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Whole Building Commissioning Process Manual

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1 Introduction

Guidelines and Policy: Commissioning for all new and renovation construction projects is *mandated* by the Energy Policy Act and the Executive Orders that have been issued to execute the requirements of this legislation. The following information provides the background that supports this mandate.

Executive Order 13423 – Strengthening Federal Environmental, Energy, and Transportation Management (January, 2007) requires that Federal Agencies to ensure new construction and major renovations comply with the *2006 Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (MOU) which was signed by the Department of Veterans Affairs and other federal agencies. The MOU creates a sustainable federal government and serves as a lynchpin for the sustainable building provisions of EO 13423 and EO 13514.*

Executive Order 13514 *Federal Leadership in Environmental, Energy, and Economic Performance (April, 2010)* mandates that federal agencies implement high performance sustainable Federal building design, construction, operation and management, maintenance, and deconstruction by:

- Beginning in 2020 and thereafter, ensuring that all Federal buildings that enter the planning process are designed to achieve zero-net-energy by 2030.
- Ensuring that all new construction, major renovation, or repair and alteration of Federal buildings complies with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings
- Ensuring that at least 15% of the agency's existing buildings (above 5,000 gross square feet) and building leases (above 5,000 gross square feet) meet the Guiding Principles by fiscal year 2015 and that the agency makes annual progress toward 100% conformance with the Guiding Principles for its building inventory;
- Pursuing cost-effective, innovative strategies, such as highly reflective and vegetative roofs, to minimize consumption of energy, water, and materials;
- Managing existing building systems to reduce the consumption of energy, water, and materials, and identifying alternatives to renovation that reduce existing asset's deferred maintenance costs.
- When adding assets to the agency's real property inventory, identifying opportunities to consolidate and dispose of existing assets, optimize the performance of the agency's real-property portfolio, and reduce associate environmental impacts, and;
- Ensuring that rehabilitation of federally owned historic building utilizes best practices and technologies in retrofitting to promote long-term viability of the buildings.

Updated High Performance and Sustainable Building guidance was issued by the Office of Management and Budget in December, 2008. Among other things, this guidance includes a revised set of *Guiding Principles for New Construction and Major Renovations* and a new set of *Guiding Principles for Sustainable Existing Buildings*.

The *2008 Guiding Principles for New Construction and Major Renovation*, sets forth the following five guiding principles:

I. Employ Integrated Design Principles

Use a collaborative, integrated planning and design process that:

- Initiates and maintains an integrated project team as described on the Whole Building Design Guide (http://www.wbdg.org/design/engage_process.php) in all stages of a project's planning and delivery
- Integrates the use of OMB's A-11, Section 7, Exhibit 300: *Capital Asset Plan and Business Case Summary.*
- Establishes performance goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building
- Considers all stages of the building's lifecycle, including deconstruction.

Commissioning: Employ commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements are met. This should include an experienced commissioning provider, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, an a commissioning report.

II. Optimize Energy Performance
III. Protect and Conserve Water
IV. Enhance Indoor Environmental Quality
V. Reduce Environmental Impact of Materials

Commissioning of new construction and major renovation projects is one of several key factors that are an integral part of the Department of Veterans Affairs compliance with the various energy and sustainability mandates.

The commissioning process outlined in this updated Whole Building Commissioning Process Manual is intended to implement the requirements included in EO 13423, EO 13514, and the *2008 Guiding Principles for New Construction and Major Renovations* and to integrate into the Department of

Veterans Affairs (VA) well-documented process for the design and construction of new facilities. The tasks and deliverables included in this commissioning process either utilize the documentation required by the existing VA process or supplement the requirements of this process to improve accountability and the transfer of information and knowledge to each member of the construction and operations team.

Commissioning and acceptance testing is integral to the design and construction process, not additive. Execution of commissioning tasks is intended to enhance the ability of the design and construction team to meet demanding building performance requirements while maintaining project budget and schedule. The Commissioning Agent is charged with identifying the 'performance impacts' of all significant design and construction decisions so that the VA can make informed decisions when budget, schedule or convenience impact the outcome of a project.

In accordance with ASHRAE Guideline 0, the anticipated outcomes of the VA Commissioning Process are:

- Document VA Owner's Project Requirements (OPR)
- Document and improve the quality of project deliverables
- Document systems performance in accordance with OPR
- Verify adequate documentation is provided to VA
- Verify and document proper training of VA's personnel
- Provide a uniform delivery process for construction projects
- Deliver completed construction projects that conform to the OPR
- Verify proper coordination among systems, equipment, and assemblies in completed project

1.1 References

a. Executive Order 13514: "Federal Leadership in Environmental, Energy and Economic Performance," October, 2010

b. Executive Order 13423 "Strengthening Federal Environmental Energy and Transportation Management," January, 2007

c. High Performance and Sustainable Buildings Guidance (2008), www.wbdg.org/pdfs/hpsb_guidance.pdf

d. Memorandum of Understanding on Federal Leadership in High Performance (2006) www.fedcenter.gov/kd/Items/actions.cfm?action=Show&item_id...

e. Green Buildings Action Plan, Implementing the Memorandum of Understanding on Federal Leadership in High Performance and Sustainable Buildings, Department of Veterans Affairs, www.cfm.va.gov/TIL/sustain/GreenBuildAction.pdf

f. ASHRAE Guideline 0-2005 – The Commissioning Process, American Society of Heating, Refrigeration and Air Conditioning, , 2005

g. ASHRAE Guideline 1.1 – The HVAC&R Technical Requirements for the Commissioning Process, American Society of Heating, Refrigeration and Air Conditioning, 2008

h. NEBB Procedural Standards for Whole Building Systems Commissioning of New Construction – Third Edition, National Environmental Balancing Bureau, 2009, www.nebb.org

i. American Society for Healthcare Engineering , Health Facilities Commissioning Guidelines, 2010

j. American Society for Healthcare Engineering, Health Facilities Commissioning Handbook; Optimizing Building Systems Performance in New and Existing Health Care Facilities, 2010

k. VA BIM Guide, Department of Veterans Affairs, http://www.cfm.va.gov/til/bim/BIMGuide/lifecycle.htm

l. VA Sustainable and Energy Reduction Manual, Department of Veterans Affairs, http://www.cfm.va.gov/til/sustain.asp

m. VA PG 18-15 A/E Design Submission Requirements

1.2 Acronyms

List of Acronyms	
Acronym	**Meaning**
A/E	Architect / Engineer Design Team
AHJ	Authority Having Jurisdiction
ASHRAE	Association Society for Heating Air Condition and Refrigeration Engineers
BOD	Basis of Design
BSC	Building Systems Commissioning
CCTV	Closed Circuit Television
CD	Construction Documents
CMMS	Computerized Maintenance Management System
CO	Contracting Officer (VA)
COTR	Contracting Officer's Technical Representative (see also VA-RE)
COBie	Construction Operations Building Information Exchange
CPC	Construction Phase Commissioning

List of Acronyms	
Acronym	**Meaning**
Cx	Commissioning
CxA	Commissioning Agent
DPC	Design Phase Commissioning
FPT	Functional Performance Test
GBI-GG	Green Building Initiative Green Globes
HVAC	Heating, Ventilation, and Air Conditioning
LEED	Leadership in Energy and Environmental Design
NC	Department of Veterans Affairs National Cemetery
NCA	Department of Veterans Affairs National Cemetery Administration
NEBB	National Environmental Balancing Bureau
O&M	Operations & Maintenance
OPR	Owner's Project Requirements
PFC	Pre-Functional Checklist
PFT	Pre-Functional Test
SD	Schematic Design
SO	Site Observation
TAB	Test Adjust and Balance
VA	Department of Veterans Affairs
VAMC	VA Medical Center
VA CFM	VA Office of Construction and Facilities Management
VACO	VA Central Office

List of Acronyms	
Acronym	**Meaning**
VA PM	VA Project Manager
VA-RE	VA Resident Engineer
USGBC	United States Green Building Council

1.3 Definitions

Acceptance Phase Commissioning: Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

Accuracy: The capability of an instrument to indicate the true value of a measured quantity.

A/E: See Design Professional.

Back Check: A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review

Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

Benchmarks: Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself.. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

Building Information Modeling (BIM): Building Information Modeling is a parametric database which allows a building to be designed and constructed virtually in 3D, and provides reports both in 2D views and as schedules. This electronic information can be extracted and reused for pre-populating facility management CMMS systems. **Building Systems Commissioning (BSC):** NEBB acronym used to designate its commissioning program.

Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

CCTV: Closed circuit Television. Normally used for security surveillance and alarm detections as part of a special electrical security system.

COBie: The COBie system is an Excel spreadsheet system developed by the US Army Corps of Engineers to gather facility and equipment data for construction projects. The COBie approach is to enter the data as it is created during design, construction, and commissioning, see Figure 1. Designers provide floor, space, and equipment layouts. Contractors provide make, model, and serial numbers of installed equipment. Much of the data provided by contractors comes directly from product manufacturers who can also participate in COBie. See the Whole Building Design Guide website for further information (http://www.wbdg.org/resources/cobie.php)

Commissionability: Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated and commissioned

Commissioning Agent (CxA): The qualified Commissioning Professional who administers the Cx process by managing the Cx team. Where CxA is used in this manual it means the Commissioning Agent, members of his staff or appointed members of the commissioning team. Note that LEED uses the term Commissioning Authority in lieu of Commissioning Agent.

Commissioning Checklists: Lists of data or inspections that should be verified to ensure proper system or component installation, operation and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements (OPR) is being achieved.

Commissioning Design Review: The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner's project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems' sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

Commissioning Issue: Any condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability or functionality of a system, equipment or component. Any condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components.. (See also – Commissioning Observation)

Commissioning Observation: An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

Commissioning Plan: A document that outlines the scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

Commissioning Process: A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

Commissioning Report: The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

Commissioning Specifications: The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Contract Documents (CD): Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

Construction Phase Commissioning (CPC): All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Coordination Drawings: Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

Data Logging: The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

Deferred System Test: Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

Deficiency: See "Commissioning Issue".

Design Criteria: A listing of the VA Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

Design Intent: The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

Design Manual: A listing of the VA Design Manuals outlining the system infrastructure requirements for the project.

Design Narrative: A written description of the proposed design solutions that satisfy the requirements of the OPR. The preparation of this document is the responsibility of the Engineer during the SD-1, SD-2 and DD-1 phases. The narrative should include a description of the systems selected and why they were chosen. It should also include reasons other systems were considered and rejected. Acceptance of the items in the Design Narrative should be the consensus of both the Owner and the Engineer. The Design Narrative is updated by the Commissioning Agent during the DD-2, CD-1, and Final Design phases to maintain a record of design changes, reasons for the changes, and the approval authority for each change.

Design Phase Commissioning (DPC): All commissioning tasks executed during the design phase of the project.

Design Phase Commissioning Report: The commissioning document prepared at the end of the Design Phase which presents the commissioning process results for the project design phase. Cx reports include an executive summary, the design phase commissioning plan, design review comment log, Owners Project Requirements, Design Narrative, meeting notes, correspondence, and other design phase commissioning documents.

Design Professional: The architect(s) or engineer(s) of record of the project.

Environmental Systems: Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

Executive Summary: A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

Functionality: This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Industry Accepted Best Practice: A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB *Design Phase Commissioning Handbook* for examples.

Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

Lessons Learned Workshop: A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

Maintainability: A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

Owner's Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Peer Review: A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The VA usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

Precision: The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT's include installation verification and system and component start-up tests.

Procedure or Protocol: A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

Range: The upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.

Resolution: This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

Schematic Design (SD): A conceptual image of the projects engineering requirements. Load calculations, preliminary system selection, and flow sheets are developed in this phase of the project. This phase could represent the project at approximately 35% of the design effort.

Site Observation Visit: On-site inspections and observations made by the CxA or CxC for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

Site Observation Reports (SO): Reports of site inspections and observations made by the CA. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

Special System Inspections: Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

Static Tests: Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

Start-Up Tests: Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

Systems Manual: A system-focused composite document that includes all information required for the owners operators to operate the systems.

Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as *"Testing*, *Adjusting, and Balancing"* and are described in the *Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.*

Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

Training Plan: A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

Trending: Monitoring over a period of time with the building automation system.

Unresolved Commissioning Issue: Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team or accepted by the VA. The Commissioning Agent shall make all reasonable attempts to resolve every issue. Commissioning Agent shall provide documentation of attempts to achieve a resolution of each unresolved issue with the VA

Validation: The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance,

measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

Whole Building Commissioning: Commissioning of all building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection.

2 Commissioning Process Overview

2.1 General

The Implementation Guide for Executive Order 13423 describes Commissioning and the Commissioning Process as:

> Building Commissioning is a systematic approach to improving system performance, operation & maintenance, indoor air quality & thermal comfort, and energy efficiency, as well as benefits like improving occupant comfort, health & welfare, and productivity, in both new and existing buildings. These activities are not, as many owners and managers believe, part of the typical design and construction process or part of standard operation & maintenance service contracts. Commissioning goes beyond testing, adjusting and balancing (TAB) and traditional inspections. Commissioning involves functional testing to determine how well the building systems, like Heating, Ventilating and Air Conditioning (HVAC) and Lighting, work together. Commissioning also seeks to determine whether the installed building equipment (e.g. chillers, boilers, motors, airflow system) meets a facility's goals or whether it needs to be adjusted to improve the efficiency and overall performance, consistent with the original design intent. The long-term life-cycle benefits of commissioning far outweigh the short-term up-front investments, as borne out by many documented case studies, both in the public and private sector building/facility infrastructure. Green building rating systems and certification programs have given a significant boost to the role of Building Commissioning, as part of the Efficient and High Performance Building stock.

Through this executive order and the interagency memorandum of understanding, incorporating commissioning into the VA Construction projects is a legal obligation.

2.2 Introduction to Commissioning

Whole Building Commissioning is a Project Management and Technical Execution practice that is being embraced by public and private organizations because of its benefits in improved project delivery results. It is a *multi-disciplined, collaborative* effort involving owners, design professionals, construction managers, and commissioning agents to achieve optimal results from the commissioning process.

Commissioning information, guidance, and resources can be addressed under the following four broad principles:

- Establish Measureable Project Performance Requirements,
- Plan and Execute the Commissioning Process,
- Verify and Document Compliance with Requirements, and
- Effectively Transfer Knowledge to the Building Operations Team.

It is important to note that all four principles are applied over the life of a capital design and construction project.

2.3 Benefits of Commissioning

Commissioning assists in the delivery of a project that provides a safe and healthy facility; optimizes energy use; reduces operating costs; ensures adequate &M staff orientation and training; and improves installed building systems documentation.

Commissioning benefits the VA through improved regulatory compliance, energy efficiency, improved workplace performance due to higher quality environments, reduced risk from threats, and prevention of business losses. Organizations that have researched commissioning claim that owners can achieve savings in operations of $4 over the first five years of occupancy as a direct result of every $1 invested in commissioning – an excellent return on investment. Meanwhile, the cost of **not** commissioning is equal to the costs of correcting deficiencies plus the costs of inefficient operations. For healthcare and other mission critical facilities, the cost of not commissioning will be measured by not only the cost of downtime and loss of facility use, but in degraded patient outcomes that may result from poor environmental control and poor compliance with the VA Standards.

2.4 Drivers

Government projects commonly employ commissioning because healthcare and mission critical facilities support essential public infrastructures. While projects with special performance needs require commissioning, all projects need some level of commissioning to perform at their best.

In addition to the performance needs of healthcare and mission critical facilities, another factor driving demand for commissioning is a desire to obtain certification through the LEED program and the Green Globes program. These rating systems have been developed to improve energy efficiency and environmental performance in buildings – and commissioning is a pre-requisite for LEED certification and a requirement for Green Globes. Commissioning beyond the basic pre-requisite requirement can earn additional LEED credits.

2.5 Commissioning Goals

Commissioning is often misunderstood to focus solely on testing during the end of the construction phase. However, Whole Building Commissioning is a collaborative process for planning, delivering, and operating buildings to work as the VA and Designer intended. Commissioning begins with project planning and includes design, construction, start-up, acceptance and training and warranty phase services. The goals of the commissioning process are to:

a. Define, document, and maintain a clearly stated set of measureable integrated system performance requirements throughout the design and construction of the project;

b. Verify and document compliance with these requirements at each completion milestone in;

c. Establish a clear set of tasks, deliverables, and schedule milestones for every member of the commissioning team to drive building delivery to a successful conclusion;

d. Demonstrate and document effective integrated buildings performance through a rigorous process of system testing;

e. Verify that operation and maintenance personnel and occupants are properly trained; and

f. Provide documentation, training tools, and building performance metrics that will allow the VA to sustain High Performance Building systems over the life of the building.

2.6 Commissioning Principles

Regardless of the extent to which the commissioning process is applied to a project, there are four overarching principles in the Commissioning Process that begin at project inception and continue through Occupancy and Operations.

a. Establish Measureable Project Performance Requirements,

As projects progress through successive Design Stages, the design team establishes Owner's Project Requirements, project work scopes and design solutions that meet the needs of the operation that will be housed in the new facility. It is the task of the commissioning process to establish ***measureable dynamic system performance requirements*** that can be definitively measured through field testing methodologies. These criteria, properly documented and measured, ultimately form the basis for project final acceptance.

Since building performance decisions are successively refined over the course a of project's life cycle, it is imperative that these ‘measureable requirements’ be refined and documented at the same time. During the pre-design and design phases of a project, the critical objectives of the commissioning process include:

- Develop Owner’s Project Requirements (OPR)
    - Define Dynamic Performance Requirements of the Project, including:
        - Environmental Control Criteria
        - Response to Threats, Risks, and Failures
        - Static and Dynamic Performance Requirements
- Review Design Documents for Compliance with the OPR
    - Design Narrative (Basis of Design) Document
    - Plans & Specifications

- Document Design Development Decisions
    - Deviations for OPR or Design Narrative
    - Value Engineering Decisions & Consequences
- Document the Process
    - Develop & Maintain a Project Commissioning Plan
    - Develop the Commissioning Specifications

b. Plan and Execute the Commissioning Process

Since Commissioning is a collaborative process involving multiple parties with potentially conflicting interests, it is critical that the process be well planned, documented and communicated to all project team members. Planning is accomplished through development and maintenance of the project Commissioning Plan. Planning must include

- Clear Roles and Responsibilities for all Team Members
- Establish clear means and methods of communications between all Team Members
- Well Defined Commissioning Work Scope and Deliverables
- Project Commissioning Schedules
- Effective Inspection and Testing Plans
    - Pre-Functional and Functional Test Plans
    - Integrated System Test Plans
    - Special testing needs for unique or innovative assemblies
- Clear Commissioning Specifications consistent with the Project Commissioning Plan
- Clear Definitions of Training Requirements to Support Long Term Sustainability

c. Verify and Document Compliance with Requirements

Commissioning serves as the historical record of both the VA's expectations for project performance and the performance achieved in the construction process. Commissioning documentation should provide a record of standards of performance for building systems and level of performance achieved in the delivered facility. Commissioning documentation should include

- A clear history of Project Development, Execution and Turnover
- A definitive record of all inspections, tests, performance issues and deficiencies and issue resolutions
- A clear methodology to evaluate building performance against that standard achieved at final acceptance of the Project (Re-Commissioning Plan)

d. Effectively Transfer Knowledge to the Building Operations Team

In order for the commissioning process to deliver sustainable results, the operations team responsible for the facility after final acceptance must be adequately prepared to assume responsibility for the installed equipment and systems at Final Acceptance of the project. It is a primary responsibility of the Commissioning Team to manage the training process to effectively prepare this team to understand and properly operate the high performance systems that will be required to sustain the VA mission. To this end, the Commissioning team should

- Engage the Operations Team in the Commissioning Process as early as possible,
- Organize and prepare all Contractors and Vendors to deliver coherent training to the Operations Team,
- Provide Systems Training and Key Performance Criteria to guide operators in monitoring and evaluating their operating systems,
- Provide Training, O&M, Performance and Re-Commissioning Documentation that will allow a facility to maintain a knowledgeable and effective operations team for the life of the facility.

2.7 Contractual Relationships

For any construction project, the Department of Veterans Affairs establishes A/E Design contracts for Design Phase and Construction Period Services. The Department also establishes a construction contract with a Prime Contractor to provide construction services. Both contracts are administered by a VA Contracting Officer and his/her designated representative. During the Design Phase, this representative is the Project Manager; during the construction phase, it is the Resident Engineer. On every project, the authority to modify any contract is strictly limited to the Contracting Officer and his/her designated representative.

In this structure, all communications on contractual issues are strictly limited to communications between the VA and these two prime contractors (A/E Team and Prime Contractor). It is the practice of the VA to require that communication between other parties to the contracts (A/E Sub-consultants, Subcontractors and Vendors) be routed through these two prime contractors and the VA.

Whole Building Commissioning is a process that relies upon high levels of communications and collaboration between all parties to the construction process. By its nature, the levels of communication and cooperation between the Commissioning Agent and all other parties to the construction process (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort. In the absence of these relationships, cooperation and support created by this communication, the Commissioning Process will likely fail to achieve its ends.

With this fundamental conflict in mind, this manual has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and his/her Designated Representative. Thus, all procedures outlined in this manual must be executed within the following limitations:

a. The Commissioning Agent may maintain a continuous open communication with the A/E team, including Sub-consultants, the Contractor and Subcontractors and the VA's team to facilitate a collaborative commissioning process subject to the specific limitations outlined below.

b. All communications shall be copied to the VA Project Manager (Design Phase) and Resident Engineer (Construction Phase).

c. All Communications shall include specific reference to these contract limitations (e.g., *"All issues identified in this Commissioning Issues Log are subject to 'Specification Section 01 91 00: Paragraph 1.2: Contractual Relationships.'"*

d. All information from the Commissioning Agent to any party to the project must be transmitted with the following clear limitations:

- No communications (verbal or written) will be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and any party to the construction project.
- Commissioning Issues communicated in writing to the Contractor or A/E Team and copied to the PM/RE are provided to all parties to the contract to expedite communication. All issues must be understood as the professional opinion of the Commissioning Agent and suggestions for issue resolution only until expressly approved as direction by the Project Manager or Resident Engineer.
- In the event that any Commissioning Issues and suggested resolutions are deemed to require either an official interpretation of the construction documents or are determined to require a modification of the contract documents, Contracting Officer or designated Project Manager (Design Phase) or Resident Engineer (Construction Phase) will issue an official directive to this effect.
- All parties to the Commissioning Process shall be individually responsible for alerting the PM/RE of any issues that they deem to constitute a potential contract change prior to acting on these issues.
- Authority for design and construction issues resolution rests solely with the Contracting Officer and his/her designated representative with

appropriate technical guidance from the A/E Team and/or Commissioning Agent.

3 Applying the Commissioning Process

3.1 Projects to be Commissioned

The Commissioning Process provides universal benefits to any construction project undertaken by the Department of Veterans Affairs. While the formal process described in this manual will be mandated for many VA projects, the process should be applied by VA Construction teams in some form for *all* projects to insure that the desired values from any construction projects are, in fact, delivered.

The VA Office of Construction and Facilities Management has determined that in order to effectively implement the *Guiding Principles for Sustaining New Construction and Major Renovation*, all new construction and major renovation projects, will be commissioned. The commissioning process should be tailored to the size and complexity of the project and its system components in order to optimize and verify performance of fundamental building systems. As a working guideline, the VA has determined that all projects in excess of $5M construction cost will be commissioned.

