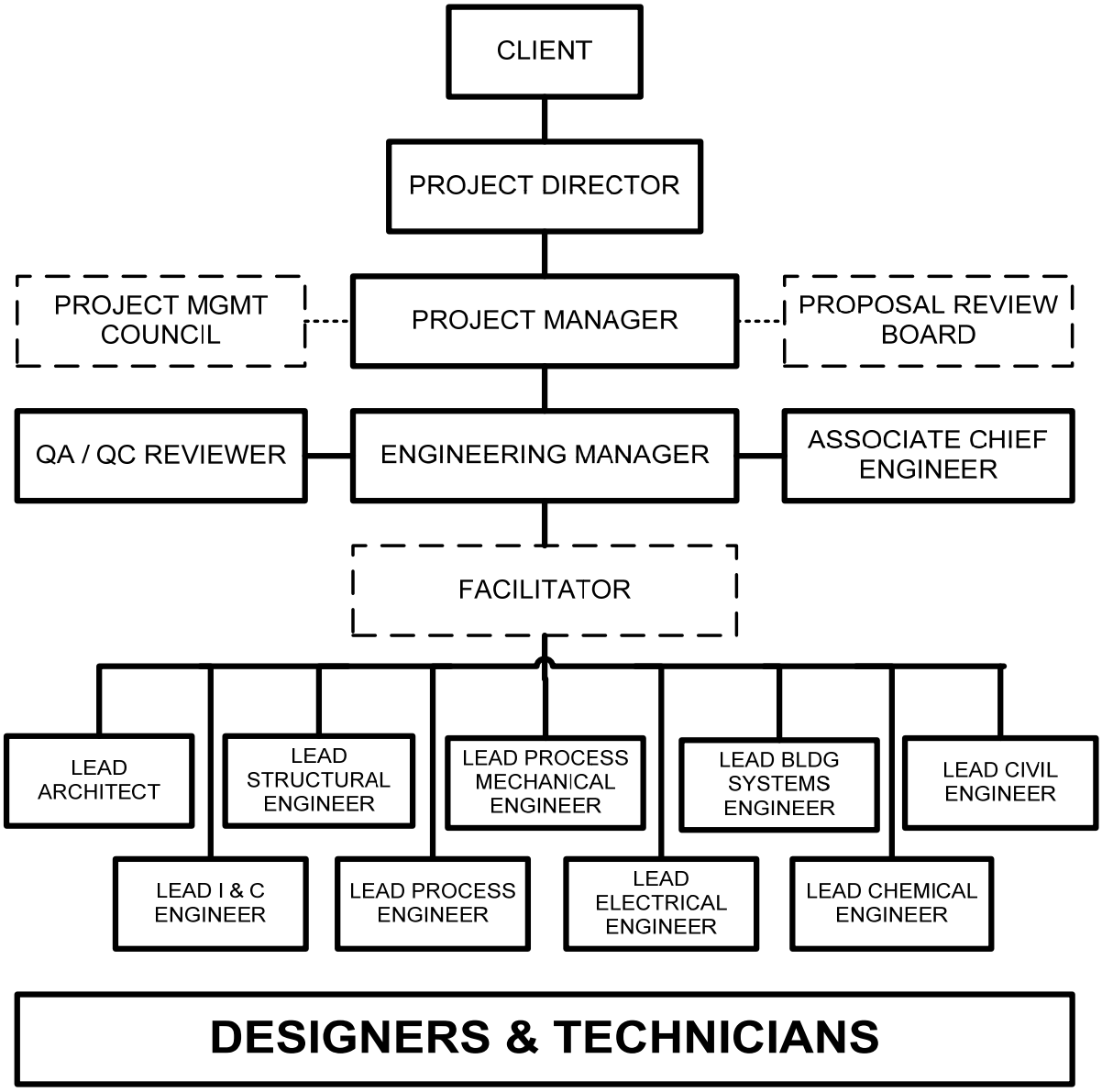

Figure 3 – Typical Project Structure for Design Services

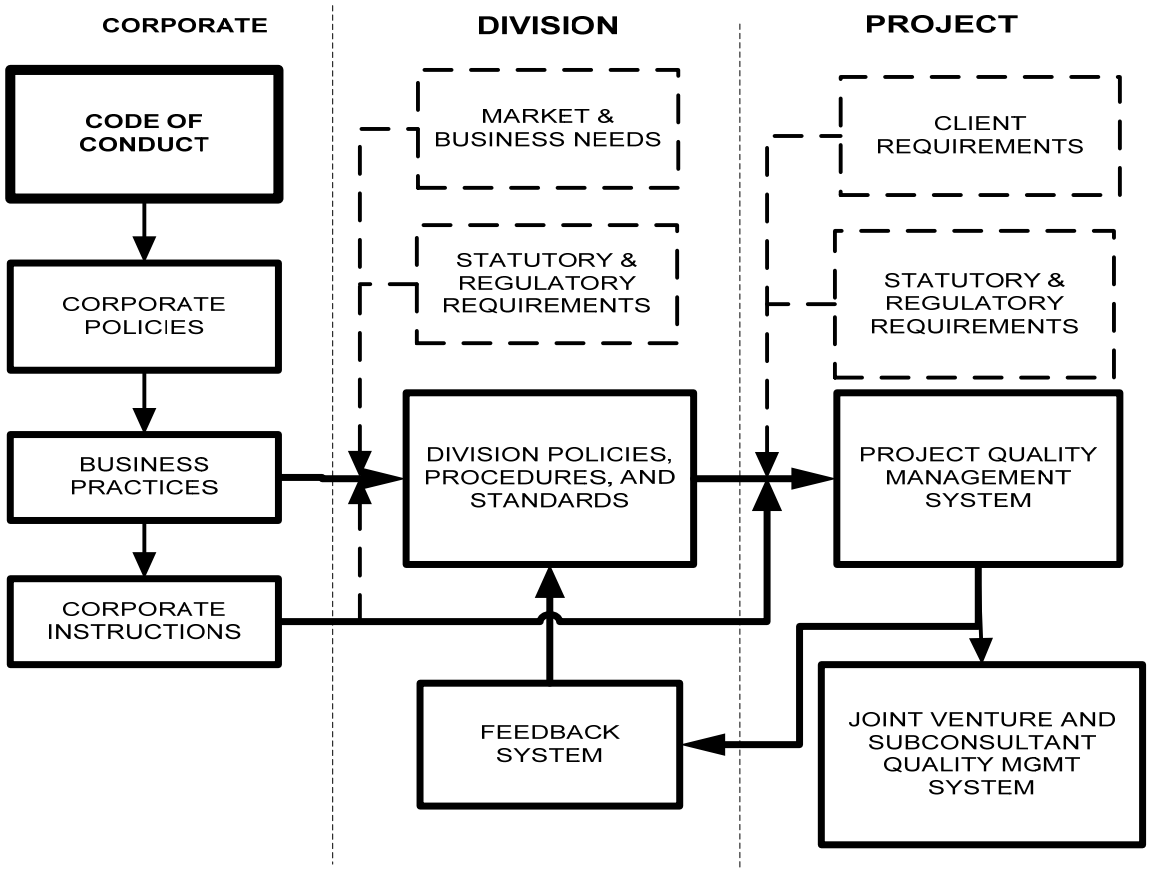

Figure 4 – QMS Structure

3.2 STRUCTURE

3.2.1 Quality Management System Structure

The QMS structure includes defined policies, procedures, standards, and guidelines established at the corporate and division levels which are incorporated into operational processes at the project level. The QMS structure and how it relates to the operational governance is illustrated in Figure 4.

3.2.1.1 Corporate Governance Structure

The relationships and definitions of the corporate governance documents are described below

- Code of Conduct

These standards establish broad policies related to legal compliance, ethical behaviors, and corporate values. The Code of Conduct forms direction for Corporate Policies, Business Practices, Corporate Instructions, and Division Governance. It is the version of the policy statements that addresses the highest level of commitment to complying with the laws and regulations that govern the firm and its operations, and establishes the most fundamental policies relative to business ethics and external conduct of business. The Black & Veatch Holding Company Board of Directors approves the Code of Conduct.

- Corporate Policies

  These policies apply to all Black & Veatch employees. They establish specific actions and responsibilities related to the most critical governance decisions. These specific policies are developed for corporate-wide issues and are approved by the Chief Executive Officer. These policies delegate specific authorities and responsibilities and define key tenets relative to corporate operations. Since they apply to the entire firm, including global operations in multiple markets, Corporate Policies are concise statements that cover the most important issues that impact Black & Veatch and its shareholders.

- Business Practices

  These practices define the actions needed to comply with the Corporate Policies, and define roles for corporate executives, divisions, designated managers, and professionals to enhance accountability. These practices are developed and maintained under the direction of the Chief Administrative Officer, reviewed by professionals designated by the Chief Executive Officer, and approved by the Chief Executive Officer. Since each division supports different business and geographic markets, it is the responsibility of each Division President to adapt these practices to the respective businesses.

- Corporate Instructions

  These instructions are developed and maintained by designated managers under the direction of the Chief Administrative Officer. The documents provide detailed instructions on functions and actions that involve interaction with corporate support and executives, span more than one division, or provide templates that have universal application and enhance overall efficiency and effectiveness. Corporate Instructions can be applied directly to the project level, or can be further supplemented by Division Policies and Standards.

3.2.1.2 Water Americas Policies, Procedures, Standards, and Guidelines

- Quality Management System Manual

  This QMS manual documents and defines the quality management system for Water Americas. The QMS program is approved for implementation by the Executive Vice President, Project Delivery.

- Policies, Procedures, Standards, and Guidelines

  Water Americas' policies, procedures, standards, and guidelines are requirements maintained and implemented through the quality management system. The majority of Water Americas' policies, procedures, standards, and guidelines have been developed to meet the needs of the market that Water Americas serves, statutory and regulatory requirements, and the requirements of the overall corporate governance documents described above.

  Water Americas' policies, procedures, standards, and guidelines reside in the Water document management system in electronic form. The primary documents and parties responsible for their maintenance are as follows:

  - Administrative Procedures – Project Delivery
  - Engineering Manuals – Designated Standards Committees and Departments
  - Standard Contracts – Legal Department
  - CAD Manual – CAD Leadership Team
  - Project Workflow Models – Engineering Design North America
  - Specifications – Designated Standards Committees and Departments
  - Standard P&IDs – I&C Department
  - Standard Details – Designated Standards Committees and Departments
  - Standard Drawings – Designated Standards Committees and Departments
  - Expanded Scope Manuals of Practice – Expanded Scope Department
  - Manual for Resident Engineers – PMCM Department
  - Engineering Department Design Guides – Designated Departments

  All Water Americas professionals have access to the Water document management system, and it is the responsibility of each professional to become familiar with those documents which affect their work.

  Professionals are requested and encouraged to provide feedback regarding any and all revision, correction, or adjustment needed on Water Americas QMS documents. Feedback can be offered directly to the party responsible for the standard document, to the chief engineers, or to the Director of Quality Assurance and Change Management.

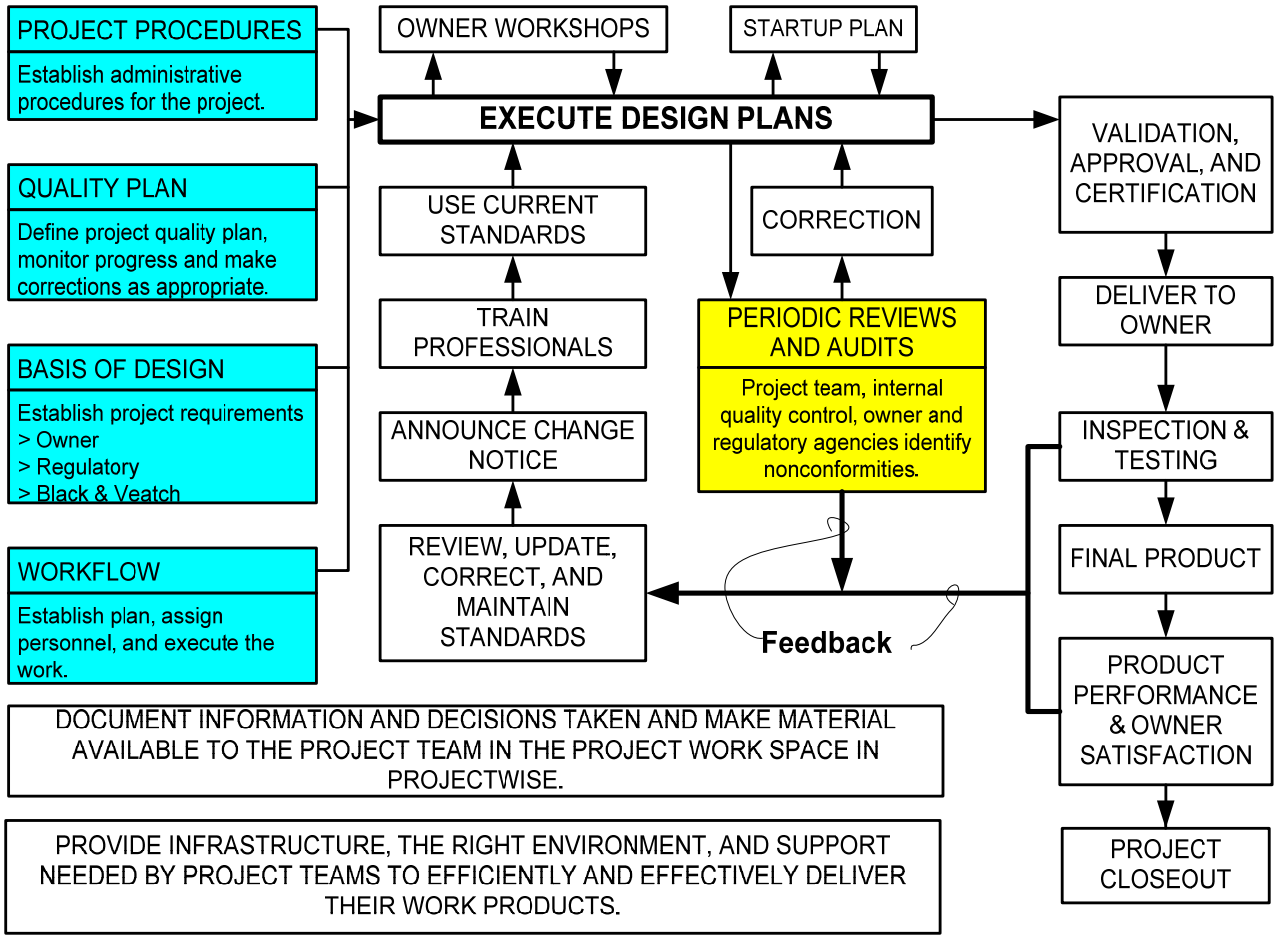

Figure 5 – Typical QMS Project Structure

3.2.1.3 Typical Project QMS Structure

Project QMS structure is illustrated in Figure 5. The structure has been developed to:

- Work in concert with and apply the requirements of the Corporate governance and Division QMS
- Establish a firm foundation for each project including a plan for technical, administrative, process flow, and quality
- Incorporate Owner requirements and obtain Owner feedback
- Provide product verification, correction, and validation through periodic QC review, construction inspection, and start-up testing

- Obtain project team feedback during both design and construction
- Evaluate feedback, incorporate improvements to Division standards, and notify Division personnel of changes
- Offer training regarding Division QMS documents
- Document, store, and provide project team access to project specific material

3.3 Quality Management System Documentation

The QMS documentation defines the requirements and processes used to effectively execute the planning, operation, monitoring, and control of the services provided and the operations performed by Water Americas. Policies, procedures, and standards are provided in many forms and media depending upon their use and which media has been determined to be suitable for the needs of Water Americas.

QMS documents are controlled. In this context, document control refers to an associated set of documents that have been created in accordance with specific requirements; reviewed for adequacy, suitability, and effectiveness; and approved for release by authorized personnel. When such documents are updated, the same control processes are used; revisions are clearly indicated along with the current revision status. QMS documents are managed in accordance with AP-9.01, Document Control.

The QMS and supporting documents are maintained in the Water document management system.

3.4 QMS IMPROVEMENT SYSTEM

3.4.1 Quality Management System Review

Management review of the QMS is conducted once a year. The Executive Vice President, Project Delivery, shall appoint a QMS reviewer who shall prepare a review plan considering the following:

- The business process activities initiated, ongoing, or completed since the last review
- The quality functions associated with the business process activities under consideration
- The organizational responsibilities required to accomplish the quality functions and their implementation status
- The results of previous audits and assessments
- The suitability of the QMS to meet business objectives
- The effectiveness of the QMS to support business process management

Once the plan has been reviewed by the President and CEO, the review shall be conducted. A report shall be prepared, and the report reviewed and approved by the Executive Vice President, Project Delivery. Inputs to the management review shall include:

- Audit results
- Client feedback
- Process performance and product conformity
- Status of preventive and corrective actions
- Follow-up actions from previous management reviews
- Changes that could affect the quality management system
- Recommendations for improvement

The output of the management review shall include decisions and actions related to:

- Improvement of the effectiveness of the quality management system and its processes
- Improvement of product related to client requirements
- Resource needs

3.4.2 Commitment to Continual Improvement

Division management continually improves the effectiveness of the QMS processes through the use of quality policy, objectives, audit results, analysis of data, corrective and preventive actions, professional and client feedback, and management reviews. Division management plans and implements monitoring, measurement, analysis, and improvement processes needed to achieve the following:

- Demonstrate conformity to requirements both internal and external, including: contractual, statutory, and regulatory requirements
- Ensure conformity of the QMS
- Continually improve the effectiveness of the QMS
- Determine applicable methods, including statistical techniques, to meet these objectives and establish new objectives

3.5 RESOURCE MANAGEMENT

Division management defines and provides the resources needed to ensure Client satisfaction and the achievement of the quality objectives. Resources may include personnel, infrastructure, work environment, information, suppliers, joint venture partners, subcontractors, and financial backing.

The implementation and responsibility of the oversight of the maintenance of the QMS and the oversight of the recommendations on improvements of its effectiveness, is the responsibility of the Project Delivery Executive Managing Director.

Professionals performing work are assigned based on their level of education, training, skills, and experience. Personnel qualification records are maintained in each professional's PeopleSoft and Performance Blueprint file.

The following measures are taken to ensure competency of Water Americas' professionals to perform work assigned:

- Department managers and project managers determine the necessary competence for personnel performing work affecting the quality of product
- Water Americas' management provides training opportunities to improve the competency of Water Americas professionals. These include the Blasiar Technology Series, Project Execution Training, Engineering Manager's Training, Project Manager's training, the annual Technology Conference, and other training opportunities offered through the Water College. Individual mentoring is also provided for professionals
- Effectiveness of training and other actions is monitored through the feedback process that is a part of Performance Blueprint which is reviewed by supervisors
- Sessions on quality principles are presented to ensure that Water Americas professionals are aware of the relevance and importance of their activities and how they affect quality objectives
- Records of training are maintained by Water Americas in PeopleSoft

3.5.1 Work Environment

Division management determines the needs and manages the work environment to achieve conformity to service and product requirements. A state of the art work environment from both a technological and personnel standpoint is provided and maintained for Water Americas professionals. Considerations include ergonomics, safety rules and guidelines, and locations for professional interaction. The work environment fosters creative work methods and provides opportunities for greater involvement and utilization of the strengths and experiences of professionals.

This environment provides a positive influence on motivation, satisfaction, and performance of our professionals, and enhances the performance of the Division and promotes conformity to the requirements defined in the QMS by our Clients, and by other interested parties.

Division management provides the following infrastructure to support its operations:

- Buildings, workspace, and associated utilities

- Integrated computer infrastructure (both hardware and software)
- Support services, such as communications and technical, management, and human resources expertise

3.5.2 Information Management

Through the use of B&V's integrated infrastructure, the Division collects information required for management to make sound decisions. Executive management uses its experience and knowledge to make decisions based on factual data and analysis tools relating to Water Americas' continuous improvement process. Division management identifies the types of information needed at different levels of management and establishes appropriate security and confidentiality provisions for the information management system to ensure access by appropriate users.

The Division has developed and maintains the Water document management system for information and document management at both the Division and project level.

3.6 Joint Venture Partnerships, Subcontractors, and Supplier Alliances

The Division has developed relationships with other firms with the aim of mutually improving the effectiveness of products and services. These arrangements help to focus expertise on particular projects and to ensure more efficient processes that create value.

3.7 Financial Resources

Division management has incorporated a Cost of Quality Program (CQP) to provide a basis of information used to monitor the effectiveness and efficiency of its QMS and to help achieve its objectives. With the CQP, management can identify ineffective or inefficient activities and processes. Through the use of the CQP and process improvement programs the Water Americas QMS positively influences the financial results of the Division by reducing internal process and deliverable failures, reducing process cycle times, and reducing external deliverable failures.

3.8 Project and Process Realization

Water Americas achieves the delivery of products or services that meet or exceed client requirements, by planning, developing, documenting, and implementing project and business processes. Project and business processes are defined and made available to Water Americas professionals through the Water document management system. Project and business processes are reviewed, modified, updated, and/or retired as needed to maintain an adequate, effective, and suitable QMS.

3.8.1 Planning for Product Realization

Water Americas has established appropriate planning criteria within the QMS. These steps include, but are not limited to, initiation of quality documents, submittal of quality documents for review, submittal of quality documents for approval, and final issuance of quality documents.

Project quality objectives and requirements are established through Project Execution plans as required by AP-2.10, Water Business Prime Contract Approval. Processes for project execution are established by Water Americas' Administrative Procedures. The Standard Project Workflow Model establishes the requirements for project quality control, client reviews, and commissioning and testing requirements. Administrative Procedures and Corporate Instruction CI.07.13.01, Records Retention Process, establishes the requirements for records of product realization planning.

3.9 Client-Related Processes

For each project, the project manager or designee determines the requirements related to the product and/or services, incorporates the client requirements into the project documents where appropriate, and ensures that any changes to client requirements are managed. Refer to the Project Management Manual, AP-3.10, Facilitating Client Change Requests, and AP-3.11, Trend Form.

3.9.1 Determination of Requirements Related to the Product

For each project, the Project Director and Project Manager review the following, and incorporate such requirements into the project documents where appropriate:

- Client requirements for design documents, contracts or purchase orders, including activities associated with the timely delivery and support needed for engineering design, the procurement of materials, construction, startup/commissioning, reporting, and subsequent services.
- Requirements associated with the intended use of the product or service, but not specifically stated by the client.
- Codes and standards mandated by statutory and regulatory bodies that are necessary for the intended construction or use of the product or service at the location of its intended use, including inspection, license, and permit requirements.
- Requirements mandated by B&V policies, business practices, corporate instructions, manuals, or standards.

3.9.2 Review of Requirements Related to the Product

Records are maintained to document the results of the review of requirements and the actions that are taken as a result of the review.

Before committing to a project, the Project Review Board reviews client requirements. This review includes assessing those requirements specified by the client or requirements that may not necessarily be specified by the client, but are inherent for the project; the associated statutory and regulatory requirements; as well as any relevant information that affects Water Americas' ability to meet those requirements for both delivery and post-delivery.

