APPENDIX VII
New-Building Commissioning Guidelines
December 8, 2000

1.0 PURPOSE

The purpose of these commissioning guidelines is to establish the project commissioning requirements, including those requirements to be specified in the construction documents. The intent of the commissioning process is to ensure that the facility's mechanical, electrical and designated systems' performance comply with the design intent and the owner's functional criteria and operational needs.

2.0 GOAL

The goal of commissioning is to provide documented confirmation that a facility fulfills the performance and maintenance requirements of the building owner, occupants, and operators. To reach this goal, it is necessary for the commissioning process to establish and document the owner's and the using agency's criteria for system performance and maintainability, and to verify and document compliance with these criteria throughout design, construction, startup, and the initial period of operation. For the process to work successfully it is equally important, and therefore a project requirement, for the building's designers, owners, using agency, operators, contractors and the commissioning agent to work as a commissioning team throughout their involvement with the project.

3.0 APPLICABILITY

Building Commissioning will be encouraged on major projects with $5 million or more in total project costs. The need for commissioning on other projects will be determined by the Project Manager and the Agency's representative based on complexity of the project.

4.0 BUILDING COMMISSIONING BUDGET

The building commissioning budget is to be estimated prior to execution of the A/E agreement. Commissioning shall be included as a separate line item in the design and construction cost estimates and budgets.

5.0 DESCRIPTION

All State of Idaho commissioning projects shall be conducted in accordance with ATTACHMENT 5, THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS (adapted from the Building Commissioning Association's *Essential Attributes of Building Commissioning*). The remainder of this document presents guidelines for implementing the building commissioning on State projects.

5.1 DEFINITIONS

5.1.1 Building Commissioning. Building Commissioning is the act of verifying and documenting that the performance and maintainability of building systems fulfill the functional and operational needs of the building's owner, using agency, and operators. It requires that these needs be documented as systems acceptance criteria, and that a formal process be implemented to verify and document that the systems are designed and constructed in accordance with these criteria. The ultimate goal of this process is to confirm, through functional

testing, that the interactive operation of the building systems complies with the acceptance criteria.

5.1.2 Commissioning Process. The Building Commissioning Process is a team effort to verify that all equipment and systems have been designed, installed and put into service in accordance with the owner's criteria for performance and maintainability (the Systems' Acceptance Criteria). The basic commissioning process consists of the following phases, beginning at the initial or pre-design stage of the project. The phases of the Commissioning Process overlap and correspond with standard phases of the design/construction process, however, the commissioning scope of work is not intended to duplicate efforts provided under the standard A/E contract. Its intent is to enhance design, construction and start-up:

5.1.2.1 Establish Systems' Acceptance Criteria: in which the owner and agency's acceptance criteria for systems' performance and maintainability (the Systems' Acceptance Criteria) are established. These criteria, which are documented in the Systems Concept and Operations Manual (defined in 5.1.5), form the bases of design and the systems' acceptance. It is critical, therefore, that they be established and documented as the first step in the design and commissioning processes.

5.1.2.2 Design Review: in which the schematic design, design development, and construction document submittals are reviewed to identify commissioning issues before they become difficult to resolve. The commissioning design review focuses on constructability of the design, compliance of the design with the owner's documented criteria for systems' acceptance, and specification of the commissioning process and acceptance criteria in the Construction Documents. Verification of Completion forms for the systems to be commissioned are developed.

5.1.2.3 Contractors' Submittal Review: in which the contractors' submittals are reviewed by the Commissioning Authority (CA) with the primary focus on obtaining the background necessary for developing comprehensive and fair functional test procedures. It also allows the CA to identify performance related installation issues before construction progress makes them more difficult and expensive to resolve.

5.1.2.4 Construction Review: in which the CA monitors the systems installation to identify commissioning related installation issues before construction progress makes them more difficult and expensive to resolve. These reviews also enable the CA to obtain the background necessary for conducting comprehensive and fair functional test procedures.

5.1.2.5 Develop Functional Test Procedures: The functional testing program objectively verifies that the building systems perform interactively in accordance with the Project Documents. Written repeatable test procedures, prepared specifically for each project, are

developed during this phase. These tests are designed to functionally test components and systems (specified for testing) in all modes of operating conditions. These tests are documented to clearly describe the individual systematic test procedures, the expected systems response or acceptance criteria for each procedure, the actual response or findings, and any pertinent discussion. It is assumed that individuals who conduct these tests will have a working knowledge of the type of system being tested. Project specific knowledge, however, should not be required in order to follow the functional test procedures.