3.2 Systems to be Commissioned

While buildings are comprised of static systems (e.g., building envelope, building structure) and dynamic systems (e.g., HVAC, emergency power, elevators), the commissioning process is intended to address the 'integrated dynamic performance of the 'building system.' Therefore, when considering which building systems to commission, the primary considerations are driven by the impacts of any given system on the overall performance of the building as a whole. So, for example, the building envelope, while a static system, will have a substantial impact on the performance of the building environmental controls, particularly if the air or vapor barriers installed are deficient. The list of commissioned systems included below is intended to identify those major systems that can have a significant impact on the ability of the integrated building system to achieve the patient safety, comfort, reliability and energy performance goals established by the OPR in the commissioning process.

The intent of the VA Standard for Whole Building Commissioning is to subject all building systems to the commissioning process. On a case by case basis, the VA recognizes that the nature of the project and its attendant budget may require that systems be selectively commissioned to maximize the value delivered by the process. With this in mind, the following criteria should be applied to evaluating each installed system (listed below) for inclusion in the commissioning process.

a. Systems with the most significant impacts on patient safety, the environmental performance, or reliability of the installed 'building system' should have highest priority in the commissioning process.

[For example, the building HVAC systems, central heating/cooling plant systems, Building Management Systems, Emergency Power Systems, Nurse Call Systems, and Security Systems]

b. Systems that have traditionally caused performance or maintenance problems on a site (or similar sites) should have a high priority in the process.

   [For example, the Building Envelope Systems, Normal Power Distribution Systems]

c. Systems that have a significant dynamic performance component but may have a moderate impact on the net environmental building system performance should have a priority in the process.

   [For example, the building elevators, domestic water distribution]

The specific list of 'Systems to be Commissioned' included on any given project must be driven by the nature of the project, the installed systems and the opportunity to impact the quality of the installed system during the construction of the project.

[For example, in a renovation project, while all HVAC systems should be commissioned regardless of the construction impact on existing systems, commissioning of the building envelope would not be appropriate unless significant modifications of the envelope were included in the project and the work defined for the project allowed for correction of deficiencies that would materially improve the energy or comfort performance of the renovated area.]

It is important to note that the list of 'Systems to be Commissioned' will change over the course of the project's design phases. The list should be developed early and be kept updated throughout the Design Phase.

Finally, it is important to engage the facilities operating staff, if available, to consult on any list of commissioned systems. While the judgments of the operating team may not be final, their input will add significant value to the effort to collaborate in the commissioning process.

The following table provides a list of typical systems used in VA facilities that should be commissioned in a Whole Building Commissioning Process. The list is intended for guidance only and is not considered comprehensive. Definition of the specific list of systems to be commissioned is the responsibility of the VA project team in consultation with the operator of the facility, the designers and the commissioning agent.

Systems To Be Commissioned	
System	**Description**
Building Exterior Closure	
Foundations (excluding structural)	Standard, special, slab-on-grade, vapor barriers, air barriers
Basements	Basement walls, crawl spaces, waterproofing, drainage
Superstructure	Floor construction, roof construction, sunshades, connections to adjacent structures
Exterior Closure	Exterior walls, exterior windows, exterior doors, louvers, grilles and sunscreens,
Roofing	Roof system (including parapet), roof openings (skylights, pipe chases, ducts, equipment curbs, etc.)
Note:	The emphasis on commissioning the above building envelope systems is on control of air flow, heat flow, noise, infrared, ultraviolet, rain penetration, moisture, durability, security, reliability, constructability, maintainability, and sustainability.
Specialties	
Patient Bed Service Walls	Medical gas certification and cross check, electrical connections
Equipment	
Parking Control Equipment	Barriers
Laboratory Fume Hoods	Fume Hood Certification
Biological Safety Cabinets	Cabinet Certification
Packaged Incinerators	Combustion Testing, Cycle Certification
Conveying Equipment	
Electric Dumbwaiters	Interface with other systems (Fire Alarm, etc.) [ASTM testing and certification by others]
Elevators	Interface with other systems (fire alarm, etc.) [ASTM testing and certification by others]
Escalators	Interface with other systems (fire alarm, etc.) [ASTM testing and certification by others]
Material Delivery Systems	Interface with other systems (fire alarm, elevators, etc.)
Pneumatic Tube Systems	Interface with other systems (fire alarm, etc.)
Fire Suppression	
Fire Pump	Fire Pump, jockey pump, fire pump controller/ATS
Fire Sprinkler Systems	Wet pipe system, dry pipe system, pre-action system, special agent systems
Plumbing	
Domestic Water Distribution	Booster pumps, backflow preventers, water softeners, potable water storage tanks

Systems To Be Commissioned	
System	**Description**
Domestic Hot Water Systems	Water heaters**, heat exchangers, circulation pumps, point-of-use water heaters*
Sewerage Pump Systems	Sewage ejectors
Wastewater Pump Systems	Sump pumps
Sanitary Waste Interceptors	Grease interceptors, acid neutralizers
General Service Air Systems	Packaged compressor systems, air dryers, filtration
Medical Air Systems	Packaged medical air compressor units. Outlet certification, cross-connection verification
Medical Vacuum Systems	Packaged medical vacuum units, outlet certification, cross-connection verification
Dental Air Systems	Packaged dental air compressor units, outlet certification, cross-connect verification
Dental Evacuation and Vacuum Systems	Packaged Dental Evacuation units, packaged dental vacuum units, outlet certification, cross-connection verification
Waste Anesthesia Gas Systems	Packaged Waste Anesthesia Gas units, outlet certification, cross-connection verification
Medical Gas Systems (other than Medical Air Systems)	Medical gas (oxygen, nitrogen, nitrous oxide, etc.) tank/manifold systems, outlet certification, cross-connection verification
Chemical Waste Systems	Chemical storage tanks, neutralization systems, ventilation, process control
Reverse-Osmosis Systems	Packaged Reverse-Osmosis systems
Water De-Alkalizing Systems	Package Water De-Alkalizing systems
HVAC	
Noise and Vibration Control	[Noise and vibration levels for critical equipment such as Air Handlers, Chillers, Cooling Towers, Boilers, Generators, etc. will be commissioned as part of the system commissioning]
Direct Digital Control System**	Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
Chilled Water System**	Chillers (centrifugal, rotary screw, air-cooled), pumps (primary, secondary, variable primary), VFDs associated with chilled water system components, DDC Control Panels (including integration with Building Control System)
Condenser Water System**	Cooling Towers, Fluid Coolers, heat exchangers/economizers, pumps, VFDs associated with condenser water system components, DDC control panels.
Steam/Heating Hot Water System**	Boilers, boiler feed water system, economizers/heat recovery equipment, condensate recovery, water treatment, boiler fuel system, controls, interface with facility DDC system.
HVAC Air Handling Systems**	Air handling Units, packaged rooftop AHU, Outdoor Air conditioning units, humidifiers, DDC control panels

Systems To Be Commissioned	
System	**Description**
HVAC Ventilation/Exhaust Systems	General exhaust, toilet exhaust, laboratory exhaust, isolation exhaust, room pressurization control systems
HVAC Energy Recovery Systems**	Heat Wheels, Heat Recovery Loops, AHU Integrated Heat Recovery
HVAC Terminal Unit Systems**	VAV Terminal Units, CAV terminal units, fan coil units, fin-tube radiation, unit heaters
Decentralized Unitary HVAC Systems*	Split-system HVAC systems, controls, interface with facility DDC
Unitary Heat Pump Systems**	Water-source heat pumps, controls, interface with facility DDC
Humidity Control Systems	Humidifiers, de-humidifiers, controls, interface with facility DDC
Hydronic Distribution Systems	Pumps, DDC control panels, heat exchangers,
Facility Fuel Systems	Boiler fuel system, generator fuel system
Geothermal Energy Direct Use Heating **	Geothermal well, ground heat exchanger, geothermal pumps, heat exchanger, valves, instrumentation
Solar Energy Heating Systems **	Solar collectors, heat exchangers, storage tanks, solar-boosted domestic hot water heater, pumps, valves, instrumentation
Facility Fuel Gas Systems	Witness Natural gas piping pressure testing, natural gas compressors and storage, propane storage
Smoke Evacuation System	Atrium smoke evacuation, other smoke evacuation and smoke management systems, controls, interface with other systems (fire alarm), emergency operation.
Electrical	
Medium-Voltage Electrical Distribution Systems	Medium-Voltage Switchgear, Medium-Voltage Switches, Underground ductbank and distribution, Pad-Mount Transformers, Medium-Voltage Load Interrupter Switches,
Grounding & Bonding Systems	Witness 3rd party testing, review reports
Electric Power Monitoring Systems	Metering, sub-metering, power monitoring systems, PLC control systems
Electrical System Protective Device Study	Review reports, verify field settings consistent with Study
Secondary Unit Substations	Medium-voltage components, transformers, low-voltage distribution, verify breaker testing results (injection current, etc.)
Low-Voltage Distribution System	Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc.)
Emergency Power Generation Systems	Generators, Generator paralleling switchgear, automatic transfer switches, PLC and other control systems

Systems To Be Commissioned	
System	**Description**
Lighting & Lighting Control** Systems	Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls
Cathodic Protection Systems	Review 3rd party testing results.
Lightning Protection System	Witness 3rd party testing, review reports
Communications	
Grounding & Bonding System	Witness 3rd party testing, review reports
Structured Cabling System	Witness 3rd party testing, review reports
Master Antenna Television System	Witness 3rd party testing, review reports
Public Address & Mass Notification Systems	Witness 3rd party testing, review reports
Intercom & Program Systems	Witness 3rd party testing, review reports
Nurse Call & Code Blue Systems	Witness 3rd party testing, review reports
Security Emergency Call Systems	Witness 3rd party testing, review reports
Duress Alarm Systems	Witness 3rd party testing, review reports
Electronic Safety and Security	
Grounding & Bonding	Witness 3rd party testing, review reports
Physical Access Control Systems	Witness 3rd party testing, review reports
Access Control Systems	Witness 3rd party testing, review reports
Security Access Detection Systems	Witness 3rd party testing, review reports
Video Surveillance System	Witness 3rd party testing, review reports
Electronic Personal Protection System	Witness 3rd party testing, review reports
Fire Detection and Alarm System	100% device acceptance testing, battery draw-down test, verify system monitoring, verify interface with other systems.
Renewable Energy Sources	
Geothermal Energy Electrical Generation Systems **	Geothermal well, DC-AC Inverters, storage batteries, turbine generator modules, switchgear, combiner boxes, instrumentation, monitoring and control systems
Solar Energy Electrical Power Generation Systems **	Solar collector modules, DC-AC inverter, storage batteries, combiners, Switchgear, instrumentation, monitoring and control systems

Systems To Be Commissioned	
System	**Description**
Wind Energy Electrical Power Generation Systems **	Wind Turbines, DC-AC inverter, storage batteries, combiners, switchgear, instrumentation, monitoring and control systems
Site Utilities	
Water Utilities	City Water Service Entrance, Backflow Prevention, Pressure Control, Booster Pumps, Irrigation Systems
Sanitary Sewerage Utilities	City Sanitary Connection, Waste Treatment Systems
Storm Drainage Utilities	City Storm Water Connection, Site Storm Water Distribution
Energy Distribution Utilities	Connection to Third Party Energy (Steam, High Temp Hot Water, Chilled Water) Supply Systems, Metering, Pressure Control
Transportation	
Active Traffic Barrier Systems	Witness 3rd party testing
Integrated Systems Tests	
Loss of Power Response	Loss of power to building, loss of power to campus, restoration of power to building, restoration of power to campus.
Fire Alarm Response	Integrated System Response to Fire Alarm Condition and Return to Normal
Table Notes	
** Denotes systems that LEED requires to be commissioned to comply with the Fundamental Commissioning pre-requisite.	

d. Commissioning Specification Requirements

In order for the Commissioning Process to be successfully integrated into the construction of VA projects, the obligations of all parties to the construction project must be clearly delineated in the Project Specifications. While the Commissioning Plan is intended to include task and responsibilities for Commissioning from Design thru Warranty Phases, the construction specifications establish the legal and binding obligations of the construction team members for participation in the process.

Commissioning Specifications are specifically designed to address the obligations of parties to the commissioning process in regard to the services, technical personnel and documentation required to satisfy the need

- to successfully demonstrate integrated system performance,
- to document the performance in a manner that enhances long term sustainable operation of the systems, and

- to effectively train the facility operating teams to maintain high performance operation of the installed building systems.

As part of the development of these specifications, it is the obligation of the Commissioning specification writer to verify the training requirements specified in other specifications sections are consistent with training obligations and scheduling requirements in the Commissioning Specification and Commissioning Plan. Coordination of the commissioning specifications with other pertinent sections of the specification is essential to avoiding conflicts and misunderstandings in the construction phase of a project.

It is essential to the success of the process that Commissioning responsibilities be referenced in each applicable section of the specifications along with references to the Commissioning Specification Section.

As a minimum, the following specification sections should be included in each Project Specification Manual to the extent the systems referenced in these sections are included in the commissioning process. It is the responsibility of the A/E Team and the Commissioning Agent to review all specification sections and include language in every appropriate section based on the scope of Commissioning activities on the project.

General Requirements (Division 1)

Building Exterior Closure (Divisions 7 and 8)

Conveying Equipment (Division 14)

Fire Protection (Division 21)

Plumbing (Division 22)

HVAC (Division 23)

Electrical (Division 26)

Communications (Division 27)

Electronic Safety and Security (Division 28)

Site Utilities (Division 33)

Renewable Energy Systems (Division 48)

In addition to the above specification sections, the equipment and technical specification sections may need to be modified to include commissioning-related requirements. The commissioning-related language that may need to be added to the equipment or technical sections includes requirements for submittal review by the Commissioning Agent; notifying the Commissioning Agent of equipment/systems startup so the Commissioning Agent can witness the startup; completion and submission of Pre-Functional Checklists; operating systems during Functional Testing; attending Commissioning Meetings; submitting Operations & Maintenance Data/Manuals for review by the Commissioning Agent; training requirements; and reporting on issue resolution.

3.3 Building Envelope Commissioning

The commissioning process described in this manual is primarily focused on the dynamic building infrastructure systems such as HVAC, electrical, plumbing, fire protection, etc. Commissioning static building infrastructure systems such as building envelope require a different approach. A successful whole building commissioning process will carefully validate interfaces and possible interferences between all building systems, including the building envelope. Due to the integration and interdependency of facility systems, a performance deficiency in one system can result in less than optimal performance by other systems. The building envelop has a significant impact on the HVAC systems and the overall indoor environmental quality.

The objective of building envelope commissioning is to address any performance objectives required by the VA for the exterior closure including the control of heat flow, air flow, noise, fire, light, infrared, ultraviolet, rain penetration, moisture, structural performance, durability, security, reliability, aesthetics, value, constructability, maintainability, and sustainability.

The building envelope commissioning process places the greatest emphasis on design phase. It is during the design when the building performance requirements are determined and implement in the design. Design reviews and other building envelope related commissioning activities are aimed at early verification of the performance requirements, verification that the building envelope design will result in a system that meets the performance requirements, review of constructability, maintainability, reliability, and sustainability. Early identification of building envelop issues during the design phase provides an opportunity to resolve the issues before bidding and construction start. It is far easier, and much more cost effective, to resolve building envelope issues during design than after bricks and mortar are being constructed.

3.3.1 Pre-Design Phase Building Envelope Commissioning

General information about the building envelope requirements is gathered and reviewed. This information includes (a) program requirement (e.g. facility interior conditions; (b) community context (e.g. reflectance limits on glazing); (c) design standards, guidelines, and regulations; and (d) site and climate (e.g. outdoor air design conditions.

3.3.2 Design Phase Building Envelope Commissioning

The Commissioning Agent's building envelope specialist should review documents developed by the A/E relative to the building envelope. These documents include (a) the Owner's Project Requirements; (b) Design Narrative; (c) design submissions (e.g. SD-1, SD-2, DD-1, DD-2, CD-1 and Final) The objectives of the review process is to:

a. Verify that each exterior closure system fulfills the VA requirements and that the various enclosure systems are coordinated with each other and with other related systems.

b. Develop commissioning process requirements for inclusion in the Construction Documents such as submittals, periodic inspections, laboratory testing, field testing, mock-ups of exterior assemblies, and documentation.

c. Developing preliminary construction checklists, pre-functional checklists, and functional performance test procedures.

d. Performing commissioning-focused design review to check proposed design solutions against the VA requirement. Reviews should also focus on inter-disciplinary coordination.

3.3.3 Construction Phase Building Envelope Commissioning

During construction, the Commissioning Agent's building envelope specialist coordinates with the construction and design teams to fulfill the following objectives:

a. Assist with developing construction details for elements not addressed or coordinated during the design phase.

b. Observe field testing, including coordinating the need for additional field testing, alteration of installation details, and resolution of issues identified during field or laboratory testing. .

c. Field review aesthetic and functional mock-ups; review the interface conditions to verify that they meet the design requirements; verify that the required level of water and air tightness can be achieved; review of iterative repair submittals; and testing prior to actual construction.

d. Submittal review of shop drawings, mock-ups, sample constructions, project schedules and sequencing, and building enclosure components to verify the required level of water and air tightness can be achieved.

e. Review of the contractor's site-specific quality plans for the building enclosure.

f. Field verification of actual construction for conformance to design and manufacturers' requirements.

g. Field observation of contractor's testing.

h. Assist in resolution of any issues identified during field reviews or testing.

3.3.4 Warranty Phase Building Envelope Commissioning

During the warranty, the Commissioning Agent's building envelope specialist coordinates with the VA RE and VAMC Facilities Operations staff to fulfill the following objectives:

a. Review and comment on contractor's documentation including (a) Operations and Maintenance Manuals; (b) manufacturers' conformance records; (c) field test records; (d) record drawings; (e) exterior envelope preventive maintenance program; and (f) manufacturer's and contractors' warranties..

b. Documentation of non-conforming performance levels relative to exterior closure systems

c. Verification of exterior closure performance levels prior to warranty expiration.

d. Coordination of corrective actions relative to exterior closure systems.

e. Coordination of seasonal testing of exterior closure systems.

f. Developing the re-commissioning or ongoing commissioning program.

3.4 Adapting the Commissioning Process to Specific Projects

The Commissioning Process described in this manual is intended to provide an outline of the process for a large, new construction project. It is recognized that the commissioning process for a particular project must be tailored to the size and complexity of the building and its system components in order to verify performance of the building components and systems and help ensure that design requirements are met. This should include an experienced commissioning provider, inclusion of commissioning requirements in the construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report.

The process can be adapted to other types of projects by scaling the commissioning process to the specific project. The level of rigor in each step remains somewhat constant, however the amount of effort required to maintain the level of rigor varies. Also, some parts of the process can be modified in scope or deleted, depending on the requirements of each project.

Each user of this manual should review and understand the Commissioning Process described in the sections that follow before attempting to tailor the process to a specific project.

There are several factors that impact the value and cost of commissioning a project. The quantity, size, and complexity of the various dynamic systems included in a project will impact the value and scope of the commissioning effort. The project schedule and the level to which the Commissioning Agent is involved in the design and construction process will have equally significant impact on the value and cost of commissioning.

The level of rigor for systems testing generally remains constant for each system test regardless of the project size and scope. See discussion in paragraph 3.2 above for guidance on selecting the systems to be commissioned.

Determining the test sample size is another means of tailoring the commissioning scope to the specific project. Generally, the major HVAC systems (chilled water, condenser water, heating hot water, steam, air handling systems, etc.) should be a 100% sample size. Other systems where there are large numbers of the same type of equipment, i.e. air terminal devices, fire alarm devices, nurse call devices, etc., a sample size of 20% -50% can be an effective means of tailoring the scope of commissioning to the project. However, it is important to note that sampling can only be used effectively on systems that are repeated many times on a project, on systems that are controlled by application specific controllers that are fixed in their configuration and for systems that are not considered critical. Applying the concept of sampling to any other system does not have statistical or real world validity.

One note of caution is that the size or capacity of a device does not usually need to be considered when evaluating the quantities of a device. For example, a VAV terminal of a specific type is usually considered as one type of equipment/device, irrespective of the box size or air-flow capacity. A fan-powered terminal box would generally be considered a different type of equipment than a VAV terminal.

There are other portions of the commissioning process that can be tailored to specific projects. The level to which the Commissioning Agent is involved in the design and construction includes the scope of:

:

a. Design Phase Controls Meetings
b. Design Reviews
c. Design Review Meetings
d. Owner’s Project Requirements Updates
e. Design Narrative Updates
f. Design Phase Commissioning Plan
g. Commissioning Specifications
h. Duration Schedule for Commissioning Activities
i. Systems to be Commissioned
j. Construction Phase Commissioning Progress Meetings
k. Construction Phase Project Meetings
l. Construction Observation Visits
m. Witnessing Equipment Startup and Contractor Testing
n. Factory Witness Testing Observation

o. TAB Verification

p. Periodic Warranty Phase Site Visits

The decision to seek LEED or Green Globe certification will also impact the scope and fees for the Commissioning Agent. LEED requires fundamental commissioning as a pre-requisite to earning other point in the Energy & Atmosphere section of the rating system.

The LEED prerequisite requirements for commissioning as described in LEED 3.0 (2009) are as follows:

- Prior to verification of equipment installation, designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.
- The CxA must have documented commissioning authority experience in at least 2 building projects
- The individual serving as the CxA must be independent of the project's design and construction management, though the CxA may be an employee of any firms providing those services. The CxA must be a qualified employee or consultant of the owner.
- The CxA must report results, findings, and recommendations directly to the owner.
- For projects smaller than 50,000 square feet, the CxA may be a qualified person on the design or construction management team who has the required experience.
- The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.
- Develop and incorporate commissioning requirements into the construction documents.
- Develop and implement a commissioning plan.
- Verify the installation and performance of the systems to be commissioned.
- Complete a summary commissioning report.

The LEED 3.0 (2009) Enhanced Commissioning Energy and Atmosphere Credit 3 requirements are as follows:

- Prior to the mid-design submission, designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.

- The CxA must conduct, at a minimum, one commissioning design review of the Owner's Project Requirements (OPR), Basis of Design (BOD), and design documents prior to mid-construction documents phase.
- The CxA must back-check the review comments made prior to the mid-design submission and verify the comments have been addressed in the subsequent design submission.
- The CxA must review contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD. This review must be concurrent with A/E reviews and submitted to the design team and the Owner.
- The CxA and other project team members must develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.
- The CxA or other project team members must verify that the requirements for training operating personnel and building occupants are completed.
- The CxA must be involved in reviewing the operation of the building with the operations and maintenance staff and occupants within 10 months after substantial completion. A plan for resolution of outstanding commissioning-related issues must be included.

The LEED rating system is in transition from the 3.0 (2009) to 2012 versions. The commissioning requirements in the 2012 version appear to be substantially increased from those in the 2009 version.

The Green Globe program requires the following:

- Engage a Commissioning Agent
- Review the Design Intent and Basis of Design
- Commissioning requirements are included in the Construction Documentation
- Develop a Commissioning Plan

Further discussion on how to tailor the tasks listed above are included in the sections of this manual that discuss each task.

4 Pre-Design Commissioning

4.1 Commissioning Agent Contracting Methods

Commissioning Services are most appropriately contracted as a Professional Service to the Department of Veterans Affairs. With responsibility spanning from the Pre-Design Phase through the Warranty Phase, the Commissioning Agent will be charged with representing critical VA interests in the design, construction, testing, acceptance, and operation of VA facilities. The responsibilities associated with Whole Building Commissioning best match the responsibilities of Professional Service Providers to the VA rather than construction providers.