As a result of reviewing requirements, the following objectives can be assured before entering into any contractual agreement for products or services:

- Product or service requirements are defined, including scope of work, schedule, and budget
- Any conflicts associated with the contract or purchase order requirements are resolved
- Water Americas, together with contractual associates such as subcontractors and joint venture partners, has the ability and resources (e.g., personnel, expertise, management, and other elements essential to project phases) to accomplish the defined requirements

If the client's requirements change, Water Americas ensures that pertinent documents are amended and that appropriate personnel are aware of the change. For example, amendments to contract specifications are to be communicated to the relevant departments. Included in the product realization process is the Trend Register which is the mechanism to effect changes in client requirements and to control and communicate these changes in an effective manner. Client feedback is obtained through surveys and client meetings throughout the duration of a project. Feedback is incorporated into project deliverables and is forwarded to appropriate process owners where relevant.

Defined project deliverables are verified against the contract, Water Americas standards, and regulatory requirements to ensure that the requirements defined by the client and applicable regulatory bodies are satisfied. The QMS enables Water Americas professionals to identify a need for any corrective or preventive action and to suggest potential improvements.

3.9.3 Project Controls and Trend Management

The project status is reported on a monthly basis, through the project review process. Water Americas projects use appropriate Project Controls tools. The project review requirements are to be in place after a contract has been signed (refer to AP-3.12, Project Reviews).

AP-3.10, Facilitating Client Change Requests and AP-3.11, Trend Form addresses the recommended practices for identification, preparation, review, and approval of all internal trends and external scope changes. The primary objective of the trend/scope change program is to control the agreed-upon "as-sold" project scope, quantities, cost, schedule, quality, and execution plan. This process is an important tool for the proactive prevention of claims, aids in the

mitigation of claims, and serves to prevent cost and schedule overruns. The process provides a history (lessons learned) of accumulated data regarding the causes of deviations from the baseline. This process provides a means for early detection and identification of potentially harmful trends so that a corrective action plan can be established to manage the risk or maximize the benefit. This process is essential for project forecasting and supports financial status reporting.

Specifically, the trend and scope change process allows the project team to accomplish the following:

- Identify cost-saving alternatives
- Provide early warnings of potential cost/schedule impacts
- Identify changes in the scope, quality, and services
- Identify changes incurred when correcting defective work provided by suppliers and/or subcontractors
- Take corrective action before design deviations or other actions are irrevocably included in the project
- Document the primary causes of deviations
- Facilitate the identification and generation of back charges to suppliers and any resultant work authorizations to subcontractors
- Assist with the prevention and/or mitigation of claims

3.9.4 Client Communications

Water Americas believes that communication with clients is critical for achieving client satisfaction and maintaining objectives and actions in alignment with client needs and user expectations. Water Americas maintains open communications with clients to address project information, inquiries, contract or purchase order issues, and client feedback or complaints. Project client communications channels are documented in the Project Procedures Manual or Project Execution Plan.

3.10 Design and Development

Design and development of Water Americas services is handled through the planning of project realization processes, with appropriate feedback from clients.

The requirements for the design of project deliverables and products involve planning, implementing, reviewing, and documenting the defined phases of the process, including provisions for controlling design changes. Project Managers and Engineering Managers are expected to develop and apply a project plan that embraces the principles of the QMS structure shown in Figure 5 and described in Section 3.2.1.3.

3.10.1 Design and Development Inputs

Before the project design and development phase begins, design inputs are defined. The input and source for project design is documented during the development of the appropriate execution plans.

Design inputs come from a number of internal sources, such as the following:

- Water Americas design standards and specifications
- Identification of skill requirements necessary to produce the services
- Relevant documentation and/or data from previous projects

External sources for design inputs can include the following:

- Contractual requirements
- Client requirements and preferences
- Statutory and regulatory requirements
- International or national standards
- Industry codes of practice

3.10.2 Design and Development Outputs

Design outputs can be in various forms including, drawings, plans, specifications, calculations, and constructed facilities. Project Managers and Engineering Managers are expected to develop and apply a project plan that embraces the principles of the QMS structure shown in Figure 5 and described in Section 3.2.1.3.

3.10.3 Design and Development Review, Verification, and Validation

Design inputs are reviewed, verified and validated in conceptual and preliminary design and at other levels of design as appropriate.

Design outputs are reviewed and approved prior to release. Refer to AP-7.20, Quality Control Review of Design Projects and AP-7.21, Quality Control Review of Reports.

Any problems identified during the review, verification, or validation stage are to be recorded, along with proposed follow-up actions.

3.10.4 Design and Development Changes

Design changes are maintained throughout the life cycle of the project. Changes can be a result of any of the following:

- Client requests
- Quality issues
- Business development

- Field service request
- Request for Information (RFI)
- Engineering change notice (ECN)
- Regulatory changes
- Trends and scope change orders

Changes after each stage of design has been fixed are documented and controlled. Refer to AP-3.10, Facilitating Client Change Requests and AP-3.11, Trend Form.

3.11 Purchasing

Suppliers and subcontractors are evaluated for inclusion on a list of vendors approved for the procurement of materials and/or services. The list can be accessed through the Global Supplier Database. The list indicates the scope of supply for which the vendor is approved. Records are maintained to substantiate vendor quality performance and to indicate the corrective action taken when the performance falls below an acceptable level.

Special requirements, such as the supply of documentation, tagging, packaging and storage, preservation, or delivery, are identified on the purchase order and are to be in accordance with C&P-P-007, Construction & Procurement Division Procedure for Project Materials Management and Inventory Control. Amendments to a purchase order/subcontract are processed in the same manner as the original, with reference made to the original purchase order/subcontract.

Water Americas is responsible for determining that purchased products and services conform to specified purchase order/subcontract requirements. The type and extent of control applied to vendors and purchased products is dependent on the effect that the purchased product will have on the subsequent product realization or the final product. The procurement process is accomplished in accordance with the detailed procurement procedures, accessed through the C&P Knowledge Library.

3.11.1 Purchasing and Supplier Management

Water Americas relies on C&P standards and services to ensure that purchased products/services conform to specified requirements.

3.11.2 Purchasing Process

C&P on behalf of Water Americas, evaluates suppliers/subcontractors to ensure that supplied materials/services conform to specified requirements. Suppliers/subcontractors are selected and performance is monitored using established criteria. Survey records or other approval criteria of approved suppliers/subcontractors are maintained.

When evaluating new suppliers/subcontractors, C&P gives preference to companies registered to a recognized national, international, or industry standard. A list of approved suppliers/subcontractors for the procurement of critical quality materials or services is maintained, and the performance of approved suppliers/subcontractors is evaluated periodically. Criteria exist for disqualifying and requalifying suppliers/subcontractors. Records are maintained to substantiate supplier/subcontractor quality performance and to indicate the corrective action taken when performance falls below an acceptable level. Refer to C&P-P-001, Construction & Procurement Division Procedure for Vendor Qualification and Performance Evaluation.

3.11.3 Purchasing Information

Purchasing information sent to the supplier/subcontractor is defined for the items or services being procured. Requirements are reviewed for adequacy prior to the release of the purchase order. Purchase orders are approved prior to release to suppliers. Purchasing information includes the following:

- Requirements for the approval of the product, specifications, procedures, processes, and equipment
- Requirements for the qualification or certification (as specified) of personnel
- QMS requirements

Amendments to a purchase order are processed in the same manner as the original, with reference made to the original purchase order. Refer to C&P-P-004, Construction & Procurement Division Procedure for Project Procurement Execution.

3.11.4 Verification of Purchased Product

Where required, verification of purchased product is carried out for Water Americas by qualified professionals from the Energy Division in accordance with the Energy Division QMS procedures.

3.11.5 Product Identification and Traceability

The identification and traceability of materials is to comply with specified contractual requirements, in accordance with C&P-P-007, Construction & Procurement Division Procedure for Project Materials Management and Inventory Control. If no specified contractual requirements exist, suitable means, typically in conformance with specified national or international standards and applicable statutory regulations, will be used to identify and trace materials.

Unless otherwise specified by the contract, an equipment tag number or schedule reference number will uniquely and consistently identify main system components on contract documentation.

Monitoring, inspection, and test documentation is, in general, traceable to the purchase order and to individual components through the supplier's own serial

numbers. Where practical, equipment will be traceable through reference to the B&V purchase order and/or manufacturing drawing as well as the serial number.

Subcontractors and suppliers are responsible for calibrating and testing the equipment that will be required for verifying the acceptability of the item under their scope of work.

3.11.6 Client Property

The handling, storage, cleaning, and preservation of client property while under Water Americas control or while being used is controlled to prevent damage or loss and to minimize deterioration. Water Americas identifies, verifies, protects, and safeguards client property provided for use or incorporation. Any client property that is lost, damaged, or otherwise found to be unsuitable for use is reported to the client; records are maintained in accordance with AP-9.10, Records Management.

3.11.7 Preservation of Product

The handling, storage, cleaning, packaging, shipping, and preservation of items is controlled to prevent damage or loss and to minimize deterioration. C&P on behalf of Water Americas ensures compliance with the requirements for handling, storage, and shipping through the following controls:

- The supplier's quality program, including applicable handling, storage, and shipping activities, is reviewed and evaluated.
- A professional designated by the Project Manager, reviews supplier submittals to verify that the supplier's program includes procedures that address the handling, storage, and shipping requirements specified in the procurement documents.
- The supplier's compliance with shipping and packaging requirements is observed during surveillance activities at the final inspection before equipment release, in accordance with the C&P-P-006, Construction & Procurement Division Procedure for Supplier Surveillance.

3.12 Control of Monitoring and Measurement Equipment

All measurement and test equipment used for final acceptance of critical components and equipment is identified and calibrated in accordance with applicable standards. Refer to C&P-P-006, Construction & Procurement Division Procedure for Supplier Surveillance.

3.13 Measurement, Analysis, and Improvement

Water Americas is committed to continual improvement. Division management continually improves the effectiveness of processes through the use of quality policies, objectives, audit results, data analyses, corrective and preventive actions, client feedback, and management reviews.

3.13.1 Workflow Management

The Division has defined workflow templates which identify the sequence and interaction of work processes commonly encountered on our projects. Project Managers and Engineering Managers are expected to tailor the workflow to meet their project needs. Additionally, they are to ensure availability of resources and information necessary to support the project, and implement actions necessary to achieve planned results. Training shall be provided where required, so that professionals know what is expected of them in the workflow process.

3.13.2 Client and Professional Feedback System

Water Americas has a client feedback system in which feedback from selected clients is collected and analyzed and action is taken to improve Division performance.

Water Americas also encourages input from B&V professionals concerning policies, procedures, and standards as well as project applications. AP-1.11, Compliance with Division Standards outlines procedures for any professional who suspects noncompliance with division standards.

3.13.3 Internal Audits

Planned and documented audits shall be used to verify that work products comply with defined requirements, determine effectiveness of the Water Americas QMS, and to focus continuous improvement attention where it is most needed. Audit standards shall provide consideration for the following:

- Audits shall be conducted by professionals that are qualified and experienced in the technical field and in the nature of the business being audited.
- Auditors shall be independent of those having direct responsibility for the activity being audited
- Audits shall be conducted according to a written standard, checklist, or plan
- Results shall be documented and forwarded to management having responsibility in the area audited
- Project managers or other management personnel responsible for the audited work shall take timely action when responding to audit findings and correcting identified deficiencies
- Follow up audits are conducted to verify corrective actions have been taken

Audit records are retained as quality records.

3.13.4 Review of Deliverables for Nonconformance

All deliverables and product are reviewed for conformance to Water Americas standards, statutory and regulatory requirements, client requirements, performance requirements, and third party requirements. Should

nonconformance be detected, it is documented and reported to the project team for correction. All corrected deliverables or product are re-inspected for conformance to documented standards and requirements.

If there is a conflict between the requirements established by the client and regulatory or statutory entities, the more stringent standard shall be applied or a waiver obtained from an authorized representative of the entity being requested to relax their standard. Any waiver so obtained will be documented and retained.

4.0 RESPONSIBILITY AND AUTHORITY

4.1 Ownership

The owner of this document is the Water Division Executive Vice President, Project Delivery. Comments and suggested improvements to these practices shall be forwarded to the document owner.

4.1 Deviation Authority

The deviation authority for this document is the Water Division Executive Vice President, Project Delivery.

5.0 RECORDS

Periodic reviews of the QMS are conducted and documented in order to assess the effectiveness of the program. The intent of the assessment is to further identify opportunities for improvement and the need for changes to the QMS.

5.1 Record Management

Policies and standards are established in AP-9.10, Records Management, for the identification, storage, protection, retrieval, maintenance, retention, and disposition of quality records.

Legible quality records shall be retained as evidence of conformance to specified requirements and the effective operation of the QMS including pertinent supplier and contractor quality records. Quality records may include any media, such as paper copy, film, magnetic, tape, optical disk, or electronic form.

Quality records are stored in facilities that minimize deterioration or damage and prevent loss. When required by contract, the Client may access the records.

6.0 REFERENCES

- ISO 9001:2008 Edition
- Black & Veatch BP 14.02, Quality Systems.
- Black & Veatch CP 3.02, Quality Systems and CP 3.03, Quality.

- Americas Division Policies and Procedures, Sections pertaining to quality assurance and quality control

7.0 APPENDIX

None

8.0 REVISION HISTORY

Revision	Author	Date	Approver	Date	Description of Change
1	Dave Blasiar	17-Dec-2003	Dan McCarthy	22-Dec-2004	Initial Release
2	David Cole Paul Wood	21-Dec-2011	Don Stevens		Updated to reflect ISO 9001:2008 requirements and changed business processes

BLACK & VEATCH
CONSTRUCTION, INC.

Field Quality Control Manual

Construction & Procurement Division

Quality Control Group Manager: Kurt Voss

President Construction/Procurement: Hal Smith

Manual Number: _____ . _____

Assigned to: _____

Controlled Copy ☐

Uncontrolled Copy ☐

Revision Sequence: **1**

Revision Date: **09/11/08**

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1.0 Quality Control Administration

1.1 Introduction

The goal of construction quality management is to ensure the designed quality is attained during the construction and startup process, thus minimizing rework and expediting schedule considerations.

The procedures contained in this manual have been written and assembled in view of expected need and use at the construction site. This manual is intended to control work that does not fall within the limits of the Black & Veatch Construction Inc.(BVCI) ASME Quality Control (QC) Manual, and supports the work performed so that all aspects of a project are covered. The Corporate Quality Control Manager (CQCM) shall be notified whenever any scope of work falls within the requirements of the American Society of Mechanical Engineers (ASME)/NB QC Manual. Any exceptions to these procedures must have written approval from the BVCI Construction & Procurement (C&P) Division CQCM. If a conflict develops between these procedures and the project specifications, the project specifications shall govern.

The procedures addressed herein are not to be changed without approval by the CQCM. This manual shall be issued as a controlled document and revisions to this manual shall be issued to all controlled copyholders.

Responsibility for a quality installation rests with assigned construction supervision and their craftsman. This assures that multiple inspections are made during the normal construction activities as the work progresses. These inspections shall be verified by the Site Quality Manager (SQM) and/or his or her designee, who shall coordinate mandatory inspections, final verification, and acceptance of all installations in accordance with the contract requirements. The SQM shall aid assigned construction personnel by providing information and training when required to assure that all work is performed according to good construction practices and the project specifications. The SQM, Construction Manager, superintendents, engineers, and subcontractors shall work together to resolve quality concerns as a team. They shall resolve all matters concerning quality with what is necessary to conform to the project specifications and good workmanship practices. The SQM shall direct the resources of the Site QC Department to fully implement the Site QC Program, and shall report to the Project Field Manager (PFM) with regard to the Site QC Program, and administratively to the CQCM. The SQM has the freedom to operate, and to enforce “Stop Work” should it be found that the work being performed does not meet the project and contract requirements. The PFM is ultimately responsible for the quality of all construction activities on the project.

These procedures outline the minimum requirements for quality control and assurance related to this project. Any additional requirements shall be adhered to as outlined in contractual documents, applicable codes and standards, and general specifications. In lieu of the standards outlined in this manual, it is acceptable to implement quality standards provided by subcontractors, provided they are reviewed and approved by the SQM or CQCM. Any conflict with this Field Quality Control Manual with project

requirements, contract requirements, and construction activities that cannot be resolved on the site by the SQM, shall be brought to the attention of the Field Construction QC Manager.

1.2 Purpose

The purpose of this manual is to provide uniform procedures to be followed in the Quality Control of construction activities. The format and language of this manual suggest that all work will be accomplished under direct BVCI management and supervision. However, the utilization of subcontractors does not negate the BVCI responsibility for the implementation of the standards and procedures, but the subcontract agreement may require a different delineation of responsibilities.

Superintendents, supervisors, and field engineers shall assist in the quality control function for all fieldwork. The various superintendents are responsible for, and shall inspect the work performed by personnel under his or her supervision for conformance to quality standards and good workmanship prior to requesting acceptance inspection from the SQM. The SQM or personnel designated to fulfill this function shall assure that all work complies with project specifications and completes acceptance reports verifying the acceptability of the work. They shall assist the construction personnel when necessary with instructions and information assuring conformance to project specifications. They shall perform periodic audits of work in progress to assure that the construction personnel are performing adequate quality control functions. The SQM shall record periodic and mandatory assessments on the inspection report form, checklists, spreadsheets, and the daily log.

Quality performance for all construction activities on a project is ultimately the responsibility of the PFM. The QC Department, led by the SQM, shall monitor the system by using the basic guidelines established to assure the approved procedures are being adhered to. Revision and updating of the system to encompass unforeseen events shall be accomplished as required with the CQCM's approval.

1.3 Project Procedures

The SQM or designated personnel shall be responsible for assuring that all required inspections and tests are performed and all quality control documents are acquired and maintained in accordance with the project and contract requirements. Deviations from project specifications or approved design or construction drawings must be approved in writing by the Discipline Site Engineer or his or her designee prior to actual work performance. Documents and drawings shall be changed to reflect deviations in accordance with document control policy.

The SQM monitors work practices and procedures and documents completed acceptance criteria during the construction phase of the project. In addition to primary duties, the SQM and field engineers shall review documents and various test reports required by the contract, project specifications, and jurisdictional requirements. Providing a product that is safe and meets the quality requirements of the project is the goal.

1.4 General Plan and Statement of Policy

1.4.1 Scope

BVCI stated policy is to deliver a quality product, satisfying in all respects the requirements of BVCI and the contractual requirements. This policy applies to both BVCI's own work, and work performed by subcontractors. This policy is carried out through the application of sound engineering, procurement, and construction methods. BVCI's QC Program provides a continuing review and audit function to verify that the work is carried out in accordance with approved procedures and specifications. The key components of the program are as follows:

- Field Quality Control Manual.
- Training, qualifications, and certifications.
- Quality control verification through inspections.
- Project quality assessment through audits and customer input.
- Follow-up on inspections and assessment activities.

BVCI's QC Program is designed to conform to the project requirements; standards, specifications; and federal, state, and local codes.

1.4.2 Field Construction Quality Control Manual

This manual provides direction to our project personnel and provides a process to verify that quality conformance is inspected and documented as required. Subcontractor's programs will be reviewed and approved in respect that their QC Program meets or exceeds the project requirements, prior to performing any work on the project. Should their QC Program not meet these requirements, then the subcontractor will work to the BVCI Field Quality Control Manual.

This manual outlines areas of administration and project control to provide a comprehensive, quality plan for the project. Inspection and reporting standards to be followed on all field projects enable BVCI to maintain continuity from project to project. The exhibits (forms) included in this manual outline the verification and documentation requirements for each area of work. The development of a project-specific construction inspection and test plan (CITP) shall include the identification of inspections and tests to be performed on the project with relation to its specified discipline. The initial CITP will be provided to the site by the Home Office QC Manager or the appropriate CQCM. The Site Project Team, as a minimum the SQM and PFM shall be involved with the final customization of the CITP to the specific project scope. In addition, the Construction Manager, and superintendents should have input as well depending upon availability and the site mobilization schedule. All members of the management and supervision team shall be familiar with the project specifications. The CITP will be based on project specifications, contract requirements; local, state, and federal codes and requirements;

and specific vendor or manufacturer recommendations. The procedures and work methods in place cover the areas of work normally encountered in the construction of an industrial plant. Any changes or alterations to the attached forms shall be documented and forwarded to the CQCM for approval. Site changes to the forms can be made by the SQM for use only on that project, when they do not delete any of the required information on the original form.

Note: The procedures and forms found in the following sections and exhibits may be utilized by subcontractors whose quality programs require additional detail to maintain BVCI quality standards.

1.5 Organization and Responsibilities

1.5.1 Scope

This section outlines the organizational structure and responsibilities of BVCI personnel. Specific duties and responsibilities of personnel outlined in this procedure are generic in nature and are subject to modification and/or delegation to allow for effective implementation under varying site organizational situations.

Organizational chart(s) are project-specific and included in the repsetive project's manual.

1.5.2 Definitions

- Construction Operations Manager (Home Office):
  - Responsible for all construction activities and Construction Department policies.
  - Responsible for the selection and administration of all field staff personnel and coordination of construction support requirements including engineering, procurement, safety, and quality.
  - Responsible for the preparation of project proposals, preparation and administration of project subcontracts, and project controls.
- Corporate Quality Control Manager (Home Office):
  - Responsible for the maintenance, review, and modification of the Field Quality Control Manual.
  - Recruitment and training of field quality control supervisors and inspectors.
  - Assessment and corrective actions.

- Responsible for ensuring that the quality plan is implemented and consistent with requirements of BVCI and the project contract documents.

- The review and approval of subcontractor quality control programs.

- Development and approval of welding procedure qualifications, welder-testing programs, in-progress inspections, nondestructive examinations (NDEs), hydrotesting programs, and other jobsite quality programs.

- Field Construction QC Manager:

  - Responsible for interfacing with all the projects with respect to staffing, technical support, and personnel issues. This includes CITP development, training, audits, assessments, and corrective actions and activities as directed by the CQCM.

- Project Field Manager (PFM):

  - Responsible to the Construction Operations Manager for all phases of the project's construction and the implementation of this manual at the construction site.

- Site Construction Manager (SCM):

  - Responsible for overseeing all construction work.

- Discipline Site Engineer:

  - Responsible for engineering liaison between the site and the design engineering organization and for supervision of the technical staff at the field office.

- Site Quality Manager (SQM):

  - The SQM is responsible for the administration of the quality program at the site and shall report to the PFM on all project quality related items. The SQM shall have a direct reporting function to the PFM on quality issues, and shall have the authority and organizational freedom to independently identify construction quality problems and to initiate corrective actions as necessary, which may include "Stop Work" until there is a resolution through the PFM to assure compliance with engineering, contract, and procedural requirements.

- The SQM shall schedule, perform, and document periodic verifications and independent inspections to confirm overall program compliance. When program deviations are identified, the SQM shall initiate timely corrective actions, coordinating activities with the PFM, and responsible superintendents/engineers to resolve the problem and prevent recurrence.

- Quality problems that cannot be resolved by the PFM and the SQM shall be brought to the attention of the Field Construction QC Manager for resolution.

- Quality problems not resolved at this level will be referred to the Operations Manager and the CQCM for final resolution.

- Construction Superintendent:

  - Responsible for directing and/or overseeing assigned construction work. Additionally, the Construction Superintendent is responsible for verifying and documenting that work in progress is performed in accordance with applicable specification, drawing, and procedural requirements; maintaining an up-to-date status of construction progress; and informing the appropriate parties about unsatisfactory items, while ensuring that corrective actions are taken to resolve these conditions.

  - The Construction Superintendent is the front line quality representative, is responsible to install their portion of the work to the required specifications and codes, and is accountable for deficiencies.

- Quality Control Inspector:

  - Responsible for performing the duties as defined under the CITP and as may be directed by SQM and this program.