5.1.2.6 Contractor's Checkout, Startup and Verification of Completion: in which the Contractors thoroughly performs final checkout and startup procedures to verify that the systems have been put into operation in compliance with the Project Documents and are operating in accordance with the functional test procedures. For some equipment the Project Specifications may include factory testing or startup by certified technicians. The Contractor documents this phase of the commissioning process with startup and certification reports as specific for equipment, and Verification of Systems Completion forms that are developed by the CA during design phase.

5.1.2.7 Conduct Functional Testing Process: in which the functional test procedures are performed, and performance issues identified and resolved. Code required functional testing that is required for some systems by government officials and authorized agencies is considered a part of the commissioning process, and these efforts need not be duplicated by the CA.

5.1.2.8 Substantial completion, the Final Commissioning Report and Systems Acceptance: Substantial completion and Systems acceptance are awarded by the owner based on the following:

Substantial completion may not be awarded until after the Functional Testing Phase (not including any deferred seasonal functional testing) has been completed and all systems comply with the Functional Test Procedures or otherwise meet with the owners approval.

Final Report: in which the CA provides the owner with a commissioning report that includes:

- An evaluation of the operating condition of the systems at the time of functional test completion,
- Deficiencies that were discovered and the measures taken to correct them,
- Uncorrected operational deficiencies that were accepted by the owner,
- Functional test procedures and results,

- A copy of the final balancing report,
- Reports that document all commissioning field activities as they progress, and
- A description and estimated schedule of required deferred testing.

Acceptance The Owner awards Acceptance based on approving the Final Commissioning Report.

5.1.3 Commissioning Plan. The Commissioning Plan is the management plan for the Commissioning Process. As such, it is included in the Project Specifications and, at a minimum, it includes the following information:

- Identifies the system to be commissioned,
- Defines the Commissioning Team, the roles of the team members, and the protocol for Commissioning Team communication,
- Describes the protocol for the commissioning reviews of design submittals, contractor submittals and construction progress,
- Specifies the procedure and format for documenting commissioning activities and resolving commissioning issues,
- Specifies the Functional Testing process including: preparation of the systems for testing, the Contractors' Notification of Systems Completion (and readiness for testing), conducting the tests, documenting the results, and resolving issues, and
- Estimates the schedule of commissioning activities relative to other construction activities.

5.1.4 Commissioning Team. Effective building commissioning requires a team effort. The commissioning team must include the project manager, agency, designers, contractors, and building operators, with the commissioning agent as the team leader. The fundamental team member roles vary little from project to project, but the level of effort for specific team members may differ with each project depending on the size of the facility and the nature of the project. This kind of flexibility is essential in order to serve the requirements of individual projects; for example, smaller projects may have overlapping or interchangeable roles for the team members. Commissioning team member responsibilities are outlined for each project phase in SECTION 5.2, RESPONSIBILITIES; however, the fundamental role of each member is as follows:

5.1.4.1 Project Manager (PM): the Division of Public Works (DPW) is the contracting authority for design and construction of public works projects for State owned facilities for numerous State agencies. DPW assigns a PM to manage projects. As the owner's representative, the PM is the primary owner's advocate and spokesperson through which all commissioning communication is channeled to and from the owner.

5.1.4.2 Agency Representative: the agency is the user of the building. The agency defines the functional and operational use of the facility, setting the operating requirements, such as the occupancy schedules, ventilation requirements for the various areas of the facility, and control and lighting requirements for the facility. The Agency Representative is the primary agency advocate and spokesperson through which all commissioning communication is channeled to and from the Agency. The commissioning authority and the flow of commissioning communication relative to the PM and the Agency Representative will be established individually for each project.

5.1.4.3 Architect/Engineer (A/E) Team: typically, the A/E Team is the owner's primary design and construction consultant. They provide the systems' design, including the plans, specifications and the documented design intent for all systems and controls, in accordance with the documented Owner's Acceptance Criteria. They also monitor construction activities and review all shop drawings, mock-ups of operation and maintenance manuals, as-built drawings and documentation for compliance with the construction documents. The A/E Team participates in all phases of the commissioning process as the authority on design intent. Each sub-consultant that participates in the design of systems within the commissioning scope (i.e. the mechanical and electrical engineers) provides a commissioning representative for this purpose.

5.1.4.4 Building Contractors: provide completed systems that are constructed and operate in accordance with the construction documents. They also assist with the development and execution of the functional performance test procedures. Each subcontractor that participates in the construction of systems within the commissioning scope (i.e. the mechanical and electrical subcontractors) provides a commissioning representative for this purpose. The General Contractor also coordinates the construction schedule with the commissioning schedule, and helps facilitate the commissioning process to keep the project proceeding smoothly.