4.1.1 Direct Contracting with the Department of Veterans Affairs

It is the intent of the Department of Veterans Affairs to acquire Commissioning Services at the Pre-Design Phase of the project. The preferred method of acquiring Commissioning Services is through Indefinite Delivery Indefinite Quantity (IDIQ) contracts with qualified Commissioning Agents. This method of acquisition provides a readily available; qualifications-based selection of the Commissioning Agent. It is important that the Commissioning Agent be selected as a Professional service with primary allegiance to the interests of the VA.

For specific large projects, as determined by the VA Contracting Officer, the VA may elect to acquire Commissioning Services through a direct, stand-alone contract between the VA and the Commissioning Agent.

In acquiring the Commissioning Agent, it is the intent of the VA to award a contract to an experienced and qualified Commissioning Agent. It is the intent of the VA that a single Commissioning Agent will be acquired for the entire project, subject to satisfactory performance.

During the Commissioning Agent acquisition process, the VA will provide experienced Commissioning Agents with the project Feasibility Study or other programming documents that describes the project, anticipated design period, and anticipated construction period. The expectation is that prospective Commissioning Agents will submit qualifications and pricing proposals that separately identify fees for the Design Phase, Construction Phase, Acceptance and Testing Phase and the Warranty Phase. The VA will most likely structure the contract as a Base Contract for Design Phase Commissioning Services with two options – Option 1 – Construction Phase Commissioning (including both Construction and Acceptance Phase commissioning services) and Option 2 – Warranty Phase commissioning services. In the event a project is put on hold, or there are difficulties with the Commissioning Agent performance, the VA can elect not to award the options

4.1.2 Alternate Contracting Methods

Recognizing that the acquisition of IDIQ or Stand-Alone contract relationships with qualified Commissioning Agents may take some time, it may be necessary

to utilize other contracting arrangements to secure the services of qualified providers in the interim. The following information provides guidance regarding the options, risks and benefits of each contracting arrangement.

a. Commissioning services can be procured through GSA Schedule Contracts with qualified Commissioning Agents. This avenue allows the VA to select Commissioning Agents on a qualifications basis and solicit competitive bids or sole source providers depending on the circumstances of each individual project.

b. For Design-Bid-Build projects, the Commissioning Agent can be engaged through the A/E Contract. In this contracting method, the selection of the Commissioning Agent is the sole responsibility of the A/E. Unless the solicitation for the A/E is structured to require that the A/E include the prospective Commissioning Agent as a key member of the design team in a manner similar to providing qualifications for the MEP Engineer, Structural Engineer, Fire Protection Engineer and other key consultants, this arrangement does not provide the VA Contracting Officer and the VA Project Manager/Resident Engineer with an opportunity to review the Commissioning Agent qualifications and to develop a relationship that encourages direct communication between the Commissioning Agent, the VA and all other members of the commissioning team.

   The most significant risk of engaging the Commissioning Agent through the A/E is that the Commissioning Agent, as a sub-consultant to the design team, may be more reluctant to surface design issues than when directly contracted to the VA. The VA Project Manager / Resident Engineer can mitigate this risk by both reviewing the A/E's prospective Commissioning Agent's qualifications and by requiring the open communication outlined in this manual between all parties. In particular, all communications from the Commissioning Agent must be delivered simultaneously to the A/E team and the VA Project Manager.

c. An alternative occasionally employed in other federal agencies is to procure Commissioning Agent services through the Contractor. This method is not recommended because the conflicts of interest created by the relationship between the Commissioning Agent and the Contractor can seriously impact both the rigor of commissioning and the open communication that is critical to the success of the commissioning process.

4.1.3 Design-Build Projects

For Design-Build projects, the Commissioning Agent should be contracted directly with the VA. In this procurement environment, the Commissioning Agent can provide technical support and representation of the VA most vital interests when contracted either through a professional services contract or a GSA Schedule contracting contract.

a. In other federal agencies, the commissioning provider is often procured through the Design Build contract with a Construction Manager or General Contractor. Under a contract to the Prime Design Build entity, the Commissioning Agent will be faced with conflicts of interest at every stage of the construction process.

4.1.4 Lease/Developer Projects

For Lease/Developer projects, similar to the Design Build contracts, the Commissioning Agent should contracted as directly with the VA as possible. In this procurement environment, the Commissioning Agent can provide technical support and representation of the VA most vital interests when contracted either through an A/E type contract or a GSA Schedule contracting contract.

4.1.5 Deferred Award of Commissioning Agent Contracts

Recognizing that the acquisition of IDIQ contract or project-specific contract relationships with qualified Commissioning Agents may take some time, it may be that the Commissioning Agent is not identified until later design phases. In this event, the VA Project Manager and the Commissioning Agent must identify the key deliverables, as described in this Manual, which must be submitted on an expedited basis. These key deliverables include:

a. Commissioning Plan

b. Commissioning Specifications

c. Review of the Owner's Project Requirements and Design Narrative

d. Review of the most recent design submission.

4.1.6 Impact of Delayed Projects

In any of the contracting methods discussed above, it is important to consider the possibility that a project may be cancelled or suspended at any point prior to start of construction. For projects where the probability of project cancellation is high, the contract with the Commissioning Agent should include a Schedule of Values for the commissioning tasks included in each phase of the design process. The Schedule of Values is a valuable tool that can be used when negotiating contract close-out with the Commissioning Agent if a project is cancelled or significantly delayed. In the event the project is significantly delayed, the Commissioning Agent will have costs associated with resuming the project. These costs, and any escalation adjustments in the fees, can be negotiated with the Commissioning Agent when the project is resumed. If the delay and associated re-design are significant (more than 5 years after initial contract award), the Contracting Office should consider Terminating for Convenience the original contract with the Commissioning Agent and issuing a new Request for Qualifications to engage a new Commissioning Agent.

4.2 Pre- Design Commissioning Kickoff Meeting

Once a Commissioning Agent is contracted for a project, a Pre-Design Commissioning Kickoff Meeting should be held with the selected Commissioning

Agent to confirm the work scope. This will allow both the Commissioning Agent and the VA to - better understand the project, project team and develop a Preliminary Commissioning Plan that is responsive to both the project objectives and the particular make-up of the project team.

Attendees at the Pre-Design Commissioning Kickoff Meeting should include, but not limited to the following:

a. VA Contracting Officer
b. VA Project Management Team
c. Commissioning Agent
d. Key A/E Design Team representatives

The Pre-Design Commissioning Kickoff Meeting should address the following issues:

a. Project Scope of Work and Critical Objectives
b. Project Schedule and Budget Requirements and Limitations
c. Significant Project Challenges
d. Commissioning Team Members that can be identified at the time of this meeting, including strengths and weaknesses of these participants.
e. Administrative Requirements for Commissioning Contract Management

Commissioning Agent Task/Deliverables Description Pre-Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
PRE-DESIGN PHASE		
Pre-Design Commissioning Kickoff Meeting	Conduct Pre-Design Commissioning Kickoff Meeting with the VA and the Design Team. Establish or review Owner's Project Requirements (OPR), goals, objectives, and preliminary schedule. Establish commissioning goals and objectives. Establish the purpose and proposed process for commissioning the project. Establish the individual roles of each participating commissioning team member. Establish systems to be commissioned and preliminary acceptance criteria.	Draft Commissioning Plan Meeting Minutes Preliminary Owner's Project Requirements

5 Design Phase Commissioning

5.1 Design Phase Commissioning Objectives

The objectives of the Commissioning Process in the Design Phase of a project are as follows:

f. Establish project 'Acceptance Criteria' for the project and the systems to be incorporated into the project that are clear and measureable. This will provide a clearly defined methodology for establishing 'substantial completion' and 'final acceptance' of the commissioned project based on delivered system performance;

g. Provide the Commissioning Agent with a clear understanding of the designer's response to the Owner's Project Requirements. This understanding allows the Commissioning Agent to act as an advocate for these design requirements and to protect the designer's intent during the construction process; and,

h. Provide technical support for the design team in developing construction documents that meet the requirements of the VA and provide systems that are functional, maintainable and commissionable, and that provide an effective response to the Owner's Project Requirements (OPR).

5.2 Design Phase Commissioning Team

Commissioning, at every stage of a project, is a collaborative effort between all parties to the construction project. The table below identifies the necessary members of the Design Phase Commissioning Team. As part of the Commissioning Plan, the list of responsible parties noted below will be tailored to the project team and populated with names and contact information. It is critical that this information be kept current throughout the project. It is, likewise, important that the history of personnel responsible for commissioning tasks be retained in the project record.

The Commissioning Process includes record keeping methodologies that retain the input from all team members for the duration of the project. By clearly establishing the Commissioning Team and individual responsibilities, the process execution becomes easier, more effective and more accountable.

Commissioning Team Design Phase		
Designation	**Team Member**	**Description**
VA-CFM	VA Construction and Facilities Management	Key Stakeholders from the VA Office of Construction and Facilities Management
CO	VA Contracting Officer	Contracting Officer Responsible for the Contract between the VA and the Commissioning Agent (or the VA and the prime consultant holding the Commissioning Agent contract). Contracting Officer Responsible for the Contract between the VA and the A/E Team, if different from above.
VA-PM	Department of Veterans Affairs Project Manager	Technical Representative of the VA Contracting Officer responsible for project delivery during the Design Phase.
VAMC	VA Medical Center Facilities Management and/or using agency	Representatives of the local VA Medical Center responsible for Facilities Operation & Maintenance, Construction Coordination and/or other VAMC departments.
A/E	Architect/Engineer Design Team	Representatives of the Architect and Engineering Design Team responsible for Design Phase Services
CxA	Commissioning Agent	Representatives of the independent 3rd Party Commissioning Contractor
IDIQ-A/E	Peer Review A/E	Representatives of the A/E firm(s) selected to perform Peer Reviews during the Design Phase

5.3 Commissioning Agent Tasks

The following table summarizes the Commissioning Agent Tasks during the Design Phase. Further details on the tasks are provided in the paragraphs that follow the table.

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
SD1 PHASE		
Design Submission Review	Complete a thorough commissioning review of the SD1 submittal documents and submitted criteria to establish the systems to be designed and installed in compliance with the Owner's Project Requirements (OPR). Review is conducted in conjunction with the IDIQ-AE Peer Review. Documents provided to the Commissioning Agent should include, SD1 Design Narrative and other submittal documents required by PG 18-15, as well as other pertinent documents.	Design Phase Commissioning Issues Log (Incorporate Commissioning Agent review comments into Dr Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Narrative	Review and Reconcile the Project Design Narrative. Narrative should incorporate OPR requirements from VA Standards and other Project Documents. Design Narrative should describe designer's approach to the project requirements. Design Narrative can include both the Owner's Project Requirements (OPR) and the Basis of Design (BOD) information. Likewise separate documents can be developed and retained in the project record.	Design Phase Commissioning Issues Log (Incorporate commissioning review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Commissioning Plan	Develop the Project Design Phase Commissioning Plan that outlines process requirements, deliverables, roles, responsibilities, schedule and milestones. Provide a copy of the Commissioning Plan to the A/E. The A/E will incorporate the Commissioning Plan into the Design Narrative as described in PG 18-15	Project Design Phase Commissioning Plan
Duration Schedule for Commissioning Activities	Based on the Project Design Phase Commissioning Plan, prepare a duration schedule for the design phase commissioning activities required by the commissioning plan. This duration schedule should include Design Phase Activities. The Duration Schedule should provide sufficient detail to comply with the AE Team CPM scheduling requirements as outlined in PG 18-15.	Design Phase Commissioning Duration Schedule – Incorporate into Commissioning Plan

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Design Review Meeting	Attend and participate in SD1 Design Review Meeting. Provide clarifications for identified Commissioning Issues as appropriate. Incorporate other comments or issues identified at Review Meeting that impact project commissioning into Commissioning Issues Log.	Revised Design Phase Commissioning Issue Log. (Note that resolution of some issues may be deferred to later design stages.)
SD2 PHASE		
Design Submission Review	Complete a thorough commissioning review of the SD2 submittal documents and submitted criteria to establish the systems to be designed and installed in compliance with the OPR. Documents provided to the Commissioning Agent should include, SD2 Design Narrative, calculations, room locations and preliminary layouts and other submittal documents required by PGA 18-15, as well as other pertinent documents.	Design Phase Commissioning Issues Log (Incorporate commissioning review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Narrative	Review the updated Project Design Narrative. The Design Narrative should incorporate OPR requirements from VA Standards and other Project Documents. Design Narrative should describe designer's approach to the project requirements.	Design Phase Commissioning Issues Log (Incorporate review comments into Dr Checks for Project Tracking – Retain for Design Phase Cx Report)
Commissioning Plan	Update the Project Design Phase Commissioning Plan. Provide a copy of the Commissioning Plan to the A/E. The A/E will incorporate the Commissioning Plan into the Design Narrative as described in PG 18-15	Updated Project Design Phase Commissioning Plan
Duration Schedule for Commissioning Activities	Based on the Project Design Phase Commissioning Plan, prepare a duration schedule for the Design Phase commissioning activities required by the commissioning plan. This duration schedule should include Design Phase Activities. The Duration Schedule should provide sufficient detail to comply with the AE Team CPM scheduling requirements as outlined in PG 18-15.	Design Phase Commissioning Duration Schedule – Incorporate into Commissioning Plan
Commissioning Specifications	Provide Outline Commissioning Specifications Sections utilizing the VA Master Construction Specification. Specifications shall be submitted in accordance with the requirements of PG 18-15.	Outline Commissioning Specifications Specification Coordination Matrix for Commissioning Agent/A/E coordination.

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Design Review Meeting	Attend and participate in SD2 Design Review Meeting. Provide clarifications for identified Commissioning Issues as appropriate. Incorporate other comments or issues identified at Review Meeting that impact project commissioning into Commissioning Issues Log.	Revised Design Phase Commissioning Issue Log Note that resolution of some issues may be deferred to later design stages.
Design Phase Issue Log Resolution	Update the Commissioning Issues Log by recording resolutions to identified Commissioning Issues.	Revised Design Phase Commissioning Issue Log
DD1 PHASE		
Design Submission Review	Complete a thorough commissioning review of the DD1 submittal documents and submitted criteria to establish the systems to be designed and installed in compliance with the OPR. Documents provided to the Commissioning Agent should include: DD1 Updated Design Narrative, calculations, equipment schedules, system and control schematic diagrams and appropriate schematics and other submittal documents required by PG 18-15, as well as other pertinent documents.	Design Phase Commissioning Issues Log (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Narrative	Review the updated Project Design Narrative. The Design Narrative should be updated to reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's approach to the project requirements.	Design Phase Commissioning Issues Log (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Phase Controls Meeting	Meet with the Design Team and VAMC to develop HVAC and other system control strategies, sequences of operation, trending, and alarms. The Commissioning Agent acts as advocate for the VAMC and the facilities operations staff to assist the Design Team in developing realistic operating strategies and sequences of operations that will enable the facilities operations staff to operate the building systems to sustain the operational, energy and other systems parameters throughout the project life cycle.	Meeting Notes

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Commissioning Plan	Update the Project Design Phase Commissioning Plan, including any revisions to Commissioning Team Members, Schedules and other modifications required by the progress of the project. Prepare a Draft Construction Phase Commissioning Plan, including systems to be commissioned, an outline of construction phase roles and responsibilities, and an outline of required system documentation requirements. Provide a copy of the updated Design Phase Commissioning Plan to the A/E. The A/E will incorporate the Commissioning Plan into the Design Narrative as described in PG 18-15	Updated Project Design Phase Commissioning Plan Draft Construction Phase Commissioning Plan
Duration Schedule for Commissioning Activities	Based on the Project Design Phase Commissioning Plan, prepare a duration schedule for the commissioning activities required by the commissioning plan. This duration schedule should include Design Phase Activities. The Duration Schedule should provide sufficient detail to comply with the AE Team CPM scheduling requirements as outlined in PG 18-15. Based on the Draft Construction Phase Commissioning Plan, prepare a preliminary duration schedule for Construction Phase Commissioning Activities. Incorporate the draft duration schedule into the Draft Construction Phase Commissioning Plan.	Commissioning Duration Schedule – Incorporate into Commissioning Plan Draft Construction Phase Commissioning Duration Schedule – Incorporate into the Draft Construction Phase Commissioning Plan.
Commissioning Specifications	Provide Draft Commissioning Specifications Sections utilizing the VA Master Construction Specification. Specifications shall be submitted in accordance with the requirements of PG 18-15. Provide a Specification Coordination Matrix that outlines the commissioning-related language that needs to be included in the individual equipment and technical specifications.	Draft Commissioning Specifications Specification Coordination Matrix for Commissioning Agent/A/E coordination.

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Design Review Meeting	Attend and participate in DD1 Design Review Meeting. Provide clarifications for identified Commissioning Issues as appropriate. Incorporate other comments or issues identified at Review Meeting that impact project commissioning into Commissioning Issues Log.	Revised Design Phase Commissioning Issue Log. (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report) (Note that resolution of some issues may be deferred to later design stages.)
Design Phase Issue Log Resolution	Update the Commissioning Issues Log by recording resolutions to identified Commissioning Issues.	Revised Design Phase Commissioning Issue Log (Incorporate review comments into Dr Checks for Project Tracking – Retain for Design Phase Cx Report)
DD2 PHASE		
Design Submission Review	Complete a thorough review of the DD2 submittal documents and submitted criteria to establish the systems to be designed and installed in compliance with the OPR. Documents provided to the Commissioning Agent should include: DD2 Updated Design Narrative, calculations, equipment schedules, system and control schematic diagrams, floor plans and appropriate schematics and other submittal documents required by PG 18-15, as well as other pertinent documents.	Design Phase Commissioning Issues Log (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Narrative	Commissioning Agent to update, review and reconcile the Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Submit the updated Design Narrative to the AE team for review and comment. Incorporate review comments into the updated Design Narrative as necessary.	Design Phase Commissioning Issues Log

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Commissioning Plan	Update the Project Design Phase Commissioning Plan, including any revisions to Commissioning Team Members, Schedules and other modifications required by the progress of the project. Update the Construction Phase Commissioning Plan, including systems to be commissioned, an outline of construction phase roles and responsibilities, and an outline of required system documentation requirements. Include the updated Commissioning Plan in the revised Design Narrative	Updated Project Commissioning Plan
Commissioning Specifications	Provide Preliminary Commissioning Specifications Sections utilizing the VA Master Construction Specification. Specifications shall be submitted in accordance with the requirements of PG 18-15. Review individual equipment and technical sections to ensure commissioning-related language has been included as provided in the Commissioning Specification Coordination Matrix.	Preliminary Commissioning Specifications Marked up equipment and technical specification sections showing any revisions to commissioning-related language. Specification Coordination Matrix for Commissioning Agent/A/E coordination.
Duration Schedule for Commissioning Activities	Based on the Project Design Phase Commissioning Plan, prepare an updated duration schedule for the design phase commissioning activities required by the commissioning plan. This duration schedule should include Design Phase Activities. The Duration Schedule should provide sufficient detail to comply with the AE Team CPM scheduling requirements as outlined in PG 18-15. Based on the Project Construction Phase Commissioning Plan and the DD2 Phase design submission, update the draft Construction Phase Commissioning Duration Schedule. Incorporate the revised Construction Phase Duration Schedule into the Draft Commissioning Phase Commissioning Plan.	Design Phase Commissioning Duration Schedule – Incorporate into Design Phase Commissioning Plan Construction Phase Commissioning Duration Schedule – Incorporate into Construction Phase Commissioning Plan

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Develop Preliminary Pre-Functional Checklists (PFC's)	The Commissioning Agent will prepare Preliminary Pre Functional Checklists (PFC) for type of system to be commissioned and distribute to all Cx Team members for review and comment. A completed PFC indicates the system and its related equipment is ready for Systems Functional Performance Testing. Preliminary Pre-Functional Checklists shall be included in the Construction Phase Commissioning Plan and the Commissioning Specifications.	Preliminary Pre Functional Checklists (PFC's)
Develop Preliminary Systems Functional Performance Test (FPT's) Procedures	Based on the systems to be commissioned and the systems shown in the DD2 submittal, the Commissioning Agent will prepare Preliminary Systems Functional Performance Test Procedures (FPT's). Preliminary FPTs shall be included in the Construction Phase Commissioning Plan and the Commissioning Specifications.	Preliminary Systems Functional Performance Test Procedures (FPT's)
Design Phase Controls Meeting	Meet with the Design Team and VAMC to update HVAC and other system control strategies, sequences of operation, trending, and alarms. The Commissioning Agent acts as an advocate for the VAMC and the facilities operations staff to assist the Design Team in developing realistic operating strategies and sequences of operations that will enable the facilities operations staff to operate the building systems to sustain the operational, energy and other systems parameters throughout the project life cycle.	Meeting Notes
Design Review Meeting	Attend and participate in DD2 Design Review Meeting. Provide clarifications for identified Commissioning Issues as appropriate. Incorporate other comments or issues identified at Review Meeting that impact project commissioning into Commissioning Issues Log.	Revised Design Phase Commissioning Issue Log. (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report) (Note that resolution of some issues may be deferred to later design stages.)