1.6 Control of the Construction Field Quality Control Manual

1.6.1 Purpose and Scope

This procedure establishes the system by which the BVCI Field Quality Control Manual is prepared, approved, issued, and controlled.

1.6.2 Procedure

1.6.2.1 Initiation. A request or recommendation for a new or revised quality control procedure may be initiated by the PFM or Project Manager. Requests shall be forwarded to the SQM, who will in turn, forward to the Home Office CQCM for processing.

1.6.2.2 Format and Style. The format and style of quality control procedures shall be in the general structure established by this procedure as given below:

- Revisions--When a significant procedure modification is necessary (e.g., change in scope, responsibility, technical control), a revision to the document shall be processed. The original issue of a procedure shall be identified as Revision "0" and subsequent revisions shall be identified with a sequential revision indicator (ᛊ) in the margin. Where a revision affects a substantial portion of the text, a note may be included to indicate specific revision indicators are not used. All revisions must be approved in writing by the CQCM.

- Cancellations--A quality control procedure may be canceled when the related material is no longer applicable or required. Cancellation notices shall include a description or reason for the cancellation. Only the CQCM shall approve and issue any notices of cancellation.

1.6.2.3 Review and Approval. The SQM shall provide a draft quality control procedure for review by appropriate construction personnel. Upon resolution of comments, the procedures shall be presented for approval by the CQCM.

1.6.2.4 Issue and Control. Each individual assigned a controlled copy of the Field Quality Control Manual shall be identified on a distribution list maintained in the BVCI Home Office QC Department.

As a minimum, an updated table of contents shall be reissued with each revision change or cancellation of the Field Quality Control Manual.

1.7 Nonconformance (NCR) Reporting and Processing

1.7.1 Purpose

This procedure establishes a system for the identification, reporting, tracking, disposition, and corrective action of nonconformances detected during final inspection, or work left uncorrected after proper notification, and ample time for corrective action. Work in progress not corrected within 7 days after notification, shall be documented as a nonconformance.

1.7.2 Responsibilities

- Site Quality Manager is responsible for compiling information and issuing all nonconformance reports on the project, other than those issued by the subcontractor within their QC Program. He will maintain an NCR Log with description of the nonconformance, assigned number, date of issue, disposition, responsible craft, and date of closure.

- Project Field Manager (PFM) (or designee) is responsible for the effective processing of nonconformances. The PFM may assign the disposition of an NCR to another BVCI employee, i.e., the Project Engineer or his designee. Client approval is required for NCR involving changes to the contract, or customer-supplied materials or equipment.

- Project Manager is responsible for the review and coordination of activities required to accept "use as is" dispositions with concurrence from the Client, when required.

- Superintendent is responsible for recording in-process discrepancies as necessary to control the work and assist in supervision of direct reports.

- Subcontractors are responsible for implementing an NCR system similar to the BVCI system. If a subcontractor does not have an NCR system, they shall use a system similar to the one described here.

1.7.3 Definitions

- Discrepancy is a deficiency that is identified in-process.

- Nonconformance is a noticeable, detectable, or traceable departure in the characteristics of an item or element of work that renders its quality unacceptable or indeterminate because of failure to meet the requirements of specifications, codes, project requirements, jurisdictional requirements, and/or contract requirements. Work in progress may be nonconforming in some aspect, but it is not the subject of a nonconformance report unless it goes uncorrected for a period of 7 days after notification.

- Nonconformance Report (NCR) is the document used to report, evaluate, track and disposition nonconformances.

- Rework is the process by which a nonconforming item is made to conform to a prior specified requirement by completion, refashioning, reassembling, or other means.

- Scrap/Return to Vendor is the action taken to eliminate a nonconforming item from its specified use and either return it to the supplier or have it scrapped, as appropriate.

- Use As Is is a disposition that may be used for a nonconformance when it can be established that the nonconformance will not adversely affect the functional requirements (including performance, maintainability, quality, and safety).

1.7.4 Procedures

1.7.4.1 Identification. Any field personnel may identify potential nonconforming conditions and report such conditions to the SQM for consideration of needed action. In the absence of an SQM on a project, all BVCI professionals have the responsibility to identify and report all nonconforming items to the PFM or Project Engineer for action to be taken in accordance with this nonconformance procedure.

1.7.4.2 Evaluation and Logging. The SQM evaluates the reported nonconforming condition to determine if a formal NCR should be issued. During the evaluation, the SQM should review applicable drawings and specifications, and consult with others as necessary. Subcontractor work requiring a nonconformance shall be recorded, tracked, and closed through the subcontractor's NCR system.

Deficiencies identified in-process shall be reported to the responsible superintendent; however, NCRs will not normally be generated for these deficiencies, unless action is not taken in an appropriate time frame of 7 days. Deficient items found during receiving inspection will be documented on the Overage, Shortage, and Damage (OS&D) form for further review to determine if the deficiency requires a formal NCR to be written. Design errors will be reported independently.

If the investigation validates the need for an NCR, then the SQM initiates an NCR report and forwards it to the PFM for disposition. Copies are also sent to responsible BVCI Site Management, Site Project Engineer, Craft Superintendent as applicable, Field Construction QC Manager, and CQCM. Additional distribution is made at the discretion of the PFM.

The SQM logs the NCR into a tracking system.

Upon notification of an NCR, the PFM or his designee identifies the disposition, signs, and dates. The PFM obtains "Required Corrective Action" from the Project Engineer or his designee and returns a copy of the report to the SQM. The SQM makes distribution of the NCR again, including the same people who received the initial notification.

If disposition is "Use-As-Is," Client concurrence is obtained by the Project Manager.

The SQM verifies that corrective action was taken, and documents this through the applicable inspection report attached to the NCR. The NCR, along with a final inspection report, is reissued to the original recipients showing that it has been closed out.

1.7.4.3 Tracking and Reporting. The SQM issues a summary of all NCRs (including subcontractors) to the PFM and Field QC Manager each month using the NCR Summary Report. This summary shows a brief description of each NCR and shows what corrective action is planned and whether or not it has been taken.

1.8 Exhibits

- Equipment/Material Receipt (CITP-1.008A).
- Equipment/Material Receipt Log (CITP-1.009A).
- Equipment/Storage Maintenance Report (CITP-1.010A).
- Overage, Shortage, and Damage Report (CITP-1.006A).
- Overage, Shortage, and Damage Log (CITP-1.007A).
- Hold Tag (BVCI-03A).
- Nonconformance Report NCR No. (BVCI-09B)
- Nonconformance Log
- Personnel Certification Log (CITP-1.004A).
- Test Device Calibration Log (CITP-1.005A).
- Punch List.
- Turnover Certificate (CITP-1.011A).

2.0 Earthwork

2.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, test, and document materials and construction practices related to earthwork.

2.2 Scope

This procedure covers construction activities related to earthwork as performed by BVCI and subcontractor personnel.

2.3 References

References shall be in accordance with project specifications.

2.4 General

2.4.1 Introduction

A laboratory service shall be required to assure the quality of the site fill material and compaction. Test methods and results shall be monitored by the SQM or QC Inspector to assure that project specifications are met.

2.4.2 Responsibilities

The QC Inspector is responsible to the SQM to assure that soils are inspected upon delivery and assure proper procedures are followed for storage, placement, and compaction. The QC Inspector shall make a daily report to the SQM detailing daily activities. Any quality deviations or concerns shall be brought to the immediate attention of the responsible Superintendent and then the SQM.

The SQM shall ensure conformance of materials with project specifications. The soils technician of the laboratory service shall be directed to perform testing of materials for compliance with project specifications. This is to include periodic testing of soils to assure conditions have not changed. Retesting of materials shall occur immediately if the visual or physical characteristics of the soils changes.

2.5 Procedure

2.5.1 Testing

As a minimum, testing shall be in accordance with the project specifications. At the discretion of the SCM, Project Engineer/Civil Superintendent, or SQM, additional testing may be utilized.

2.5.2 Implementation of Testing

The SCM, Project Engineer/Civil Superintendent and SQM or designated personnel are responsible for coordination of the soils technicians (whether onsite or offsite). They are responsible for the coordination of required services with client and subcontractor. Upon completion of the testing, the soils technician shall inform the QC Inspector of results and supply written documentation. As a minimum, this documentation shall be supplied daily during this activity. The QC Inspector or SQM shall be notified immediately when test results do not meet the project requirements. Testing for moisture and compaction shall be "plotted" on a drawing by test number by the testing lab for accurate location of the tests. The test number on the plotted drawing shall match the assigned test number on the report. All test equipment used shall meet the applicable codes and standards.

2.5.3 Earthen Materials Handling

The following guidelines cover handling of earthen materials purchased in bulk. Such materials include soils, bank sand, shell, iron ore, gravel, caliche, clay, rock or gravel, etc.

The PFM shall designate an area sufficient to meet the storage requirements of earthen materials. The responsible superintendent shall notify the soils testing technician of each unloading area being used. Craft workers shall be directed to visually observe the unloading of trucks, monitoring for excessive wetness, obvious trash content, caked material remaining in truck, etc. Certain trucks should be totally empty after each load is dumped. If any change is noted, the Superintendent or the QC Inspector shall be notified immediately. The QC Inspector or Superintendent shall take appropriate action to have the situation investigated. Materials not meeting the project requirements shall not be used and shall be disposed of away from the jobsite.

2.6 Exhibits

- Erosion Control Checklist (CITP-2.002A)
- Clearing and Grubbing Inspection (CITP-2.001A)
- Underground Pipe Installation Inspection (CITP-2.005A)
- Duct Bank Installation Inspection (CITP-2.004A).

- Underground Electrical Conduit Inspection.
- Underground Pipe Backfill Release (CITP-2.006A).
- Earth Excavation, Foundation Preparation, and Embankments and Backfill Inspection (CITP-2.003A).
- Soil Report Log.
- Compaction Report Log.
- Piles Installation Inspection (CITP-2.007A).
- Auger Cast-In-Place Pile Installation Inspection (CITP-2.010).
- Micropile Installation Inspection (CITP-2.011).
- H-Pile Installation Inspection (CITP-2.012).
- Paving and Road Surfacing Inspection (CITP-2.009A).

3.0 Concrete and Grout

3.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, test, and document materials and construction practices related to concrete and grout work.

3.2 Scope

This procedure shall cover construction activities related to concrete and grout work performed by BVCI personnel and subcontractor personnel.

3.3 References

References shall be in accordance with project specifications.

3.4 General

3.4.1 Introduction

A premobilization or prefirst pour inspection should be performed of the batch plant to verify that equipment conditions and storage facilities of components meet the applicable codes and standards. All mix designs and any changes to previously approved mix designs to be used on the project shall be submitted to the Project Engineer for his written approval prior to placing any concrete or grout on the project. This written approval shall be maintained in the project QC records and in Document Control. All concrete placements shall conform to the requirements of project drawings and specifications. The QC Inspector and Project Engineer/Civil Superintendent shall assure that all aspects of formwork and reinforcing steel, clearances, and presoaking are in accordance with the specifications and drawings. "Pour cards" shall be utilized to assure that all steps have been properly executed and checked prior to installation of concrete or grout. BVCI shall utilize an approved concrete testing agency to assure concrete and grout meet project specifications. A concrete tracking database has been developed and shall be used on direct-hire projects. Typically, the responsibility of tracking concrete placement falls in a subcontractor's scope when subs are utilized. It is acceptable to give the subcontractor a copy of the concrete tracking database to use for the project if they need help with a tracking method. Embedded in the concrete tracking database is the release form for anchor bolts and foundations for steel erection. This release is required to meet the current Occupational Safety and Health Administration (Act) (OSHA) steel erection standards and is signed by the SQM and the PFM and transmitted to our files if self-performing steel erection or to the appropriate subcontractor if steel erection by others.

3.4.2 Responsibilities

The SQM shall be responsible for verifying that the work is performed in accordance with this procedure and the project specifications. The Civil Superintendent/Project Engineer shall be responsible for all concrete documentation.

3.5 Procedures

3.5.1 Pour Card - Concrete

The Civil Superintendent shall be responsible for initiation and coordination of the pour card for acceptance signatures, the completed concrete pour card (refer to the exhibit pour card), and required testing by the concrete testing agency. In addition, all required other inspections such as special inspections or local and state required inspections are the responsibility of the Superintendent and may be coordinated with the SQM. When possible, the signature of these special inspectors should be on the pour card. Where not possible, there should be unsigned written inspection report on the paper or form to release for pour. The Field Engineer or his designee shall be responsible for initial and final check for location and conformance to project specifications and drawings. The concrete technician from the approved testing agency is responsible for testing of concrete for compressive strength, slump, air entrainment, temperature, batch time, and general appearance to verify material quality. The QC Inspector shall audit the technician for verification of this testing.

3.5.2 Pour Card - Grout

The Mechanical and Civil Superintendents shall be responsible for initiating and getting all acceptance signatures on grout cards for major rotating equipment and structural columns respectively and for coordinating of any required testing with the Concrete Testing Agency.

All concrete surfaces to receive grout for steel and equipment shall be properly prepared and inspected prior to setting of equipment or steel.

The Concrete Technician, from the approved testing agency, shall be responsible for routine testing of grout materials for compliance with project specifications. They shall be given adequate notice by the Civil Superintendent of time and date of concrete or grouting work for implementation of specific test.

The SQM shall be responsible for verifying the work performed and shall verify through use of QC Inspectors that equipment/columns are level or plumb as required and that no further work is required to be performed prior to release for grout. The completed grout card shall be documented by the Civil Superintendent with a copy transmitted to the SQM.

3.5.3 Prepour Inspections

Individuals responsible for performing prepour inspection shall be familiar with the drawings and specifications for the pour and shall assure conformance. Inspection shall be performed as quickly and expeditiously as possible after initiation of the pour card. Any inconsistency or deviation from the drawings and specifications shall be corrected or resolved before the pour card is initialed.

Inspections shall be performed by the appropriate Craft Supervisor (foreman, general foreman, or superintendent), Field Engineer/Civil Superintendent, and QC Inspector. Whenever possible, inspections should be made just prior to pouring and the pour card should be signed on the same day or the day before the pour is made.

Checks performed in the prepour inspection may include, but not be limited to, the following:

- Check the pour areas for cleanliness. Debris, mud, spilled concrete, standing water, and any other bond hindering material must be removed from the surfaces that are to receive concrete.

- Assure that all surfaces are wetted and no significant amount of free water remains.

- Verify that construction joints are cleaned and prepared in accordance with the drawings and specifications.

- Check water stops at joints for cleanliness and water tightness.

- Inspect forms for cleanliness, tightness, bracing, support, chamfers, and proper form coating.

- Check type, quantity, size, and spacing of embedded items in accordance with the drawings. (Refer to the Exhibit Pour Card)

- Assure embedded items are properly secured to prevent movement during concrete placement.

- Check that excavation is to proper grade and is suitably prepared to receive concrete. Check alignment and elevation of anchor bolts. Check concrete cover to form edge distance on reinforcement. Document all concrete poured on project in permanent work areas; i.e., precast concrete elements, poured-in-place piles, footings, piers, slabs, and concrete encasements.

3.5.4 Concrete Placement

- The Civil Superintendent/Field Project Engineer or his designee shall determine the mix design for each pour to be ordered out by reviewing the applicable drawings and specification. The mix design shall be indicated on the pour card.

- Orders for concrete shall be placed with the batch plant for specific pours. The time of batching shall be placed on each truck ticket by the concrete vendor. The actual amount of concrete placed shall be recorded on the pour card.

- Ready-mixed concrete shall be mixed and delivered in accordance with project specifications.

- Concrete may be conveyed by belt conveyors, concrete pumps, buckets, chutes, tremies, or directly from the ready-mix truck chute. Conveyance equipment shall have no adverse effect on the concrete.

- Conveying shall be accomplished in such a manner as to ensure a uniform pour from mixer to forms with a minimum of slump loss.

- Height of unconfined drop shall be so that it shall not cause clustered segregation of coarse aggregate.

- Sufficient equipment shall be available for each concrete placement to ensure continuity of the placement to completion. Standby and/or replacement equipment shall be readily available so that cold joints do not develop.

- Designed construction joints shall be thoroughly drenched with water until saturated and until the new concrete is placed.

- Before depositing concrete, foreign materials and standing water shall be removed from the conveying equipment and area of placement. Construction joints shall be clean and ready. The formwork to contain the deposited concrete shall be complete and ready to accept the construction loads. Reinforcement shall be complete and all required embedment shall be in place. Reinforcing steel shall be free of mud, oil, or other materials that would adversely affect bonding of the steel to concrete.

- Foundation construction joints not indicated on drawings shall be approved by the Project Engineer or his designee prior to placing concrete. Joints in walls shall be keyed and all reinforcement shall continue through the joint, unless otherwise specified on the drawings.

- The pour height shall be limited to the construction joints as detailed on design drawings. Placing shall progress so that the previously placed layer is still in a plastic state as the new concrete is being consolidated.

- Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow. Rainwater shall not be allowed to increase the mixing water or to damage the surface finish.

- All foundation concrete shall be consolidated uniformly during placement by vibration using either an air or electric powered vibrator of sufficient size to properly consolidate the concrete in a minimum amount of time and without excessive vibration.

- Sufficient consolidation equipment and personnel shall be available to handle the maximum production rate of the concrete system.

- In cold weather, concrete placement and curing shall be planned in advanced to include a method for protection. Adequate equipment for heating and protecting concrete during freezing or near freezing temperatures shall be provided. All concrete materials, reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.

- In hot weather concrete placement, proper attention shall be given to concrete materials, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation.

3.5.5 Testing

The Concrete Technician from the approved testing agency shall be responsible for performing all testing:

- Batch Plant Inspection--Prior to the start of construction, the SQM shall inspect the batch plant for conformance to American Concrete Institute (ACI) procedures and ASTM standards for ready-mix concrete and to ascertain the capacity and reliability of the proposed supplier. This requirement may be waived if the supplier has been previously used and has demonstrated satisfactory performance.

- Slump Tests--Slump tests shall be in accordance with ACI Standard C-143. Recommended slumps for various types of construction shall be in accordance with project specifications and approved mix design(s).

- Taking of Cylinders--Test cylinders shall be prepared by the Concrete Technician at intervals and quantities in accordance with the project specifications. The method for making cylinders shall be in compliance with ACI Standard C-172. Cylinders shall be labeled immediately and stored according to ACI standards.

  Minimum requirements for identifications of cylinders shall be as follows:

  – Equipment number and type of foundation, i.e., column, mat, etc.

  – Geographical or area location.

  – Date poured.

  – Specified PSI.

  – Cylinder number.

  – Mix design.

- Test Reports--All cylinder compression test reports shall be written documentation prepared by the Testing Laboratory. Distribution shall be as follows:

  – Project Engineer.

  – SQM.

  – Concrete Supplier.

  – Client (if required by project specifications).

3.5.5.1 Procedure for Grouting.

- Epoxy grout shall be used where specified on drawings or by equipment manufacturer.

- Nonshrink grout shall be used for all applications (i.e., mechanical and reciprocating equipment, filling voids, column baseplates, anchor bolts, etc.), unless otherwise specified on design drawings.

- Concrete surfaces to be grouted shall be cleaned to remove laitance, sand, loose aggregate, contaminants, and dust. The concrete surfaces shall be saturated with water for 24 hours prior to grout placement.

- Surfaces of embedded items, which would be concealed after setting, shall be cleaned of grease, dirt, loose rust, mill scale, and other foreign matter prior to setting. Baseplates, bedplates, and/or soleplates shall be securely fastened and set to line and grade as shown on the design drawings:

  – In the case of grouting under equipment, soleplates and structural baseplates only, preparation for grouting shall be inspected and a grout card shall be signed off by the Field Engineer or the QC Inspector.

  – The space between the bolt and the sleeve on sleeved anchor bolts shall be protected from filling with grout unless called to be filled on design drawings or specifications. During freezing weather, this space must be kept free of water.

- Installation of the grout shall be accomplished in a manner that all voids are filled between the base or soleplate and the foundation.

- The exterior surface of the grout shall be finished with a beveled edge and shall not extend up on the sides of the equipment bases or structural baseplates more than 1/8 inch.

- Mechanical equipment should be grouted prior to connecting piping or other appurtenances capable of resulting in the application of external forces. The Project Engineer or his designee shall make the determination if piping should be aligned to equipment prior to grouting.

- Adequate wedges and/or shims shall be utilized to support the item being grouted to prevent distortion of the item and distress of the foundation. Wedges and/or shims should be under the supported item and shall be completely encapsulated during the grouting process.

- Baseplates and soleplates shall be leveled in complete accordance with the manufacturer's recommendations and requirements. Structural columns, vessels, and tanks shall be leveled in accordance with design drawings.

- Water shall be provided around cementitious grout (or another proven method employed) to provide moisture for hydration during the curing period. Epoxy grout does not require water.

3.6 Exhibits (Suggested Forms)

- Concrete Batch Plant Checklist (CITP-3.003A).
- Concrete Pour Card (CITP-3.001A).
- Concrete Pour Log.
- Grout Pour Card (CITP-3.002A).
- Piers Installation Inspection (CITP-2.008A).
- Precast Wall Panel Checklist (CITP-3.004A).
- Precast Structures Checklist (CITP-3.005A).

4.0 Structural Steel

4.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, test, and document materials and construction practices related to structural steel erection.

4.2 Scope

This procedure shall cover construction activities related to structural steel erection as performed by BVCI and subcontractor personnel.

4.3 References

- Project specifications.
- American Institute of Steel Construction (AISC).
- American Welding Society (AWS).
- Project drawings.

4.4 General

4.4.1 Introduction

Upon receipt, fabricated steel is separated and checked for conformance to the purchase order. Fabrication, welding, piece marking, galvanizing, painting, etc., are inspected by warehouse receiving and material control personnel and the designated QC Inspector. Superintendents observe the erection to assure that the steel is properly handled, proper preheat followed and welding activities are completed, bolts securely torqued, and all bracing and miscellaneous trim completed.

4.4.2 Responsibility

The Structural Superintendent shall be responsible for the quality of work performed, and the work is performed in accordance with project specifications. The SQM or his designee shall perform the required inspections to verify compliance to the project requirements. The applicable craft supervisor shall oversee the quality of all structural welding. Only those welders qualified to American Welding Society (AWS) D1.1 shall perform any structural welding on the project.

4.5 Procedure

4.5.1 Receiving and Storage

- All fabricated steel is received by the Warehouse Receiving Department or subcontract personnel with receiving reports. The warehouse supervisor or site receiving personnel shall notify the Structural Superintendent and SQM whenever a shipment of structural items has arrived onsite.

- Materials are inspected for quantity and quality conformance to purchase specifications.

- All materials accepted shall be marked, tagged, or otherwise identified.

- Materials are stored elevated off the ground and handled in a manner to ensure cleanliness, facilitate identification, and prevent damage during storage.

4.5.2 Erection

- Prior to any steel erection, an anchor bolt and foundation release form must be on file from the general contractor, to assure a minimum of 75 percent of the design strength has been achieved prior to loading foundations and anchor bolts. Compression test requirements have been met.

- Shim plates or leveling nuts are checked for proper elevation and support.

- All mating surfaces are to be free of dirt, burrs, excessive galvanizing, or any foreign substance that would prevent “flush” fit.

- Structures are erected in an order that enables member connection to be achieved most productively (columns, girder, and beams). The Field Engineer shall verify plumbness and elevation of main steel members on report forms and turn these in to the SQM for maintaining in the project quality control records.