5.1.4.5 Building Operators: participate in developing the Owner's Acceptance Criteria, participate in reviewing the design for conformance with these criteria, and attend and evaluate the contractor and manufacturer training. They may also participate in functional performance testing. The building operators participate in the commissioning process through the Agency Representative.

5.1.4.6 Commissioning Authority (CA): is in charge of the commissioning process and makes the final recommendations to the owner regarding functional performance of the commissioned building systems. The CA conducts all State of Idaho commissioning projects in accordance with ATTACHMENT 5, THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS. According to these, the CA is an advocate for the performance and maintainability of building systems, in accordance with the owner's

requirements. This requires commissioning to be conducted independently from interests other than performance and maintainability criteria. The CA's contract may be held directly with the owner, or through the project Architect. In either case the CA's contract shall be written in accordance with Element Number 2 of THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS, and such that the CA shall answer to and communicate directly with the Owner.

5.1.5 Systems Concept and Operation Manual. This document differs distinctly from the Operation and Maintenance Manual. It documents the building systems' acceptance criteria and design concepts, and narratively describes how they are intended to operate and interact. The systems within the commissioning scope are designed, specified, and accepted based on this document. Its development must, therefore, begin as the initial stage of design. This pre-design document will include fundamental criteria and concepts that will be further developed and revised as the project progresses. It is critical that the full intent of the fully developed document be clearly incorporated into the Construction Documents.

The Systems Concept and Operation Manual is developed under the CA's direction, with input from the Owner/Agency (including the building operators) and the A/E team. The CA develops table of contents and format for the document, which is reviewed by the Owner/Agency and the A/E team. The A/E is then responsible for developing the contents of the initial (Concept Design) document and updating it for the Schematic Design, Design Development, and Construction Documents review submittals. The Owner and CA review the initial document and each of the subsequent submittals. During the construction, acceptance, and post-acceptance phases of the project, the CA will update the document for owner/agency and A/E review.

At a minimum, the contents of the Systems Concept and Operation Manual shall comply with ATTACHMENT 1, SYSTEMS CONCEPT AND OPERATION MANUAL; MINIMUM CONTENTS

5.1.6 Operation and Maintenance Manual. In this manual the contractor provides the narrative descriptions and technical data required for the long term operation and maintenance of systems and their components. It covers capacity, maintenance, operation, start up, shut down and trouble shooting. At a minimum, it shall be specified by the A/E and provided by the contractor in accordance with ATTACHMENT 2, OPERATION AND MAINTENANCE MANUAL OUTLINE.

5.2 RESPONSIBILITIES

The fundamental roles of the commissioning team members are defined in Section 5.1.4. This section outlines the primary commissioning responsibilities corresponding to those roles; however, these are only guidelines and all parties are expected to perform as required to fulfil their fundamental role.

5.2.1 COMMISSIONING AUTHORITY

5.2.1.1 COMMISSIONING REVIEWS: The purpose of a CA review of any phase of the project is to facilitate the commissioning process. The CA is not

responsible for design concept, design criteria, compliance with codes, design or construction scheduling, cost estimating, or construction management. If any action by the CA causes a conflict between parties of the commissioning effort, the CA must be a participant in the conflict resolution.

5.2.1.2 PRE-DESIGN PHASE: The building commissioning process helps establish and document the performance and maintainability criteria for systems design and acceptance. This must be done as the first step in the design process (the concept or pre-design phase). During this phase the CA's responsibilities include:

5.2.1.2.1 Manage the development of the Owner/Agency performance and maintainability criteria. The CA leads a workshop with the Owner, Agency, Building Operators and A/E Team to establish these criteria. (Refer to Section 5.1.2.1)

5.2.1.2.2 Manage development of the Systems Concept and Operation Manual. The CA provides the A/E Team with the format and Table of Contents for this document. The CA and the Owner/Agency review the initial draft of the document after it has been prepared by the A/E. (Refer to Section 5.1.5 and ATTACHMENT 1)

5.2.1.2.3 Begin Developing the Commissioning Plan. At a minimum, the pre-design draft of the Commissioning plan should identify the roles and communication protocol for the Commissioning Team. (Refer to Section 5.1.3)

5.2.1.3 DESIGN PHASE: The CA should be included in the project from the onset of design. During this phase the CA's primary responsibilities include:

5.2.1.3.1 Develop Commissioning Plan. The Commissioning Plan is fully developed during the design phase.

5.2.1.3.2 Conduct commissioning review of design submittals. (Refer to Section 5.1.2.2) The commissioning design review focuses on constructability of the design, compliance of the design with the owner's documented criteria for systems' acceptance, and specification of the commissioning process and acceptance criteria in the Construction Documents. The CA reviews the schematic design, design development, and construction document submittals, and provides written review comments to the Owner/Agency and the A/E.