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Design Phase Issue Log Resolution	Update the Commissioning Issues Log by recording resolutions to identified Commissioning Issues.	Revised Design Phase Commissioning Issue Log (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
CD1 PHASE		
Design Submission Review	Complete a thorough commissioning review of the CD1 submittal documents and submitted criteria to establish the systems to be designed and installed in compliance with the OPR. Documents provided to the Commissioning Agent should include: calculations, equipment schedules, system and control schematic diagrams, floor plans and appropriate schematics and other submittal documents required by PG 18-15, as well as other pertinent documents.	Design Phase Commissioning Issues Log (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Narrative	Commissioning Agent to update, review and reconcile the Project Design Narrative. The Design Narrative should be updated to reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Submit the updated Design Narrative to the AE team for review and comment. Incorporate review comments into the updated Design Narrative as necessary.	Revised Design Narrative
Commissioning Plan	Update the Project Design Phase Commissioning Plan, including any revisions to Commissioning Team Members, Schedules and other modifications required by the progress of the project. Update the Construction Phase Commissioning Plan, including systems to be commissioned, an outline of construction phase roles and responsibilities, and an outline of required system documentation requirements. Include the updated Commissioning Plan in the revised Design Narrative	Updated Design Phase Project Commissioning Plan Updated Construction Phase Project Commissioning Plan

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Duration Schedule for Commissioning Activities	Based on the Project Design Phase Commissioning Plan, prepare a duration schedule for the commissioning activities required by the commissioning plan. This duration schedule should include Design Phase Activities. The Duration Schedule should provide sufficient detail to comply with the AE Team CPM scheduling requirements as outlined in PG 18-15. Based on the Project Construction Phase Commissioning Plan and the DD2 Phase design submission, update the draft Construction Phase Commissioning Duration Schedule. Incorporate the revised Construction Phase Duration Schedule into the Draft Commissioning Phase Commissioning Plan.	Design Phase Commissioning Duration Schedule – Incorporate into Design Phase Commissioning Plan Update Construction Phase Duration Schedule – Incorporate into Construction Phase Commissioning Plan
Commissioning Specifications	Provide Final Commissioning Specifications Sections utilizing the VA Master Construction Specification. Specifications shall be submitted in accordance with the requirements of PG 18-15. Review individual equipment and technical sections to ensure commissioning-related language has been included as provided in the Commissioning Specification Coordination Matrix.	Final Project Commissioning Specifications Marked up equipment and technical specification sections to identify any changes to commissioning-related language.
Develop Draft Pre-Functional Checklists (PFC's)	The Commissioning Agent will update the Preliminary Pre Functional Checklists (PFC) to Draft Pre-Functional Checklists for each type of system to be commissioned and distribute to all Cx Team members for review and comment. Draft Pre-Functional Checklists shall be included in the Construction Phase Commissioning Plan and the Commissioning Specifications.	Draft Pre Functional Checklists (PFC's)
Develop Preliminary Systems Functional Performance Test (FPT's) Procedures	Based on the systems to be commissioned and the systems shown in the CD1 submittal, the Commissioning Agent will update the Preliminary Systems Functional Performance Test Procedures (FPT's) to become Draft Systems Functional Performance Test Procedures. . Draft FPTs shall be included in the Construction Phase Commissioning Plan and the Commissioning Specifications.	Draft Systems Functional Performance Test Procedures (FPT's)

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Design Phase Controls Meeting	Meet with the Design Team and VAMC to update HVAC and other system control strategies, sequences of operation, trending, and alarms. The Commissioning Agent acts as advocate for the VAMC and the facilities operations staff to assist the Design Team in developing realistic operating strategies and sequences of operations that will enable the facilities operations staff to operate the building systems to sustain the operational, energy and other systems parameters throughout the project life cycle.	Meeting Notes
Design Review Meeting	Attend and participate in CD1 Design Review Meeting. Provide clarifications for identified Commissioning Issues as appropriate. Incorporate other comments or issues identified at Review Meeting that impact project commissioning into Commissioning Issues Log.	Revised Design Phase Commissioning Issue Log. (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report) (Note that resolution of some issues may be deferred to later design stages.)
Design Phase Issue Log Resolution	Update the Commissioning Issues Log by recording resolutions to identified Commissioning Issues.	Revised Design Phase Commissioning Issue Log
FINAL DESIGN DOCUMENTS		
Design Final Design Submission Review	Review Final Design Submission for resolution of Outstanding Commissioning Issues	Design Phase Commissioning Issues Log (Incorporate review comments into Dr. Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Narrative	Commissioning Agent to provide a Final Design Narrative to Include all modifications and/or deviations from CD1 Design Narrative. The Design Narrative should be updated to reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approved deviations from design standards and reasoning for same.	Revised Design Narrative

Commissioning Agent Task/Deliverables Description Design Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Commissioning Plan	Update & Submit Project Construction Phase Commissioning Plan Include the updated Commissioning Plan in the revised Design Narrative	Project Construction Phase Commissioning Plan
Duration Schedule for Commissioning Activities	Based on the Project Construction Phase Commissioning Plan, prepare a duration schedule for the commissioning activities required by the commissioning plan. This duration schedule should include Construction Phase Activities. The Duration Schedule should provide sufficient detail to allow the Prime Contractor to incorporate commissioning activities into the Master Project Schedule.	Construction Phase Commissioning Duration Schedule – Incorporate into Commissioning Plan
Commissioning Specification	Provide updated Final Cx Specifications. Specifications shall be submitted in accordance with the requirements of PG 18-15.	Updated Project Commissioning Specifications
Design Phase Issue Log Resolution	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.	Revised Design Phase Commissioning Issue Log (Incorporate review comments into Dr Checks for Project Tracking – Retain for Design Phase Cx Report)
Design Phase Commissioning Report	Prepare Design Phase Commissioning Report to document the Design Phase commissioning process and results	Design Phase Commissioning Report

5.4 Commissioning Roles and Responsibilities

The objective of the Design Phase Commissioning process is to facilitate a collaborative effort to deliver construction documents

- that are clear and constructible;
- that are free of confusion or conflicts that might result in project changes in cost or schedule; and,
- that clearly identify performance objectives that must be met to consider the project acceptable for final acceptance at the schedule conclusion of the project schedule.

To this end, the Commissioning Agent is tasked with the responsibility to support the Designers of Record (Architect and Engineers) with focused design reviews and supportive recommendations regarding construction document clarity,

system and component accessibility and maintainability, training requirements and commissionability of the installed systems. The Commissioning Agent and the commissioning team members are expected to offer their experience and expertise in systems operations, testing and operator training to support the Designers of Record in meeting the team's quality objectives for the project design documents.

It is important to note that the Design Phase Commissioning activities are not intended to compromise the authority of the Designers of Record. Design Phase Commissioning reviews do not meet the standard of Peer Reviews and do not replace the Peer Review process in place for VA projects. The obligation of the Commissioning Agent is to offer the full benefit of his/her experience in constructing, starting up and operating buildings and building systems. It is the obligation of the Designers of Record to provide sufficient and clear responses to the issues raised by the Commissioning Agent so that he/she can facilitate a process that achieves the performance objectives expressed by the collective project documents.

The following tables describe both the task associated with executing the Design Phase commissioning process and the responsibilities of each commissioning team member in execution of each task. It is imperative that the Team Members are identified, and that the roles and responsibilities are clearly identified and tailored to each specific project, as well as to the systems to be commissioned.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Pre-Design	Commissioning Kick Off Meeting	Facilitate the Kick Off Meeting Participate in Kick Off Meeting Provide VA Schedule Requirements and Milestones Review Meeting Minutes & Comment	Identify Cx Team Members Participate in Kick Off Meeting Review Meeting Minutes & Comment	Identify Cx Team Members Participate in Kick Off Meeting Review Meeting Minutes & Comment	Identify Cx Team Members Discuss Design Schedule and Critical Milestones Participate in Kick Off Meeting Review Meeting Minutes & Comment	Prepare and disseminate Agenda Lead Kick Off Meeting Produce Meeting Minutes and Incorporate Comments Prepare Draft Commissioning Plan

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-1	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & provide feedback as appropriate Facilitate resolution of comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Dr. Checks comments. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Perform commissioning review and comment on SD1 Design Review submission. Record review comments on Commissioning Issues Log. Incorporate review comments into Dr. Checks. . Record resolution for each issue based on A/E Response; record in Commissioning Issues Log and on Dr. Check.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-1	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Comment	Review Design Narrative & Comment	Develop Design Narrative to Include OPR and Basis of Design response to OPR.	Review Design Narrative for compliance with VA Standards and other stated VA Objectives for project. Provide support for developing measurable performance criteria for installed systems.
SD-1	Commissioning Plan	Distribute Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Develop & Submit Project Design Phase Commissioning Plan
SD-1	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Prepare Duration Schedule for Design Phase Commissioning Activities

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-1	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues	Attend Design Review Meeting as req'd by other VA requirements.	Attend Design Review Meeting	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified
SD-2	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on SD2 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-2	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Update Design Narrative to Include OPR and Basis of Design response to OPR.	Review Design Narrative for compliance with VA Standards and other stated VA Objectives for project. Provide support for developing measurable performance criteria for installed systems.
SD-2	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan
SD-2	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities
SDS-2	Commissioning Specifications					
SD-2	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-2	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.
DD-1	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on DD1 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-1	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Update Design Narrative to Include OPR and Basis of Design response to OPR.	Review Design Narrative for compliance with VA Standards and other stated VA Objectives for project. Provide support for developing measurable performance criteria for installed systems.
DD-1	Design Phase Controls Meeting	Facilitate and schedule meeting. Participate in meeting	Attend and participate in meeting	Attend and participate in meeting	Chair meeting Attend and participate in meeting	Attend and participate in meeting
DD-1	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Project Commissioning Plan
DD-1	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Prepare draft duration schedule for Construction Phase Commissioning Activities

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-1	Commissioning Specification	Review Cx Draft Specs & Comment	Review Cx Draft Specs & Comment	Review Cx Draft Specs & Comment	Incorporate Draft Cx Specifications into Project Specification Submittal. Review Cx Draft Specs & Comment	Develop Draft Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.
DD-1	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified
DD-1	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-2	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on DD2 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-2	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Review Updated Design Narrative to Include OPR and Basis of Design response to OPR.	Commissioning Agent to update, review and reconcile the Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approval of deviations from VA Design Criteria and reasoning for same. Provide support for developing measurable performance criteria for installed systems.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-2	Preliminary Pre-Functional Checklists and Preliminary System Functional Performance Test Procedures	Distribute to Cx Team. Review and comment	None	Review and Comment	Review and Comment	Prepare Preliminary PFC and FPT. Incorporate review comments into the Draft PFCs and FPTs as appropriate.
DD-2	Design Phase Controls Meeting	Facilitate and schedule meeting. Participate in meeting	Attend and participate in meeting	Attend and participate in meeting	Chair meeting Attend and participated in meeting	Attend and participate in meeting
DD-2	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan
DD-2	Commissioning Specification	Review Cx Preliminary Specs & Comment	Review Cx Draft Preliminary & Comment	Review Cx Draft Preliminary & Comment	Incorporate Preliminary Cx Specifications into Project Specification Submittal. Review Cx Draft Specs & Comment	Develop Preliminary Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-2	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Update draft duration schedule for Construction Phase Commissioning Activities
DD-2	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified
DD-2	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on CD1 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative for conformance with current project status. Verify recorded decisions are consistent with Design Team intent and contracts with the VA.	Commissioning Agent to update, review and reconcile the Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approval of deviations from VA Design Criteria and reasoning for same.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Draft Pre-Functional Checklists and Functional Performance Test procedures	Distribute to team Review and comment	None	Review and Comment	Review and comment	Starting from the Preliminary PFCs and FPTs and review comments, develop Draft PFCs and FPTs. Incorporate into the Construction Phase Commissioning Plan and Commissioning Specifications.
CD-1	Design Phase Controls Meeting	Facilitate and schedule meeting. Participate in meeting	Attend and participate in meeting	Attend and participate in meeting	Chair meeting Attend and participated in meeting	Attend and participate in meeting
CD-1	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Update draft duration schedule for Construction Phase Commissioning Activities
CD-1	Commissioning Specification	Review Cx Final Specs & Comment	Review Cx Final Specs & Comment	Review Cx Final Specs & Comment	Incorporate Final Cx Specifications into Project Specification Submittal. Review Cx Final Specs & Comment	Develop Final Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.
CD-1	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.
Final	Design Final Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Facilitate Resolution of Comments by A/E Team	None	None	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to all Outstanding Issues	Review Final Design Submission for resolution of Outstanding Commissioning Issues

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Design Narrative	Review & Approve Final Design Narrative	None	None	Review Design Narrative for conformance with current project status. Verify recorded decisions are consistent with Design Team intent and contracts with the VA.	Commissioning Agent to provide Final Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approval of deviations from VA Design Criteria and reasoning for same.
Final	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Draft Pre-Functional Checklists and Functional Performance Test procedures	Distribute Review and back-check	None	Review and back-check	Review and back-check	Incorporate back-check comments into the Draft PFCs and FPTs; incorporate into the Commissioning Plan and Final Commissioning Specifications.
Final	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Update draft duration schedule for Construction Phase Commissioning Activities
Final	Commissioning Specification	Review Cx Updated Specs & Approve	Review Cx Updated Specs & Comment	Review Cx Updated Specs & Comment	Incorporate Updated Cx Specifications into Project Specification Submittal.	Provide updated Final Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.
Final	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	None	N one	None	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Design Phase Commissioning Report	Review, comment and approve	Review and Comment	Review and Comment	Review and Comment	Prepare and submit Design Phase Commissioning Report.

5.5 Design Narrative

The Department of Veterans Affairs Design Guides provide detailed guidance and templates for the various type spaces included in projects. These guides include typical space allocation, space functions, furnishings, equipment, environmental, electrical, telecommunications/data, and security requirements. When combined with specific project programming documents they provide the VA and the A/E with sufficient information to develop the project requirements.

Department of Veterans Affairs Design Manuals provide general guidance on the types and configuration of systems necessary to support the project requirements. The project requirements, along with the guidance provided in the Design Manuals, allows the A/E to develop the project infrastructure system requirements and begin the process of engineering and selecting the appropriate systems needed to support the facility operations. These documents (available in the VA Technical Information Library, http://www.cfm.va.gov/TIL) constitute the fundamental Owner's Project Requirements (OPR as described in ASHRAE Guideline 0.

The VA-CFM or Project Manager may elect to provide more specific guidance on system types, operating parameters, or other deviations from the Design Guides or Design Manuals. In this event, these deviations should be documented and included with the programming documents to provide complete and clear project-specific direction to the A/E design team. This project-specific documentation relative to the infrastructure systems should also be provided to the Commissioning Agent to provide the basis for evaluation of the Design Narrative and subsequent design submissions.

The A/E design team develops the Design Narrative to document their understanding of the overall Owner's Project Requirements and to describe how their design will satisfy the requirements outlined in the VA Design Guides. The Design Narrative is submitted as a key component of the A/E submission to the VA at the SD1, SD2, and DD1 stages of design.

As the design progresses into the DD2, CD1 and Final Construction Document stages, the A/E is focused on completing the design and is making only a few engineering or architectural changes to the project. However, an updated Design Narrative remains a critical part of the project documentation. It provides information that is useful to the VAMC long after the project is complete.

Therefore, the focus of the Design Narrative shifts from one where the A/E design team describes what they intend to design, to a focus of documenting what key design decisions were made, the rationale for the decisions, and how the design has changed and progressed. In reality, this focus begins to match several of the key elements of the Systems Manual. The Systems Manual is a key element in transferring knowledge to the facilities operations team.

In order to preserve this critical design information in a form that will facilitate preparing the Systems Manual, the Commissioning Agent should update the

Design Narrative beginning with the DD2 submittal. During the commissioning design review, while evaluating the design documents with the Design Narrative, the Commissioning Agent will update the Design Narrative. This will maintain the accuracy of the Design Narrative while allowing the A/E to concentrate on completing the design documents.

At the completion of the Final Construction Documents, the Design Narrative should include all the design information needed to complete the design-related sections of the Systems Manual. See the discussion of the Systems Manual in Chapter 8 of this manual for further information.

5.6 Commissioning Plan

The Design Phase Commissioning Plan is the execution plan for the Commissioning Process during the design phase. The Commissioning Agent will prepare a Design Phase Commissioning Plan during the SD1 Phase of the project. This plan will be updated throughout the project to reflect both increasing levels of available project detail and the evolution in development of the commissioned systems. Prior to the Final Design submit, the plan will be updated into Construction Phase Commissioning Plan and inserted in the project specifications. The Construction Phase Commissioning Plan will identify members of the Commissioning Team (by discipline) that will represent the Contractor, subcontractors and other team members with construction, acceptance and warranty phase responsibilities. The names and contact information will be added to this plan once the Contractor mobilizes for the work

The Commissioning Plan should include the following components:

a. Commissioning Program Overview
    - Goals and Objectives
    - General project information
    - Systems to be commissioned
b. Commissioning Team
    - Team members,
    - Team member roles, and responsibilities
    - Communication protocol, coordination, meeting, and management
c. Commissioning Communications Plan
    - Commissioning document development, review, and distribution
    - Collaboration on issue resolution
    - Issues Log assignment of responsible party
    - Recommendations for issue resolution
    - Directives for issue resolution and contract changes
d. Commissioning Process Activities

- Documenting the VA's project requirements
- Preparing the Design Narrative
- Documenting the commissioning design review process
- Reviewing contractor submittals
- Developing Pre-Functional Checklists
- Developing Systems Functional Performance Test procedures
- Reporting observations and issues, as well as the resolution process
- Developing the System Manual
- Verifying the training requirements for operations personnel
- Accepting the building systems
- Reviewing building operations after final acceptance

e. Pre-functional Checklists (PFT), Systems Functional Performance Tests (FPT) and Integrated Systems Tests (IST)

- Provide a list of PFT's, FPT's and Integrated System Testing Documents that will be required to complete the project.
- The list of documents will be updated as the project progresses.

5.7 Commissioning Specifications

Typically, the project commissioning specifications included with the Project Manual prepared by the A/E are used to inform contractors of their responsibilities in the commissioning process. These specifications should be developed by the Commissioning Agent based on the VA Guide Specifications and the particular requirements of each project and should include the following components:

- Commissioning team involvement
- Commissioning Team roles and responsibilities for VA RE, A/E, Commissioning Agent, and the Contractor
- Submittal review procedures
- Systems Manuals
- Meetings
- Construction verification process
- Startup plan development and implementation
- System Functional Performance Testing and verification
- Acceptance and closeout
- Training
- Warranty review site visit

5.8 Commissioning Design Reviews

The Commissioning Agent should conduct commissioning design reviews at each submission. This review is conducted in addition the Peer Review conducted by the IDIQ A/E. The commissioning design review should include review of the Owner's Project Requirements, Design Narrative, design drawings, design specification, and other design submissions (e.g. design calculations) to give the VA PM an independent assessment of the state of the design for the commissioned systems. The A/E submission requirements for each design submission are outlined in the VA PG 18-15. Typically a design review performed by the Commissioning Agent focuses on the following issues:

Design Area	Review Description
General Review	Identify major concerns that could potentially affect operations, maintenance or testing of the systems.
OPR and Design Narrative	Review to identify major discrepancies between the OPR and Design Narrative documents and the construction documents.
Commissioning Facilitation	Identify to what extent commissioning activities are included in the construction documents including testing, training and O&M documentation requirements.
Energy Efficiency	Review the efficiency of system types and components for HVAC systems, lighting systems and building envelope for the purposes of understanding the objectives of the Design Engineer. The Commissioning Agent shall develop techniques to confirm the energy performance of the installed and commissioned system during the first year of system operation.
Control System & Control Strategies	Review HVAC, lighting, fire control, emergency power, strategies and sequences of operation are sufficient to develop functional test procedures.
Operations And Maintenance (O&M)	Review for effects of specified systems and layout toward facilitating O&M (equipment accessibility, system control, etc.).
Indoor Environmental Quality	Review to verify that systems relating to air quality comfort and air distribution comfort are in accordance with the VA Requirements.
O&M Documentation	Verify adequate building O&M documentation requirements.
Training	Verify adequate operator training requirements.
Commissioning Specifications	Verify that bid documents adequately specify building commissioning, including testing requirements by system type.
VA's Design Guideline Or Standard	Review to identify major discrepancies between VA's design guidelines and the construction documents.
Environmental Sustainability	Review to verify that the building materials, site design and use of water and energy are in accordance with VA objectives.
Fire Protection	Review the fire protection design to facilitate commissioning.
Plumbing	Review the plumbing design to facilitate commissioning.
Mechanical	Review the mechanical design to facilitate commissioning.

Design Area	Review Description
Electrical	Review the electrical systems to facilitate commissioning.
Communications	Review the communications design to facilitate commissioning.
Electronic Safety & Security	Review the electronic safety & security design to facilitate commissioning.
Site Utilities	Review the site utilities design to facilitate commissioning.
Equipment	Review the equipment design to facilitate commissioning.
Conveying Equipment	Review the conveying equipment design to facilitate commissioning.
Building Exterior Closure	Review to identify major discrepancies between VA's design guidelines and the construction documents. Review the systems to facilitate commissioning.
Design Review Comment Back-Check	Verify the all issues identified and discussed in previous design reviews have been adequately addressed.

5.9 Design Phase Controls Meetings

The Design Phase Controls Meetings include one or more meetings with the Mechanical Design Engineer, Electrical Design Engineer, VAMC Energy Manager, VAMC Facilities Manager, VA Project Manager and Commissioning Agent. The purpose of the meeting is to discuss various Building Automation System/Direct Digital Control System strategies for operating the building systems that will be included in the construction documents. The discussion should include:

- System Operating Schedules (Time of Day scheduling and 24/7 system operations for various functional areas)
- Temperature and Humidity Setpoints
- Freeze protection strategies and frost control sequences of operations
- Energy recovery systems operating sequences of operations
- Humidity control sequences of operations
- HVAC System infection control strategies
- Economizer (air- and water-side) mode operating strategies
- Smoke Control System sequences of operations
- Stairway pressurization system sequences of operations
- Chilled water, steam, and heating hot water flow control sequences of operations
- Normal power distribution system, emergency power distribution system, and emergency generator system sequence of operations

- Renewable energy system sequences of operations
- Operating Room and Isolation Room pressure differential control system sequences of operations.
- Laboratory hood system sequences of operations and room pressure differential controls.
- Building pressure control sequences of operations.
- Other control strategies and sequences of operations for systems particular to a specific project.

5.10 Design Review Meetings

Design Review Meetings are an opportunity for the design team to meet and candidly discuss the review comments made by the Peer Reviewer, VACO, VA CFM, VAMC, and the Commissioning Agent. Therefore, as a key member of the project team, the Commissioning Agent should attend and actively participate in these meetings to discuss the commissioning review comments.

The focus is on providing constructive feedback to the design team. It should be a free exchange of issues aimed at improving the design and ensuring the design continues to meet the project requirements, codes and standards, and other guidance. These meetings are discussed in other VA documents and handbooks.

5.11 Design Review Comment Follow-up

The Commissioning Agent should maintain a Commissioning Design Review Comment Log of all comments generated by the Commissioning Agent during the review process. This log is submitted to the VA PM and to the A/E. Additionally, these review comments should be entered into the Dr. Checks system used by the VA and the Peer Reviewers.

The A/E should evaluate the commissioning review comments and provide written responses to the Commissioning Agent. The commissioning design review comments are discussed during the Design Review Meetings. The A/E responses are documented on the Commissioning Design Review Comment Log and/or in the Dr. Checks system.

The comments should also be incorporated into the design drawings and specifications. During subsequent design reviews, the Commissioning Agent will evaluate the A/E response to the comment and verify that the design documents have adequately addressed the review comments.

5.12 SD1 Design Submission

Design review is the responsibility of VA staff, the A/E QC team, the Peer Reviewer (if applicable) and the Commissioning Agent. The SD1 Design Review consists of the following elements:

a. OPR Review and Update:

The Commissioning Agent will review the initial OPR and provide comments and/or recommended updates. The review will focus on any initial deviation requests and/or revised directives from the VACO

b. Design Narrative Review:

The Commissioning Agent will review the Design Narrative prepared by the A/E for compliance with the OPR. The review will also focus on any deviations from the Design Manuals that would require deviation requests be submitted to VACO.

c. Develop the Design Phase Commissioning Plan

The Commissioning Agent will develop and maintain the Design Phase Commissioning Plan. This plan is the roadmap describing how Design Phase Commissioning will be implemented for the specific project. At a minimum the Design Phase Commissioning Plan should address the following topics:

- Design Phase Commissioning Scope
- Design Phase Commissioning Team
- Design Phase Commissioning Team member roles and responsibilities
- Communications protocols
- List or matrix of commissioning checklists, forms and other documents used in the Design Phase
- Commissioning Schedule

d. SD1 Design Review

Design review is the responsibility of VA staff, the A/E QC team, the Peer Reviewer (if applicable) and the Commissioning Agent. The SD1 Design Review will include the review elements identified in paragraph 5.8 above.

e. Commissioning Design Review Comment Log/Dr. Checks:

The Commissioning Agent should enter commissioning review comments on the Commissioning Design Review Comment Log and/or in the Dr. Checks System.

f. SD1 Design Review Meeting

Clearly, the Design Review Meeting's purpose is to review, discuss, and make decisions on the comments generated from various sources during the SD1 Design Review outlined above. These meetings are well-defined in other VA documents and handbooks. The purpose of these meetings is also well-defined in other documents. The requirement should simply be that the Commissioning Agent participates in both the review process and the review meetings. Attendance at the meeting by a representative of the Commissioning Agent should be mandatory.

g. SD1 Design Review Comment Follow-Up

This is the feedback (or back-check) step in the process to ensure the A/E team has addressed each comment and that the Schematic Design is revised as agreed in the SD1 Design Review Meeting. This is a sort of “Trust But Verify” step. The responsibility for follow-up should be assigned to each team member. VA staff should verify their comments have been addressed and appropriate design changes made; similarly the Peer Reviewer should verify Peer Review comments and the Commissioning Agent should verify Commissioning comments.