- Anchor bolts, nuts, and washers shall be as specified on construction drawings.

- All designed holes in the structural steel shall be made or enlarged by drilling, punching, or reaming. If this is impractical, an alternative method may be employed, provided it is approved in writing by the Project Engineer:

  – Drift pins shall be used only to bring members into alignment.

  – Drain holes shall be provided as specified on the construction drawings.

- Galvanized bolts and nuts shall be used on galvanized structures or platforms, unless otherwise specified.

- Field bolting materials and installation shall be in accordance with construction drawings.

  The tightening of bolted connections shall be handled by one of the following methods:

  – Calibrated wrench in accordance with American Institute of Steel Construction (AISC) requirements.

  – Turn-of-the-nut in accordance with AISC requirements. (Refer to Note 2.)

  – Fasteners in accordance with manufacturer instructions.

  – Impact or spud wrench when load-indicating washers are used in accordance with manufacturer's instructions. (Written approval from the Project Engineer shall be obtained prior to using direct fastening tension indicators (DFTIs) or "squirters.")

  – The use of tension control bolts.

  Note 1: Unless otherwise stated in the contract specifications, or required by local building authorities, all bolted connections not shown as "slip critical" or "direct tension" in the design specifications or drawings, shall be verified in accordance with AISC as "shear bearing" type connections. "Shear bearing" connections shall be installed in properly aligned holes, but need only be tightened to the "snugtight" condition. Snugtight is defined as the tightness that exists when all plies in a joint are in firm contact. Visual verification is all that is required. (Reference AISC Specification for Structural Joints using A325 or A490 Bolts, Para. 8c)

Note 2: There is no practical method for checking "turn-of-the-nut" tensioned bolts after they have been installed. One method that may be used to verify that the erector is accomplishing this is demonstrated by a "tension measuring device" such as the "Skidmore-Wilhelms" device. The Skidmore-Wilhelms shall be clamped to a building column and the proper adapters installed for the size bolt being tested. The bolting crew should then select three bolts and nuts from the stock to be used that day as a sample. Using either a hand or pneumatic wrench, the nut shall be brought to snugtight in the same manner to be used on the actual connection. Then, using whatever marking system that has been selected for this project, an additional one-third turn-of-the-nut (normal case) shall be made and the gauge shall be checked on the machine to see that the minimum tension value has been exceeded by at least 5 percent. If not, the procedure shall be adjusted until the crew can consistently reach this minimum. This could mean changing the snugging procedure or the amount of turning. The SQM on the project has the responsibility to observe this procedure and then verify that the crew is following the same procedure on the frame connections. If a special or permit inspection is required by the jurisdictional authority, it is essential that the erector and the inspection agency agree on the exact procedure to be followed by the bolting crew and the QC Inspector prior to beginning steel erection.

- Impact wrenches and torque tools shall be periodically checked for calibration in accordance with manufacturer's recommendations or project requirements to assure they are providing the required torque. Impact guns shall tighten bolts to at least the minimum tensions specified by AISC. This shall be accomplished in 10 seconds or less. If the gun shall not properly tension bolts in this period of time, the gun shall be replaced and/or the reason determined and corrected. Excessively long impacting of bolts is not allowed.

- All steel structures shall be plumbed, leveled, and braced, and bolts properly impacted prior to loading with an external weight source. If in the case of multi-level structures, where loading must occur before erecting the next level, the first level shall be complete, inspected, and signed off by Site Quality Control prior to loading.

- All primary structural members shall be in accordance with drawings.

- All grating and floor plates shall be properly supported and secured down.

- Foundation and anchor bolt release forms shall be complete prior to any steel erection.

  Note: External wind loading shall be considered and measures taken to assure that no damage occurs to the structure during erection.

4.5.3 Welding

- All steel structures shall be plumbed, leveled, fastened, braced, or guyed prior to start of welding to keep it plumb and true during erection.

- All welding shall be in accordance with applicable codes and specifications. The technique of welding, workmanship, appearance, and quality of welds, shall be in accordance with Section 3, "Workmanship," and Section 4, "Technique," of the AWS Structural Welding Code D1.1. Only qualified welding procedures and qualified welders shall be permitted to perform welding activities of structural steel. A "Welder's Performance Qualification Log" shall be maintained by the SQM with distribution to the rigging and or structural superintendent.

- Welding department and/or QC Department may request random weld examinations to verify weld quality, in addition to the mandatory requirements. These additional NDE requests shall be one of the following: dye penetrant, magnetic particle, ultrasonic, or radiographic examinations (Refer to Exhibits, Section 4 for Field Welding NDE). These examinations shall be in accordance with AWS-D1.1 Section 6 or applicable project specifications.

- After the welding of structural connections is completed, they shall be inspected by the QC Inspector prior to loading the structure with any external load.

4.6 Exhibits (Suggested Forms)

- Structural Steel (Bolted) Inspection (CITP-5.001A).

- Structural Steel (Welded) Inspection (CITP-5.002A).

- Bolt Torque Inspection (CITP-5.003A).

- Stairs, Ladders, and Platforms Inspection Report.

- Structural Inspection Form.

- Report of Structural Completion (CITP-5.004A).
- Metal Wall Panel Installation Inspection (CITP-7.002A).
- Masonry Checklist (CITP-4.001A).
- Roofing Installation Inspection (CITP-7.001A).
- Prefab Metal Building Checklist (CITP-13.001A).

5.0 Field Welding

5.1 Purpose

The purpose of this section is to establish a guideline to monitor, examine, and document material and construction practices related to field welding. These methods are to ensure compliance with project specifications, applicable codes, and contractual requirements. For welding applicable to ASME Section I, VIII, and the National Board, such work shall be in accordance with the applicable code(s) and the ASME QC Manual. Notification shall be given to the CQCM when the use of the ASME QC Manual is applicable prior to performing this work.

5.2 Scope

This procedure describes activities and documentation related to welding performed by BVCI construction personnel, nondestructive examination personnel, and subcontractor personnel.

5.3 References

- Welding Manual.
- ASME Quality Control Manual.
- Project Specifications.
- General Specifications for Welding.
- ASME/ANSI B31.3 and B31.1.
- ASME Section V.
- ASME Section IX.
- AWS Structural Welding Codes.

5.4 Responsibilities

The SQM shall be responsible for verifying that the Quality of the work performed is in accordance with project specifications through mandatory inspections, random inspections, and documented third party reports. The applicable craft discipline Superintendent shall be responsible for ensuring that the work is in accordance with project specifications, procedures, applicable codes, and quality standards; and that the required tests are performed and documentation has been distributed and filed with the

Site Quality Department. Approved third party subcontractors are to perform NDE testing, as directed.

5.5 Procedure

5.5.1 Materials

Welding electrodes, wires, and fluxes shall meet the specifications of Section II, Part C of the ASME Code or Section 5.3, Welding Consumables and Electrode Requirements of AWS-D1.1. Receiving, storage, handling, use, and disposal of these materials shall be based on the welding manual filler material control (FMC-1). Project specifications for the requirements of MTRs for weld filler metals shall be checked. Purchase requisitions or purchase orders for weld filler metals shall be reviewed and approved for compliance to the project requirements by the SQM or other appropriate management personnel. The Welding Craft Discipline Supervisor shall be familiar with the applicable codes and welding specifications to which he or she is performing work. The Welding Craft Discipline Supervisor shall issue the Field Welding Material Requisition (FWMR) to the welder for acquiring weld filler metal from the Rod Room Attendant. A Filler Material Issuance Log shall be used for welding outside the scope of ASME. Bare filler metals shall be purchased "embossed" on each end. Containers shall be clearly marked for size, diameter, length, type of material, AWS-ASME designation and specification number, heat number, lot number, and manufacturer. Bare filler metal in wire coils shall be "flagged" on each coil end, or the spool shall be identified. Container shall be clearly marked as bare filler metals mentioned above.

5.5.2 Welding Procedure Specifications

Welding procedures are implemented for the job in accordance with the project specifications and applicable codes. Welding shall not start without approved qualified welding procedures. Particular attention shall be given to determine the types and combinations of materials to be welded. This welding procedure specification shall be based on the following information:

- Piping specification or equipment specification.
- Material specification.
- Base material and weld deposited thickness.
- Welding process (es).
- Preheat and post-weld heat treatment requirements.
- NDE requirements.

- Project-specific and contractual requirements.
- Applicable codes.

The SQM and Welding Supervisor shall ensure the welding procedure being used is in accordance with the project specifications or code requirements. The SQM shall develop a "welding procedures used for project" list using information from drawings, project specifications, contractual requirements, and codes, shall maintain the Master Log and shall distribute a copy to the SCM and Welding Supervisors. The QC Inspector shall perform daily inspections to assure compliance to these requirements and procedures. All welding procedures used on the project by subcontractors shall be submitted and approved prior to beginning work.

5.5.3 Welder Performance Qualifications

5.5.3.1 General. Each welder shall be qualified in accordance with requirements of Section IX of ASME BPV Code or AWS-D 1.1 for structural welding, and in accordance with BVCI WQ-1 from the Welding Manual. The SQM shall establish a "Welder Identification System" for the project and shall maintain a Welder Qualification Log containing the following information:

- Welder's name.
- Welder's identification number or letter.
- Welder's badge or Social Security number.
- Welder qualification test.

Welders shall be qualified under the supervision of the SQM. Welder Performance Qualification Records (WPQRs) for subcontractor Welders shall be submitted to the SQM for approval prior to the subcontractor performing any welding activities. Any personnel performing welding on the project shall be qualified to the applicable welding process, procedure and code even if the work is temporary. The SQM shall assign each welder an identifying number or symbol to be used to identify welds performed. Pipe and tube welders shall be assigned a letter or letters, and structural welders shall be assigned a number or numbers. This symbol shall be applied to pipe approximately 1 inch from the weld and not in the Heat Effected Zone. The stamp shall either be a low stress steel type with rounded edges or of dot configuration, or with a permanent paint marker. Identification of welds on alloy piping shall be accomplished by use of "Non-corrosive Paint Markers." Markers used on stainless steel materials shall contain no harmful chlorides. As an alternative, a weld map may be maintained instead of stamping welds, except a weld map shall be established for those welds that require mandatory radiography (RT) or ultrasonic testing (UT), and or post-weld heat treatment (PWHT). All welder qualification testing, on or off the project, is the responsibility of the SQM to assure compliance to code requirements. Weld qualification tests that are

subjected to RT for acceptance shall have a copy of the test report "Reader's Sheets" attached to the qualification form, as well as maintaining a copy of the RT film for documentation support.

5.5.3.2 Base Materials. Performance qualification tests for welding P1, P2 P3, P4, P5, P6, P7, P8, P9B, Pl0A, P10B, P10C, Pl0F, PIIA, PIIB, P41, P42, P43, and P45 may be performed using carbon steel (P1) test coupons, in accordance with ASME Section IX. Refer to AWS-D1.1 for structural welder requirements.

5.5.3.3 Welder Test.

- Guided bend test jig that conforms to QW-466, ASME Section IX, shall be used.
- Test specimen shall be forced into the die by applying load on the plunger until the curvature of the specimen is so that a 1/8-inch diameter wire cannot be inserted between the specimen and the die.
- 100 percent radiography may be used on test coupon in lieu of bend testing.
- Production weld qualification has to be approved by the SQM prior to performing.
- All pipe and tube welders shall be tested in the 6G position in accordance with ASME Section IX, Figure QW-461.
- All structural welders shall be tested in accordance with AWS-D1.1 in the 3G and 4G positions with a backing strip.
- The SQM shall verify additional tests to meet the project requirements.
- The maximum time allowed for welding out of a pipe test up to and including 6-inch diameter Schedule 80 is 4 hours.
- The maximum time allowed for each 3G and 4G plate positions (4 hours total) is 2 hours.
- The SQM has the authority to stop the test at any time he or she feels the welder cannot perform to the level to meet the code requirements.

5.5.3.4 Acceptance Criteria. For welders tested in accordance with ASME Section IX, acceptance criteria are in accordance with ASME Section IX. For welders tested in accordance with AWS-D1.1, acceptance criteria are in accordance with AWS-D1.1. Where jurisdictional requirements exist, i.e., steam cards, etc., the SQM shall assure these requirements are met.

5.5.3.5 Welder Qualification Documentation. The SQM shall maintain a current list of active welders (Exhibit C, Welder Qualification Status Log) and make this list available to the Site Construction Manager (SCM) and Welding Supervisor(s). This list shall be updated monthly or weekly for fast pace projects such as "Outage Work." For direct-hire projects, the CSPEC Program will be used to generate Welder Performance Records and may be used to assist subcontractors. Original "Signed" copies of the WPQR shall be maintained for Quality Records. The applicable WPQR shall be used for ASME Sect. IX and or AWS Qualification Tests. When it cannot be verified through Documentation that a Welder previously tested in the BVCI System has not welded in a Process or Processes within a 6 month period of time, then he or she shall be re-tested. Subcontractors shall maintain a Welder Continuity Log and submit this Log, along with the WPQRs, to the SQM.

5.5.3.6 Nondestructive Testing and Examination (NDE). All NDE for welding and PWHT shall conform to project specifications, codes, and contractual requirements.

Types of NDE may include the following:

- Liquid penetrant (LPT).
- Magnetic particle (MPT).
- Brinnel hardness (BHT).
- Ultrasonic (UT).
- Radiography (RT).
- Visual (VT).

When NDE is performed by subcontract personnel, their performance shall be monitored by the Quality Department. Any third party used to perform NDE shall submit their procedures for each NDE process being used, certifications on all NDE personnel performing these activities with eye exams, and a copy of the company's Level III certification. All personnel evaluating NDE examinations (i.e., LP, RT, MT, and UT) shall be at minimum Level II certified through ASNT-TC-1A "Recommended Practices for Non-Destructive Testing Personnel Qualification and Certification." A Level I certified individual may perform some NDE examinations with the results evaluated by a Level II Technician when the Level I Trainee is properly supervised in accordance with ASNT Recommended Practice SNT-TC-1A. Visual examinations shall be performed by a certified welding inspector (CWI), or have satisfied BVCI written practice procedures for the control and administration of NDE personnel. BVCI certified personnel may perform MT and PT examinations.

5.5.3.7 Radiography. The SQM shall initiate a letter of appointment to the NDE company Level III Examiner, appointing that person as the Level III NDE Representative for the project if the BVCI Level III is not available to support the project. The Piping Superintendent, in conjunction with the QC Inspector, shall assist in coordinating the work for the NDE subcontractor. The designated Level II Inspector shall grade all film for quality and weld acceptability. The Level II shall be responsible for the making of any overlays required for repairs and to advise the SQM of weld RT results. All radiographic film shall be retained in the Quality Department office and available for audit for conformance to code requirements and acceptability. The RT film envelopes shall be clearly marked on the outside with the system, weld number(s), welder ID(s), project name and number, date, and results. A copy of the Reader Sheet(s) shall be in the envelope with the film. The SQM shall verify that NDE records, i.e., film, reader sheets, and MT, PT, and UT records, meet minimum code requirements. Any conflict with the Level II interpretation and the SQM shall be brought to the attention of the company Level III for resolution.

5.5.3.8 Visual Inspection. The Craft Supervisor shall be responsible to verify all welds meet the requirements for visual inspection and/or other types of nondestructive examination, and notify the SQM or Quality Inspector. This shall include the work of structural welders who may be assigned to other crafts such as electrical, structural, etc. The QC Inspector shall audit the Discipline Department for conformance to this procedure. The Visual Inspector shall verify that the following are not rejectable:

- Excessive undercut.
- Size of weld (reinforcement for root and cap).
- Excess or lack of penetration.
- Appearance.
- Misalignment.
- Verify proper gap on socket weld type fittings whenever possible.
- Arc strikes.
- Slag.
- Surface porosity.
- Presence of welder’s ID stamp.
- Proper preheat.

Note: The Visual Inspector shall also monitor fabrication procedures to assure proper fit-up, cleanliness, bevel, and use of proper qualified welding procedures, and welders. Welds not meeting required quality after NDE testing, regardless of type of NDE, shall be documented and flagged with red plastic flagging in such a manner as to be seen from ground level, repair area plainly marked on the weld with waterproof marking. The Craft Supervisor shall assure that the welds are repaired and notify the Visual Inspector when this is completed for re-examination. The Craft Supervisor shall ensure that each welder is provided with windbreaks, rain covers, access, dry rods, good fit-up, etc., to assure maximum quality of welding is attained.

5.6 Documentation

Inspectors and piping personnel shall monitor NDE services and the SQM shall maintain necessary drawings, isometrics, etc., to record results of NDE and PWHT services.

Each weld requiring mandatory NDE beyond visual inspection, or requiring PWHT services shall be given a unique number for identification purposes and weld mapped. (Note: Weld mapping shall be performed for ASME/NB boiler work.) This number shall be traceable to the following information:

- Unit/area.
- Service.
- Line number/drawing number/revision.
- Pipe specification or equipment specification.
- Welder's stencil.
- Weld number to include prefixes and suffixes as required.
- Pipe size.
- Date.

This number shall be written on one or more of the following:

- Orthographic or isometric drawing.
- On pipe next to weld.
- On NDE or PWHT, request list.

- On database maintained by the quality department.

Copies of all NDE reports shall be maintained by the SQM where the required information shall be recorded. The Piping Superintendent shall be notified of any rejections and informed that the weld is to be repaired.

The SQM shall make reports to the SCM and distribution as required by the SCM, as to status of PWHT and progress and status of radiography.

All piping leaving a fabrication shop shall be properly identified by isometric drawing and spool number. Identification methods may include the following:

- Metal tags on end of pipe spool.
- Metal stamping on end of pipe spool.
- Color-coding or permanent paint markers.

5.7 Inspection of Welding Processes

In-process welding shall meet GWS-1 ASME General Welding specification, and GWS-2 AWS General Welding specification of the Welding Manual and the following shall be the responsibilities of the SQM and Welding Supervisors.

The SQM and Quality Department shall assure the following:

- All essential variables of an approved welding procedure are followed
- No preheating shall occur using an oxy-acetylene torch with a cutting tip. A heating tip (rosebud) must be used for heating with oxy-acetylene torches. All preheating with torches must be checked with a temperature-indicating crayon. (Verify with project specifications the type of preheating that is allowed. Some projects do not allow the use of rose buds).
- No steel stencils are to be used on stainless and aluminum alloys.
- Low chloride, halogen, lead and sulfur free stickers, labels or permanent type markers shall be used on alloy materials and thin wall piping where metal stamping would dent the pipe.
- Only qualified welders and welding operators are performing welding activities and within their qualified ranges.

- Re-qualify welders when their time limit has expired for a welding process, or when there is reason to doubt the welder's or welding operator's ability to make a code quality weld.

- Maintain files on all welding procedures used, welder qualifications, welding inspections and test results, PWHT records.

The Welding or Craft Supervisor shall have the responsibilities to:

- Keep records of which welds each welder makes under his direct supervision and submit this to the SQM or QC Inspector at the end of each workday, for official weld mapping, and weld mapping verification.

- Verify all welders under his direct supervisor have been properly qualified by QC for the welding being performed.

- Assure the correct welding procedure is being utilized and followed, and the welder fully understands the requirements.

- Follow weld filler metal control process FMC-1.

- Assure all welders mark or stamp their welds.

- Protect weld joints from elements of weather.

- Verify the proper use of flash shields, wind protection, fire blankets, and barricades.

  Note: Weld filler metal found in or near the vicinity of a weld in progress, which is not appropriate for the base metal being welded, will be cause for an immediate "Stop Work" in that area until such time as it can be determined that the weld in progress is being made with the proper filler materials. If this cannot be determined to the satisfaction of the SQM, then the weld will be cut out.

Weld Repairs

The SQM is responsible for inspections and verifications of weld repairs to the requirements of the applicable code, standards, and specifications. The SQM will notify the Welding Discipline Supervisor as to the weld defects and the methods to be used to repair the weld. All boiler and pressure vessel weld repairs shall not proceed prior to notification of the authorized inspector or CQCM.

Defects shall be removed by machining, grinding, or thermal gouging. When repairs are made on stainless, then grinding wheels, tools, and brushes shall be of a type to not

contaminate the stainless material. Wheels that contain carbon wire mesh shall not be used. Tools previously used on carbon steel, shall not be used on stainless.

If thermal gouging is used, a minimum of 1/32 inch shall be removed by the previously gouged surface. A preheat of the surface prior to thermal gouging shall be conducted as applicable with the standard preheat requirements of the approved welding procedure.

Surface defects, which do not encroach on the minimum wall thickness required by design, can be blended uniformly to correspond with the adjacent surface, without the addition of weld metal. Where there is doubt to the minimum wall thickness, the wall thickness shall be verified by mechanical or ultrasonic means as deemed necessary by the SQM.

The final inspection is to be made by the QC Inspector or SQM.

Verification of the defect removal shall be as required for the original inspection or by an approved alternate method that will give equal or greater confirmation.

Weld repair shall be performed by using an approved weld repair procedure as verified by the SQM. Welders performing the repairs shall be qualified to the approved repair procedure.

Required preheat and PWHT shall be performed for the defect and adjacent areas as specified in the approved weld repair procedure.

Final examination of the completed weld repair shall be as required for the original weld/material or by an approved alternate method, which will give equal or greater information as to the soundness of the repair weld.

No more than two repairs are allowed for repairing a weld. If the second repair attempt is not acceptable, the weld shall be cut out.

5.8 Exhibits (Suggested Forms)

- Welding Procedures Used for Project (CITP-1.002A).
- Record of Welder Qualification Test Log (BVCI-13).
- Welder Qualification Log (CITP-1.003A).
- Rod Oven Temperature Log (BVCI-15).
- Weld Material Issue Log.
- Welding Rod Issuance Log (BVCI-16).

- Inspection and Test Plan (BVCI-05A).
- Inspection/Examination Summary (BVCI-06).
- Master Weld Data Log (BVCI-07).
- Field Weld Summary.
- Weld Completion Record (BVCI-17A).
- Welders Continuity Log (BVCI-38).
- Traveler Report (BVCI-33).
- Traveler Index (BVCI-34).
- Traveler Revision Sheet (BVCI-35).

6.0 Pipe Installation and Testing

6.1 General

Piping shall be checked for cleanliness prior to installation. Clean shall be defined as removal of loose mill scale, rust, oil, dust, dirt, sand, rocks, welding debris, loose nuts/washers, surplus fabrication materials/consumables, or any other construction-related trash from the equipment or pipe.

6.2 Pipe Installation

6.2.1 Purpose

This procedure establishes a guideline to monitor, examine, and test pipe installation in order to assure quality and an effective turnover at job completion.

6.2.2 Responsibilities

The SQM (or designee) shall be responsible for verifying that the work is performed in accordance with this procedure, engineer's specifications, and project requirements. The Craft Superintendent is responsible for craft work meeting quality requirements and documentation necessary for system turnover at project completion. The QC Inspector is responsible for assuring quality of work, witnessing all required tests, and performing daily in-process inspections of craft work.

6.2.3 Scope

This procedure describes the methodology employed to assure the quality conformance of the materials and the installation of piping systems and components is in accordance with project specifications. This procedure addresses the minimum in-process inspections for fabrication, assembly, and installation of piping systems.

6.2.4 Procedure for Metallic Piping

- All piping shall be installed in accordance with applicable codes, drawings, and the project specifications unless specified otherwise on the drawings, (i.e., boiler external piping, which is governed by ANSI B31.1).