5.2.1.3.3 Review the development of the Systems Concept and Operation Manual. As a part of the schematic design, design development, and Construction Documents commissioning reviews, the CA reviews the updated Systems Concept and Operation Manual. By the end of design phase the manual should be fully developed by the A/E.

5.2.1.3.4 Develop the commissioning specifications and coordinate with A/E Team to incorporate them into the appropriate sections of the Project Specifications.

5.2.1.3.5 Develop Contractors Verification of Completion forms. (Refers to section 5.1.2.6)

5.2.1.4 CONSTRUCTION PHASE:

5.2.1.4.1 Commissioning review of Contractor's submittals. Conducted concurrently with A/E review. (Refer to Section 5.1.2.3)

5.2.1.4.2 Commissioning construction review. (Refer to Section 5.1.2.4)

5.2.1.4.3 Develop Functional Test Procedures. (Refer to Section 5.1.2.5)

5.2.1.4.4 Schedule commissioning field activities. Work with the General contractor or construction manager to coordinate the commissioning schedule with the construction schedule.

5.2.1.4.5 Witness startup of specified systems.

5.2.1.4.6 Manage or review HVAC Test and Balance (as required by the CA scope of work).

5.2.1.4.7 Update Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project.

5.2.1.5 ACCEPTANCE PHASE:

5.2.1.5.1 Schedule Functional Testing. At least 30 days prior to functional testing the CA and the Contractor are to coordinate the functional testing schedule with the construction schedule.

5.2.1.5.2 Review startup/certification reports of specified systems and the Contractors Verification of Systems Completion forms. (Refer to Section 5.1.2.6)

5.2.1.5.3 Manage or review HVAC Test and Balance (as required by the CA scope of work).

5.2.1.5.4 Conduct Functional Test Procedures. (Refer to Section 5.1.2.7) After the contractor has submitted ATTACHMENT 4, COMMISSIONING CERTIFICATE OF COMPLETION, the CA will conduct functional testing efforts with the assistance of the Contractor, participate in the resolution of commissioning issues, and make recommendations to the owner regarding acceptance of the commissioned systems. The CA is responsible for testing systems a second time if they do not comply with their Functional Test Procedure on the first try. The CA shall coordinate with the A/E to specify in the Project Documents that; CA will receive additional fees for labor and expenses if additional functional testing is required.

5.2.1.5.5 Update Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project.

5.2.1.5.6 Review the Operation and Maintenance Manuals. (Refer to Section 5.1.6 and ATTACHMENT 2)

5.2.1.5.7 Review owner training. (Refer to Section 6.0)

5.2.1.5.8 Prepare and submit preliminary commissioning report. (Refer to Section 5.1.2.8 and ATTACHMENT 5)

5.2.1.5.9 Schedule post-acceptance commissioning activities.

5.2.1.6 POST-ACCEPTANCE PHASE:

5.2.1.6.1 Perform seasonal testing (as required by the Commissioning Scope of Work)**.**

5.2.1.6.2 Prior to expiration of the construction contract warranty, assist the owner in assessing systems' performance and addressing related issues.

5.2.1.6.3 Respond to operator questions during the warranty period.

5.2.1.6.4 Prepare and submit the final commissioning report.

5.2.1.6.5 Update Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project.

5.2.2 ARCHITECT/ENGINEER

5.2.2.1 GENERAL RESPONSIBILITIES (during all project phases): The A/E will work cooperatively with the CA and the Owner and client Agency to provide a properly commissioned project. The traditional and contractual duties of the A/E are not altered by these guidelines, however, and no part of these guidelines shall relieve the A/E of any responsibility assigned under the A/E contract agreement. If a conflict arises between this document and the A/E agreement, the A/E agreement takes precedence unless the Owner provides some other direction.

The A/E is responsible for providing a complete and working design, construction documents, compliance with codes, permits, scheduling, cost estimating, review of the contractor's shop drawings and submittals, construction observation and preparation or review of as-built drawings as described in the A/E agreement. The A/E team will also be responsible for incorporating commissioning specifications into the construction documents.

5.2.2.2 PRE-DESIGN PHASE: The building commissioning process helps establish and document the performance and maintainability criteria for

systems design and acceptance. This must be done as the first step in the design process (the concept or pre-design phase). During this phase the CA's responsibilities include:

5.2.2.2.1 Assist in the development of the Owner/Agency performance and maintainability criteria. The CA leads a workshop with the Owner, Agency, Building Operators and A/E Team to establish these criteria. (Refer to Section 5.1.2.1)

5.2.2.2.2 Develop the initial draft of the Systems Concept and Operation Manual. The CA provides the A/E Team with the format and Table of Contents for this document. The A/E prepares the initial draft of the Manual in accordance with Section 5.1.5 and ATTACHMENT 1, for review by the CA and the Owner/Agency.