5.13 Schematic Design Phase II Submission

The Commissioning Agent will conduct a commissioning design review in parallel to the Peer Review. The Commissioning Design Review process is discussed in above.

In addition to reviewing the design submission, the Commissioning Agent will evaluate previous design review comments to verify they have been adequately addressed in this submission.

a. OPR Review and Update:

The Commissioning Agent will review the OPR and provide comments and/or recommended updates.

b. Design Narrative Review:

The Commissioning Agent will review the Design Narrative prepared and updated by the A/E for compliance with the OPR. The review will also focus on any deviations from the Design Manuals that would require further evaluation.

c. Update the Design Phase Commissioning Plan

The Commissioning Agent will update the Design Phase Commissioning Plan to incorporate any changes required as the design progresses.

d. SD2 Design Review

Design review is the responsibility of VA staff, the VAMC staff, the VA Project Manager, the A/E QC team, the Peer Reviewer (if applicable) and the Commissioning Agent. The SD2 Design Review will include the review elements identified above.

e. Outline Commissioning Specifications

The Commissioning Outline Specifications should mimic other Divisions and Sections Outline Specifications, all of which will be part of the project Contract Documents. For the Cx Outline Specification, each Section Title should be included with a brief (i.e. one-paragraph) description of what will be included in the Section. The Cx Outline Specification should cover all Divisions and Technical Sections previously agreed to be part of the commissioning process. The requirements should parallel other VA documents that define for

the A/E team what is required for the Technical Outline Specifications for the project.

f. Commissioning Design Review Log/Dr. Checks:

The Commissioning Agent should enter commissioning review comments on the Commissioning Design Review Comment Log and/or in the Dr. Checks System.

g. SD2 Design Review Meeting

The Commissioning Agent attends this meeting to discuss commissioning review comments with the A/E, VA, and Peer Reviewer.

h. SD2 Design Review Comment Follow-Up

The A/E should provide updated responses to the Commissioning Design Review comments based on the issues discussed during the design review meeting. The Commissioning Agent should review these updated responses to ensure they adequately address the results of the design review meeting.

5.14 Design Development Phase I Submission

The Commissioning Agent will conduct a commissioning design review in parallel to the Peer Review. In addition to reviewing the design submission, the Commissioning Agent will evaluate previous design review comments to verify they have been adequately addressed in this submission.

a. Update the Design Phase Commissioning Plan

The Commissioning Agent will update the Design Phase Commissioning Plan to incorporate any changes required as the design progresses.

b. Outline Construction Phased Commissioning Plan

Since the design is only partially developed at this stage of the project, an Outline Construction Phase Commissioning Plan should be developed in parallel with the design. The Outline Commissioning Plan should list each piece of system to be commissioned during the project. Where more detail is known, the Outline can be filled-in to further describe the commissioning requirements. Where little is known about a piece of equipment or system, only the existence of that item and the fact that it will be commissioned need be included in the Outline.

c. Draft Commissioning Specifications

The Commissioning Draft Specifications should mimic other Divisions and Sections Preliminary Specifications, all of which will be part of the project Contract Documents. The Commissioning Agent will also prepare a Draft Commissioning Specification Coordination Matrix that provides commissioning language that should be included in the technical specifications prepared by the A/E.

d. OPR Review and Update:

The Commissioning Agent will review the OPR and provide comments and/or recommended updates.

e. Design Narrative Review:

The Commissioning Agent will review the Design Narrative prepared and updated by the A/E for compliance with the OPR. The review will also focus on any deviations from the Design Manuals that would require further evaluation.

f. DD1 Design Review

Design review is the responsibility of VA staff, the A/E QC team, the Peer Reviewer (if applicable) and the Commissioning Agent. The DD1 Design Review will include the review elements identified above.

g. Commissioning Design Review Log/Dr. Checks:

The Commissioning Agent should enter commissioning review comments on the Commissioning Design Review Comment Log and/or in the Dr. Checks System.

h. DD1 Design Review Meeting

The Commissioning Agent attends this meeting to discuss commissioning review comments with the A/E, VA, and Peer Reviewer.

i. DD1 Design Review Comment Follow-Up

The A/E should provide updated responses to the Commissioning Design Review comments based on the issues discussed during the design review meeting. The Commissioning Agent should review these updated responses to ensure they adequately address the results of the design review meeting.

5.15 Design Development Phase II

The Commissioning Agent will conduct a commissioning design review in parallel to the Peer Review. In addition to reviewing the design submission, the Commissioning Agent will evaluate previous design review comments to verify they have been adequately addressed in this submission.

a. Design Development Controls Conference

It is expected that experts from all appropriate team members will participate in the conference to make major decisions about control system type, configuration, and capabilities together with key decisions about equipment and systems sequences of operation. The Commissioning Agent should play a major role in this conference since the ultimate decisions made will affect the ability to commission certain systems and their associated components.

b. Update Design Phase Commissioning Plan

The Commissioning Agent will update the Design Phase Commissioning Plan to incorporate any changes required as the design progresses.

c. Preliminary Construction Phase Commissioning Plan

The Preliminary Construction Phase Commissioning Plan is the completed and updated extension of the Outline Commissioning Plan. The Preliminary Commissioning Plan is a detailed document that includes all the required testing, review of balancing, and functional tests that will be required for each component and system. The Preliminary Commissioning Plan will include each piece of system to be commissioned during the project. The Preliminary Commissioning Plan will be adjusted (as hereinafter described) as project design or requirements change from Design Development through Final Design.

d. Update Commissioning Specifications

Update the Draft Commissioning Specifications based on changes in the design and/or systems included in the project. Back-check technical specification sections to ensure commissioning-related requirements have been incorporated by the A/E design team. The Draft Commissioning Specifications are subject to further modifications as the project moves from Design Development to Construction Documents to Final Design.

e. O & M Data Requirements:

The Commissioning Agent will review all technical Sections of the specifications to ensure appropriate O & M Manual requirements are included in the Technical Specifications. Continued proper operation of components and systems is a key goal of commissioning, since continued proper operation and maintenance help ensure the overall goal of energy efficiency. The Cx Standards document should outline key issues that are the Commissioning Agent's responsibility with regard to O & M Data/Manuals.

f. Training and Demonstration Requirements:

The Commissioning Agent is best positioned to help establish training and demonstration requirements for the VA's personnel. Since the Commissioning Agent oversees all functional tests included in the Commissioning Plan, they should assist the VA in establishing the training and demonstration requirements of the construction contract.

g. DD2 Design Review

Design review is the responsibility of VA staff, the A/E QC team, the Peer Reviewer (if applicable) and the Commissioning Agent. The DD2 Design Review will include the review elements identified above.

h. Design Narrative Update:

The Commissioning Agent will update the Design Narrative to incorporate any design changes that impact commissioned systems. The update will also be updated to incorporate design information that impacts system operations and maintenance that will need to be included in the Systems Manual.

i. Commissioning Design Review Log/Dr. Checks:

The Commissioning Agent should enter commissioning review comments on the Commissioning Design Review Comment Log and/or in the Dr. Checks System.

j. DD2 Design Review Meeting

The Commissioning Agent attends this meeting to discuss commissioning review comments with the A/E, VA, and Peer Reviewer.

k. DD2 Design Review Comment Follow-Up

The A/E should provide updated responses to the Commissioning Design Review comments based on the issues discussed during the design review meeting. The Commissioning Agent should review these updated responses to ensure they adequately address the results of the design review meeting.

5.16 Construction Documents Phase I

This is the final step and the last chance for the Commissioning Agent to provide input and exert influence on the design and to monitor systems design so they will operate effectively to minimize energy consumption. The Commissioning Agent should have input during all design phases regarding system design and control, operations and maintenance procedures or design solutions that impact operations and maintenance.

The Commissioning Agent will conduct a commissioning design review in parallel to the Peer Review. In addition to reviewing the design submission, the Commissioning Agent will evaluate previous design review comments to verify they have been adequately addressed in this submission.

a. Construction Documents Controls Conference

As a continuation from the Design Development Phase, the team should continue to meet and discuss the major issues/decisions about control system type, configuration, and capabilities together with key decisions about equipment and systems sequences of operation. The Commissioning Agent should play a major role in these conferences since the ultimate decisions made will affect the ability to commission certain systems and their associated components.

b. Final Design Phase Commissioning Plan

The Commissioning Agent will update the Design Phase Commissioning Plan to incorporate any changes required as the design is completed.

c. Final Construction Phase Commissioning Plan

As the design reaches the Construction Documents Phase, all the major equipment and system decisions should be finalized, so the Preliminary Construction Phase Commissioning Plan can be revised into the Final Commissioning Plan.

d. Final Commissioning Specifications

At the Construction Documents Phase, the final specification language can be developed form the Outlines prepared during the Design Development Phase. All Division and Sections should have full language information and text included in this Final version. The Commissioning Agent should also coordinate with the A/E to verify that commissioning language has been included in other technical specification sections as indicated in the Commissioning Specification Coordination Matrix.

e. O & M Data Requirements:

The Commissioning Agent will again review all technical Sections of the specifications to ensure appropriate O & M Manual requirements are included in the Technical Specifications.

f. Training and Demonstration Requirements:

The Commissioning Agent will again review the training and demonstration requirements for the VA's personnel to ensure appropriate requirements are included in the Technical Specifications.

g. Design Narrative Update:

The Commissioning Agent will update the Design Narrative to incorporate any design changes that impact commissioned systems. The update will also be updated to incorporate design information that impacts system operations and maintenance that will need to be included in the Systems Manual.

h. CD1 Design Review

Design review is the responsibility of VA staff, the A/E QC team, the Peer Reviewer (if applicable) and the Commissioning Agent. The CD1 Design Review will include the review elements identified above.

i. Commissioning Design Review Log/Dr. Checks:

The Commissioning Agent should enter commissioning review comments on the Commissioning Design Review Comment Log and/or in the Dr. Checks System.

j. CD1 Design Review Meeting

The Commissioning Agent attends this meeting to discuss commissioning review comments with the A/E, VA, and Peer Reviewer.

k. CD1 Design Review Comment Follow-Up

The A/E should provide updated responses to the Commissioning Design Review comments based on the issues discussed during the design review meeting. The Commissioning Agent should review these updated responses to ensure they adequately address the results of the design review meeting.

5.17 Final Construction Documents

This is the final step in the design process and the Commissioning Design Review focuses on verifying that all previous design review comments have been adequately addressed in the final design documents.

a. Final Construction Phase Commissioning Plan

As the design reaches the Final Construction Documents Phase, all the major equipment and system decisions should be finalized, and any tweaks or minor changes can be inserted into the Final Construction Phase Commissioning Plan.

b. Final Commissioning Specifications Review and Back-Check

By this stage, all Commissioning Specifications should be completed. During the Final Construction Documents Phase, all Divisions and Sections should be reviewed and back-checked to ensure all required full language information and text have been included in the Final version.

c. Final Construction Document Review and Back-check

By this stage, all commissioning comments should be included in the Construction Documents. During the Final Construction Documents Phase, all drawings and related Construction Documents should be reviewed and back-checked to ensure all required Commissioning information has been included in the Final version and that the design conforms to the OPR.

d. Final Construction Document Review Comment Follow-Up

As with other Phases, this is the feedback (or back-check) step in the process to ensure the A/E team has addressed each comment and that the Construction Documents are revised as agreed.

e. Design Narrative Update:

The Commissioning Agent will update the Design Narrative to incorporate any design changes that impact commissioned systems. The update will also be updated to incorporate design information that impacts system operations and maintenance that will need to be included in the Systems Manual.

f. Design Phase Commissioning Report

The Commissioning Agent will prepare a Design Phase Commissioning Report to document the commissioning activities completed during the Design Phase. This report should include the following:

- Executive Summary
- Project Owner’s Project Requirements (final version)
- Design Narrative (final version)
- Design Phase Commissioning Plan (final version)
- Construction Phase Commissioning Plan (preliminary)

- Commissioning Design Review Comment Log (final version)
- Commissioning communications

5.18 Adapting the Design Phase Commissioning Process

The Design Phase Commissioning process can be tailored to a specific project by including, deleting or adapting the commissioning tasks to the project. The following tasks can be adapted:

a. Design Phase Controls Meeting

The scope of work includes Design Phase Controls Meetings in the DD1 and CD1 design phases. For projects where the control strategies are well defined in the DD-1 controls meeting and have been incorporated into the design documents in the DD-1 or DD-2 submission, the CD-1 Controls Meeting can be deleted.

The Design Phase Control Meetings can be deleted from projects where the control strategies are not complex and the design team, the VAMC Facilities, and the VAMC Energy Manager have already effectively collaborated on control strategies, both Design Phase Controls Meetings can be deleted.

b. Design Reviews and Design Review Meetings

Commissioning Design Reviews should be coordinated with the design submissions required from the A/E. For projects where design phases are combined or deleted, the corresponding commissioning design review and design review meetings can be adjusted. .

Note that the LEED Enhanced Commissioning credit includes the requirement for the Commissioning Agent to conduct a commissioning review prior to the mid design submission and to verify the comments have been addressed in subsequent design submissions. For VA projects, this can be interpreted to mean that the Commissioning Agent must conduct a commissioning design review for at least one of the DD submissions and again for the CD-1 or Final CD submission to verify that comments have been addressed. The scope of commissioning design review must include at least these two design reviews in order to qualify for the Enhanced Commissioning credit.

c. Owner's Project Requirements Updates

For projects where the Owner's Project Requirements are not prepared, or for projects where the Owner's Project Requirements are not so complex to require frequent updating; or for projects where the VA or others are preparing the Owner's Project Requirements updates, the number of updates by the Commissioning Agent can be adjusted accordingly. In these cases, the Commissioning Agent should review and comment on

the updates; however the effort to review is significantly less than the effort required for updating.

d. Design Narrative Updates

   Design Narrative updates by the Commissioning Agent should be coordinated with the design submissions.

e. Design Phase Commissioning Plan

   For less complex projects, the requirement to prepare and update the Design Phase Commissioning Plan can be adjusted to include design phase commissioning into an overall Commissioning Plan that describes implementation of the commissioning process for the entire project.

f. Design Phase Commissioning Report

   For less complex projects that involve few design phase commissioning tasks and less Commissioning Agent involvement, the Design Phase Commissioning Report can be deleted as long as the design phase commissioning tasks are documented in the Commissioning Report prepared at the end of the project.

6 Bid and Pre-Construction Phase

6.1 Commissioning Agent Tasks

The Commissioning Agent has the responsibility of supporting the A/E Team in confirming that the specification of Construction Phase Commissioning responsibilities for all commissioning team members is clearly defined. This includes providing clarifications that may be required both during the Pre-bid Meeting and during the bidding period.

Commissioning Team Task/Deliverables Description Bid and Pre Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Pre Bid Meeting	Attend Pre Bid Meeting; provide overall description of Commissioning Process, provide clarifications for Commissioning Issues.	Meeting Notes for PM/RE Clarifications for Addendum if required
Pre-Construction Meeting	Attend Pre Construction Meeting and be prepared to clarify the Commissioning Process for this project (e.g., discuss commissioning representative selection).	None

6.2 Pre-Bid Meetings

The Commissioning Agent shall attend the Pre-Bid Meeting. At the request of the VA Contracting Officer, the VA Project Manager / Resident Engineer and/or the A/E, the Commissioning Agent will provide a brief explanation of the Commissioning Process and answer any questions that may arise during the Pre-Bid Meeting.

As required by the VA PM/RE, the Commissioning Agent shall develop clarification language for Pre-Bid Meeting notes and/or Contract Addendums in response to questions that may arise with regard to the Commissioning Process.

6.3 Bid RFI Review and Response

As required by VA PM/RE in response to written questions or requests for clarification, the Commissioning Agent shall develop clarification language for Contract Addendums with regard to the Commissioning Process.

6.4 Roles and Responsibilities

The following table outlines the commissioning roles and responsibilities for the members of the Commissioning Team during the Bid / Pre-Construction phase:

Commissioning Team Roles and Responsibilities Bid and Pre-Construction Phase						
Phase	**Project Phase/Cx Task** **(ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM/VA-RE	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Pre-Bid	Pre Bid Meeting	Organize, schedule and conduct meeting	None	Attend meeting, respond to questions	Attend meeting, respond to questions	Attend meeting, respond to questions
Pre-Const.	Pre-Construction Meeting	Organize, schedule and conduct meeting	None	Attend meeting, respond to questions	Attend meeting, respond to questions	Attend meeting, respond to questions

6.5 Adapting the Bid and Pre-Construction Phase Commissioning Process

The Bid and Pre-Construction Phase Commissioning process can be tailored to a specific project by including, deleting or adapting the commissioning tasks to the project. The following tasks can be adapted:

a. The requirement for the Commissioning Agent to participate in the Pre-Bid Conference and the Pre-Construction meetings can be deleted for less complex projects or for projects where prospective bidders are familiar with the VA Whole Building Commissioning Process.

7 Construction Phase

7.1 Construction Phase Commissioning Objectives

The objectives of the Commissioning Process in the Construction Phase of a project are as follows:

a. Establish a Construction Phase Commissioning Team to work together collaboratively toward the common goal of delivering a functional high-performance facility on schedule and within budget. ;

b. To verify system installation, contractor testing, and systems operations through rigorous testing and evaluation.

c. Provide technical support for the construction team in resolving commissioning issues that affect systems installation, startup, contractor testing, systems functional testing, or sustainable operations.

7.2 Commissioning Team

Construction Phase Commissioning is a collaborative effort between all parties to the construction project. The table below identifies the members of the expanded Commissioning Team during the Construction, Acceptance and Warranty Phases of a project. As part of the Commissioning Plan, the list of responsible parties noted below will be tailored to the project team and populated with names and contact information. It is critical that this information be kept current throughout the project. It is, likewise, important that the history of personnel responsible for commissioning tasks be retained in the project record.

The Commissioning Process includes record keeping methodologies that retain the input from all team members for the duration of the project. By clearly establishing the Commissioning Team and individual responsibilities, the process execution becomes easier, more effective and more accountable.

The table below identifies the members of the Commissioning Team during the Construction Phase. The Team members on the Commissioning Team should be updated as often as necessary to maintain the list up-to-date throughout the project.

Commissioning Team Construction Phase		
Designation	**Agency/Professional/Contactor**	**Description**
VA RE	Department of Veterans Affairs Resident Engineer(s)	Technical Representative of the VA Contracting Officer responsible for project delivery
VAMC	VA Medical Center Facilities Management and/or using agency	Representatives of the local VA Medical Center responsible for Facilities Operation & Maintenance, Construction Coordination and/or other VAMC departments.
A/E	Architect/Engineer Design Team	Representatives of the Architect and Engineering Design Team responsible for Construction Administration
CxA	Commissioning Agent	Representatives of the independent 3rd Party Commissioning Contractor
Contractor	Prime Contractor	Representatives of the Prime Contractor responsible for project construction.
SC	Installing Sub-Contractors and Service Providers, to include but not necessarily be limited to	Representatives of the Fire Protection, Plumbing, HVAC, Electrical, Communications, Electronic Security 1st-Tier subcontractors responsible for installing systems and equipment
TAB	Test and Balance Agency	Representatives of the Test and Balance contractor responsible for air and water balance of HVAC systems
DDCC	Direct Digital Control System contractor	Representatives of the Control System contractor responsible for installing and programming the Direct Digital Control system

Commissioning Team Construction Phase		
Designation	**Agency/Professional/Contactor**	**Description**
SpC	Specialty Contractors	Representatives of the Fire Alarm, Electronic Security System, and other specialty contractors responsible for installation and programming of special systems that interface with the DDC system, HVAC and/or Electrical systems. This can include independent 3rd-Party Test Agencies (e.g., NETA Qualified Testing Agents)

7.3 Commissioning Agent Tasks

The following table summarizes the Commissioning Agent Tasks during the Construction Phase. Further details on the tasks are provided in the paragraphs that follow the table.

Commissioning Team Task/Deliverables Description Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Commissioning Kick Off Meeting (Construction Phase) [The kickoff meeting should occur within 60 days of Notice to Proceed.]	Conduct a "Commissioning Kickoff Meeting" with the Construction Team Establish the purpose and process for commissioning the project. Establish the individual roles of each participating commissioning team member. Review the Construction Phase Commissioning Plan and Commissioning Specifications. Review the Commissioning Documents Review the Project Schedule and discuss how commissioning activities will be incorporated into the master schedule. Review Draft PFC and FPT; identify pre-requisites for functional testing. ATTENDEES: Commissioning Agent, A/E Design Team Representatives, Contractor's Commissioning Representative, Subcontractor's Commissioning Representatives, VA RE.	Meeting Minutes Revised Project Commissioning Plan (Include Names/Contact Information for selected Commissioning Team Members)
Duration Schedule for Commissioning Activities	Based on the Construction Phase Commissioning Plan, prepare a duration schedule for the commissioning activities required by the commissioning plan. This duration schedule should be incorporated into the contractor's project schedule to track all commissioning activities of the commissioning team.	Commissioning Duration Schedule (Schedule shall be periodically updated to reflect changes in the project schedule and/or scope.)