- Piping materials shall be in accordance with engineering design and construction drawings.

- The exterior surface of shop fabricated carbon steel pipe shall be cleaned and coated in accordance with project specifications.

- Each piping section shall be clearly identified with spool piece markings as shown on the fabrication drawings.

- Prior to erection, all fabricated piping shall be subject to inspection by the QC Inspector for cleanliness and conformance to specifications and drawings. This inspection shall be on a random basis with the inspector checking as often as the opportunity arises, however, no work shall be held up awaiting this inspection, unless previously agreed to by the SCM. All piping to engineered equipment shall be inspected by the QC Inspector or SQM prior to connecting or erecting for internal cleanliness.

- All flange faces and other machined surfaces shall be properly protected during fabrication, handling, and storage to prevent damage.

- Pipe welding procedures and welding operator qualifications, shall be in accordance with the code for pressure piping ANSI/ASME Section IX, unless otherwise specified. Modifications shall be specified on design drawings.

- Joint preparation shall be in accordance with design drawings. All oil, grease, slag, scale, coatings, and rust must be removed from the area to be welded.

- Field bending of pipe shall not be permitted without the specific approval of the Project Engineer or his designee.

- Threaded pipe joints shall be made up with thread compound applied to male ends only.

- Flange bolting shall be installed in accordance with the specification.

- No compounds shall be applied to flange faces or gaskets.

- Piping that has been coated with paint prior to erection shall be handled with care to avoid damage to coatings. Nylon slings shall be used when loading or unloading.

- Piping shall be properly guided, anchored, and supported to prevent excessive sagging or vibration during construction and operation.

- The flanges of rotating machinery shall not be used as anchor points and shall not be bolted-up under stress.

- Piping boltup to rotating equipment shall be in accordance with manufacturer’s recommendation or project specification.

Underground Piping

Quality Control shall monitor the installation of underground piping as the work progresses in order to verify the following:

- Proper depth.
- Slope as required by piping drawings.
- Mechanical joints properly installed and tight.
- Weld inspections are performed in accordance with applicable code and project specifications.

Coated and wrapped piping shall be tested and verified as holiday free. The Piping Department shall be responsible to perform the required testing (JEEP) and record the results on the Coating and Lining Holiday Test Record. Quality Control shall witness these tests to the extent necessary in order to assure proper performance. The completed record shall be issued to Quality Control at the end of each shift for review and sign-off.

Thrust blocks shall be installed in accordance with the piping drawings. Concrete thrust blocks shall not be poured over mechanical joints.

Any backfill materials and soil compaction requirements, as shown in the piping specification, shall be verified by the SQM.

Prior to backfilling any under ground piping; the Piping Superintendent shall issue a Piping Inspection Report to the SQM requesting a release of the piping to be buried. The SQM shall conduct and verify that all inspections and any applicable tests have been performed, and release the piping for backfill. **This is a mandatory hold point.**

6.2.5 Procedure for Nonmetallic Piping

BVCI shall provide site/field services and training for craft installation personnel as needed to get all site bonding operators qualified and certified to manufacturer's specific bonding procedure specifications (BPS). ASME B31.1, Appendix III, Sections 5 and 6, shall be included as mandatory requirements. Fabrication qualification and joiner certification shall be in accordance with ASME RTP-1.

6.2.5.1 General Requirements.

Dimensional Accuracy. Dimensional accuracy shall be in accordance with PFI Standard ES-3.

Pipe Joints. All joined straight sections of pipe should be furnished with a nontapered bell and spigot fully bonded type joint or butt and strap joint. Couplings shall not be used to join straight sections of pipe except where finished spool dimensions must be reworked.

Beveled Joints. When angular deflection is required in otherwise straight pipe runs, special beveled joints shall be provided for the exact angle. Where the Purchaser's drawings and/or bill of quantities specify a nonstandard fitting angle, supplier shall manufacture the fitting to the specified angle or shall prepare the fitting with special beveled joints for the exact angle.

Deflection obtained by opening joints on one side of a pipe bell or fitting shall not be acceptable. The machining of the special bevel shall not encroach upon the minimum structural wall of the pipe, fitting, or bell end, unless overlays for the entire joint to obtain the required structural integrity are provided.

Gasket and Bolting Material Requirements. Flanged joint gaskets and bolting specifications should be provided under project specifications and should include recommended bolt-up procedures that include target torque values for all bolted joints.

Bonders/Joiners Certifications. The fabrication shop or field installation shall meet or exceed the qualification requirements specified in ASME RTP-1, B31.1, or B31.3. Fiberglass pipe joints shall be fabricated by certified secondary bonders (joiners). Joiners maybe certified by BVCI to BVCI or suppliers PBS or be certified by an independent testing organization. The certification program and the results of the certification process may be submitted to the Purchaser for review and approval prior to commencement of fabrication. As a minimum, the program shall include equipment training, joint preparation, fitting, bonding, curing, and repair, testing by written examination, and testing of a joint that was fabricated by the joiner being certified. Joiners must be certified specifically for each piping system and joining method used.

Testing. The completed piping system will be field hydrostatically tested after installation in accordance with the project specifications or code requirements.

Handling. All pipe, fittings, and special fittings shall be handled carefully and shall not be bumped or dropped. Hooks shall not be permitted to come in contact with joint surfaces or flange faces. All pipe and fittings shall be stored on dunnage and not permitted to contact the ground or concrete floors.

The fiberglass pipe shall be lifted and moved using nylon type lifting equipment with minimum 3 inches width. Chains and metal lifting equipment shall not be used. Contact with metal such as fork truck arms or fabrication bench rollers or blocks is not permitted at any time.

These procedures shall be followed during receipt of materials, during storage and fabrication, and during installation or preparation for shipment, including loading.

Pipe or fittings damaged or mishandled shall be replaced.

Marking, Identification, Traceability. Each section of piping, all fittings, and all specials shall be plainly marked with a number corresponding to an identifying number to be indicated on the designers drawings and tracked markings shall be applied with black permanent ink or black waterproof paint using line widths not less than 3/16 inch.

Fiberglass Overlay Kits. Fiberglass materials shall be shop precut to the required widths and lengths and assembled in durable individual packages indicating the pipe size for each field joint. Resin, adhesive, and catalyst shall be provided in durable kits by pipe size in a means suitable for use on a remote project with consideration for a shelf life in excess of 3 months. Storage instructions shall be followed.

Protection During Shipment. If piping is to be shipped, it shall be prepared for shipment in a manner that minimizes the total volume. All piping shall be supported for shipment at least every 6 feet and on each change of direction, and provided with bracing to prevent shifting, maintain the pipe roundness, and prevent damage during shipment and handling. Unsupported lengths of pipe shall not exceed 3 feet, and unsupported lengths shall not include any fittings. Shipping support and shielding shall prevent direct contact of any pipe or fittings with each other or with the bottom or sides of the shipping container or trailer.

All pipe and fitting ends shall be protected with reinforced caps or plugs and secured with weather resistant tape or at least four bolts. Caps or plugs shall be of 1/2 inch thick plywood or 3/16 inch thick plastic minimum, and shall fully protect flange faces and all surfaces of pipe or fitting ends (interior, end preparation, exterior). Protection of open ends shall be suitable for use during storage for 1 year prior to field erection without excessive maintenance.

Procedures for High Density Polyethylene Piping (HDPE). This procedure describes the pressure test preparations, operations and code requirements for HDPE piping systems and components to be pressure tested. HDPE piping may be utilized for water distribution and transmission, municipal and industrial sewer and applications and underground fire main systems as well as other engineered solutions. This is a generic application but should be adaptable to most installations. Each application listed requires piping design materials that meet or exceed the performance needs for the particular application, i.e., chemical resistance for M&I piping, etc. Typically, color coding of the piping from the manufacturer is utilized to differentiate the various types of PE piping.

Applications and Fabrication/Installation/Inspection Procedures.

- Water Distribution and Transmission:

  – Water system piping must be designed for the continuous internal pressure and for transient (surge) pressures (working pressures) imposed by the particular application.

  – HDPE pipe and fittings are joined using heat fusion, flanges, and mechanical connections that are designed for polyethylene (PE) pipe and electrofusion. Heat fusion is a visual procedure that utilizes controlled temperature and pressure to melt and fusion-join PE pipe materials together. Butt fusion is used to join components end to end; saddle fusion to attach a branch outlet to a main pipe, and socket fusion to join smaller pipes to socket fittings. Specific fusion/joining procedures will be obtained from the manufacturing or joining company. BVCI requires that acceptable proof of training in electro-fusion techniques be submitted prior to fabrication/fusion of the piping. Project code requirements and manufacturer's recommendations shall be checked for possible additional installation and test requirements.

  – Thrust anchoring may be required to control Poisson effect forces where PE pipes are connected to bell and spigot piping. PE piping and fittings may also be joined together or transitioned to other materials with flanges, mechanical connections that are designed for PE pipe or electrofusion. These connections must be made in accordance with the connection manufacturer's instructions. Some connections such as mechanical OD compression couplings may require a stiffener in the pipe bore.

- Installation:

  – Surface and above grade installations must be properly supported and must take thermal expansion and contraction into account. For surface and above grade installation subjected to freezing temperatures, lines may be insulated and heat traced. Heat tracing equipment should not exceed 120° F (49° C).

  – Suitable embedment soils are required to provide support around the pipe and embedment soils must be placed so that the pipe is properly surrounded in embedment materials. Compacted embedment is preferred.

- Typical Leak Testing:

  – Consideration for the type of service the system being subjected to pressure testing should be considered, Leak tests should be conducted using hydrostatic leak testing procedures. In general, the maximum allowable test pressure for leak testing is 150 percent of the pipe working pressure at the lowest elevation in the line; the maximum time allotted to conduct a leak test is 8 hours including bringing the line up to pressure, maintaining test pressure, and depressurizing. If leaks are found, the line shall be depressurized before repairs are made. Pneumatic testing, if required, shall be performed in accordance with ASME B31.1 or other applicable code. Hydrostatic testing of HDPE may be performed utilizing the Plastic Pipe Institute recommendations for hydrostatically testing HDPE. This allows for the expansion characteristics of HDPE and generally follows the rules and requirements listed in the following section of this manual:

    (1) Procedure for Hydrotest of Pipe

    All necessary precautions shall be taken to ensure the safety of persons and property while conducting leak tests. A faulty fusion joint, when pressurized, may immediately precede catastrophic separation and result in violent movement of piping or parts and the release of pipeline contents under pressure. Never approach or attempt to repair or stop leaks while the piping is pressurized. Faulty fusion joints cannot be repaired; they must be cut out and rejoined using proper heat fusion procedures.

- Disinfecting:

  – Applicable procedures for disinfecting new and repaired potable water mains are presented in standards such as ANSI/ AWWA C651, Disinfecting Water Mains. ANSI/AWWA C651 utilizes liquid chlorine, sodium hypochlorite or calcium hypochlorite to chemically disinfect the main. Disinfecting solutions must not exceed 12 percent active chlorine because greater concentrations can chemically attack and degrade polyethylene. After disinfecting, all disinfecting solution must be flushed from the system, especially from dead-end lines.

HDPE Underground Fire Main Systems

Joining and trench installations should follow the typical rules shown in this manual. However, because of the surge potential of firewater systems, the following requirements shall be observed:

1. When HDPE or PE piping is connected to an existing firewater piping system, the transition connection must be fully restrained utilizing manufacturer recommended flange adapters.

2. When long straight pipe lengths are pressurized, the Poisson effect will cause the length to shorten slightly. Although the overall length reduction is slight, the cumulative effect for a long length may be enough to cause pull-out of an unrestrained joint that is in-line with the long length. Anchoring the pipe in the ground can effectively control Poisson effect shortening. Conventional thrust blocks are not effective because they are designed to restrain fitting movement, not pipe movement. When the flow direction changes, a thrust force develops in the fitting and tries to move it away from the pipe but the Poisson effect moves the pipe away from the fitting. In cases where the HDPE pipe transitions to existing firewater piping, unrestrained joints in the existing firewater piping may be affected if the unrestrained joints are in-line with the PE pipe. In cases such as this, external restraints should be added to a number of the bell and spigot joints that are in-line with the pipe run or the PE pipe at the transition connection should be anchored.

3. If thrust blocks are utilized, the blocks must fully encapsulate the fitting. Conventional thrust blocks that bear against only part of the fitting surface may result in impingement loads that may cause future failures. Thrust blocks shall be installed in accordance with the piping drawings. Concrete thrust blocks shall not be poured over mechanical joints of any underground piping systems.

6.3 Piping Systems and Components Testing

6.3.1 Scope

This procedure describes the pressure test preparations, operations, and ANSI code requirements for piping systems and components to be pressure tested.

6.3.2 Procedures

- The Piping Superintendent shall be responsible for conducting the pressure test. The QC Inspector shall be notified in sufficient time prior to the test to enable the test to be witnessed. Hold points for client witness will be set as appropriate and identified on the CITP.

- The Piping Supervisor (or designee) shall be responsible to inspect for mechanical completeness, accuracy, and document acceptance on the prehydro acceptance form prior to calling for inspection.

- The SQM shall issue a "Release Form" verifying that all NDE is completed on the piping requested by the Piping Supervisor to be hydrostatically tested.

- Unless otherwise specified, test shall be hydrostatic using water.

- The Piping Supervisor shall create a sketch or utilize a P&ID to highlight and clearly identify the test boundaries of the system and the actual physical configuration.

- The test package shall consist of the sketch or highlighted boundary P&ID, piping pressure test form, and copy of the gauge calibration papers.

  Note: SQM and the Safety Department shall be notified prior to any pneumatic testing being performed. A job hazardous analysis (JHA) will be written prior to performing pneumatic testing.

- All weld joints, including nonpressure attachment welds, shall be left un-insulated, uncovered, and exposed for examination during the test, except that joints previously tested in accordance with ANSI may be insulated or covered. Project Engineering written approval shall be obtained before any insulated or covered (not exposed) welded joint that has not been tested, be tested with an extended hydrotest hold time as determined by the Project Engineer.

- Piping design for vapor or gas shall be provided with additional temporary supports, as necessary, to support the weight of the test liquid.

- Expansion joints shall be isolated from the test.

- Equipment not subjected to the pressure test shall be either disconnected from the piping or isolated by blinds or other means during the test. Valves may be used provided that the valve (including the closure mechanism) is suitable for the proposed test pressure.

- A flanged joint at which a blank is inserted to blank off other equipment during the test need not be retested after blind is pulled. A visual exam of the gasket (a new gasket must be installed) and a check for bolt tightness is required by Quality Control Inspection.

- Caution shall be exercised to avoid excessive pressure, and to prevent thermal expansion of the test liquid. Either a relief valve must be installed

or a person designated to watch for rising pressure and to bleed off the system as required until the test is completed.

- Where piping attached to a vessel and the vessel are subject to the same operating conditions, they may be tested together at the test pressure of the vessel with approval of the Project Engineer or his designee.

- Test pressure at any point in the system shall be not less than 1-1/2 times the design pressure of the system, unless otherwise specified. A calibrated test gauge shall be utilized to assure the test pressure is adequate throughout the system being tested.

- All pertinent test data and results shall be recorded on the pipe hydrotest record. This record shall be placed in the system turnover package. A copy should be kept in the pipe office as a backup.

6.4 Pipe Inspection Checklist

Perform all checks required in accordance with specification and the below listed items:

- Elevation, orientation, and flow.

- Hangers.

- Supports.

- Stand-offs.

- Welds.

- Witness test and sign-off by the Craft Supervisor in charge of the test.

- Notify all parties required to witness, verify, and sign as required.

- Maintain test reports and mark locations of test points on design drawings or sketches.

- Complete turnover data.

- Mechanically check each hydrotest package.

- Check post hydrotest items.

- Notify all parties required for post hydro inspection to verify and sign off on post hydro acceptance form.

6.5 Procedure for Hydro Test of Pipe

6.5.1 Pretest Check

Prior to hydrostatic testing, the Site QC Manager shall assure that the following activities are performed:

- Applicable contract design drawings are marked up to show all piping segments included in the test system.
- Notify all parties required to witness the test(s).
- Test procedures comply with the requirements of project specifications and the applicable codes and standards.
- Verification of chloride content of test water when testing stainless steel, if required.
- Verify safety precautions have been taken during the hydrostatic test.
- Walkdown of the piping system to be hydrostatically tested and verify that:
  - Sizes, material, and schedule of fittings and pipe are correct.
  - All supports, spring hangers, guides, shoes, and anchors are installed as shown on the contract design drawings.
  - All welds and PWHT have been completed and inspected.
  - Required NDE has been completed and evaluated.
  - Sizes, materials, and rating of valves are correct.
  - All valves are installed in the correct position.

    Note: Any welding on a hydrostatically tested line shall result in the line being retested, or an acceptable NDE performed as directed by the Project Engineer in writing to the SQM.

6.5.2 Test Preparation

- Confirm that pressure source and test gauge are upstream of any check valve. Check valve should have flapper removed or jacked up. (Pressure must be released downstream from the valve after test completion.)

- Verify that test blinds installed are the correct thickness.

- Verify that all items (such as control valves, relief valves, rupture discs, orifice plates, diaphragm instruments, expansion joints, etc.) that could be damaged during pressure tests have been removed or isolated as indicated on the pressure test flow diagram.

- Verify that equipment (such as filters) with internals that may be damaged during pressure testing is either blocked from the test or that the internals have been removed.

- Check all temporary supports that have been called for on the pressure test flow diagrams, piping arrangement drawings or spool drawings, to assure that they have been properly installed.

- Verify that equipment which must be included in field tests, (such as compressors); have been properly blocked off with the casing drain open.

- Check open and closed position of all valves.

- Check for proper installation of vents and drains.

- Confirm that pressure test gauges are calibrated, annually, as a minimum. Hydrotest gauges must be re-calibrated any time error is suspected. The validity of previous inspections must be assessed and documented when inspection, measuring or test equipment is found to be out of calibration. A gauge and instrument calibration tag shall be affixed to each instrument. The tag shall show the date of calibration and the date that the next calibration is due. Each piece of equipment shall be assigned an identification number, permanently attached to the piece of equipment. A gauge and instrument calibration record shall be maintained for each piece of equipment.

6.5.3 Testing

- Hydrostatic testing of the designated piping system during the entire period of testing shall be monitored and the following shall be verified:

  – The test is in accordance with accepted hydrostatic testing and procedures.

- Stops (test blocking) on variable support hangers are checked.
- Cleaning and filling of the piping system has been conducted in accordance with the applicable contract design documents, codes and standards.
- Fill equipment and test equipment are in accordance with the applicable codes and standards. All test equipment has been calibrated in accordance with applicable national standards.
- Pressure test gauges are 1-1/2 times greater than the intended test pressure.
- Calibration records are submitted.
- Pressure test gauge shall normally be located at grade near the test pump and have an isolation valve to prevent the gauge being subjected to a vacuum.
- Care is being exercised not to exceed pressure that is specified on the pressure test data.
- Test pressure and test duration is in accordance with the applicable contract design documents, code and standards.
- Pressure and temperature changes are recorded.

- When conducting a pneumatic test, it is essential that the safety precautions for pneumatic testing be adhered as outlined in the approved JHA:
  - Pneumatic test systems must include double-block valves with a bleeder valve between them to safely isolate the pressure source (by closing block valve and opening bleeder valve to the atmosphere) when incremental and final test pressures are attained.

6.5.4 Test Completion

- Exercise care in controlling the rate of drainage from vessels (in respect to inflow of air through the vent) to assure that a vacuum is not applied.
- **CAUTION:** Prior to commencing drainage, ensure that all vents are open with plugs and blind flanges removed.
- After drainage, remove all temporary blinds and blanks, temporary spools, supports and/or testing connections.

- Check that hydrovent and drain plugs are backwelded after hydrotest, where required.

- Reinstall all items that were removed for the test. Ensure that line specifications and/or P&IDs are being used when reinstalling these items.

- Remove all shipping bars from expansion joints.

- Remove stops from spring hangers and check cold settings.

Notes:

- Piping Department is responsible for installing test blinds and pressure gauges.

- Piping Department to apply test pressure as designated by the pipeline list.

- Piping Department shall communicate with QC Inspectors as to scheduled hydrotest in order to facilitate planning and reduce delays. The QC Inspector shall witness pressure and check paperwork for accuracy and begin start time for test.

- QC Inspector and piping department shall inspect the pipe and welds for leaks.

- Pipe Superintendent (or designee) and QC Inspector shall sign the hydrotest forms.

- Piping department shall remove the test blinds and test gauges.

- Piping Department shall drain and flush lines using test medium and dry internal piping and equipment, if so required.

6.5.5 Internal Inspection of Turbine Piping

Care shall be taken to assure that all turbine piping is received with suitable pipe caps installed and that the caps remain in place until time of installation. Just prior to installation, all piping to be connected to both gas and steam turbines shall be inspected internally by the SQM or his designee, Startup, or the equipment manufacturer's representative. This includes air intake, steam or water injection piping, water wash piping, fuel piping downstream of the fuel filter, as well as all lube oil piping. Piping subject to flushing, steam, or air blows (with the exception of lube oil) is exempt from this requirement.

The method of internal inspection of turbine piping shall be visual inspection where accessible. If direct visual inspection is not possible due to piping configuration,

borescope inspection shall be used. Required inspections shall be documented on a form for project QC records. Acceptance criteria shall be as noted on the form, or as accepted by Startup or the equipment manufacturer's representative.

Internal inspection of turbine piping in accordance with this policy is a Mandatory Hold Point and work shall not progress until all required inspections are completed.

6.6 Exhibits (Suggested Forms)

- Pipe Pre-Erection Inspection (CITP-15.006A).
- Pipe Erection Process Checklist (CITP-15.011A).
- Valve Installation Inspection (CITP-15.007A).
- Pipe Support Inspection Checklist (CITP-15.002A).
- Pipeline Accessories Inspection (CITP-15.008A).
- Flushing and Blowdown Report (CITP-009A).
- Pre-Pressure Test Inspection (CITP-15.003A).
- Line Check for Pressure Test.
- Hydrostatic Test Record (BVCI-04).
- Pressure Test Data Report (CITP-15.013).
- Piping Pressure Test Record.

7.0 Electrical

7.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, test, and document all work associated with electrical activities.

7.2 Scope

This procedure covers construction activities related to electrical and associated construction activities performed by BVCI or subcontract personnel.

7.3 References

- Project specifications.
- National Electrical Code (NEC).

7.4 General

7.4.1 Introduction

The Electrical Department or electrical subcontractor shall assure that cable and wiring are checked for continuity and systems are "rung out" to assure proper functioning during startup. Motor run-in programs to check rotation as well as a reasonable period of low load running shall be implemented to assure that motor problems are found in time to make corrections prior to startup. Underground conduit shall be installed in accordance with the specifications and the proper "red" concrete protective cover installed in accordance with code and specification if required. The quality of installation of underground conduit shall receive attention as to spacing, proper sweep at changes of direction, installation of conduit bank supports and encapsulation with protective concrete. Inspectors shall verify underground installations before concrete covering is added. They shall witness and sign-off when required for all acceptance.

7.4.2 Responsibilities

The Electrical Superintendent shall be responsible for ensuring that the work is in accordance with approved specifications, procedures, workmanship, and that the required tests are performed, and documentation is distributed and properly filed. All work shall be in accordance with project specifications.

The SQM is responsible for verifying that work is performed in accordance with project specifications and referenced documents. This shall be accomplished with the assistance of qualified electrical supervisors/craftsmen/inspectors who are responsible for

surveillance of site construction activities and associated documentation to assure all work conforms to job requirements and the requirements of this manual.