5.2.2.2.3 Review the initial draft of the Commissioning Plan.

5.2.2.3 DESIGN PHASE:

5.2.2.3.1 Review the fully developed Commissioning Plan. (Refer to Section 5.1.3)

5.2.2.3.2 Review Verification of Completion forms .

5.2.2.3.3 Fully develop the Systems Concept and Operation Manual. As a part of the schematic design, design development, and Construction Documents commissioning review submittals, A/E submits an updated Systems Concept and Operation Manual for CA and Owner/Agency review. By the end of design phase the manual should be fully developed by the A/E.

5.2.2.3.4 Respond to commissioning design submittal reviews. (Refer to Section 5.1.2.2) The CA reviews the schematic, design development, and construction documents submittals. (The commissioning review focuses on constructability, compliance with the Owner's acceptance criteria, and specification of the commissioning process.) The Owner/Agency and the A/E respond to the commissioning review with written descriptions of how the CA's review comments will be addressed.

5.2.2.3.5 Coordinate with CA to incorporate commissioning components of the project specifications.

5.2.2.4 CONSTRUCTION PHASE:

5.2.2.4.1 Participate in resolving issues that may be identified in the commissioning review of Contractor's submittals. Conducted concurrently with A/E review. (Refer to Section 5.1.2.3)

5.2.2.4.2 Participate in resolving issues that may be identified in the commissioning construction review. (Refer to Section 5.1.2.4)

5.2.2.4.3 Review the Functional Test Procedures for conformance with the design intent**.** (Refer to Section 5.1.2.5)

5.2.2.4.4 Provide Design Team input on issues that may be identified during systems startup.

5.2.2.4.5 Provide Design Team input on HVAC Test and Balance issues.

5.2.2.4.6 Review updated Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project. Changes will be reviewed by the Owner/Agency and the A/E.

5.2.2.5 ACCEPTANCE PHASE:

5.2.2.5.1 Provide Design Team input on issues that may be identified during systems startup and certification.

5.2.2.5.2 Provide Design Team input on issues that may be identified during HVAC Test and Balance.

5.2.2.5.3 Provide Design Team input on issues that may be identified during Functional Test Procedures. (Refer to Section 5.1.2.7).

5.2.2.5.4 Review updated Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project. Changes will be reviewed by the Owner/Agency and the A/E.

5.2.2.6 POST-ACCEPTANCE PHASE:

5.2.2.6.1 Respond to operator questions during the warranty period.

5.2.2.6.2 Provide Design Team input on commissioning issues that may be identified.

5.2.2.6.3 Review updated Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project. Changes will be reviewed by the Owner/Agency and the A/E.

5.2.3 OWNER (/AGENCY/OPERATORS)

5.2.3.1 PRE-DESIGN PHASE: The building commissioning process helps establish and document the performance and maintainability criteria for systems design and acceptance. This must be done as the first step in the design process (the concept or pre-design phase). During this phase the CA's responsibilities include:

5.2.3.1.1 Assist in the development of the Owner/Agency performance and maintainability criteria. The CA leads a workshop with the Owner, Agency, Building Operators and A/E Team to establish these criteria. (Refer to Section 5.1.2.1)

5.2.3.1.2 Review the initial draft of the Systems Concept and Operation Manual. The CA provides the A/E Team with the format and Table of Contents for this document. The A/E prepares the initial draft of the Manual in accordance with Section 5.1.5 and ATTACHMENT 1, for review by the CA and the Owner/Agency.

5.2.3.1.3 Review the initial draft of the Commissioning Plan.

5.2.3.2 DESIGN PHASE:

5.2.3.2.1 Authorize work performed by the A/E and CA.

5.2.3.2.2 Review the Commissioning Plan. (Refer to Section 5.1.3)

5.2.3.2.3 Review Verification of Completion forms.

5.2.3.2.4 Review the development of the Systems Concept and Operation Manual. As a part of the schematic design, design development, and Construction Documents commissioning reviews, the Owner/Agency reviews the updated Systems Concept and Operation Manual. By the end of design phase the manual should be fully developed by the A/E.

5.2.3.2.5 Respond to commissioning design submittal reviews. (Refer to Section 5.1.2.2) The CA reviews the schematic, design development, and construction documents submittals. (The commissioning review focuses on constructability, compliance with the Owner's s acceptance criteria, and specification of the commissioning process.) The Owner/Agency and the A/E respond to the commissioning review with written descriptions of how the CA's review comments will be addressed.