Commissioning Team Task/Deliverables Description Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Submittal & Shop Drawing Review	Review all pertinent project shop drawings necessary to support the Commissioning Process. Review of the shop drawings is for the purpose of developing appropriate Pre Functional Checklists and Systems Functional Performance Test Procedures. Submittals & Shop drawings shall be reviewed for commissionability, maintainability and for compliance to the Construction Documents. Note any issues identified in the Shop Drawing Review that might compromise the final commissioned system on the 'Commissioning Review Log' and submit comment to the Design Team and the RE contemporaneously with the A/E review for resolution. Comments shall be submitted in accordance with the contractual submittal review time. Comments shall be provided to the Design Team no less than 7 days prior to the Submittal Review Due Date provided that the Cx Agent has no less than 7 days to review the submittals. **ANY ISSUES IDENTIFIED IN THE SUBMITTAL REVIEW THAT MIGHT REQUIRE A CONTRACT CHANGE BUT IS NECESSARY TO MEET DESIGN INTENT SHOULD BE SPECIFICALLY REFERRED TO THE RE.**	Shop Drawing Cx Review List Shop Drawing Review Comments
Construction Phase Commissioning Plan	Based on the work completed in the items above, the Construction Phase Commissioning Plan for the project shall be periodically reviewed with the Commissioning Team and updated to reflect changes in project equipment, sequences of operations, scope or schedule and with project personnel.	Revised Project Commissioning Plan

Commissioning Team Task/Deliverables Description Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Commissioning Construction Observations	During the course of construction, the Commissioning Agent will visit the site to observe the progress of construction with respect to the systems being commissioned. The focus of the observations will to verify that systems being installed comply with the Construction Documents and can be successfully configured, operated and maintained. In addition, site observations visits will be scheduled to include ● Witnessing factory testing and/or contractor equipment/system start-up activities; ● Verification of Completed Pre Functional Checklists ● Verification that the Contractor and his subcontractors are completing and documenting Pre-Test procedures required by the specifications. ● Clarification and technical support for understanding and resolving Commissioning Issues.	Site Observation Reports Updated Commissioning Issues Log
Commissioning Team Meetings	The Commissioning Agent will hold regular commissioning team meetings to review progress of the commissioning effort and reinforce individual responsibilities. The team will review schedule, construction sequence, and completed work (PFC, PFT and FPT's) and outstanding issues on the Commissioning Issues Log. Commissioning Team Meetings may be held at the jobsite or by teleconference depending upon the status of construction. While it is imperative that many of the Commissioning Team Meetings be held in person, during early construction phases, some meetings may be more cost effectively conducted remotely. Scheduling and location of meetings shall occur by consultation between the Commissioning Agent and the VA-RE. The Prime Contractor's scheduler should attend approximately every other Commissioning Team Meeting to review the master schedule and any changes that will affect commissioning activities.	Commissioning Meeting Agenda and Minutes Updated Commissioning Issues Log

Commissioning Team Task/Deliverables Description Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Develop Final Pre-Functional Checklists (PFC's)	The Commissioning Agent will prepare Pre-Final Pre Functional Checklists (PFC) for the project and distribute to all Cx Team members for review and comment. The Commissioning Agent will incorporate review comments and prepare Final PFCs. An executed PFC submitted by the Prime Contractor indicates the system and its related equipment is ready for Systems Functional Performance Testing. The requirements for Pre Functional Checklists shall be coordinated with the startup requirements specified for each commissioned system. The PFC's shall be constructed to leverage the specified contractor and vendor start activities to avoid unnecessary duplication.	Pre Functional Checklists (PFC's)
Final Systems Functional Performance Test (FPT's) Procedures	Based on construction documents and approved submittals, the Commissioning Agent will prepare Pre-Final Systems Functional Performance Test Procedures (FPT's) for systems to be commissioned. Completed Final FPT's will be distributed to all appropriate members of the Commissioning Team for review and comment. Final FPT's will be issued once comments are reviewed and incorporated into final documents as appropriate.	Pre-Final and Final Systems Functional Performance Test Procedures (FPT's)
Review Operations & Maintenance Manuals	The Commissioning Agent shall review Operations and Maintenance Manuals submitted by contractors for general conformance with specifications and VA's requirements, including: If provided with the manuals, Review Preventive Maintenance Schedules provided as part of the O&M Manuals for completeness. Verify that data is provided in a manner consistent with VA process for managing Preventive Maintenance tasks. Review of O&M Manuals will include a review of system and component warranties to confirm conformance with contract requirements and adequate documentation of warranty contact information and VA obligations. Review of O&M Manuals shall be completed in accordance with the Submittal Review schedule requirements.	Updated Commissioning Issues Log

Commissioning Team Task/Deliverables Description Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Review Contractor Equipment Startup Checklists, TAB Reports and PFC's	The Commissioning Agent will review all contractor prepared Equipment Startup Checklists, TAB Reports (including "pencil" daily test results) and PFC's to confirm that the systems are have been subject to appropriate Quality Control and Start Up procedures prior to initiation of Functional Performance Testing. Incomplete work, inadequate preparation and deficiencies will note noted and tracked on the Commissioning Issues Log.	Commissioning Issues Log

Commissioning Team Task/Deliverables Description Construction Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
TAB Verification	The Commissioning Agent shall work with the TAB Contractor to verify that all Testing and Balancing work is conducted in strict accordance with the specified Procedural Standards for Testing, Adjusting and Balancing by either NEBB or AABC. The Commissioning Agent shall execute the following tasks: • Review the TAB Agenda provided by the TAB Contractor to verify that it is complete, thorough and in compliance with the specification and Procedural Standards requirements. • On the project site, the CxA shall review the calibration certificates for the instrumentation being used by the TAB Contractor during the execution of TAB activities to confirm that the instrumentation meets the requirements of the spec and the appropriate Procedural Standard. • The CxA shall periodically visit the project site and review the TAB documentation for method, reasonable values, and compliance with the specification, Procedural Standard and TAB Agenda. • Upon completion of the TAB activities, the CxA shall visit the project site with the TAB Contractor and the RE. The TAB Contractor shall demonstrate readings selected by the CxA that demonstrate that the system performance is consistent with the submitted values on the TAB report. Readings shall include Air Handling Unit total flows, static pressure control values, select outlet flows, building, and space pressures selected by the CxA as critical system operating values.	TAB Agenda Review Comments TAB Agenda Review Meeting Minutes Field Observation Reports of TAB Inspections Summary Report of TAB Verification Readings

7.4 Roles and Responsibilities

The primary goals of Construction Phase Commissioning Process are

- to verify, the commissioning tasks are incorporated into the construction schedule, and
- to verify system are installed in accordance with the construction documents, including proper access for maintenance and repair.

Commissioning Team Roles and Responsibilities Construction Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Commissioning Kick Off Meeting	Facilitate the Kick Off Meeting Provide VA Schedule Requirements and Milestones Review Meeting Minutes & Comment	Prepare and disseminate Agenda Lead Kick Off Meeting Produce Meeting Minutes and Incorporate Comments	Identify Cx Team Members Review Meeting Minutes & Comment	Identify Cx Team Members Review Meeting Minutes & Comment	Identify Cx Team Members (including SC, TAB, DDCC, SpC) Review Meeting Minutes & Comment
Duration Schedule for Commissioning Activities	Review Commissioning Agent Duration Schedule and Comment as Appropriate	Refine Commissioning Duration Schedule provided with the specification to include Commissioning Activities, Estimated Duration for each Activity and Conditions Required for Activity Execution	Review Commissioning Agent Duration Schedule and Comment as Appropriate Schedule VAMC Personnel to support Commissioning Process as appropriate	Review Commissioning Agent Duration Schedule and Comment as Appropriate	Review Commissioning Agent Duration Schedule and Comment as Appropriate Incorporate Commissioning Activities into Project CPM Schedule. Confirm with Commissioning Agent

Commissioning Team Roles and Responsibilities Construction Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Submittal & Shop Drawing Review	Facilitate Delivery of Shop Drawings to Commissioning Agent Review and approve submittals and shop drawings after review by A/E and Commissioning Agent	Provide a list of Required Shop Drawings to CM/GC Review required Shop Drawings in parallel with A/E Team. Deliver Comments to A/E Team as part of Submittal Review Process	None	Review Commissioning Agent Comments Incorporate into A/E Comments as Appropriate Communicate with Commissioning Agent where Cx comments are deemed inappropriate.	Deliver appropriate Shop Drawings to Commissioning Agent when provided to A/E Team. Submittal deliverable must be in contract -Agent address /Section 01340 -in specs?
Review RFI'S ASI'S and other Contract Documents	Distribute to CxA	Review documents to identify impacts on Commissioning Process. Review to identify any conflicts with the project OPR.	None	In addition to other contract responsibilities, review and respond to CxA comments.	In addition to other contract responsibilities, review and respond to CxA comments.
Project Commissioning Plan	Distribute Design Phase Cx Plan Review Cx Plan & Comment/Approve	Update Project Commissioning Plan to include specific individuals and team members. Update as required for changes in project schedule or work scope as appropriate.	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment Support Construction Team adherence to Cx Plan

Commissioning Team Roles and Responsibilities Construction Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Site Observations	Review Site Visit Reports and Commissioning Issues Logs and Comment as appropriate. Forward Site Visits Report to Contractor and A/E Facilitate resolution of Commissioning Issues Log Items as expeditiously as possible.	Visit the Project Site on a regular scheduled basis as agreed upon with the VA RE. Submit Site Visit Report to RE. Update and deliver Commissioning Issues Log	Review Site Visit Report & Comment as Appropriate	Review Site Visit Report & Comment as Appropriate Assist the Commissioning Agent in resolving all Design related Commissioning Issues.	Forward Site Visit Report to all Subcontractors, Commissioning Representatives and other appropriate construction team personnel. Review Site Visit Report & Comment as Appropriate Assist the Commissioning Agent in resolving all commissioning Issues.
Commissioning Team Meetings	Review Meeting Minutes & Comment	Prepare and disseminate Agenda for regular periodic Cx Team Meetings Lead Cx Team Meetings Produce Meeting Minutes and Incorporate Comments	VAMC Cx Team Members Attend Review Meeting Minutes & Comment	A/E Cx Team Members Attend Review Meeting Minutes & Comment	Cx Team Members (including SC, TAB, DDC, SpC) Attend Review Meeting Minutes & Comment

Commissioning Team Roles and Responsibilities Construction Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Develop Pre Functional Checklists (PFC's)	Review & Comment as appropriate	Develop Pre Functional Checklists. (PFC's) Provide to Contractor for comment. Disseminate final PFC's for use by Construction Team.	Review & Comment as appropriate	Review & Comment as appropriate	Review & Comment – All Cx Team Members. Incorporate PFC requirements into start-up schedules and processes.
Develop Functional Performance Test (FPT's) Procedures	Review & Comment as appropriate	Develop Functional Performance Tests (FPT's). Provide to Contractor team for comment. Disseminate final FPT's for use by Construction Team.	Review & Comment as appropriate	Review & Comment as appropriate	Review & Comment – All Cx Team Members. Incorporate FPT requirements into project and personnel schedules.

Commissioning Team Roles and Responsibilities Construction Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Review Contractor Equipment Startup Checklists, TAB Reports and PFC's	Review & Comment as appropriate	Review & Comment on result s of Start Up testing, TAB results and PFC documentation. Field Verify a sampling of PFC's to confirm compliance with PFC requirements. Evaluate readiness for Functional Performance Testing	Review & Comment as appropriate	Review & Comment as appropriate	Provide Factory and Contractor Start Up documentation in accordance with Specifications and PFC's to VA PM/RE, Commissioning Agent and A/E Team for review & comment. Correct any deficiencies or deviations noted on the Commissioning Issues Log and report corrective action.
Review Operations & Maintenance Manuals	Review & Comment on Operations and Maintenance Manuals.	Review & Comment on Operations and Maintenance Manuals. Incorporate into Systems Training as appropriate.	Review & Comment on Operations and Maintenance Manuals.	Review & Comment on Operations and Maintenance Manuals.	Complete & Submit Operations and Maintenance Manuals prior to equipment start up and execution of Pre Functional Checklists. Correct issues identified with O&M Manuals identified on the Commissioning Issues Log.

7.5 Construction Phase Commissioning Kickoff Meeting

The Commissioning Agent shall prepare and facilitate a Construction Phase Kickoff Meeting with the Contractor and all key subcontractors, TAB Agency and DDC Contractor. The VA Project Manager and Resident Engineers and representatives of the A/E Team with construction responsibilities should also attend. This meeting shall occur within 60 days of Contract Award or Notice to Proceed as directed by the RE. All subcontractors shall be identified. Each subcontractor shall appoint a Commissioning Team Representative who shall attend the meeting.

The meeting should discuss, but not necessarily be limited to, the following topics:

a. Review the Commissioning Process, Commissioning Goals, Commissioning Objectives and the Project Commissioning Plan
b. Review Project Performance Objectives & Verification Strategies
c. Review Process Documentation Requirements
d. Identify Commissioning Team Members
e. Discuss Project Communication Protocols
f. Discuss Project and Commissioning Schedules, including Construction Observation Visits, and Commissioning Team Meeting Schedules
g. Discuss Shop Drawing/Submittal Review Process
h. The Commissioning Agent shall deliver Meeting Minutes of the Kickoff Meeting to all the VA-RE and the Contractor for distribution to all other Commissioning Team members.

7.6 Construction Phase Commissioning Plan

The Construction Phase Commissioning Plan is a living document that should updated throughout the construction phase of the project to document current members of the Commissioning Team, to update the communications protocols that may be agreed upon from time to time and to reflect changes in either project or commissioning scope that may occur from time to time.

The Construction Commissioning Plan should reflect the goals, objectives, and execution strategy for the project. The Commissioning Plan should describe all commissioning activities, commissioning duration schedules and schedule updates, commissioning documentation requirements, including a specific list of Site Visit Report, Pre-Functional Checklists, System Functional Performance Test Procedures, and other support documents that are required to demonstrate successful completion of the project. The Commissioning Plan should include

assignment of responsibilities for each team member for developing, reviewing and approving the various commissioning documents. An appendix to the Commissioning Plan should include a sample of each commissioning document the contractor will see during the commissioning process. The Construction Commissioning Plan should be reviewed at each Commissioning Team Meeting and updated as required to keep the commissioning process on track.

7.7 Construction Schedule Facilitation and Integration

The objective of the Commissioning Process is to integrate commissioning tasks into the project construction schedule. The majority of commissioning activities should be completed as part of the normal construction schedule and finalized prior to the scheduled construction completion date. To this end, it is imperative that the Commissioning Agent and the Contractor collaborate to integrate commissioning activities into the Contractor's overall construction schedule.

The Commissioning Plan will identify critical commissioning activities and associated construction/start-up tasks that must precede these activities to allow for successful execution of these tasks. In order to coordinate these activities with the construction schedule, the Commissioning Agent should provide a Commissioning Duration Schedule to the VA RE and the Contractor to provide a rational basis for integration of commissioning into the construction schedule. The Commissioning Duration Schedule should include the following information:

a. Description of Commissioning Activity
b. Prerequisite Construction Tasks Required to Execute the Cx Activity
c. Elapsed Time Duration of Each Activity
d. Documentation Associated with Each Task/Document Responsibility

Once the duration schedule is delivered to the Contractor, the Commissioning Agent will collaborate with the Contractor to integrate all commissioning activities into the fixed duration construction schedule in accordance with VA requirements for scheduling the project.

Often, Contractors elect to construct projects in a particular sequence that may facilitate accelerated turn-over of parts of the project to the VA ahead of other portions of the facility. Contractors very often think and schedule this sequential construction and turn-over based on "bricks and mortar", "finishes" and other general construction tasks without sufficient thought towards coordination of HVAC, electric, plumbing and other specialty trades into the schedule. They sometimes also overlook the ability of the HVAC, electrical and other systems to support the "phased turnover" concept. An example is planning to turn over one wing of a facility when the Air Handling System supports the entire floor, including areas still under construction.

The Commissioning Agent can provide valuable technical expertise and experience to assist the Contractor with planning the construction process to accomplish the following goals:

a. Schedule construction of ‘prototype areas’ so that critical construction details and construction methods can be evaluated and documented for construction trades.

b. Schedule and complete construction so that systems testing can begin in portions of the project as early as reasonably practicable to facilitate early identification and resolution of systems level issues.

c. Schedule construction collaboratively with subcontractors to encourage the most time efficient construction of all trades and the most cost effective use of construction labor on the project.

This methodology often allows the construction team to incorporate reasonable time into the schedule for the specialty trade contractors to complete their work in a manner and facilitates the transition from construction to occupancy.

7.8 Construction Phase Meetings

Construction Phase meetings requiring the participation of the Commissioning Agent must be clearly and specifically identified and quantified in the project specifications and the Commissioning Agent’s scope of work.

a. Construction Progress Meetings:

While these regularly-scheduled meetings are well-stipulated in other VA documents, it is unlikely the Commissioning Agent needs to attend all of the construction phase meetings. The Commissioning Plan should identify the frequency during the construction process when the Commissioning Agent will attend these meetings. The primary purpose for the Commissioning Agent attending these meetings is to review outstanding commissioning issues that warrant attention by the Contractor or the VA RE. These meetings also allow the Commissioning Agent to be informed of construction progress, construction schedule updates, RFI status, Change Orders, and other directives that could impact the commissioning process.

b. Commissioning Team Meetings:

Commissioning tasks and requirements are clearly different and separate from other construction phase activities. The Commissioning Agent will be required to plan and lead these meetings. Issues addressed at Commissioning Progress Meetings will be specific to the commissioning process and will be items that enhance the success of project commissioning. The Commissioning Plan should address when, during the construction process, these meetings should begin and how often they should be held. The VA RE, Contractor, installing contractors, DDCC, TAB and specialty contractors should attend these meetings. Commissioning meetings are often scheduled immediately prior to, or immediately following, sub-contractor meetings conducted by the Contractor. The Commissioning Progress Meetings are used to plan and coordinate commissioning activities and to review system/equipment installation. These meetings also provide an

opportunity for the sub-contractors to discuss technical or coordination issues regarding systems and equipment installation.

As a minimum, the following issues should be on the Commissioning Team Meeting Agenda. Additional issues should be added as required to maintain the schedule and progress of the commissioning process.

- Commissioning Plan Review
- Review Documentation Requirements/Outstanding Documentation Issues
- Review Current Commissioning Issues Log/Document Resolved Issues
- Review Project & Commissioning Schedule
    - Progress to Date
    - Upcoming 30 Day Schedule
    - Schedule Inspections/Tests as Appropriate

7.9 Commissioning Construction Observation Visits

The Commissioning Agent will schedule periodic visits to the construction site to observe construction progress and verify systems/equipment installation. The Commissioning Agent has an overall understanding of the plans, specifications, VA's requirements, construction procedures, and systems operational demands. The Commissioning Agent's role is to confirm that the installed systems are installed in accordance with the intent of the project documents and are maintainable and commissionable.

These site visits are not a substitute for the contractor's Quality Control inspections, nor are they a substitute for any required inspections by the VA RE or A/E. Rather, they supplement other reviews performed by the RE and the A/E design team. The construction observation visits are intended to identify issues early in the process to allow the Contractor to devote sufficient time and resources to correct the situation. Early identification also provides an opportunity for the Contractor and the installing contractors to prevent recurrence of the issue on similar equipment or systems. Early identification also allows the Contractor and the installing contractors the opportunity to resolve the issue while the appropriate resources are still on-site, thereby minimizing the costs to resolve the issues and the impact on the overall construction schedule.

Installation verifications are a systematic set of procedures intended to identify whether individual system components have been installed properly. This process occurs during both the Construction Observation Visits and at equipment startup. The contractor will be required to complete the Pre-Functional Checklists and provide any supporting documentation to demonstrate proper component and system installation and start up. The Commissioning Agent uses the Pre-Functional Checklists and Equipment Startup Checklists as a guide to ensure consistency in the observations. During the Construction

Observation Visits, the Commissioning Agent will validate that the completed Pre Functional Checklists have been properly completed. This process supplements the Contractors' Quality Control program to ensure that relatively minor issues (e.g. an improperly wired sensor, a control valve installed backwards, etc.) are discovered and corrected prior to Systems Functional Performance Testing.

The Commissioning Agent should have the experience to recognize potential conflicts between the various trades involved in equipment and systems installation. By identifying potential conflicts early, it allows the Contractor to resolve the coordination issues without the need for extensive (and expensive) re-work. The Commissioning Agent should identify coordination issues that will impact the facility Operations & Maintenance staff (for example, piping and conduit installation may limit or block adequate maintenance access to key components).

The Commissioning Agent, through a comprehensive series of Construction Observation Visits and Commissioning Team Meetings will provide a resource for the Contractor and A/E Team to support the identification and resolution of construction issues and conflicts. The Commissioning Agent's specific objective is to facilitate the construction of systems that will perform as intended and can be operated and maintained over the life of the facility.

The frequency and duration of the visits will be established based on construction progress. For new construction projects, the Commissioning process will always begin with a Commissioning Kick-Off Meeting within 60 days of contract award. After the Kick-Off Meeting, it is imperative that the Commissioning Agent continue to be engaged with the construction team to build effective relationships that promote proactive and collaborative quality process for delivery of the construction project. For any project, the RE and the CxA should schedule meetings with the following issues in mind:

a. If the early stages of project construction do not involve significant construction of commissioned systems, Construction Observations visits and Commissioning Progress Meetings should occur no less than once per quarter.

b. In the interim between Construction Site Observations, the CxA should maintain contact with the project thru remote Commissioning Team Meetings (teleconference and/or Web Based Meetings).

c. Once the construction of commissioned systems commences, Construction Observation Visits and Commissioning Progress Meetings should occur no less than monthly.

d. When the installation of commissioned systems reaches approximately 50% in any single area of the project, the frequency of Construction Observations Visits should increase to bi-weekly or weekly visits. Note that the Commissioning Agent will be engaged with the construction team in verifying Pre Functional Checklists as well as conducted observations of construction progress. The frequency of Commissioning Progress

Meetings should also be adjusted based on the issues to be discussed and the pace of construction.

e. During Testing and Balancing Activities, the Commissioning Agent should visit the project no less than weekly to observe progress of the TAB work and support the TAB Contractor's efforts to deliver an effective facility.

f. Once Systems Functional Performance Testing has commenced, the Commissioning Agent will typically be on site regularly enough that separate site visits are not required.

The objective of the Commissioning Agent during construction observations visits is to verify that the construction team is adequately preparing systems for functional testing. The Commissioning Agent should validate completion of the Pre-Functional Checklists completed by the Contractor. The Commissioning Agent and the Contractor should also review the data needed from the Contractor to provide input for the COBie system. This data should be incorporated into the Pre-Functional Checklists.

Construction Site visits will be documented using a Site Visit Observation Reports that outlines the purpose of the visit, the Commissioning Agent representative conducting the visit, others (VA RE, Contractor, installing contractors, etc.) present or contacted during the visit and general observations of the work underway, quality of workmanship, and other general issues that should be brought to the attention of the VA RE and/or Contractor. If any commissioning issues are identified, they will be described and highlighted in the field report. The issue will also be entered on the Commissioning Master Issues Log and tracked until the issue is resolved. A commissioning issue is anything that impacts system operations or maintenance, safety, compliance with construction drawings or specifications, compliance with industry standards, and/or will impact the construction schedule.

The Commissioning Agent may also identify commissioning observations while on the site. Commissioning observations are issues that are mainly quality control issues that do not directly affect system operations, maintenance, safety or compliance with construction documents. These commissioning observations will not be entered on the Master Commissioning Issues Log. They will be documented and provided to the RE and the Contractor.

Site Visit Observation Reports are submitted to the VA RE for distribution to the Contractor and A/E Team.

7.10 RFI's, Change Directives, Change Orders

The Commissioning Agent will review RFI's for their potential impact on the commissioning process. Also, the Commissioning Agent should review all VA-issued Change Directives or Change Orders that affect construction and may, therefore, impact the commissioning process and systems manual documentation. The Commissioning Agent should be included on the distribution list for RFIs, Change Directive, Change Orders and other

correspondence that affects the commissioned systems. The Commissioning Agent also attends selected Construction Progress Meetings where this information is reviewed. This provides the opportunity for the Commissioning Agent to become familiar with each issue and to identify the specific information need to update the Functional Test Plans, systems manuals, and other commissioning documents.

The Commissioning Agent will also issue RFIs when necessary to obtain clarification or direction from the VA RE or A/E. These will usually request clarification or change to systems operating sequences or other issues that impact system/equipment operations, maintenance or functional testing.

In each case, the Commissioning Agent should note any issues identified with the documents noted above either on the Commissioning Issues Log or, if an issue is specific to the VA decision making process, in separate correspondence to the VA RE. Resolution of these issues should, whenever appropriate, be reflected in the Design Narrative and the Construction Commissioning Plan.

7.11 Submittal Review

Submittals and shop drawings must be reviewed and commented upon by the Commissioning Agent. Not all submittals require Commissioning Agent review, but those submittals that have an impact on commissioned systems, energy, and Operations & Maintenance must be reviewed by the Commissioning Agent. Generally, all submittals required by Division 21, 22, 23, 26, 27, 28, and 31 should be sent to the Commissioning Agent. The Commissioning Plan should include a matrix identifying each submittal to be reviewed by the Commissioning Agent. The Commissioning Agent should review the submittals concurrently with the A/E review. Commissioning Agent review comments are provided to the A/E to be incorporated into the A/E review response that is submitted to the VA RE for submittal approval.