7.5 Procedure

Personnel shall observe safety regulations in accordance with project requirements. All construction activities shall be in accordance with project specifications.

7.5.1 Receiving and Storage

The Electrical Superintendent, or his designee, shall perform a visual inspection to assure the following:

- Check equipment for damage upon receipt at project.
- Verify proper factory assembly.
- Verify nameplate data against project specification requirements.
- Store reels in an orderly manner and separate according to wire size and type of insulation.
- Assure quality standards for insulation resistance; tape the end of the unused cable or otherwise seal it before it is returned to the storage area, to prevent moisture from entering.
- Notify Quality Department of any irregularities encountered when receiving material.

7.5.2 Installation

- Protection devices designed to provide enclosure integrity shall be properly installed.
- All electrical equipment shall be set, installed, or erected in accordance with the design and manufacturer's drawings and applicable instruction manuals.
- Shipping or equipment protective devices shall be removed prior to installation.
- The equipment shall be protected from lifting slings and proper measures shall be taken to prevent damage during relocation of the equipment from storage to permanent position.

- Equipment shall be set carefully over anchor bolts and stub-outs and properly aligned and checked for level, plumb, and proper elevation, and then secured tight. Conduit knockouts shall be removed, as required.

- After installation the equipment shall be inspected for cleanliness and paint damage and proper identification.

- Temporary protection from falling objects or other hazards shall be provided, as necessary.

- Final installation inspection shall be performed by the Electrical Superintendent and/or startup personnel and, if complexity of installation warrants, the vendor electrical specialist or other electrical specialist.

- Cubicles shall be inspected for proper installation, number, and location as shown on the construction drawings.

- Factory internal wiring shall be visually inspected for broken wire and loose connections.

- Nameplates shall be correct and installed properly.

7.5.3 Prepour Inspection of Underground Conduit and Cable

- Prepour inspection shall be performed by the cognizant Craft Superintendent (or designee) prior to calling for the Inspector.

- Inspection shall be performed to assure that excavations are safe, that subgrade is at the proper elevation, and that concrete clearances and mix are in accordance with specifications and drawings.

- Underground duct runs shall be verified against installation drawings for accuracy of duct run location, slope, underground obstructions, conduit number, and size for respective duct run.

- Conduit shall be inspected to assure that it is installed straight and that rebar and conduit are properly secured.

- Cuts in metal conduit shall be reamed and dressed on the inside to provide a smooth surface for pulling cables.

- PVC conduit shall be checked to ensure that no cracks or broken areas exist and that all joints are properly cemented.

- Underground splices or taps for grounding shall be inspected for accuracy of wire size, number, and location.

- Electrical Superintendent (or designee) shall document performance of prepour inspection by initialing and dating the appropriate line on the pour card.

- Location and elevation of pour to be checked and acceptance documented on the concrete pour card by initialing.

- The Electrical Superintendent (or designee) shall assure that the cable pulling equipment is adequate and in good condition, without sharp corners or other such conditions which would cause abrasions to the cable jacket. When required, strain gauges for measuring pull loads on cables shall be properly calibrated and properly placed as to obtain accurate readings.

7.5.4 Proper Grounding

The Electrical Superintendent shall assure that all equipment that requires grounding is accomplished in accordance with details. All grounding cable is protected and metallic surfaces must be clean before connecting. Grounding grids shall be installed in accordance with the engineered drawings and/or applicable equipments drawings. The SQM shall assure that grid inspections are performed prior to backfill and/or slabs are poured.

7.5.5 Cable

A thorough visual check for shipping or manufacturing defects and conformance to purchaser order shall also be done at time of receipt.

Prior to making a cable pull, the Electrical Supervisor shall ensure the cables are checked for proper number, length, size, type, insulation, shields and jackets, voltage rating, correct identification in accordance with drawing, and the fill requirements do not exceed NEC specifications. The raceway system is substantially complete, blown, or swabbed clean and that there are adequate pull points installed in the system.

7.5.6 Cable Trays and Conduit

The Electrical Superintendent shall:

- Assure that trays are properly identified in accordance with drawing and routing of tray is correct. Assure that hangers and supports for trays are properly installed and supported. Inspect cable tray rungs and cable supports for sharp projections, such as metal slivers or galvanizing defects that may damage cable jackets during pulling operations. Assure trays are grounded in accordance with requirements. Cable trays shall meet the requirements of the NEC.

- Inspect conduit and trays to assure that they are installed true, level, and plumb, securely fastened, and check that all joints are tight.

- Assure that conduit and supports are installed in accordance with drawing, have correct clearances, and meet the requirements of the NEC. Underground conduit ends shall be closed at end of daily shift during construction to assure cleanliness.

7.5.7 Overload Relays, Circuit Breakers, and Fuse Holders

Overload relays and circuit breakers required by plan (type/mark/model/size) shall be installed and adjustable ones arc set to value required. Fuse holders shall be the correct type.

7.5.8 Insulation Resistance and Continuity

Insulation resistance and continuity tests shall be monitored. Proper documentation of tests must be adhered to. Underground and aboveground cables shall be "meggered" after installation to assure compliance with specifications. The electrical supervisor shall witness these tests and sign off on the appropriate document.

7.5.9 Proper Interconnecting Wiring and Wire Markers

Interconnecting cable shall be the proper type, connected and correctly marked in accordance with specification and drawings. Installation is the responsibility of the Electrical Superintendent and is verified by the project startup team.

7.5.10 Terminal Lugs and Connections

Terminal connections shall be the correct size and type and properly tightened in accordance with specifications. Random sample checks shall apply.

7.5.11 Mounting

Equipment shall be properly mounted, aligned, and clearances are correct. Bushings are installed at J-boxes, fittings, or other enclosures.

7.5.12 Routing Check

Cables are properly routed and identified with identifying tags terminal to terminal. All of the above are to be checked by electrical supervisor.

7.5.13 Testing Records and Documentation

Electrical testing and records shall be documented on appropriate forms. Any acceptance form not provided by site-specific field quality control plan must have the approval of the

Project Engineer or his designate prior to use. Where hi-pot testing is required, BVCI or a designated subcontractor shall perform all required testing on cable, motor switchgear, motor controls, transformers, and grounding. All required testing shall be witnessed by the Electrical Superintendent or his designate. All test documentation shall be transmitted to client in a system turnover package upon job completion.

7.5.14 Welding

Welding of electrical components and supports shall fall within the same requirements as all other welding on a project as far as welder qualifications and inspections are required. The exception being the welding and qualification of aluminum welders for isophase and buss welding. Welders welding on electrical aluminum can be qualified visually as outlined in the welding manual. The isophase manufacturer shall be checked for any additional requirements, and/or recommended welding techniques.

7.5.15 Summary

The Electrical Superintendent (or designee) shall inspect all work for conformance to quality standards, including all welding of structural attachments for conduit and other electrical devices prior to notifying the SQM for request for inspection. The Electrical Superintendent shall assure that all inspections as indicated in the electrical section, project specifications, drawings, etc., have been performed, witnessed by Electrical Superintendent as required, and documented. All documentation shall be turned over to the SQM upon completion or as directed by the Startup Manager for incorporation into the system turnover packages.

The Electrical Department shall assure all electrical work is in compliance with drawings and specifications.

7.6 Exhibits

Other forms may be necessary as required to provide adequate proof of required inspection by the client. These shall be generated by the Electrical Department and/or subcontractor in the case of specialty work and approved by Quality Control:

- Pole Lines Checklist.
- Grounding Checklist.
- Grounding Test Report.
- Switchgear Test Record.
- Switchgear Circuit Breakers Test Record.

- Insulation Resistance Test and CD High-Voltage Test on Electric Cables and Wires.
- 600 Volt Motors Test Record.
- AC Medium Voltage Motors Test Record.
- Battery and Charger Test Record.
- Conduit Checklist.
- Seals and Drains Checklist.
- Cable and Wire Checklist.
- Cable Trays Checklist.
- Lighting Checklist.
- Cathodic Protection Inspection (CITP-13.002A).
- Grounding Inspection Checklist (CITP-16.001A).

8.0 Instrumentation

8.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, test, and document all work assBVCIated with instrumentation activities. This procedure defines instrumentation as those devices that are required for monitoring, recording, and control of processes by manual and/or automatic methods including levels, flow, pressure and temperature.

8.2 Scope

This procedure covers construction activities related to instrumentation and associated construction activities performed by BVCI. Final acceptance will be performed by the project startup team. All work is to be monitored and audited by the QC Department.

Subcontract instrumentation work shall be governed by the subcontractor's approved QC Manual. Subcontractors are responsible for quality control inspection of their work and shall be audited by quality control instrumentation inspection. Final acceptance of work shall be by project startup personnel.

8.3 References

- Project specifications.
- Manufacturer's manuals and recommendations.

8.4 Procedure

8.4.1 Material Receiving

BVCI or subcontract personnel shall receive, inspect, unload, and store all instrument material to be used in accordance to the manufacturer's requirements.

BVCI or subcontract personnel shall unload and deliver all instrumentation materials for use by BVCI instrumentation or subcontractors to the warehouse section designated for instrumentation or subcontractor use. BVCI or the subcontractor shall receive and inspect all material to assure there are no damaged or missing components and that the necessary supporting documentation is received, i.e., certified calibration data, nameplate data, and manufacturer's technical manuals. The specified dimensions of orifice plates shall be verified using a micrometer and tagged to indicate that they have been checked. The material shall then be stored in a weatherproof environment, such as a warehouse. The distributed control sysem (DCS) must be stored in a controlled climate and the CEMS require temporary power for the air conditioning units.

Quality Control Department shall be notified of any material received, which may require separate verification.

8.4.2 Responsibilities

BVCI or subcontractor supervision shall be responsible for ensuring that work is in accordance with approved project specifications, procedures, standards, drawings, and engineering directives. Instrument storage, checkout, and calibration shall be in accordance with project specifications, subcontractor QC Manual, and/or manufacturer's recommendations.

The SQM and/or his designate are responsible for verifying that work is performed in accordance with the approved project specifications and referenced documents.

8.4.3 Installation

All instrumentation installation activities shall be performed and in compliance with the project specifications.

All instrumentation within the subcontractor scope of work, as defined by the Responsibility Matrix, shall be installed and tested in accordance with the responsible parties QA/QC Manual. QC checklists as indicated in the exhibits may be used to document inspections.

The following list contains some of the quality attributes that are to be inspected and verified by construction, site QC Inspectors, or subcontractor QC supervision as applicable. The QC Inspector shall perform in-progress monitoring to assure compliance with the following:

- If calibration is in the scope of work, it shall be performed in accordance with the project specifications. A calibration tag shall be attached to each instrument after calibration and a log maintained by the calibration personnel.

- Local instrument stands and mounts shall be fabricated and installed true, level, plumb and securely fastened.

- Local instruments shall be securely mounted on stands in accordance with drawings and specifications, unless otherwise noted.

- Instrument supports shall not be welded to tanks, vessels, piping, equipment, or the top run of handrail (and shall be offset 3 inches if attached to handrail).

- After mounting, each instrument shall bear the identification tag or instrument number.

- Instrument tubing/piping shall be checked for proper material, size, and makeup and installed to allow proper headroom and prevent tripping hazards. All tubing bends with connections to instruments, equipment and in-line fittings shall not be cross-threaded and all connections shall be made airtight.

- Instrument tubing/piping shall be routed in such a way to not block access to other equipment and can be readily serviced. Tubing shall be located where it is least likely to be damaged.

- Makeup of compression fittings shall be monitored to the extent necessary to assure tubing is cut square and de-burred as required, ferrules installed, tubing fully inserted, and not overtightened (approximately 1-1/4 turns past fingertight).

- The installing contractor shall perform all inspection work indicated in the control systems inspection criteria, specifications, drawings, etc., for the work which they have installed. These inspections shall be monitored/audited by startup personnel. Some of the inspections that may be audited include the following:

  – The installation, check, and the operation of the complete control system shall be in accordance with project specifications, standards, and drawings.

  – Instrument equipment, systems, and material shall be visually inspected upon arrival at jobsite for shipping damage, compliance with purchasing agreement, quality, and workmanship.

  – Bench calibration of controllers, transmitters shall be as specified in project documents or manufacturer recommendations.

  – Instrument air, blowback headers, and block valves shall be installed.

  – Correct elevations, orientations, and mounting of instruments shall be checked.

  – Field installation of controllers and transmitters.

  – The location and support of lines.

  – Vibration monitors.

  – Thermocouples and resistance temperature detectors (RTDs).

- Rotameters, turbine meters, and magnetic flowmeters.
- Orifice plates.
- Cleaning and testing of instrument air and blowback systems.
- Panel mounted instruments.

- Checkout testing of instrument assemblies for panel consoles and third party package units shall have been done prior to shipment to jobsites.

- BVCI and/or their subcontractors shall be responsible for maintaining any "as-built" documentation necessary to perform final loop checkout and turnover. Instrumentation subcontractors have the responsibility to maintain and turn over a complete set of "as-built" loop folders (drawings, data sheets, etc.) in compliance with project specifications.

8.4.4 Turnover

- Instrumentation inspections for acceptance shall be performed in accordance with the "Loop Checkout Procedure" and the project specifications.

- The loop checkout and turnover procedure is established to provide a uniform tracking structure and a central information collection point for each cost schedule area. The basic installation and field physical methods are not intended to be altered. The Project Engineer or his designee is responsible for the development of loop folders containing documents necessary to achieve field sell-off. The loop folder shall be maintained by the installing contractor's project manager until mechanical completion and sign-off by the startup personnel and system turnover, at which time the folders shall be transmitted to the SCM. The assembly of a loop folder allows early organization and identification of inspection hold points.

- If instrument work is subcontracted, the instrument subcontractor shall pursue standard construction practice during all erection and testing phases. The instrument subcontractor shall maintain loop status and prepare the individual loop sell-off acceptance forms. The completed form shall be included in the turnover system package(s).

- Instrumentation Subcontractor Manager (or designee) shall notify the startup personnel of loops ready for inspection and turnover. Upon completion, the QC Inspector and/or startup personnel shall sign the acceptance sheet or advise the Instrument Manager of any relevant items outstanding by means of a punch list.

- Punch lists shall be forwarded to the craft involved by way of a copy to the appropriate superintendent. Mechanical exceptions shall be cleared by the craft and upon completion of outstanding items, the SQM (or designee) to reinspect the loop for acceptance.

- Revisions by engineering to loops mechanically complete and turned over to the client shall require a new folder marked "revision" and the entire loop turnover procedure repeated. The original loop folder shall be attached to the revised loop folder:

  – If part of an instrument loop is revised prior to turnover, a new instrument loop drawing (if loop drawings are applicable to the project) shall be made or the existing instrument loop drawing shall be revised. This new or revised loop drawing shall comply with the requirements of project specifications.

- Punch List and Exception List:

  – The Site Quality Inspector or his designate shall issue to the SCM and the Subcontractor Project Manager, a list of items found to be incomplete during an inspection. This list shall receive full distribution and be tracked by the Instrumentation Superintendent.

  – The list shall be worked in conjunction with the requirements of the contract dealing with project completion. The outstanding punch list (deficiency) items shall be surveyed by the crafts, alerting the Instrument Superintendent of long-range completion items due to engineering information or material. The Instrument Subcontractor Superintendent in conjunction with the Project Engineer and/or the QC Inspector shall determine if the item(s) shall be an acceptable exception to the subcontract. If approved as an exception, the item(s) shall be upgraded from a deficiency to an exception status, which does not relieve the craft of responsibility to expedite correction.

  – Any work involved in the completion of an exception item in a loop that has been turned over to the client must be scheduled through a client operations representative since the parent loop is under their care, custody, and maintenance.

- When installations are mechanically complete, the crafts shall initiate an internal inspection to check the physical installation to assure compatibility with the most recent drawing issue. This shall be monitored by startup personnel. During this check, an internal craft punch list shall be generated to identify outstanding items. The craft shall complete those items required to make the installation complete.

- During the checkout activity, startup personnel shall audit or witness the required testing and functional activities performed by BVCI or subcontractor. Discrepancies found that are not corrected during loop checkout shall be listed on a punch list.

- Startup personnel shall sign off on those items or activities accepted during system checkout. A discrepancy punch list of activities rejected, or conditionally accepted with cosmetic repair/work remaining, shall be generated for the loop. These punch lists shall be maintained by BVCI or the instrument subcontractor until all items are repaired and accepted.

8.5 Exhibits (Suggested Forms)

- Calibration Tag (BVCI-02).
- Calibration Control Log Sheet (BVCI-01).
- Instrumentation Loop Checkout and Acceptance Form (P10-02).
- Loop Acceptance (P10-03 Rev. 2).
- Instrumentation and Controls Inspection (CITP-17.001A).

9.0 Paint

9.1 Purpose

The purpose of this guideline is to assure that the surface preparation and painting for field painted items shall be complete and conform to project specifications, drawings and standards.

9.2 Scope

This guideline covers the field surface preparation and painting in general. Specific requirements are stipulated in the project specifications.

9.3 References

- Project specifications.
- Manufacturer's recommendations.
- Structural Steel Painting Council (SSPC).

9.4 General

9.4.1 Responsibilities

The Craft Supervisor is responsible for ensuring that the work is performed in accordance with project specifications.

The SQM is responsible for verifying that the work is performed in accordance with the approved project specifications, and this manual.

9.5 Procedures

9.5.1 Materials and Storage

Material shall be received in the paint manufacturer's original containers bearing the brand name and brand number identification.

Material for painting shall be stored in accordance with manufacturer's recommendations and jobsite safety procedures.

9.5.2 Application

The QC Inspector shall perform all inspections necessary to verify that painting and coatings conform to project specifications. Inspection shall include the following:

- Surface preparation is in accordance with project specifications, and prepared as specified by the coating manufacturer.
- Surfaces to be coated or painted shall be cleaned with the applicable cleaning method as described in Chapter 2 of the SSPC.
- Where the manufacturer requires a surface profile and no additional information is specified, the surface shall be prepared in accordance with SSPC 6 (commercial blast) as a minimum.
- Any abrasive blast cleaning operations performed in the field shall be located as far as possible from permanent plant equipment and personnel. When a remote area is not possible, then adequate protection of equipment and personnel shall be provided.
- Silicon based abrasives shall not be used for blasting operations in the field.
- Paint is applied in accordance with project specifications and manufacturer's recommendations, including environmental conditions that would restrict application. Additional application requirements as specified in SSPC PA.1 shall apply.
- Mill thickness is verified. Dry film thickness is in accordance with project Painting specifications and SSPC PA.2
- Surface temperature is within limits of manufacturer's recommendations.
- Surface is free from moisture and humidity is within limits of project specifications
- Wind velocity is within limits if spray painting. Spray painting requires specific approval from SCM prior to use.
- Application techniques are in accordance with project specifications for the paint being used.
- Safety policies are adhered to.

- Intermediate coats are properly cured before next coat is applied. Time between coats is also verified so as not to exceed manufacturer's recommendations.

- Paint adhesion is acceptable.

- Daily humidity test are conducted and documented. If the humidity is too high, no paint shall be applied that day.

The scope of painting or coating, including exclusions and exceptions, shall be as shown on drawings or in specifications. The following items shall not be painted unless specifically addressed to do so:

- Piping, ductwork, or boiler skin to be insulated.

- Galvanized steel or pipe.

- Aluminum or stainless steel.

- Glass.

- Plastic.

- Concrete.

- Equipment, instruments, and devices provided with the manufacturer's standard finish.

- Weathering steel.

9.5.3 Underground Pipe Protection (Coating and Wrapping)

- Underground pipe protection shall be performed in strict compliance with the manufacturer's and site specifications, especially in the application at welded joints and irregular shapes (such as valves, pipe ells, tees, etc.).

- The coating and wrapping for underground piping protection is verified by applying sufficient electrical potential (jeeping) to the outside of the pipe to detect defects or discontinuities in the coating.

- Verifications should be made while the pipe is still on skids aboveground.

- Additional electrical verifications are made at the time the pipe is lowered, especially at those places where the pipe has rested on skids. All defects disclosed shall be repaired immediately and documentation of the systems or parts of systems have tested shall be maintained. This can be accomplished with a "weld map" type of document or marked up drawings.

- Underground pipe backfill release, Exhibit No. P1-04, is used when coating inspection is complete.

- Coated pipe shall be handled at all times with wide canvas/nylon slings.

- During embedment and backfill operation, coated pipe shall not be damaged.

- Inspection and acceptance forms shall be verified for accuracy and completeness.

- Joints requiring a hydrostatic or pneumatic test shall not be coated or wrapped until after a successful completion of the test(s).

9.5.4 Equipment

Equipment received with finish paint or primer already applied shall be inspected for damage. Should corrective action be necessary, work shall be in accordance with approved specifications for the original paint for the equipment.

9.5.5 Material Disposal

Container disposal must be followed in accordance with environmental protection-waste management specifications.

9.6 Exhibits (Suggested Forms)

- Site Inspection of Supplier Applied Coated Equipment (CITP-9.001A).

- Release to Coat.

- Surface Preparation and Coating Inspection.

- Field Applied Coating Checklist - Metals (CITP-9.002A).

- Field Applied Coating Checklist - Concrete and Masonry (CITP-9.003A).

- Field Applied Coating Checklist - Architectural (CITP-9.004A).

10.0 Insulation

10.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, and document receiving, storing, and installation of insulation.

10.2 Scope

This procedure covers construction activities related to insulation and associated construction activities performed by personnel and/or subcontractor(s).

10.3 Reference

- Project specifications.
- Manufacturer's reference standards.

10.4 General

10.4.1 Introduction

A thorough understanding of the project specifications serves as the best guideline to quality control of insulation. Materials are inspected and verified upon receipt and stored to assure good installation condition. Craft supervision monitors operations closely to see that materials are handled carefully and fitted properly. Close fit tolerances are critical in the case of cold insulation.

10.4.2 Responsibility

The Insulation Superintendent shall be responsible for ensuring that work is performed in accordance with project specifications.

The SQM is responsible for verifying that work is performed in accordance with the approved project procedures and referenced documents

10.5 Procedures

Insulation materials and installation shall be as specified in the project specifications.

10.5.1 General Guidelines

- All safety regulations for the removal and abatement of any insulation containing asbestos shall be followed by BVCI personnel and/or subcontractor.

- A release form shall be initiated by the Insulation Superintendent to release systems or areas for insulation and signed off by the various Superintendents that their work is complete and ready for insulation. This form shall then be presented to the SQM for final sign-off to release the area for insulation.

- Surface to be insulated shall be clean of oil, grease, dirt, debris, moisture, etc.

- Verification performed that all equipment and piping have been properly painted before insulation is applied.

- Unless otherwise specified, insulation work shall not be started prior to the completion of hydrostatic or pneumatic tests.

- Where double layer insulation is called for, the joints in the second layer shall be staggered with respect to the joints in the first layer. Inner layers shall be properly tied off prior to installing any subsequent layer in multi-layer insulation.

- Insulation and final coverings shall be closely fitted around structural support attachment projecting through the insulation. Insulation voids in these areas shall be filled with bat type insulation and/or cement. The openings in the final covering shall be scaled off, unless otherwise specified.

- Insulation shall be stopped short on both sides on insulated and uninsulated flanged joints and unions a sufficient distance to permit removing bolts or breaking unions without damaging the insulation, unless otherwise specified.