5.2.3.2.6 Provide input into the incorporation of commissioning components into the project specifications.

5.2.3.3 CONSTRUCTION PHASE:

5.2.3.3.1 Participate in resolving issues that may be identified in the commissioning review of Contractor's submittals. Conducted concurrently with A/E review. (Refer to Section 5.1.2.3)

5.2.3.3.2 Participate in resolving issues that may be identified in the commissioning construction review. (Refer to Section 5.1.2.4)

5.2.3.3.3 Review the Functional Test Procedures for conformance with the owner's performance and maintainability criteria**.** (Refer to Section 5.1.2.5)

5.2.3.3.4Provide owner input for the resolution of issues that may be identified during systems startup.

5.2.3.3.5 Provide owner input for the resolution of HVAC Test and Balance issues.

5.2.3.3.6 Review updated Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project. Changes will be reviewed by the Owner/Agency and the A/E.

5.2.3.4 ACCEPTANCE PHASE:

5.2.3.4.1 Provide owner input for the resolution of issues that may be identified during systems startup and certification.

5.2.3.4.2 Provide owner input for the resolution of issues that may be identified during HVAC Test and Balance.

5.2.3.4.3 Provide owner input for the resolution of issues that may be identified during Functional Test Procedures. (Refer to Section 5.1.2.7).

5.2.3.4.4 Review updated Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project. Changes will be reviewed by the Owner/Agency and the A/E.

5.2.3.4.5 Make final decisions regarding results of commissioning activities.

5.2.3.4.6 Designate the lead facility maintenance contact and arrange for facility maintenance personnel to attend field commissioning and training sessions.

5.2.3.4.7 During this period, the Owner and building operators should not make any system adjustments, alterations or repairs without first contacting the CA. Adjustment of room thermostats may be made at building occupant's discretion. In the event that adjustments, alterations or repairs are necessary the CA should be notified, and the PM should be contacted as soon as possible to have the Contractor carry out a permanent repair. Emergency repairs and

adjustments may be made to prevent damage to system or building components without first contacting the CA if followed up in writing to the CA, A/E, PM, and Contractor. Emergency procedures would include items such as repairing leaks, adjusting controls to prevent building freeze-up or other similar adjustments to prevent the building from becoming uninhabitable or unsafe.

5.2.3.5 POST-ACCEPTANCE PHASE:

5.2.3.5.1 Prior to expiration of the construction contract warranty, work with the CA to assess systems' performance and address related issues.

5.2.3.5.2 Provide owner input for the resolution of commissioning issues that may be identified.

5.2.3.5.3 Standard maintenance procedures are the responsibility of the building Owner's client Agency during this period.

5.2.3.5.4 Review updated Commissioning Plan and Systems Concept and Operation Manual as required. It is the CA's responsibility to update these documents to reflect changes made during the construction, acceptance, and post-acceptance phases of the project. Changes will be reviewed by the Owner/Agency and the A/E.

5.2.4 CONTRACTOR

No part of these instructions shall relieve the Contractor of any responsibility assigned under the construction contract. The contractual duties of the Contractor are not altered by this document, and if a conflict arises between this document and the contract, the contract takes precedence.

5.2.4.1 CONSTRUCTION PHASE:

5.2.4.1.1 Schedule commissioning field activities. Work with the CA to coordinate the commissioning schedule with the construction schedule. This includes all construction activities that are included in the Commissioning Scope of Work, such as witnessing systems startup, reviewing startup reports, or scheduling or reviewing HVAC Test and Balance.

5.2.4.1.2 Participate in resolving issues that may be identified in the commissioning review of Contractor's submittals. Conducted concurrently with A/E review. (Refer to Section 5.1.2.3)

5.2.4.1.3 Participate in resolving issues that may be identified in the commissioning construction review. (Refer to Section 5.1.2.4)

5.2.4.1.4 Review the Functional Test Procedures for conformance with the construction documents and any proprietary or manufacturer specific operating characteristics**.** The General Contractor is responsible for managing the participation of the subcontractors and

their equipment suppliers. The specifications must require the contractor to provide written review comments to all Functional Test Procedures from each of the contractors and equipment suppliers to whom they pertain. (Refer to Section 5.1.2.5 and ATTACHMENT 4)

5.2.4.1.5 Work with the rest of the Commissioning Team for the resolution of issues that may be identified during systems startup.

5.2.4.1.6 Work with the rest of the Commissioning Team for the resolution of HVAC Test and Balance issues.

5.2.4.1.7 Review the Commissioning Plan and Systems Concept and Operation Manual for conformance with the Construction Documents. The specifications must require the contractor to provide written review comments for these documents from each of the contractors and equipment suppliers to whom they pertain.