The Commissioning Agent review of the submittals is not a substitute for the A/E review, rather it supplements their review. The A/E still retains the overall responsibility for recommending approval/disapproval of the submittal. The VA RE retains overall authority to approve or disapprove submittals and shop drawings. The Commissioning Agent review will focus on Operations & Maintenance issues, determination that sufficient components and instrumentation is included with the equipment to allow the system to be tested and commissioned, and that the sequences of operation are sufficiently detailed to facilitate preparing the Systems Functional Performance Test Procedures.

The Commissioning Agent will specifically evaluate the contractors' submittals for the following:

- Conformance with the VA's construction documents
- Fulfilling operation and maintenance requirements
- Facilitating Systems Functional Performance Testing

Submittal review comments will be documented using the Commissioning Issues Log.

7.12 Construction Phase Controls Conference

Once design is complete, construction is underway, and DDC submittals have been reviewed, the Commissioning Team should meet with the DDC vendor to conduct a detailed review of the DDC submittal. The primary purpose of this review is to verify the DDC vendor, the A/E, the Commissioning Agent, and the VAMC fully understand how the DDC will be installed and programmed to properly control the HVAC and other systems to meet the VAMC and construction document requirements.

The DDC Sequences of Operations are a critical component that controls all aspects of system operation and performance. Often the DDC submittal includes Sequences of Operations that are merely copied from the plans and specifications. The submittals are often prepared by the sales engineer and the system programmer has not had the opportunity to evaluate how the sequences will be implemented. Early understanding of the sequences by the DDC programmer and the VAMC staff is vital to successful facility turnover and operations. The primary purpose of the meeting is to provide a forum for all parties to discuss systems operations and to facilitate the preparation of the DDC programming and graphics. The meeting allows the programmer to discuss the intent with the A/E design team, and for the VAMC staff to understand the reasoning behind the sequences. It also provides the opportunity for the programmer to conduct a detailed review of the sequences and to identify any potential issues before system programming is finalized. It is essential that the DDC programmer attend the review conference to facilitate effective communications between the programmer, A/E, Commissioning Agent and the VAMC.

7.13 Pre-Functional Checklists

The commissioning process includes the need to verify that systems and equipment is properly installed and started up prior to functional testing. The Commissioning Agent will develop Pre-Functional Checklists that will provide a means for the Contractor and installing contractors to notify the Commissioning Agent and VA RE that each commissioned system and the equipment components are properly installed and ready for testing.

The Commissioning Agent will prepare preliminary checklists to describe the equipment installation requirements. The checklist will include provisions to verify that the major components are installed; connections to piping and ductwork are complete; vibration/noise control is installed; proper seismic or other restraint is complete; gauges, sensors, dampers, actuators, and DDC components; electrical connections; control connections; DDC programming;

interface to other systems (i.e. fire alarm); TAB; manufacturers' startup; and/or 3rd party testing is complete.

These checklists will be submitted to the VA RE and distributed by the RE to the Contractor, and the A/E design team for review and comment. The Commissioning Agent will revise the checklists as necessary to incorporate review comments. Upon final approval, the checklists will be issued to the Contractor to be completed prior to testing. The Pre Functional Checklists will also include spaces for the Contractor and installing contractors to certify that installation is complete and the system/equipment is ready for functional testing. This certification can also be used by the VA RE as an indication of the percentage of completion for use while reviewing payment applications.

The checklists will also include spaces to record data that will be needed for the COBIE and/or CMMS systems. This includes manufacturer, model, serial number, and similar as-installed data. The TAB contractor will also be required to provide final TAB data and readings that will be incorporated into the survivable data entered into the COBIE system.

The Commissioning Agent will spot check the completed checklists and field-verify that the checklists accurately portray the actual installation. This will be done using sampling techniques that will initially select a representative sample of checklists. If the field verification indicates a significant portion of the sample does not accurately portray the system installation, or that system installation is not complete, the Commissioning Agent will select a larger sample to be field verified. When this larger sample indicates a significant variation between the document and the actual field conditions, the entire lot of checklists will be returned to the Contractor and installing contractors for revision and re-submission.

7.14 Preliminary Systems Functional Performance Test Procedures

Each system and component to be commissioned shall undergo a final Systems Functional Performance Testing. The Commissioning Agent shall develop a Systems Functional Test Procedure that mimics the sequence of operation for each system or sub-system. The Functional Test shall act as a checklist to verify that each step of the sequence was implemented by the control system as described in the contract documents. The Commissioning Agent shall also ultimately witness and document the Systems Functional Performance Tests performed by the Contractor.

The Systems Functional Performance Test Procedures will include system/equipment installation verification steps. These will be similar to the information provided in the Pre-Functional Checklists and includes information provided by the Contractor and installing contractors. The Commissioning Agent will verify the information and that the system/equipment is properly installed prior to beginning the testing.

The first steps of the functional testing following verification of installation will test the basic operation of the system component equipment and any associated safety shutdowns. These steps will include verifying that the system/equipment can be started/stopped using local controls, via the DDC controls and via any remote controls (i.e. Emergency Operations Center shutdown, Fire Alarm system shutdown, Fire Control Center control of start/stop for smoke evacuation systems, etc.). Safety shutdowns, such as High Duct Static, motor overload, high temperature, etc. will also be verified.

When the system/equipment has successfully completed the initial static checks, the system operation in normal steady-state operation will be verified in all operating modes (i.e. occupied, unoccupied, night setback, manual, etc.). These steps will verify that the system properly responds to the input signals to maintain the required system output. For example, these steps will verify that an AHU will maintain the proper discharge air temperature in response to variations in return air temperature, chilled water temperature, hot water temperature, etc.

The next section of the testing will verify that the system will properly respond to step-changes imposed on the system. For example, the test will verify that the VAV terminal unit and/or AHU system will properly respond when the room temperature setpoint is changed. Another example would be to verify that the OR AHU and Air Terminals will properly respond when the Operating Room staff activates the “low temperature” mode or other special conditions.

Finally, the system operation is verified under emergency conditions. This verifies that the system will properly react to the failure of a critical component, to loss of power, or to manual override. For example, if a chilled water system includes a standby secondary pump, the test will simulate the failure of the operating pump and verify that the system will recognize the failure, indicate the proper alarm, and automatically start the standby pump, and that the standby pump will assume all operating requirements of the prime pump. Another example would be to simulate a power failure to the system and verify that the system will operate on backup power. This test would also verify that the system will return to normal operation with normal power is restored.

7.15 Adapting the Construction Phase Commissioning Process

The Construction Phase Commissioning process can be tailored to a specific project by including, deleting or adapting the commissioning tasks to the project. The following tasks can be adapted:

a. Commissioning Construction Observation Visits, Commissioning Team Meetings, Construction Progress Meetings

   The number of on-site meetings can have a significant impact on the cost of commissioning with some corresponding reduction in the value delivered by the Commissioning Agent. Therefore, determining the

number of trips to the project site is one method of controlling the cost of commissioning.

For a typical large greenfield construction project early construction primarily involves building the foundations, structural support systems, and the building envelope. Generally, the HVAC and Electrical sub-contractors are doing underground and other rough-in for equipment. Equipment, such as air handlers, chillers, boilers, switchgear, and generators may not yet be on site for installation. During this phase of construction, the Commissioning Agent provides marginal added value. The primary purposes of the Commissioning Agents visits to the site are to obtain updated construction schedule information, to observe equipment rough-in work, and to maintain visibility and person-to-person contact with the construction team. Commissioning Team Meetings are devoted to reviewing the commissioning process and discussing commissioning. Therefore, Commissioning Agent site visits can be scheduled quarterly.

As construction continues and components of the systems to be commissioned are being installed, the Commissioning Agent will need to visit the site more often to observe system installation and to conduct Commissioning Team Meetings to begin more frequent coordination of commissioning tasks with the installing sub-contractors. At this point, the frequency of commissioning construction observations should increase to monthly visits.

When construction is nearing the time when equipment is being started and the installing sub-contractors are conducting contractor testing, the Commissioning Agent will need to be on site more frequently. Commissioning Team Meetings will also need to be more frequent to allow coordination of startup, contractor testing and preparation for system functional testing. Also, the Commissioning Agent, the VA RE, prime contractor and installing sub-contractors will need to coordinate resolving commissioning issues that have been identified during construction observations, equipment startup, and contractor testing. The Commissioning Construction Observations should by schedule approximately every two weeks.

b. Factory Witness Testing

The VA may specify that some critical equipment shall be tested at the factory prior to shipment to the project site. In this case, the Commissioning Agent should be a member of the VA team that observes the factory testing. The requirement for the Commissioning Agent to observe factory testing will impact the commissioning fees.

c. Witness Equipment Startup and Contractor Testing

The Commissioning Agent should witness the installing sub-contractors' manufacturer's startup of equipment and systems to be commissioned. When possible, the Commissioning Construction Observations can be

schedule to accommodate observation of equipment startup, however this is not always possible.

The VA PM, VA RE and the Commissioning Agent should review which equipment startups the Commissioning Agent should witness. With this information, or a reasonable estimate of the number of startups the Commissioning Agent will witness, will allow the Commissioning Agent to include these tasks in the base fee. An alternative might be tor the Commissioning Agent to provide a “Unit Price” per trip to the site to witness additional equipment startups that are not included in the base Commissioning Agent fee. Limiting the witnessing equipment startups to the most critical equipment is a means of controlling the Commissioning Agent scope and fee.

In some cases, steps that are included in the system functional performance testing is also included in the equipment startup. When the Commissioning Agent witnesses the equipment startup, he can often substitute the equipment startup documentation for part of the system functional testing, thereby preventing duplicate effort.

d. TAB Verification

The Commissioning Agent should verify that TAB is proceeding in accordance with the TAB Plan; that the TAB instruments are properly calibrated; and that the TAB readings are being correctly recorded. The TAB verification should begin shortly after the TAB agency begins actively testing and adjusting the systems. This will allow any issues with the TAB equipment or process to be corrected as early as possible to prevent TAB rework.

8 Acceptance and Testing Phase Commissioning

8.1 Acceptance and Testing Phase Commissioning Team

The table below identifies the members of the Commissioning Team during the Construction Phase. The Commissioning Team remains much the same as the Construction Phase Commissioning Team. The involvement of the VAMC Facilities Staff is strongly encouraged during the systems functional testing to enable them to see the new systems in operations which will facilitate the knowledge transfer to the operations team. The members on the Commissioning Team should be updated as often as necessary to maintain the list up-to-date throughout the project.

Commissioning Team Acceptance and Testing Phase		
Designation	**Agency/Professional/Contactor**	**Description**
VA RE	Department of Veterans Affairs Resident Engineer(s)	Technical Representative of the VA Contracting Officer responsible for project delivery
VAMC-	VA Medical Center Facilities Management and/or using agency	Representatives of the local VA Medical Center responsible for Facilities Operation & Maintenance, Construction Coordination and/or other VAMC departments.
A/E	Architect/Engineer Design Team	Representatives of the Architect and Engineering Design Team responsible for Construction Administration
CxA	Commissioning Agent	Representatives of the independent 3rd Party Commissioning Contractor
Contractor	Prime Contractor	Representatives of the Prime Contractor responsible for project construction.
SC	Installing Sub-Contractors and Service Providers, to include but not necessarily be limited to	Representatives of the Fire Protection, Plumbing, HVAC, Electrical, Communications, Electronic Security 1st-Tier subcontractors responsible for installing systems and equipment

Commissioning Team Acceptance and Testing Phase		
Designation	**Agency/Professional/Contactor**	**Description**
TAB	Test and Balance Agency	Representatives of the Test and Balance contractor responsible for air and water balance of HVAC systems
DDCC	Direct Digital Control System contractor	Representatives of the Control System contractor responsible for installing and programming the Direct Digital Control system
SpC	Specialty Contractors	Representatives of the Fire Alarm, Electronic Security System, and other specialty contractors responsible for installation and programming of special systems that interface with the DDC system, HVAC and/or Electrical systems. This can include independent 3rd-Party Test Agencies (e.g., NETA Qualified Testing Agents)

8.2 Acceptance and Testing Phase Commissioning Tasks

The following table summarizes the Commissioning Agent Tasks during the Acceptance and Testing Phase. Further details on the tasks are provided in the paragraphs that follow the table.

Commissioning Team Task/Deliverables Description Acceptance and Testing Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Systems Functional Performance Testing	The Commissioning Agent will oversee, facilitate, and document all FPT testing. Execution of FPT's shall be executed in accordance with the Functional Testing Procedures published by the Commissioning Agent. All systems tested in accordance with the FPT's shall be operated by the contractors in accordance with the approved FPT. Contractors shall retain responsibility for the installed systems during and after functional testing until substantial completion or final acceptance as determined by the VA. The Commissioning Agent, in collaboration with the control contractor shall include long term trends (greater than 7 days) of integrated system performance once all systems have been commissioned. The Commissioning Agent shall provide analysis of these trends to confirm that the installed systems are stable and reliable	Executed Functional Performance Tests and support documentation. Long Term Trend Data and Analysis
Prepare Systems Manuals	The Commissioning Agent shall work with the design team, contractor and VA to develop Systems Manuals. Manuals will contain system design, operations and sequence information that describes the design intent, operational features and appropriate operational practices necessary to sustain the system operation in accordance with the Design Narrative and the VA's overall objectives for the facility. Systems Manual will include sections for each major system included in the commissioning process.	Project Systems Manual

Commissioning Team Task/Deliverables Description Acceptance and Testing Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Training Plan Review	The Commissioning Agent shall collaborate with the Prime Contractor and installing subcontractors to develop effective contractor and manufacturer training plans and agendas for general conformance with specifications and VA's requirements. Observe training for quality of training and for general conformance with the training plan and agenda. The CxA shall observe contractor and vendor training for critical systems. The Contractor shall provide and the CxA shall maintain all attendance records and associated agendas and presentations for all training sessions. Attendance records shall be written original sign in sheets for each training session.	Compiled Training Plan Individual Training Agendas Training Attendance Sign In Sheets
Systems Training	The Commissioning Agent will conduct training sessions to provide systems-level training for O&M personnel. Training will include: ● Review of system design, capacity, and equipment selection ● Review of system operating sequences ● Review of interconnection with other systems ● Review of Emergency operating procedures ● Review of the Project Systems Manual and its Use ● Student Evaluation forms The number, duration and scope of the Systems Training sessions shall be determined by the specific requirements of the project. The training provided by the CxA does not in any way relieve the Contractor from any specified training obligations.	Systems Training Presentations (electronic)

Commissioning Team Task/Deliverables Description Acceptance and Testing Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Final Commissioning Report	The Commissioning Agent shall compile a comprehensive commissioning report documenting all commissioning activities, including but not limited to the following: ● Executive Summary ● Commissioning Scope of Work ● Test methods and results ● Outstanding commissioning issues ● Comprehensive Commissioning Issues Log, including resolved items and a description of their resolution, ● Commissioning plan, ● Field Observation Reports, Status reports and other field activity documentation, ● Submittal and O&M manual reviews ● Training record ● Completed Pre Functional Checklists ● Completed Functional Performance Test protocols and support documentation ● Other support documentation developed as part of the execution of the project Construction Phase Commissioning Process	Final Commissioning Report

8.3 Acceptance and Testing Phase Commissioning Team Roles and Responsibilities

The primary goals of Acceptance and Testing Phase Commissioning Process are

- to verify, demonstrate and document that the installed systems and components operate in accordance with the Owner's Project Requirements and the Construction Documents, and
- to verify that the Operations & Maintenance Team are effectively trained to sustain high performance operation of the installed systems.

The following tables describe both the task associated with executing an effective commissioning process and the responsibilities of each commissioning team member in execution of each task. It is imperative that the Team Members be identified, and that the roles and responsibilities be clearly identified, as well as being tailored to each specific project.

Commissioning Team Roles and Responsibilities Acceptance and Testing Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Systems Functional Performance Testing	Facilitate execution of the Functional Performance Testing as required. Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Commissioning Issues Log and reporting requirements between the Commissioning Agent and the Construction team.	In collaboration with the Contractor Commissioning Team, direct the execution of the Functional Performance Testing. Identify issues and deficiencies in system operation and performance on the Commissioning Issues Log. Retest systems as appropriate to demonstrate compliance with the Contract Documents and the Commissioning Plan.	Participate with the Commissioning Agent as agreed upon to support the commissioning process and facilitate training of the Operations Team. Review & Comment on Commissioning Issues Log as appropriate.	Review & Comment on the Commissioning Issues Log as appropriate.	Provide Qualified Technicians and Professionals to operate the installed systems and components as required by the Functional Performance Testing and any retesting required by the Commissioning Agent. Provide documentation of test results from installed systems as required by the FPT's. Correct issues and deficiencies identified on the Commissioning Issues Log and report methods and results of corrective actions to the Commissioning Agent.

Commissioning Team Roles and Responsibilities Acceptance and Testing Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Prepare Systems Manuals	Review Systems Manual & Approve	Utilizing the accumulated information and data, prepare a Systems Manual for the Operations Team. Review submitted data and note any issues or deficiencies on the Commissioning Issues Log. Deliver Systems Manual to the Cx Team for Review and Comment.	Review Systems Manual & Comment	Provide systems diagrams and other appropriate data to the Commissioning Agent in electronic format for development of Systems Manual. Review Systems Manual & Comment	Provide data, including record drawings and submittal data for all commissioned systems. Correct any deficiencies and issues identified with the submitted data. Review Systems Manual & Comment

Commissioning Team Roles and Responsibilities Acceptance and Testing Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Training Plan Review	Facilitate Development of Training Agendas and Training Schedules. Review Training Plan & Comment	Facilitate development of Training Agendas. Collaborate with CM/GC/SC and VAMC teams to schedule training activities. Review and Approve all CM/GC/SC training agendas. Note any issues or deficiencies in Agendas on the Commissioning Issues Log.	Review Training Plan & Comment Schedule Appropriate Operations Personnel in accordance with the training schedule.	Review Training Plan & Comment	Develop training agendas in accordance with Project Specifications and submit to Commissioning Agent for review. Coordinate training schedule with Commissioning Agent and other Cx Team members. Schedule and execute training in accordance with training schedule and agendas.

Commissioning Team Roles and Responsibilities Acceptance and Testing Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Systems Training	Review & Approve Systems Training Agenda Facilitate Systems Training in accordance with the Agenda and Schedule	Develop Systems Training Sessions in accordance with the Commissioning Plan. Sessions shall include the use of the Operations and Maintenance Manual and a 'Systems Manual' developed for the VAMC operations Team. Deliver Systems Training in accordance with the approved Systems Training Agenda.	Schedule key O&M Personnel to attend Systems Training Sessions.	Review & Comment on Systems Training Agenda.	Review & Comment on Systems Training Agenda.
Final Commissioning Report	Review & Approve Final Commissioning Plan.	Create and submit Final Commissioning Report in accordance with the Commissioning Plan and other contract requirements.	Review & Comment on Final Commissioning Plan	Review & Comment on Final Commissioning Report	None

Commissioning Team Roles and Responsibilities Acceptance and Testing Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Lessons Learned Review Meeting	Facilitate Lessons Learned Meeting Review & Comment on Meeting Minutes	Distribute the Agenda for the Lessons Learned Meeting. Lead the Lessons Learned Meeting. Complete and distribute Meeting Minutes. Incorporate comments as appropriate.	Attend & Contribute to Meeting. Review & Comment on Meeting Minutes	Attend & Contribute to Meeting. Review & Comment on Meeting Minutes	Attend & Contribute to Meeting. Review & Comment on Meeting Minutes

8.4 Construction Meetings

As with the Construction Phase, Acceptance and Testing Phase meetings requiring the participation of the Commissioning Agent must be clearly and specifically identified and quantified in the construction documents.

a. Construction Progress Meetings:

While these regularly-scheduled meetings are well-stipulated in other VA documents, it is unlikely the Commissioning Agent needs to attend all of the construction phase meetings. The Commissioning Plan should identify the critical steps during the construction process that warrant meeting attendance by the Commissioning Agent. The primary purpose for the Commissioning Agent attending these meetings is to review outstanding commissioning issues that warrant attention by the Contractor or the VA PM/RE. These meetings also allow the Commissioning Agent to be informed of construction progress, construction schedule updates, RFI status, Change Orders, and other directives that could impact the commissioning process

b. Commissioning Progress Meetings:

Commissioning tasks and requirements are clearly different and separate from other acceptance and testing phase activities. The Commissioning Agent will be required to attend all commissioning related meetings and will also be required to plan and even lead these meetings. Issues addressed at Commissioning Progress Meetings will be specific to the Commissioning process and will be items that enhance the success of project commissioning. The Construction Commissioning Plan will identify the required number and content/context of all Commissioning Progress Meetings for the project. The Commissioning Progress Meetings will also focus on planning, preparing for, and coordinating System Functional Performance Testing.

8.5 Commissioning Construction Site Visits

As with the Construction Phase, Acceptance and Testing Phase Construction Site visits requiring the participation of the Commissioning Agent must be clearly and specifically identified and quantified in the Commissioning Plan. It is expected that the frequency of these visits will increase as the systems installation near completion. These visits will have the same purpose as those conducted during the Construction Phase, with increasing emphasis on preparations for systems functional performance testing.

8.6 Equipment/System Start Up Observation and Review

As construction and system/equipment installation progresses, various items will be ready for startup. Specific sections of the construction specifications require that the installing contractor will engage the services of a qualified manufacturers' representative to conduct an equipment startup. The installing contractor should schedule these startups with Contractor, VA RE, A/E, and

Commissioning Agent in addition to scheduling with the manufacturers' representative. Sufficient notice should be provided to allow coordinating the startup with other scheduled activities.

The VA RE and the Commissioning Agent will determine which equipment startups should be witnessed by the Commissioning Agent. Not all startups need to be witnessed by the Commissioning Agent, but critical equipment such as chillers, cooling towers, air handlers, generators, boilers, etc. should be witnessed by the Commissioning Agent. Often the manufacturer's startup includes verification of start/stop, equipment safety shutdown, and other testing that is included in the initial sections of the Systems Functional Performance Test Procedures. When the Commissioning Agent witnesses the manufacturers' startup verification of these items, it provides the opportunity to document successful completion of those Systems Functional Performance Test steps without having to duplicate them later. This is especially important when verification of the safety shutdown involves temporary adjustments to the equipment controls that should only be made by qualified manufacturer's representatives. The intent is to streamline the process and not require that the manufacturers' representative and the Commissioning Agent return to the site multiple times.

In the case of multiple installations of the same or similar equipment provided by the same manufacturer that involves several visits by the manufacturer's representative, it may not be necessary for the Commissioning Agent to witness each startup. At the discretion of the VA RE and Commissioning Agent, it may be sufficient for the Commissioning Agent to verify the startup procedure is correctly performed and then the Commissioning Agent can review startup documentation for subsequent startup. For example, the project may include many AHUs provided by the same manufacturer. The construction sequence may entail installing and starting the AHUs in one section of the facility followed by additional AHUs installed in other portions of the building later in the construction. In this case, the Commissioning Agent should witness the startup of the first AHUs, but can review the startup documentation for subsequent AHU startups.

8.7 Pre-Functional Checklist Verification

As discussed earlier in the Pre-Functional Checklist section, the Commissioning Agent will spot check completed checklists submitted by the Contractor and installing contractors. The intent of this verification is to determine that all steps necessary to install the systems/equipment have been properly completed and the equipment is functional and the systems are ready to be tested.