- At the juncture of insulation and piping or equipment, the insulation shall be finished off at a 45 bevel.

- Where wires are used for insulation ties or lacing, they shall be drawn taut to embed them flush with the face of the insulation, firmly twisted, the excess ends cut off, and the twisted ends bent over and imbedded in the insulation.

- Correct wire ties or bands shall be used. Where bands are used for insulation ties and final coverings, they shall be machine stretched and sealed to remove slack only.

- Inspection port kits shall be installed where required.

10.6 Exhibits (Suggested Forms)

- Release for Insulation (CITP-15.004A).

- Insulation and Lagging Inspection (CITP-15.005A).

- Inspection Record - Piping Insulation.

11.0 Equipment

11.1 Storage and Preventive Maintenance for Equipment

11.1.1 General

This procedure is to provide guidelines for preservation and maintenance of received equipment until turned over to the client.

The Mechanical/Millwright Superintendent is responsible for assuring the proper storage, preservation, and maintenance of all mechanical equipment, both rotating and non-rotating, including applicable tanks and vessels assigned to his work. He shall maintain the documentation on this activity and submit it to the SQM for project QC records.

The Electrical Superintendent is responsible for assuring the proper storage, preservation, and maintenance of all electrical equipment and motors.. He shall take the same responsibility for instrumentation devices including control valves until the arrival of the Instrument Superintendent. The Electrical Superintendent shall maintain the documentation on this activity and submit it to the SQM for project QC records.

The Piping Superintendent is responsible for assuring the proper storage, preservation, and maintenance of piping and valves.

11.1.1.1 Receiving. Upon arrival of a piece of plant equipment, materials handling personnel shall receive and have a designated knowledgeable person provided by the applicable craft discipline superintendent to inspect the equipment for possible damage and/or shortages. The Craft Superintendent for whom the equipment or material is assigned, shall supply a person to perform inspections for compliance to project requirements upon receipt, as well as perform the preservation and maintenance requirements. Quality Control shall be notified of the arrival of equipment and permanent plant materials so that inspections can be performed. Exhibit CQC - 10-01, Material/Equipment Receiving Log**.**

11.1.1.2 Inspection.

- Receiving and identification--As each item is received, it must be identified and checked against the appropriate specification and purchase order by warehouse personnel and the Craft Representative. When vendors have not properly identified the items by numbers and tags, then field applied permanent tags must be attached. The use of chalk or paint is unacceptable because they deteriorate and are easily obliterated or painted over.

- Initial maintenance--Some mechanical equipment arrives at the jobsite with a vendor-applied preservative, as specified on the purchase order or

equipment specification. The preservatives must be inspected for proper application and any shipping damage and/or deterioration. The initial maintenance procedure may vary with the different types of equipment; however, the main purpose is to prevent any damage during prolonged storage.

- Storage--Material and equipment shall be stored in accordance with the manufacturer's recommendations. The SCM shall designate appropriate lay-down and storage areas provide necessary enclosures, weather protection, and dunnage. Equipment should be protected against extreme heat or cold, wind, water, dust, and sand. Space shall be provided in a well drained and level area for outdoor storage. The components must be placed on a sufficient number of properly leveled blocks or dunnage to prevent distortion until placed at final service location. The components may be enclosed with a temporary weatherproof structure. Extra care and caution must be used while storing equipment under plastic film (polyethylene) due to climate changes. High humidity causes moisture to condense on and in the components, which could result in the breaking down of the preservative and the formation of rust. All miscellaneous erection materials (bolts, gaskets, lubricators, etc.) shall be stored to assure weatherproofing and in a retrievable manner.

- Routine inspection and maintenance--Inspections shall be made at regular intervals and renewal of the preservatives shall be accomplished when necessary. This inspection program shall maintain accurate records documenting the work done to protect each equipment item. This documentation shall be submitted to the SQM for the project QC records.

- Direction of rotation--A check shall be performed on rotating equipment to assure that the direction of rotation is adequately indicated.

11.1.1.3 Specifications.

- Warranties/recommendations--When available, manufacturer's recommendations shall be followed for methods of storage. When manufacturer's recommendations are not available, the Project Engineer or his designee shall provide direction for storage recommendations.

- Lubrication--Manufacturer's recommendation (when available) shall be followed for type of lubricant to be used. The client should recommend preferred lubricants (brand).

- Secure openings--All external openings on equipment left unsecured shall be covered with blinds where flanged. Plugs/caps of similar material shall be used on all other openings.

11.1.1.4 Lubrication.

- Oil reservoir--Check that all oil reservoirs are filled to the proper level with approved and/or recommended lubricants.

- Grease fittings--Although not a routine inspection, grease fittings shall be checked as directed and the appropriate lubricant shall be used to provide proper maintenance.

11.1.1.5 Protective Covering.

- Crated/boxed equipment--Equipment that is received in a crated or boxed form shall be recrated or boxed, if necessary, after inspection, and stored in a sheltered environment or covered, if remaining outside.

  Note: For outdoor storage, wrapping equipment in plastic should be avoided due to moisture condensing inside the plastic. A raised tent over the equipment is the preferred method, when practical.

- Exposed metal--All exposed metal surfaces of a critical nature, such as shafts, couplings, flanges, etc., shall be coated with rust inhibitor and wrapped with wax cloth. (Type of inhibitor to be specified).

- Weather sensitive equipment--Any equipment of a critical nature that may be sensitive to weather exposure shall be stored in the construction warehouse or in some type of covered environment to protect it from moisture damage.

11.1.1.6 Rotating Equipment.

- Maintenance--Physically rotate the shaft of a piece of equipment twice weekly, if required by manufacturer's recommendation and/or project specification. Rotate approximately 3 to 4 turns, stopping 1/4 turn from last mark setting. Applicable exhibits for recording maintenance activities shall be found at the end of the section. Note: Not following the manufacturer's recommendations could negate the factory warranty.

- Contamination--During the rotation process, an inspection shall be performed to detect any possible contamination of the lubricant. In the event of such contamination, the bearing housing shall be drained and flushed and new lubricant shall be installed. Spot analysis of oil starting on 45 day period, may be extended if 45 days does not indicate problems.

- Electric motors--Indoor storage is required for all motors, except motors designed for outdoor use. These motors may be stored outdoors without protective covering. These are generally XP, IE, TEFC, and TEWAC,

motors. All motors, 5 horsepower and above, shall receive a maintenance megger in order to assure windings are dry, when received and in accordance with the manufacturer's requirements. If space heaters are furnished within the units, they shall be connected to a continuous supply of power of the proper current/voltage rating. After installation at the final service location, motors with oil lubricated bearing shall be protected. Exhibit CQC 10-04, equipment protection, motor data, may be used to document the maintenance activities as follows:

– Oil lubricated bearings: Plug, cap or blind vent and drain connections as applicable using steel fittings. Do not grease bearings of electric motors unless specifically required by the manufacturer's data. The internal surfaces shall be coated (by filling, sloshing, spraying or rotation as appropriate). Any contaminants observed during routine rotation checks/45 day analysis shall require draining flushing and refilling with clean oil.

- Shafts and couplings--Clean shafts, couplings and exposed machined surfaces with solvent and coat with exterior rust preventive, if not already coated. Turn shafts twice weekly, 3 to 4 revolutions, stopping 1/4 turn from last mark, and renew rust preservative, if necessary.

- Grease lubrication--If grease lubricated units are at worksite more than 6 months from the date of shipment without having been operated, inspect the bearing grease for any visible deterioration of the lubricating properties of the grease. If the grease shows signs of deterioration, grease should be pumped out and unit refilled with clean grease.

- Nitrogen blanket--Equipment that is received with, or that requires a nitrogen blanket, shall be inspected a minimum of twice weekly to ensure continuity. Should a deficiency be found, the Millwright Department representative shall be notified to correct the situation.

11.1.1.7 Record Retention. An Equipment Maintenance Record for each piece of equipment requiring weekly maintenance shall be filled out at the time of such maintenance and initialed by the craftworker performing the work. It is recommended that the log be enclosed in a watertight plastic envelope and attached to its respective equipment.

The information as logged on the maintenance form for each piece of equipment shall also be logged on a Master Preventive Maintenance Log and retained by the Millwright Superintendent until equipment is turned over.

11.2 Procedure for Preservation of Rotating, Reciprocating, and Miscellaneous Equipment

11.2.1 Scope

These procedures apply to all rotating, reciprocating, solids handling, and miscellaneous equipment received for immediate storage prior to installation at permanent location, during the construction period and prior to the commissioning phase. Two categories are treated: (1) Electric motors not approved for outdoor storage; and (2) All other equipment including motors approved for outdoor storage.

11.2.2 Time Period Covered

Equipment preservation as specified herein begins within 5 days of receipt and continues, uninterrupted, until equipment is turned over to client for commissioning. Operating lubricants shall be installed prior to the commissioning phase unless otherwise specified.

11.2.3 General Requirements

11.2.3.1 Electric Motor Lubrication. Oil lubricated motors shall be filled with a manufacturers recommended oil immediately after receipt and/or placing in storage or on base. This oil shall be flushed and replaced if water is detected in the oil. Grease lubricated bearings shall be inspected at time of receipt and lubricated, if necessary. The grease shall be checked every 3 months and additional grease added if necessary. Grease to be used shall be at manufacturer's recommendation or instruction. Manufacturer's instructions shall be strictly followed as serious damage to motors can result from improper lubrication.

11.2.3.2 Specifications.

- Equipment Not Approved for Outdoor Storage:
  - Electric motors--Motors shall be stored indoors in a selected area of the warehouse or other suitable covered area. If equipped with electric heaters, the electric heaters shall be connected on appropriate power source provided in the storage area. Insulation values shall be recorded within 3 days of receipt. Every 3 months thereafter, until installation in the plant, insulation resistance values of all units rated at 2300 volts or higher shall be measured and recorded and every 6 months for all units rated below 2300 volts. If resistance is low, the SQM shall be notified for further action/instructions.

    Note: Proper warning signs shall be installed to prevent injury to personnel or damage to equipment possibly caused by mishandling of "electrically" hot equipment.

– Equipment--Couplings and exposed machined surface shall be coated with a rustproof compound spray.

- Equipment Approved for Outdoor Storage:

  – Electric motors--Motors approved for outdoor storage shall be stored at least 1 foot above grade to prevent flooding, mud contamination, or rodent entry. Insulation resistance values for each winding shall be checked and recorded. For equipment with ratings of 2300 V or more, this procedure shall be repeated every 3 months thereafter until installation in the plant. If resistance is low, the SQM shall be notified for further action/instructions. Space heaters shall be connected to an appropriate power source. Proper warning signs shall be installed.

  – Rotating Equipment Excluding Motors--All exposed machined surfaces shall be cleaned with suitable solvent and coated with rustproof spray compound.

  – Compressor, Gear, Pump, and Turbine Internals--Nitrogen purge may be required. This requirement shall be determined on a case-by-case basis and OEM recommendations.

    Bearing brackets and gear cases shall be flushed with manufacturer recommended oil until clean, if required. The indicator shall be filled to the correct level. The shaft shall be turned 3 to 4 times, stopping at 1/4 turn from last mark setting.

    If mechanical seals are designed integral with the pump, the indicator shall be filled to the correct level with manufacturer recommended oil. If a turbine is shipped with carbon rings installed, these shall be removed and stored. Rings shall be reinstalled just prior to startup. If chain drives are exposed, chains shall be removed; the chain shall be coated with rustproof spray. Chains shall be wrapped with Kraft type paper, labeled for identification, and stored.

    There may be additional requirements for centrifugal compressors, blowers and gas turbines.

    Owner/or manufacturer representative shall be consulted to determine if additional intermediate shaft supports are required and shall be provided as necessary. Spare rotating elements shall be stored in accordance with manufacturer’s specific instructions (all indoors).

– Reciprocating Pumps and Compressors--Compressors shall be stored with integral coolers with drain valves closed. Drain valves shall be opened weekly to check for condensate buildup. Chains shall be removed, if exposed; coated with rustproof spray; wrapped in Kraft type paper; and stored. If a pump is received with service packing installed, it shall be removed and repacked prior to commissioning/startup.

– Proportioning and Metering Pumps--The drive mechanism shall be flushed with manufacturer recommended oil until clean. The indicator shall be filled to the correct level. The drive shaft shall be rotated 3 to 4 turns twice weekly, stopping at 1/4 turn from last mark setting.

– Reciprocating Compressors--Protective covers on openings in the cylinders and crank case shall be inspected when the compressor is received onsite. Damaged covers shall be repaired or replaced. If water or dirt has entered the equipment, the equipment shall be cleaned out and all machined surfaces shall be rechecked. If the compressor requires field assembly, protective coatings shall be removed and all parts cleaned, including crank case. For assembly, rustproof spray shall be used to freely coat cylinder walls, valves, rods, bearing, and rubbing parts. Carbon pistons, carbon rings, or rod packing shall not be installed until the compressor is serviced for initial operation. The crankcase and lubricators shall be filled with recommended oil. Valves shall not be installed. An approved rust preventive shall be used to coat. Kraft type paper shall be used to wrap equipment, label for retrieval, and store in a warehouse. Twice weekly, the force feed lubricators shall be cranked and the drip feed lubricators opened. If the compressor has a manual priming main oil pump, it shall be operated for 1 minute. The crankshaft shall be turned two revolutions. The drip feed lubricators shall be closed. Lubricators shall be refilled as needed. Dry nitrogen purge to all cylinders, cross-heads and crank cases, shall be installed with prior approval of the owner. The proper warning signs shall be displayed in the area of a nitrogen purge. If suction/discharge bottles are an integral part of machine as received, they shall be sealed and nitrogen purge shall be installed.

– Internal Combustion Engines--Actions required for reciprocating compressors shall be conducted as listed previously. Electrical accessories that may be damaged by moisture shall be removed, labeled for retrieval, and stored in a warm/dry place. Spark plugs and fuel injection nozzles shall be removed, a small amount of

rustproof spray injected into each cylinder, and the holes plugged. A small additional quantity of rustproof spray shall be inserted each time the machine is rotated.

- Gear Boxes--The reservoir shall be filled to correct indicator level with manufacturer's recommended oil. Exposed surfaces shall be sprayed with rustproof spray. The output shaft shall be rotated 3 to 4 turns twice weekly, stopping 1/4 turn from last mark setting. Manufacturer's recommendations shall be followed for idle storage until the particular item is commissioned.

- Mechanical equipment such as hoists, conveyors, etc.--Oil lubricated bearing brackets and gear cases shall be flushed with manufacturer recommended oil until clean. Units shall be filled with recommended oil to correct level in indicator. Shaft shall be rotated several times. A coating of rustproof spray shall be applied to all exposed machined surfaces. All exposed chains shall be removed and cleaned with solvent cleaner. Chains shall be coated with rustproof spray; wrapped in Kraft type paper, labeled for retrieval, and stored.

- Generators--Generators shall receive the same treatment as electric motors.

SAFETY NOTE: WHEN NITROGEN BLANKET IS REQUIRED, SIGNS SHALL BE PLACED AND MAINTAINED ON THE EQUIPMENT TO NOTE THE PRESENCE OF NITROGEN AND SPECIFY PRECAUTIONS TO BE TAKEN.

*****Note: Nitrogen blankets may not be allowed on the unit proper; dry instrument air may be used instead.

11.2.3.3 Preventive Maintenance Card/Log. Responsible Craft Superintendent or the Materials Manager shall prepare a Preventive Maintenance Card/Log for each piece of equipment and shall review manufacturer's recommendation for additional requirements. This Maintenance Card/Log shall be made available to the SQM for audit and then submitted to the SQM or Startup Manager when the equipment is turned over to commissioning or the customer. Manufacturer's requirements shall govern should conflict arise between specifications and procedures.

11.3 Storage General

11.3.1 Piping

- All random lengths of pipe shall be stored in a lay-down area of the site subject to good runoff drainage and shall be kept off the ground by the use of dunnage. As far as practical, pipe shall be segregated by material type and size. Factory markings or color-coding shall be maintained in order to determine material type. If color-coding is not utilized, all markings as required by code and material specifications shall be transferred to each piece of cut length, and verified by Quality Control. The suggested color-coding scheme for piping is as follows:

  – TYPE GRADE COLOR REMARKS.

  – SA106 B PINK SMLS.

  – SA53 B YELLOW SMLS.

  – SA53 ERW WHITE WELDED.

  – SA335 P5 GOLD 5 PERCENT CHROME.

  – SA335 P11 BLUE 1-1/4 PERCENT CHROME.

  – SA335 P22 GREEN 2-1/4 PERCENT CHROME.

  – SA335 P91 SILVER 9 PERCENT CHROME.

  – SA333 6 RED LOW TEMPERATURE.

  – SA312 T304 ORANGE STAINLESS STEEL.

  – SA312 T316 BLACK STAINLESS STEEL (Note 2).

  Note 1: Additional color-coding schemes may be utilized, provided they are documented and submitted to warehouse and piping supervisors. The SQM shall establish the site piping color-coding scheme.

  Note 2: For austenitic steel pipe, the marking paint or ink shall not contain any harmful metal, or metal salts such as zinc, lead, or copper which cause corrosive attack on heating.

- Stainless steel piping shall not be stored in direct contact with carbon steel. Piping materials specifically designated for ASME code work shall

be kept segregated from other materials, and in a "marked" designated area.

- Piping fittings and valves shall be stored on pallets or other suitable dunnage. Flanges shall not be stored in such a way as to damage the gasket-sealing surface.

- Valves shall have all openings taped or capped in order to prevent harmful debris from entering valve seats. Control valve operators shall be properly weather protected or stored under cover.

- All studs, bolts, nuts, and gaskets shall be stored indoors.

- Fabricated pipe spools shall be stored on dunnage and have all openings taped or capped until time of installation.

11.3.2 Equipment

- All equipment shall be stored in accordance with the manufacturer's instructions.

- All pump suction, discharge, and vessel nozzles shall remain capped at all times until pipe is ready to connect.

11.3.3 Electrical and Instrumentation

- All electrical and instrumentation devices including motor control center (MCC), switchgear, transformers, motors, junction boxes, panelboards, and local mounted instruments shall be stored in accordance with the manufacturer's instructions.

- Cable, conduit, and cable trays may be stored outdoors as long as it is kept off the ground and properly supported. Cable reels shall be placed vertically on their reels and not stacked.

- Instruments and electrical devices installed on skid-mounted equipment stored outdoors shall be suitably weather protected.

- Control valves and their actuators shall be stored indoors. Care shall be taken to avoid damage of installed tubing while storing and handling.

- All tagged instruments shall be stored indoors on suitable shelving, off the floor, and in their original boxes with the tag number written on the outside of the box.

11.3.4 Distributed Control System (DCS)

- Because of the extremely sensitive nature of the DCS electronic and mechanical components, the DCS will not be shipped to the jobsite prior to the preparation of a suitable storage environment. Conditions meeting the following shall be considered suitable:

  – The DCS shall be stored in a room with a completed floor, walls, and ceiling. All drywall construction, including sanding and painting, shall be completed.

  – The DCS shall be stored in a climate controlled (operational heating, ventilating, and air conditioning [HVAC]), noncondensing atmosphere between the temperatures of 40° F and 80° F, and be free of dust or corrosive containments.

- The purchasing agent, or procurement person, shall be responsible for providing notification to the Electrical Superintendent, and the SQM that the DCS if ready for shipment from the supplier. The Electrical Superintendent shall then assure that storage conditions at the site are in conformance with the above noted requirements. The Electrical Superintendent shall then notify the purchasing agent, or procurement person, in writing that the DCS can be released for shipment. A copy of this release shall be sent to the SQM.

- Once the DCS is in place on the site, access to the area shall be limited to authorized personnel only and so posted.

11.3.5 Storage Location Assignments

Note: The following levels of A, B, C, and D items, and storage assignments are guidelines only, and should be adhered to when no other mandated storage requirement is specified, i.e., manufacturer's, etc. Good practical judgment and prevailing circumstances such as duration of storage, available facilities, and alternative storing methods that are reasonable and acceptable, should be considered. Project specifications and requirements take precedence over these guidelines.

For the simplicity of determining storage conditions for items, a level designation has been assigned for identification.

Level A--Items classified to Level A are those that are exceptionally sensitive to environmental conditions and require special measures for protection from one or more of the following effects:

- Temperatures outside the required limits.

- Sudden temperature changes.
- Humidity and vapors.
- Physical damage.
- Airborne contaminants, e.g., rain, snow, ice, dust, dirt, salt spray, and fumes.

The following are examples of Level A Items:

- Special electronic equipment and instrumentation.
- Special materials such as chemicals that are sensitive to the environment.

Items classified as Level A shall be stored under special conditions similar to those described for Level B Items, but with additional specified limits, i.e., ventilation system with filters to provide an atmosphere free of dust and harmful vapors. Items in this category must meet the manufacturer and contract specifications.

Level B--Items classified to Level B are those that are sensitive to environmental conditions and require protection from the effects of temperature extremes, humidity, vapors, physical damage, and airborne contaminants, but do not require the special protection required for Level A Items. The following shall be used as a guide for classifying items to the Level B category:

- Instrumentation.
- Batteries.
- Welding filler metals.
- Motor control centers, switchgear, and control panels.
- Motors and generators, precision machined parts; i.e., bearings, etc.
- Erection spares such as gaskets and “O” rings.
- Air handling filters.
- Computers.
- Nonflammable paints.
- Bag cement.

Items classified as Level B shall be stored within a fire-resistant, tear-resistant, weather-tight, and a well ventilated building or equivalent enclosure. Precautions shall be taken against vandalism. This area shall be situated and constructed so that it will not be subject to flooding. The floor shall be paved or equal, and well drained. Items shall be placed on pallets or shoring to permit air circulation.

Level C--Items classified to Level C are those that require protection from exposure to the environment, airborne contaminants, and physical damage. Protection from water vapor and condensation is not as important as that for Level B Items. The following shall be used as a guide for classifying items in the Level C category:

- Pumps.
- Valves.
- Fluid filters.
- Compressors.
- Auxiliary turbines.
- Instrument cables.
- Fans and blowers.
- Plastic piping (only that which is subject to deterioration from exposure).
- Insulation.

Level C items shall be stored indoors or equivalent with all provisions and requirements as set forth in Level B Items except, heat and temperature control is not required.

Level D--Items classified as Level D are those that are less sensitive to the environment than Level C Items. These items require minimal protection against the elements, airborne contaminants, and physical damage. The following shall be used as a guide for classifying items in the Level D category:

- Tanks.
- Heat exchangers.
- Demineralizers.
- Piping.
- Electrical cable.

- Structural items.
- Reinforcing steel.
- Aggregates.

Level D items may be stored indoors in an area marked and designated for storage. Most of these items are stored outdoors in designated areas. The area shall be well drained, preferably gravel covered or paved, and reasonably removed from the actual construction area and traffic so that possibility of damage from construction equipment is minimized. Items shall be stored on cribbing or dunnage to allow for air circulation and to avoid trapping water.

11.4 Exhibits (Suggested Forms)

Equipment Protection: Pumps, compressors, blowers, etc.--Data Sheet Equipment Maintenance Record.

12.0 Mechanical

12.1 Purpose

The purpose of this procedure is to establish a guideline to monitor, examine, maintain, and document the installation of mechanical equipment.

12.2 Scope

This procedure covers construction activities related to installation of equipment and associated construction activities. All construction activities shall adhere to project specifications. Should any conflict arise between this manual, manufacturer's recommendations or specifications, the manufacturer's recommendations shall govern.