5.2.4.1.8 Complete systems checkout and startup in accordance with the Contract Documents and the Functional Test Procedures and submit start-up and certification reports and Verification of Completion forms.

5.2.4.2 ACCEPTANCE PHASE:

5.2.4.2.1 Schedule Functional Testing. At least 30 days prior to functional testing the CA and the Contractor are to coordinate the functional testing schedule with the construction schedule.

5.2.4.2.2 Work with the rest of the Commissioning Team for the resolution of issues that may be identified during systems startup and certification.

5.2.4.2.3 Work with the rest of the Commissioning Team for the resolution of issues that may be identified during HVAC Test and Balance.

5.2.4.2.4 Participate in performing Functional Test Procedures. (Refer to Section 5.1.2.7) After the contractor has submitted ATTACHMENT 4 (COMMISSIONING CERTIFICATE OF COMPLETION) a representative of the subcontractor for each applicable trade will participate in functional testing and the resolution of related issues (as specified in the contract documents), under the direction of the CA. The CA is responsible for testing systems a second time if they do not comply with their Functional Test Procedure on the first try. If a system must be tested three or more times because the Contractors' work has not been completed in accordance with the project documents, the Contractor will reimburse the Owner for related CA labor and expenses. The project specifications must clearly communicate the extent of Contractors' participation in the performing the functional test procedures (i.e. whether CA witnesses the functional tests which are conducted by the Contractor, or the CA conducts the tests with full time assistance from

the Contractor, or the CA conducts the tests without occasionally consulting with the Contractor). Also, the specifications should include sample functional test procedures, copies of ATTACHMENT 4 and all other commissioning forms, estimates of the amount of trend logging support required, and if available, the acceptance criteria for each system.

5.2.4.2.5 Review updated Commissioning Plan and Systems Concept and Operation Manual as required.

5.2.4.2.6 Provide the Operation and Maintenance Manuals in time for owner training**.** (Refer to Section 5.1.6 and ATTACHMENT 2)

5.2.4.2.7 Provide owner training. Coordinate training for CA review. (Refer to Section 6.0)

5.2.4.2.8 Facilitate transition to Owner operation. During this period, the Contractor will identify Owner's responsibilities required to maintain the warranty of equipment and systems, explicitly listing time schedules and procedures for any routine maintenance. The Contractor will coordinate with subcontractors and manufacturers to determine specific requirements to maintain the equipment and systems.

5.2.4.3 POST-ACCEPTANCE PHASE:

5.2.4.3.1 Work with the rest of the Commissioning Team to resolve performance issues prior to expiration of the construction contract warranty.

5.2.4.3.2 Assist with seasonal testing (as required by the Commissioning Scope of Work)**.**

5.2.4.3.3 Respond to operator questions during the warranty period.

5.2.5 PROJECT MANAGER

- The PM manages the A/E agreement, the construction contract, and the commissioning services, and is responsible for facilitating cooperation and coordination of the Commissioning Team during all phases of the Commissioning Process.
- The PM is the Owner's primary commissioning contact and coordinator.
- It is the responsibility of the PM to communicate to the A/E Team and the Contractors the importance that the Owner places on building commissioning, and the authority that the state has given the CA.
- The PM, with the assistance of the CA, is the main facilitator of all commissioning related issues.

6.0 TRAINING

The Training will be coordinated and supervised by the CA. During the design phase the Commissioning Team shall determine which systems require selected contractor/manufacturer/supplier training sessions and which sessions, if any, should be video taped; these will be so specified in the construction documents. The contractor and specified manufacturers' representatives or suppliers shall be responsible for conducting selected training sessions, providing handout information at these training sessions, and video taping sessions as specified.

- The CA will work with the agency representative and contractor to develop and publish a training schedule.
- The CA will present an overview of the systems design including the design criteria, special features and limitations, and the manner in which the systems interact with one another.
- Training shall be a separate session and not occur during normal equipment start-up and check out by contractor/manufacturers' representatives/suppliers.
- Training will not occur until the Operation and Maintenance Manuals have been approved, accepted, and distributed by the State.
- Training sessions (as a minimum) shall cover the following:
    - Explain any special features or intricacies of system operation.
    - Identify safety features, hazards to be aware of, and precautions to be observed to avoid damage to equipment.
    - Describe any necessary seasonal adjustments.
    - Generally discuss service frequency for devices such as bearings, belt drives, filters, strainers, etc. This information should be clearly stated in the O&M Manuals for reference.