8.8 Systems Functional Testing (Season 1)

Systems Functional Performance Testing occurs once all system components are installed, energized, programmed, balanced, and otherwise ready for operation under part- and full-load conditions. Testing should include each process in the sequence of operation under central and packaged equipment

control, including startup, shutdown, capacity modulation, emergency and failure modes, alarms, and interlocks to other equipment or systems. The Contractor indicates the system is ready for functional testing by submitting the completed Pre-Functional Checklist.

Testing is directed by the Commissioning Agent using the approved Functional Test Procedures. As discussed earlier, the Systems Functional Test Procedure is a detailed step-by-step "script" that begins with verification of the system installation and basic start/stop and safety shutdown verification. As the actual functional testing starts, the system is placed in the specified initial condition. The test proceeds to test individual components and equipment under steady state conditions. As the performance of individual components and equipment is successfully demonstrated, the testing progresses to test sub-systems and finally the entire system under steady state conditions is all operating modes.

When steady state operation has been successfully demonstrated, the system, sub-systems, and components/equipment are tested for response to step changes. These steps are designed to subject the system to anticipated extreme operating conditions such as full load, minimum load, temporary overload, and other situations that could be encountered. Often, this testing places the system in conditions that are rarely, if ever, seen under normal operations. The intent is to verify that the systems will safely and properly react to these extreme conditions without damaging the system or causing other unintended consequences. It is imperative that the test procedures adequately identify the risks involved and do not subject the system to dangerous or damaging situations. Therefore, the Contractor, installing contractor, manufacturers' representatives, and the A/E must review the Systems Functional Performance Test procedures to identify potential situations that could damage the equipment and or cause other harm or injury.

System Functional Performance Testing continues by simulating anticipated failure conditions and evaluating system response to these failures. Normally, the Systems Functional Performance Test Procedures will be written to subject the system to single failure situations – multiple failures are not normally included in the testing. In the event that multiple failures are reasonably expected, these can be included in the testing. Examples of single failure situations would include failure of one pump in a multi-pump system; failure of a single chiller in a multi-chiller system, etc. Examples of multiple failures would include failure of a single pump in a multi-pump system and simultaneous or subsequent failure of one chiller in multi-chiller system when the pumps and the chillers are part of a single chilled water system. In these cases, the Commissioning Agent can assist in developing contingency plans to be used by the VAMC FM for manually configuring and/or manually operating the system with multiple failures.

Systems Functional Performance Testing uses the DDC system to control the systems. The DDC system normally includes trending and alarm capabilities. The Commissioning Agent should use the DDC trend capabilities to record system responses to test conditions. As part of the analysis of the test results,

the Commissioning Agent should carefully review DDC trend logs and other data gathered during testing to ensure the system performance is consistent with the construction documents. Systems Functional Performance Testing should also include verification that the proper alarms and alarm priorities are indicated when the alarm conditions are present.

Evaluation of results is the final step. At each point in the process of installation inspections and system performance testing, the Commissioning Agent should evaluate whether the installed systems meet the criteria as set forth in the construction documents. Any issues or observations are reported to the VA RE and the Contractor on Field Reports and the Master Commissioning Issues Log. The team should work collaboratively to find and implement an appropriate solution.

In projects being constructed in regions that have multiple operating seasons (i.e. heating season and cooling season), the construction schedule does not normally allow testing system operations in both seasonal modes. These systems will require additional testing under Season 2 conditions. For example, in a project where initial system testing is conducted during the cooling season, the cooling season become Season 1. Season 2 testing will be conducted during the heating season. Therefore, the Season 2 testing will generally be scheduled during the Warranty Phase of the project, approximately 6 months after initial testing, when environmental conditions are conducive to the alternate season testing.

Functional testing requires support from many Construction Team members. The Commissioning Agent witnesses and documents the testing while the Contractor, installing contactor and the DDC vendor operate and manipulate the systems. Since testing often identifies minor issues that can easily be corrected by minor adjustment or repair, other supporting contractors should be readily available to assist the testing, adjustment and/or repairs. In the case of HVAC system testing, the HVAC contractor and the DDC contractor are required to be present and to conduct the test. The electrical contractor, TAB contractor, and other subcontractors do not need to be present at the test, but should be onsite and be readily available if needed.

It is also recommended that the VAMC staff be present during functional testing. The rigor of the testing is such that it provides an excellent opportunity for the O&M staff to see the systems in full operation and to witness the system response to the abnormal operating conditions. The systems are operated under conditions that the O&M staff may not witness in day-to-day operations for many years. It is very valuable for them to see and hear how the system reacts to these extreme situations. For example, the noise level in the system may rise considerably when operating at full load or temporary overload. The O&M staff needs to know that this is normal and to recognize it as a symptom of a system reacting normally to the extreme condition. This also allows the O&M staff to learn to differentiate between normal, abnormal and dangerous noises, vibrations, reading, or other indications of impending problems.

System failures, observations, and other issues are often identified during testing. The Commissioning Agent is a technical resource that can provide assistance and direction towards identifying the root cause of the problem. Together with the installing contractor, DDC vendor and TAB contractor, the Commissioning Agent can often identify possible causes and recommended corrective measures. Where these measures can be readily identified and the corrective action can be completed by readily available personnel and material, the functional testing can be temporarily be interrupted to complete the corrective action. If the corrective action cannot be completed in a reasonable time (usually 15 – 20 minutes), testing can continue with other portions of the test that are not impacted by the problem. If the problem is severe enough that, if in the opinion of the Commissioning Agent, functional testing cannot continue in a meaningful manner with a reasonable probability of a partially successful completion, the Commissioning Agent will recommend that testing be halted. Final direction to halt testing is at the sole discretion of the VA RE. If testing can proceed on other systems, those tests can be conducted. If no other testing or commissioning tasks can be completed, the Commissioning Agent will leave the site. Resumption of functional testing will be scheduled at a time and date mutually acceptable to all parties involved in the testing.

The results of functional testing are documented on the Systems Functional Performance Test Procedure. The Commissioning Agent will also prepare a Field Report to document the testing activities and any significant issues found during testing. Significant issues will also be entered on the Master Commissioning Issues Log.

8.9 Operations and Maintenance Manuals

The Contractor is required to submit O&M Manuals for systems and equipment as identified in the specifications. These manuals should be submitted at within 90 days of approval of all related shop drawings. Early delivery of Operations and Maintenance Manuals allows both the Commissioning Agent and the Construction Team to validate the accuracy of these manuals and utilize them as an effective training tool during the turn over phase of the project.

The Commissioning Agent has the experience and knowledge to assist in review of the O&M Manuals. The submittal process is expanded into multiple submittals throughout the construction phase. The requirements for each submittal are designed to coordinate with the point in the construction process when the contractor obtains the required information.

The first submittal may include the binder(s) with a Table of Contents and divider tabs for each section of the manual. This submittal includes the approved equipment submittal information and basic equipment manuals available from the manufacturer. This O&M submittal is due shortly after Equipment Submittal/Shop Drawing approval.

The second O&M submittal may expand on the first submittal by including data sheets for each item of equipment installed on the project. Generally this data

will include make, model, size, equipment identification, serial number, installed location, and other item-specific information.

The final O&M submittal expand the earlier submittals by including scheduled maintenance information, recommended critical spare parts information, and contact information for local suppliers.

Coordination of the O&M Manual Submittal process should be considered and clearly described in the Project Specifications.

8.10 Systems Manual

The Commissioning Agent, with the assistance of the Contractor and the A/E team, will develop a Systems Manual that gives operating staff the information needed to understand and optimally operate the commissioned systems. The Systems Manual is provided in addition to the O&M Manuals submitted by the contractors. The Systems Manual generally focuses on operating, rather than maintaining, the equipment. It also focuses on the interactions between systems.

The Systems Manual should include the following for each commissioned system:

- Final version of the Design Narrative
- Single-Line Diagrams, Flow Diagrams
- As-built sequences of operations, control drawings, and original setpoints
- Operating instructions for integrated building systems
- Recommended schedule of maintenance requirements and frequency, if not already included in the O&M Manuals.
- Recommended schedule for re-testing of commissioned systems with blank test forms from the original commissioning plan
- Recommended schedule of calibrating sensors and actuators

8.11 Training Verification

Successful and sustained operation of building systems relies on experienced and trained operating personnel. To this end, the construction specifications require that the Contractor and/or the Manufacturers' Representative provide training to operating personnel.

The Commissioning Agent is in a unique position to evaluate the training needs for operating personnel. These needs can then be translated into training requirements that the contractors must address in the training plans they develop. Common topics that should be included in the training plans are as follows:

- General purpose of the system (design narrative)

- Use of O&M Manuals
- Review of Control Drawings and schematics
- Startup, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control setup and programming, troubleshooting and alarms.
- Interactions with other systems
- Adjustments and optimizing methods for energy conservation
- Health and safety issues
- Special Maintenance and replacement sources
- Occupant interaction issues
- System response to different operating conditions

8.12 Commissioning Issues Follow Up and Resolution

Throughout the construction commissioning process, issues will be identified that need to be evaluated and resolved. There are several vehicles available to the Commissioning Agent to assist with documenting and tracking these issues. These include:

- Field Reports
- Commissioning Issues Log
- Systems Functional Performance Test Procedures
- Commissioning Requests for Information (Cx RFI)

Opportunities to follow-up on outstanding issues include Construction Progress Meetings, Commissioning Progress Meetings, emails, face-to-face meetings, phone calls, and informal discussions with the VA RE, A/E, Contractor, DDC vendor, TAB contractor, as well as others who may have information relevant to the issue.

The Commissioning Agent has the expertise, experience and overall knowledge of the system design to assist the project team with identifying root causes and recommending appropriate solutions. The recommended resolution of an issue may require review by the A/E team with final approval and direction by the VA RE. The Commissioning Agent will often recommend that the installing contractor, DDC vendor, TAB contractor or Contractor submit an RFI to the VA RE and the A/E for review and approval. In some cases, the Commissioning Agent will submit a Commissioning RFI to request clarification from the A/E and VA RE.

Final approval of, and direction on, proposed resolutions rests with the VA RE who will issue the appropriate Change Order, Field Directive or other document. The Commissioning Agent should be included in the distribution for these approval documents so they can be included in revisions to the Design Narrative and the Systems Manual. The A/E and the Contractor may also need to

document the issue resolution in the As-Built drawings, Sequences of Operation, and/or control schematics. If necessary, the Commissioning Agent will modify functional test procedures to address changes made during the issues resolution process.

8.13 Final Commissioning Report

The Commissioning Agent will prepare a comprehensive Commissioning Report that documents the commissioning activities and results. This report is prepared after installation inspections and systems functional testing activities have been completed, and the results have been tabulated and evaluated.

The Commissioning Report should include the following:

- Executive Summary of the process and the results of the commissioning program, including observations, conclusions, and any outstanding issues.
- Summary of the design review process
- Summary of the submittal review process
- Summary of the O&M Manual and Training processes.
- History of any system deficiencies identified and how they were resolved, including any outstanding issues or seasonal testing scheduled for later during the warranty phase.
- Systems performance test results and evaluation.
- Confirmation from the Commissioning Agent indicating whether individual systems meet the Owner's Project Requirements, design narrative and contract documents.

8.14 Lessons Learned Review Meeting

This is a meeting convened by the Commissioning Agent for the purpose of reviewing the project and the commissioning process. The meeting should be scheduled shortly after the Commissioning Report has been submitted and reviewed by the VA. Attendees at the meeting should include:

- VA PM and VA RE
- Commissioning Agent
- VAMC FM managers
- VAMC user agency representative
- VA CFM
- A/E
- Contractor
- VA Contracting Officer (optional)

This should be an open forum where all parties can address concerns, recommendations for improvement, and other issues aimed at improving the facility and the project delivery process.

Topics could include concerns and recommendations for improving the following:

- the design or design process
- the construction process
- facility performance
- energy performance
- building or systems operations
- building or systems maintenance
- the commissioning process

The results of this conference will be summarized by the Commissioning Agent and submitted to VA CFM and VA PM and VA RE for review and follow-up.

8.15 Adapting the Acceptance Phase Commissioning Process

The Acceptance Phase Commissioning process can be tailored to a specific project by including, deleting or adapting the commissioning tasks to the project. The following tasks can be adapted:

a. Commissioning Construction Observation Visits, Commissioning Team Meetings, Construction Progress Meetings

   The number of on-site meetings can have a significant impact on the cost of commissioning with some corresponding reduction in the value delivered by the Commissioning Agent. Therefore, determining the number of trips to the project site is one method of controlling the cost of commissioning.

   As construction progress continues the project transitions from the Construction Phase to the Acceptance Phase. The start of systems functional testing approaches there is need for closer coordination of the Commissioning Team. The Commissioning Agent will need to closely monitor that the systems are ready for testing, to coordinate the test team, verify that the appropriate test equipment is available and properly calibrated, and a great deal of other details. The Commissioning Construction Observation visits should now be scheduled weekly, or even daily to ensure that functional testing can be performed efficiently and effectively.

b. Lessons Learned Meeting

   For less complex projects where the commissioning process is straightforward and the benefits of the Lessons Learned Meeting are marginal, this meeting can be deleted from the commissioning scope.

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9 Warranty Phase

9.1 Warranty Phase Commissioning Team

The table below identifies the members of the Commissioning Team during the Warranty Phase. By this point in the project, most of the A/E and construction team is no longer on-site and their participation is limited. The members on the Commissioning Team should be updated as often as necessary to maintain the list up-to-date throughout the project.

Commissioning Team Warranty Phase		
Designation	**Agency/Professional/Contactor**	**Description**
VA RE	Department of Veterans Affairs Resident Engineer(s)	Technical Representative of the VA Contracting Officer responsible for project delivery
VAMC	VA Medical Center Facilities Management and/or using agency	Representatives of the local VA Medical Center responsible for Facilities Operation & Maintenance, Construction Coordination and/or other VAMC departments.
CxA	Commissioning Agent	Representatives of the independent 3rd Party Commissioning Contractor
Contractor	Prime Contractor	Representatives of the Prime Contractor responsible for post-construction and warranty services.

9.2 Warranty Phase Commissioning Tasks

The following table summarizes the Commissioning Agent Tasks during the Warranty Phase. Further details on the tasks are provided in the paragraphs that follow the table.

Commissioning Team Task/Deliverables Description Warranty Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Deferred and/or Seasonal Testing	The Commissioning Agent shall witness and document Systems Functional Performance Testing that was deferred to allow systems to be tested in appropriate seasonal conditions. Testing will be conducted in accordance with Systems Functional Performance Test Procedures. Testing support will be required from the installing contractors, EMCS Vendor and VA. Requirement for seasonal testing will be incorporated into the project specifications. As part of the Seasonal Testing Effort, the Commissioning Agent shall review systems operations with the onsite operations team and reinforce training and best operating practices of the operations team.	Executed Functional Performance Test and Support Documents Commissioning Issues Log
Warranty Period Site Visits	The Commissioning Agent shall make quarterly visits to the project site to reinforce training, evaluate performance of the installed systems and provide technical support to the operating team to sustain commissioned performance of the systems.	Warranty Site Visit Reports

Commissioning Team Task/Deliverables Description Warranty Phase		
Project Phase/ Cx Task	**Commissioning Task Description**	**Commissioning Deliverables**
Post-Occupancy Inspection	Return to the project approximately 10 months after substantial completion to review the building operation with the facility occupants and O&M staff, and to discuss outstanding issues related to commissioning. Provide suggestions for improvements to systems operation including, • Measurement & Verification Issues, • Re-Commissioning Tasks, and • Improvements in Preventive Maintenance or Operational Strategies Assist facility staff in developing warranty issues, documents and requests for service to remedy outstanding problems. As part of the Post Occupancy Inspection, the Commissioning Agent shall analyze the energy consumption records from the project site (both utility and system generated reports) and provide the team with an analysis of actual system energy performance versus predicted performance. To the extent possible, deficiencies in performance shall be analyzed to provide an understanding of the systems, components or operating strategies that may be operating outside predicted parameters.	Post Occupancy Field Visit Report Commissioning Issues Log Warranty Issues Report Systems Energy Review Report
Final Commissioning Report Amendment	Amend Final Commissioning Report to document the Warranty Phase commissioning activities.	Final Report Amendment

9.3 Warranty Phase Commissioning Roles and Responsibilities

The primary goals of Acceptance and Testing Phase Commissioning Process are

- to conduct deferred and seasonal systems functional performance testing, and
- to verify that the commissioned systems continue to perform as demonstrated during initial systems functional performance testing, and
- to reinforce the Operations & Maintenance Team training necessary to sustain high performance operation of the installed systems.

The following tables describe both the task associated with executing an effective commissioning process and the responsibilities of each commissioning team member in execution of each task. It is imperative that the Team Members be identified, and that the roles and responsibilities be clearly identified, as well as being tailored to each specific project.

Commissioning Team Roles and Responsibilities Warranty Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Deferred and/or Seasonal Testing	Facilitate Seasonal Testing with all appropriate parties. Review Commissioning Agent Issues Log & facilitate issues resolution. Facilitate Resolution of identified Commissioning Issues.	Schedule & Execute Seasonal Testing in Accordance with Functional Performance Testing Protocols. Maintain & Distribute Warranty Phase Commissioning Issues Logs. Facilitate and record resolution to identified Issues and Deficiencies recorded on Commissioning Issues Log.	Provide O&M Personnel to support seasonal testing in accordance with the Commissioning Plan. Review Commissioning Agent Issues Log & Comment Operations Team will operate systems under the deferred season testing protocols.	Review & Comment on Seasonal Testing. Provide and report resolution of any issue identified as a Design Issue.	Contractor will be invited to participate in the execution of seasonal testing and assist in resolution of issues and deficiencies identified. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Warranty Phase					
Project Phase/ Cx Task	**Commissioning Team Member Responsibilities**				
	VA RE	**Commissioning Agent**	**VAMC**	**A/E Team**	**Contractor**
Post-Occupancy Warranty Checkup	Facilitate Post Occupancy Warranty Check Up Meetings. Review and approve Final Commissioning Report Amendment.	Meet with the VAMC Operations Team. Interview team members to evaluate system performance and identify any issues with operation of the commissioned systems. Evaluate system performance through a review of operating performance data and warranty phase (re-commissioning) tests as identified in the Commissioning Plan and Systems Manual. Develop a Warranty Report identifying any outstanding warranty issues for VAMC use in resolving warranty issues on the project.	Provide O&M personnel to participate with the Commissioning Agent in the Post Occupancy Warranty Checkup. Identify any outstanding or persistent warranty issues to the Commissioning Agent.	A/E Team will be invited to participate at their discretion. Review & Comment on Seasonal Testing. Provide and report resolution of any issue identified as a Design Issue.	Contractor will be invited to participate at his discretion. Assist in resolution of issues and deficiencies identified. Assist in facilitating execution of all warranty obligations identified.
Final Commissioning Report Amendment	Review & Approve Final Commissioning Report Amendment.	Create and submit Final Commissioning Report Amendment in accordance with the Commissioning Plan and other contract requirements.	Review & Comment on Final Commissioning Report Amendment	Review & Comment on Final Commissioning Report	None

9.4 Systems Performance Monitoring

During the Warranty Phase, the Commissioning Agent, VA staff, and representatives of the A/E team and the Contractor's team shall verify on-going system performance by repeating selected Systems Functional Performance Tests and by reviewing energy bills and other performance-related documentation. The Commissioning Agent shall prepare a report to the VA stipulating any issues with on-going system performance and/or confirming that the systems are functioning as designed and intended.

9.5 Deferred Seasonal Testing

Functional Testing is performed on systems that could not be tested during the Acceptance and Testing Phase of the project due to seasonal load issues that prevent reasonable testing of a system or of integrated systems whose operation is dependent on seasonal building loads. Systems Functional Performance Testing will be executed in the opposite season to confirm successful operation of the integrated systems under building loads. These tests can also be required to demonstrate the performance of the occupied building where insufficient internal loads in the building prevented the Commissioning Agent from adequately challenging the systems during initial testing.

The Commissioning Agent will issue the following documentation:

- Warranty Phase Commissioning Issues Log for issues and deficiencies identified during Seasonal Testing. The Contractor should be obligated to resolve any identified issues and report resolution to the Commissioning Agent. Resolutions will be verified by the Commissioning Agent and documented on the Warranty Phase Commissioning Issues Log.
- Commissioning Field Observation Reports that document the seasonal testing results

9.6 Post-Occupancy Warranty Checkup

In order to support the VAMC Operations Team and the VA RE in the Post Occupancy Period and provide technical support for warranty enforcement, the Commissioning Agent will provide a Post Occupancy Inspection of the project at least once no later than 10 months after start of the Contractor's project warranty period. Visits should be scheduled quarterly to provide ongoing evaluation of system performance, training reinforcement/enhancement and warranty support. The objectives of the Post Occupancy Warranty Check Up shall be:

a. To evaluate system performance against commissioned performance thru execution of 're-commissioning' testing and performance evaluation strategies;

b. To Evaluate staff operational methodologies and expertise;

c. To reinforce training delivered at the end of construction and to recommend additional staff training to enhance operational expertise; and,

d. To provide assistance and technical expertise in documenting outstanding warranty and latent defect issues that may be identified during this period.

During the Post Occupancy Checkup, the Commissioning Agent should

a. Meet with the VAMC Operations Team. Interview team members to evaluate system performance to identify any issues with operation of the commissioned systems and to reinforce good operational practices.

b. Evaluate system performance through a review of operating performance data and warranty phase (re-commissioning) tests as identified in the Commissioning Plan and Systems Manual.

c. Develop a Warranty Report identifying any outstanding warranty issues for VAMC use in resolving warranty issues on the project.

9.7 Final Commissioning Report Addendum

Once the Post Occupancy Site Visit is complete, the Commissioning Agent will issue a final addendum to the Commissioning Report that documents all Warranty Phase efforts including Seasonal Testing, additional training efforts, post occupancy system performance evaluations and Warranty Reporting. The Addendum should be issued in a manner that allows the VAMC to incorporate the information into their working copy of the Final Commissioning Report.

9.8 Adapting the Warranty Phase Commissioning Process

The Warranty Phase Commissioning process can be tailored to a specific project by including, deleting or adapting the commissioning tasks to the project. The following tasks can be adapted:

a. Periodic Warranty Phase Site Visits

The number of Warranty Phase visits to be made by the Commissioning Agent can have a significant impact on the cost and value of the commissioning process during the Warranty Phase. The number of visits should be adjusted as necessary based on the complexity of the systems, the ability of the facilities operations staff to effectively and efficiently operate the systems, the need for reinforcing operations staff training provided during construction, and the expected value of these visits.

Link to Appendix documents on CFM Website

Appendix A – Commissioning Process Flowcharts

Appendix B – Sample Commissioning Agent Scope of Work

Appendix C - Sample Commissioning Agent Request for Proposals

Appendix D - Sample Design Narrative TOC

Appendix E – Sample Design Review Comment Log

Appendix F – Sample Commissioning Plan with Documentation Log

Appendix G – Sample Commissioning Progress Meeting Minutes

Appendix H – Sample Commissioning Field Report

Appendix J – Sample Commissioning Master Issues Log

Appendix K – Sample Pre-Functional Checklists

Appendix L – Sample Systems Functional Test Procedures

Appendix M – Sample Systems Manual

Appendix N – Sample Final Commissioning Report