12.3 References

- Project specifications.
- Manufacturer's recommendations and requirements.

12.4 General

12.4.1 Introduction

If required, BVCI shall provide equipment preservation programs as outlined in Section 11.0 of this manual throughout the construction phase of the job to assure quality equipment at the time of startup. A thorough inspection of rotating equipment shall highlight any apparent problems with pumps, compressors, etc. During installation, subcontractor craft supervision and subcontractor's quality representative(s) observe the work to verify that the equipment is handled properly, aligned, grouted correctly, and connected to piping without undue stress.

12.4.2 Responsibility

The Mechanical Superintendent shall be responsible for ensuring that work is in accordance with approved project specifications, that required tests are performed, and that documentation has been distributed and properly filed. The SQM is responsible for verifying that work is performed in accordance with this procedure and referenced documents. The subcontractor's quality representative is to verify that all aspects of the project specifications are followed.

12.5 Procedure

12.5.1 Equipment

An equipment schedule shall be maintained by the Mechanical Superintendent, as necessary. This schedule shall serve as a status report for completion of required work. Equipment check sheets, itemizing checkout activities to be performed, are compiled for each item of major equipment. Copies of this documentation will be made available to the SQM for audits, and as part of the project QC records.

12.5.2 Procedures for Setting Equipment

- Pumps, motors, and baseplates:

  – All new baseplates shall be center-lined by the center of suction and discharge flanges. Field engineers shall establish center lines on the foundation, which the mechanical constructor shall use for the installation of this equipment. The elevation shall be determined using the same methods as described above.

  – Pumps, motors, and baseplates shall be leveled by the use of a machinist level. Each pump flange shall be checked to ensure that the flanges are level.

  – Pipe alignment shall be accomplished by millwrights and pipe fitters. The millwrights shall conduct the indicator setup before and during the piping connection. Pipe misalignment shall be corrected by rework of the pipe. Movement of equipment, other than minor adjustments in order to facilitate pipe connections and preliminary alignment shall not be allowed without written Project Engineering approval. This procedure shall be continued until the alignment is satisfactory.

  – After permanent pipe supports are installed in accordance with piping drawings, the connections shall be bolted to the equipment. Nozzle loading shall be considered acceptable as follows:

    (1) Prior to tightening bolts/studs, the gap between the equipment flange and the piping flange does not exceed two (2) gasket thickness. (Not applicable for ring joint type gaskets.)
    (2) All bolts/studs move and engage freely without binding another.

  – The Mechanical Superintendent shall then contact the SQM for a grout placement number and initiate a grout card. A separate grout

card is required for each placement of grout and/or for each piece of equipment.

- The Superintendent then submits the grout card to the SQM for their inspection. Once the SQM has determined acceptability, he/she shall then release the item for grouting by signing the grout card and notifying the Superintendent. The Superintendent will then sign and attach a tag to the equipment stating the equipment is ready to grout.

- The type and nominal thickness of grout shall be as specified on the design drawings. However, thickness less than 3/4 inch or greater than 3 inches shall not be grouted without engineering written approval.

- Standard 2 inch x 2 inch grout cubes shall be taken for all rotating equipment with drivers over 50 horsepower, and all major static equipments, such as transformers, stacks, tanks, and vessels. The number of cubes taken, as well as the test results shall be recorded in the space provided on the grout release form by Quality Control as the results are received. Grout shall reach full specified strength by 28 days to be considered acceptable. Should preliminary results lead to concerns, Engineering shall be notified.

- After grout, millwright personnel shall check the alignment and establish if there are any voids in the grout. In the event a void is discovered, workers shall drill and tap for 1/8 inch NPT, install a 1/8 zerk fitting, and pump epoxy grout into the void. After all voids have been eliminated, there shall be an allowance of time for the epoxy to set up, followed by another check for alignment of pump and pipe.

12.5.3 Compressors and Drivers

All compressors shall be aligned basically using the same methods as described in vendor original data sheets and equipment history record sheets.

- Shaft alignment shall be accomplished by the method indicated on design and construction drawings and vendor alignment target sheets:

  - Misalignment shall not exceed the manufacturer's recommendations or project specifications, unless otherwise approved in writing.

  - Alignment brackets shall be nonmagnetic and rigid and readings demonstrated to be repeatable.

- Shims shall be full bearing. Thickness of shims shall be sized in such a manner as to minimize the number required with maximum of 6 allowed. Each machine foot shall have at least one thick (1/8 inch minimum) shim. The use of shims thinner than 0.002 inch is not allowed. Tapered shim packs are not allowed without prior approval, in writing, from engineering.

- Only after the final shaft alignment has been accepted by the SQM can pipe connections be made up. Any deviations from this procedure must have the approval of the Site Engineer or SCM.

- Final alignment check and realignment as necessary shall be made after the unit has been run-in and normal operating temperatures prevail.

- Doweling, when required shall be accomplished in accordance with machinery and equipment manufacturer's recommendations and contract requirements.

- Piping connections to machinery and equipment shall be made in accordance with design and construction drawings.

  - Flanges of connecting piping shall make up precisely and not forced or sprung into position.

  - All piping, machinery, and equipment shall be cleaned, checked out, inspected, and tested in accordance with contract requirements and documented on the appropriate field inspection form.

12.6 Exhibits (Suggested Forms)

- Pump Alignment Record (CQC-13-03).

- Dual Coupling Equipment Acceptance Report (CQC-13-02).

- Equipment Alignment Report--Pipe Disconnected (CITP-15.010A).

- Grouting Pour Inspection.

- Compressor/Turbine/Driver Motor Data and Acceptance (CQC-13-01).

- Pump Data and Acceptance (CQC-13-04).

- Equipment Installation Checklist (CQC-13-07).

- Equipment Installation Inspection (CITP-11.001A).

- Conveyor Equipment Checklist (CITP-14.001A).
- Small Motor and Pump Release (CQC-13-05).

13.0 Subcontractors

13.1 Purpose

The purpose of this policy is to establish a means by which subcontractors can be monitored for their required level of quality performance to meet the project requirements, and supply that documentation to verify performance.

13.2 Scope

This policy is in relation to those subcontractors performing work directly for BVCI at the jobsite. Should a subcontractor let out work to another subcontractor, then that subcontractor shall also meet the requirements of this policy.

13.3 References

- Contractual requirements.
- Project specifications.

13.4 Quality Requirements

The quality control requirements of the subcontractor shall be established prior to commencement of any work. A means of executing this is through the standard submittals of the subcontractor's quality program for review and approval by the CQCM. The Project Engineer and Project Manager shall consult with the CQCM to determine the appropriate reviews of Quality Manuals are performed. These reviews shall be documented and placed in the project records for use by the project staff.

14.0 Control and Calibration of Tools, Measuring, and Testing Equipment

14.1 Scope

This policy describes the types of tools and test equipment that are required to be calibrated, the procedure(s) for calibration control, and documentation requirements to assure that items inspected or tested during construction meet the design and equipment manufacturer's specifications, and any applicable project specifications.

14.2 Equipment to be Calibrated

The types of tools and equipment listed in Exhibit A shall be calibrated in accordance with this policy.

The SQM shall generate a log of specific tools and equipment by type and serial/ID number that will be used on the project. (Calibrated Tool Log Form). Each Craft Discipline Superintendent shall notify the SQM when new tools/equipment are received and calibrated in order to maintain this log current.

The SQM may generate and maintain a separate log of tools and instruments used by Startup for commissioning activities on the project.

14.3 Procedure

Measurement, test, and examination equipment that require calibration shall be marked with a unique serial number.

The SQM and Startup Manager (when BVCI self-performs commissioning activities) is responsible for assuring that all equipment is maintained in proper and dated calibration.

Equipment to be calibrated shall be verified against measurement standards traceable to national or international, where such standards exist. The standard or basis used for calibration shall be recorded on the Calibration Report Form.

Onsite calibration may be accomplished by manufacturer (for new equipment) or by a properly qualified and approved testing organization.

Pressure gauges for hydrostatic or pneumatic testing shall be calibrated against a dead weight tester or calibrated master gauge annually, or whenever there is reason to question their accuracy.

14.4 Records

Each calibrated item shall have a calibration report form that describes the method of calibration and acceptance in accordance with the applicable standard or specification. Calibration records shall be maintained by the SQM for construction activities, and by the Commissioning Manager for BVCI self-performed commissioning activities.

Measurement and test equipment shall be identified through use of a calibration decal or sticker, which indicates the item's serial number, date of calibration, date of next calibration, and the initials of the person who performed the calibration.

Subcontractor's calibration records shall be issued to the SQM for construction activities and to the Commissioning Manager for commissioning activities. Subcontractor calibrations shall be in accordance with this procedure, or with an approved subcontractor procedure.

14.5 Out of Tolerance Equipment

When inspection or test equipment is found to be outside the specified tolerances, the SQM will tag the item "Do Not Use Until Calibrated," remove it from the work area, and arrange for its calibration or replacement.

All items inspected or tested with equipment that is out of tolerance, shall be considered as nonconforming until the SQM can verify that all specified requirements have been met, or the items are reinspected or retested with known accurate instruments.

15.0 Systems Turnover

15.1 Scope

This section defines the inspections, tests, and verifications to assure and provide objective evidence that the facility is ready for commissioning activities.

This section describes the procedure and responsibilities for the preparation of turnover packages, scheduling, and coordination of system turnover.

This section shall be used as a guide when there is no other issued procedure from BVCI startup and commissioning group to the jobsite.

15.2 Contractual Requirements

Where the contract requires specific startup and commissioning activities, different or additional forms or methods of acceptance of completed systems, then the contract requirements shall supersede the requirements in this section. An issued procedure from BVCI startup and commissioning group to the jobsite to be used for systems turnover shall also supersede this section.

Conflicts between the contract requirements, systems turnover procedures, and the owner's expectations with relation to the contents provided in the systems turnover packages, shall be brought to the attention of the Project Manager for resolution.

15.3 Glossary of Terms

The terminology used in this section shall be defined as follows:

- Alignment--Rough: The initial alignment of rotating equipment to their drivers and/or gear boxes. Readings taken at this stage are for information only.

- Alignment--Final: Final alignment after equipment is grouted (if grouting is required). After final alignment, motors and pumps will not be coupled until motors have been checked for correct rotation.

- Alignment--Hot: Final alignment check under operating conditions (hot).

- Calibration--Initial: The initial setting or check of instruments using instrument data sheets or manufacturer's set points as reference data.

- Discipline: The designated craft or department, i.e., piping, electrical, instrumentation, etc.

- Engineering: The Design Engineer or designated representative.

- Instrumentation--BVCI-Supplied: Instruments assigned a BVCI tag number, shown on the P&ID, I&C database, and shown in the system turnover package.

- Instrumentation--Vendor-supplied: Instruments, which are skid-mounted and/or shipped loosed by the supplier, and may or may not have a tag number, or be shown on the P&IDs or in the system turnover packages.

- Loop--Startup: Functional loop of the control process (from end to end) which may or may not extend beyond a particular system or turnover package, and may include DCS software.

- Lubrication--Factory: Rotating equipment verified to have been initially lubricated at the factory.

- Lubrication--Initial: Providing initial lubrication in accordance with the manufacturer's recommendations, including type and quantity.

- Motor Bump: Briefly energizing the motor to determine direction of rotation.

- Motor Run-In: Extended running of the motor (15 minutes to 3 hours) in order to monitor and document any vibration, noise, bearing temperature, performance, etc.

- Nozzle Loading: Alignment, stress, or weight of piping at rotating equipment connections.

- Pressure Test: Hydrostatic or pneumatic test in excess of normal operating pressure as required in accordance with the piping line list, specification, or code.

- Priorities: Priority numbers assigned to punch list items via joint review by the Startup Manager, Quality Control, and Project Field or Construction Manager:

  – Priority 1--Needed to turn over the system.

  – Priority 2--Needed to operate the system.

  – Priority 3--Needed for final acceptance of a completed system.

- Punch List: A list of incomplete work generated and updated by Startup, including missing or incomplete documentation.

- Restoration: Replacing, reconnecting, or installing piping, equipment, instrumentation, or devices that were removed or disconnected to facilitate testing or flushing activities.

- Ring-Out: Point-to-point continuity check using phones, bells, or other electronic devices to verify positive continuity.

- "Scoped" P&IDs: Set of P&IDs marked up to show boundaries of each particular system, or section thereof, as they pertain to startup activities.

- Service Test: Observation of piping, tanks, vessels, instrument, and equipment for leaks during the initial operation of the system. Sometimes referred to as in-service test (IST).

- Startup: Group within BVCI (or site-designated group), responsible for the startup and commissioning of the facility, including performance testing (unless customer or subcontractor performed).

- Startup Schedule: A schedule prepared by Startup designating the dates that each system, or sections of system, needed to support the contract completion mile stone dates, and incorporated in the overall project schedule.

- Startup Support: Craft personnel assigned by the Construction Manager to support startup activities such as testing, final hot alignments, couple and uncouple drivers, etc.

- Supervisor's Turnover Folder: Copied sections of a turnover package separated by Craft Discipline, which contain all the applicable blank forms and "scoped" P&IDs for a particular system, and issued to the Craft Superintendent by the SQM, for completing all the required check and verifications, and documenting them on the appropriate form.

- System Walkdown: Walkdown of the system or section of system by Quality Control, Construction, and Startup to document remaining work that shall be completed to allow for meaningful startup and commissioning activities.

- Turnover Package: A book representing one system and containing the "scoped" P&IDs or electrical one-line drawings, index of equipment and instrumentation, piping line lists, and applicable acceptance and test forms.

15.4 Responsibilities

15.4.1 Engineering

Engineering shall support Startup by providing the following:

- Equipment and instrument numbers and descriptions (computer database).
- Piping and instrument diagrams (P&IDs).
- Piping line lists.
- Instrument data sheets.
- Vendor documentation and operation maintenance manuals.
- Spare parts lists required for startup.

As deletions or additions occur, Engineering will promptly issue engineering change notices (ECNs) or a revised database and documents to Startup.

15.4.2 Startup

Startup shall be responsible for the review and/or preparation of the following:

- Dividing the plant into systems utilizing approved for construction drawings and P&IDs, and providing "scoped" P&IDs to construction that clearly identify the boundaries of each system for the turnover packages.
- Preparing a system-by-system breakdown, which lists all equipment in each system. This will include the following major craft discipline categories:
  - Mechanical (rotating and nonrotating).
  - Electrical.
  - Instrumentation.
  - Piping.
- Responsible for researching and writing, in conjunction with Engineering, all startup procedures to be used on the project, including boil out, steam blows, flushing, synchronization, and any pre-operational testing procedures required.

- Researching and reviewing Engineering list of spare parts, which will be provided during the project startup phase.

- Preparing a detailed startup schedule.

- Preparing a system turnover schedule. This schedule will give direction to construction when to switch from an area completion program of working, to a system-oriented program.

- Tagging systems after they are released to Startup to clearly identify system boundaries, including all valves, MCC buckets, instruments, etc. This also identifies to construction personnel what system, or section of system, is now with the Startup personnel.

- Writing startup field reports to identify design or equipment problems noticed during startup.

- Generating and maintaining the systems punch list, and issuing updates to the Construction Manager and SQM on a weekly basis.

- Perform and record baseline operating data on systems and equipment, including full load running current, vibration, etc.

- Perform all required preservation and maintenance activities required by the manufacturer for all systems that have been turned over to their care, custody, and control. (may be supported by construction personnel).

15.4.3 Construction

To support the systems turnover schedule, the Construction Manager shall be responsible for completing the system(s) and ensuring that all data required in the turnover packages is compiled, complete, and correct and entered on the appropriate forms.

Prior to turnover of a system(s), or section of a system, the SQM and Craft Superintendents(s) shall be responsible for the following:

- Providing inspection of all systems to verify that erected systems conform to flow diagrams, construction drawings, vendor prints, codes, regulations, and specifications.

- Verify that all specified materials have been installed in the systems and documentation is complete to the extent required.

- Perform joint turnover walk downs with Startup to identify remaining work.

  (Note: Refer to documentation for additional SQM responsibilities.)

15.4.4 Vendor Startup Services

To protect product warranties, the following systems and/or equipment, unless otherwise approved by the Project Manager or Project Engineer, shall require the support of vendor services (representative) during the startup phase of the project:

- Uninterruptible Power Supply (UPS).
- Distribution Control System (DCS).
- Continuous Monitoring System (CMS.
- Gas Turbines/Generators.
- Steam Turbines/Generators.
- Gas Compressors.
- High-Pressure Feed Water Pumps.
- Water Treatment Equipment.
- Scrubbers and Bag Houses.
- Precipitators.
- Fire Pumps.
- Diesel Generators.
- Auxiliary Boiler.
- Duct Burner.
- Major Engineered Electrical Transformers.
- Variable Speed Drive Controllers.

15.4.5 Turnover Packages

The Turnover Package Book, prepared by Startup, is the basis for system acceptance and shall contain, as a minimum, the following information:

- System name and number.
- Table of contents.
- Scope of boundaries of the system (marked-up P&ID or electrical one-line).
- Applicable instrument, equipment, and line lists.
- All blank forms required for verifying completion of the system.

The prepared turnover packages shall be transmitted to the Project or Construction Manager. The Project or Construction Manager will receive the turnover packages, and then issue the package to the SQM for his custody and control until time to transmit to the Startup Commissioning Manager.

Startup shall not be responsible for updating the "scoped" P&IDs and drawings after the turnover packages have been issued to construction. However, prior to the startup phase of the project, the Startup Manager, or his designee, will review the packages at the jobsite and assist the SQM in updating scope and equipment/instrument lists.

15.4.6 Documentation

Upon receiving the turnover packages from the Project or Construction Manager, the SQM will now have care, custody, and control of the packages. Based on the system turnover schedule, the SQM will prepare the Supervisor's turnover folders by organizing the required forms and issuing the folder to each Craft Superintendent responsible for that portion of work and documentation. A copy of each form will be kept in the "Master Copy" of the system turnover package and replaced when the completed original is returned.

As the work progresses on each particular system, the Craft Superintendent, or his designee, shall perform all required verifications and enter the required data as shown on the applicable forms. When completed, the Superintendent shall return the forms to the SQM for inclusion in the master copy of the system turnover package.

The use of white out is not allowed on any documentation for the system turnover package. Black ink shall be used for all entries. All entries must be legible and in good professional form. A change shall be performed by one lining through the improper entry, placing the correct information just above it, and then initialing and dating the change. Some entries of information will require a signature, and some entries will

require initials. A signature/initial sign-off list shall be placed in the front of each turnover package listing those personnel and title that will be filling out any part of the documentation.

15.4.7 Systems Turnover

As construction completes the work within a system, and all required documentation has been returned to the SQM, the Craft Superintendent, after performing a Craft-Only walk down, will schedule a system walkdown with Quality Control and Startup to determine the readiness of the system, or section thereof, to commence meaningful startup activities. The Customer may also be included in this walkdown at the discretion of the Startup Manager and Construction Manager.

During the system walkdown, Startup shall generate and maintain the initial punch list or "work-to-complete" list identifying, as much as possible, all incomplete work, including missing or incorrect documentation in the turnover package.

When the system inspection and turnover package review is completed, the Startup Manager, in conjunction with the Construction Manager and SQM, shall prioritize all punch list and exceptions list items as follows:

- Priority 1--Needed for system turnover.
- Priority 2--Needed to safely operate the system.
- Priority 3--Needed for final acceptance.

Upon verifying that no Priority 1 items are listed on the punch list or exceptions list, the Site QC Manager shall prepare a turnover package transmittal form for submittal of the package to Startup. This form shall be signed off by the Construction Manager and SQM. The Construction Manager shall review the attached punch list or exceptions list items prior to signing. Startup may not accept the package with too many Priority 2 or 3 items.

Documentation may still be coming in to the SQM from Construction for those sections still not completed, but the turnover package has been accepted by Startup. The SQM will review this documentation for accuracy, then forward to the Startup Manager to be placed into the turnover package.

15.4.8 Startup and Final Acceptance

Once Startup has reviewed and accepted the completed turnover package (with or without exceptions) for each system, then Startup will have care, custody, and control of that system, or section thereof, from an operational and maintenance standpoint. Under Startup care, custody, and control, the Startup Manager shall be responsible for performing all required checks, verifications, and precommissioning activities, including

full restoration of the system to its operational condition. Startup may require craft support for some of these activities.

The Startup Manager shall be responsible for issuing the completed system turnover package to the customer's representative for final acceptance using a transmittal letter form. The responsibility of providing the owner with a complete and operational system and or facility remains with BVCI. Disputes regarding acceptance shall be referred to the Project or Construction Manager for resolution.

15.4.9 Commentary

One of the benefits of being a part of a full service "EPC" Organization is that we have the ability to work hand-in-hand with BVCI's Support Startup group as required. It is not the intent of this manual section to restrict, or replace the requirements of the BVCI Support Startup Group. The intent of this section is to provide a guideline when there has not been a project startup and commissioning plan issued to the jobsite. It can also provide a "beginning" until such a plan is issued.

In order to meet project goals, it is acceptable for Construction and Startup to work concurrently on systems prior to acceptance of the turnover package. However, it would be outside the intent of this manual to operate systems and/or run rotating equipment, other than minor motor "bump," until the turnover package has been accepted in accordance with the requirements of this procedure.

Appendix A

Type Calibration Frequency Accuracy

Appendix A
Type Calibration Frequency Accuracy

- Amprobe (Clamp On), 1 year in accordance with manufacturer.
- Conductivity Tester, 1 year in accordance with manufacturer.
- Dead Weight Tester, 5 years in accordance with manufacturer.
- Dial Calipers, 6 months ±0.001.
- Documenting Process Calibrator, 1 year in accordance with manufacturer.
- Dry Block Temperature Calibrator, 1 year in accordance with manufacturer.
- Frequency Counter, 1 year in accordance with manufacturer.
- Frequency Source, 1 year in accordance with manufacturer.
- Gas Monitors, 1 year in accordance with manufacturer.
- Handheld Temperature Calibrator, 1 year in accordance with manufacturer.
- Hi-Pot Testers, 1 year in accordance with manufacturer.
- Infrared Thermometer, 1 year in accordance with manufacturer.
- Live Line Tester, 1 year in accordance with manufacturer.
- LUX Meter, 1 year in accordance with manufacturer.
- Manometer, 1 year in accordance with manufacturer.
- Megaohm Meter, 1 year in accordance with manufacturer.
- Milliamp Loop Calibrator, 1 year in accordance with manufacturer.
- Micrometer, 6 months ±0.001.
- Megger Tester, 1 year in accordance with manufacturer.
- Multimeter, 1 year in accordance with manufacturer.

- Phase Shifting Stroboscope, 1 year in accordance with manufacturer.
- Precision Level, 1 year in accordance with manufacturer.
- Pressure Gauges, 1 year ±2 percent over full scale.
- Pressure Modules, 1 year in accordance with manufacturer.
- Process Signal Calibrators, 1 year in accordance with manufacturer.
- Psychrometer, 1 year in accordance with manufacturer.
- PWHT Recorders, 1 year in accordance with manufacturer.
- Silica Tester, 1 year in accordance with manufacturer.
- Sound Level Meter, 1 year in accordance with manufacturer.
- Survey Equipment (Total Station), 1 year in accordance with manufacturer.
- Tachometer, 1 year in accordance with manufacturer.
- Torque Wrench, 1 year ±6 percent over full scale.

Exhibits

- Calibration Log.
- Calibration Report Form.