7.0 CERTIFICATION

For each system within the commissioning scope a COMMISSIONING CERTIFICATE OF COMPLETION (ATTACHMENT 4) will be completed and signed by each trade listed, indicating that all commissioning work has been completed and that all systems are installed according to the contract documents, the manufacturer's installation instructions, and the requirements of the functional test procedures. The Contractors further certify that all adjustment, lubrication, alignment and startup procedures have been carried out.

ATTACHMENT 1
SYSTEMS CONCEPT AND OPERATION MANUAL; MINIMUM CONTENTS
12/20/99

Contained in the Systems Concept and Operation Manual is the Owner/Agency's criteria for systems' performance and maintainability, the basis for design, the design intent, and the sequences of operation under all anticipated operating conditions. At a minimum this shall include, for each system within the commissioning scope, the Owner/Agency's acceptance criteria, the basis of design, and the design intent for each of the following:

A1.1 Applicable design standards such as ASHRAE publications, special code requirements, etc.

A1.2 Design Conditions

A1.2.1 Outdoor Winter dry-bulb temperature and frequency level from ASHRAE design table.

A1.2.2 Outdoor Summer dry-bulb, wet-bulb, and frequency levels from ASHRAE design table.

A1.2.3 Indoor relative humidity and thermostat setpoints.

A1.3 Building Programming for each temperature control zone and HVAC System.

A1.3.1 Number of occupants & cooling-load per occupant

A1.3.2 Function/usage of the area served

A1.3.3 Interior equipment and lighting cooling-loads

A1.3.4 Ventilation heating and cooling loads

A1.3.5 Occupancy schedules

A1.3.6 Noise criteria

A1.3.7 Narrative description of temperature control zoning rationale

A1.3.8 Thermal transmittance of building envelope

A1.4 Indoor Air Quality Design Criteria

A1.4.1 Minimum outside airflow rates CFM (cubic feet / minute) of outside air /person

A1.4.2 Minimum total supply airflow rates (CFM/square foot or air changes /hour)

A1.4.3 Design approach and control logic for maintaining ventilation airflow rates to the occupied space.

A1.4.4 Special requirements for construction materials and methods.

A1.5 Mechanical and Electrical (and other applicable) Equipment selection criteria

A1.5.1 Capacity required for this project

A1.5.2 Additional capacity for future use

A1.5.3 Safety factors

A1.5.4 Noise criteria

A1.5.5 Operation and maintenance considerations

A1.6 Operation and Maintenance Criteria (for mechanical, electrical, other applicable systems.)

A1.6.1 Service clearances

A1.6.2 Access panel sizes locations

A1.6.3 Service valve requirements (isolation and drain down)

A1.6.4 Standardized manufacturers and models

A1.6.5 Requirements for control system/operator interface graphics

A1.6.6 Requirements for control documentation

A1.6.7 Maintenance oriented control strategies

A1.6.8 Training requirements

A1.7 A description of special energy conservation measures, requirements, and control sequences.

A1.8 Special power systems considerations (such as emergency power or power quality requirements)

A1.9 Fire and life safety system considerations.

A1.10 Other applicable system considerations (i.e. elevators, lab systems, cold storage, building envelope, etc).

A1.11 A narrative for each system describing the main operating concepts, and the interaction with the other building systems.

A1.12 Detailed Sequences of Operation for all systems in all seasons, in occupied and unoccupied modes.

ATTACHMENT 2
OPERATION AND MAINTENANCE MANUAL OUTLINE
12/20/99

All information in this manual must be specific for the items provided. Cut sheets, instructions, etc. must highlight the specific items and options provided and delete or cross out those items and options that do not pertain.

A2.1 System Division. The system division of the manual will be organized into sections by system. For example, each major fan system will be completely documented in its own section. For each section include the following sub-sections as appropriate:

A2.1.1 Descriptive Information

A2.1.1.1 Function or service and area served
A2.1.1.2 Narrative description of the system type and configuration
A2.1.1.3 Schematic diagram
A2.1.1.4 Control diagram
A2.1.1.5 Specified and rated system capacity
A2.1.1.6 Performance characteristics and data
A2.1.1.7 Principal components list describing each major component and its function, and referencing them by their specifications location and equipment schedule designation from the project documents

A2.1.2 Operating Instructions

A2.1.2.1 Starting and stopping procedures
A2.1.2.2 Adjustment and regulation
A2.1.2.3 Seasonal changeover
A2.1.2.4 Seasonal start-up
A2.1.2.5 Seasonal shutdown
A2.1.2.6 Logs and records
A2.1.2.7 Part load performance

A2.1.3 Control System

A2.1.3.1 Panel layout sheet
A2.1.3.2 Point checkout sheets
A2.1.3.3 As-built control diagrams and sequences of operation
A2.1.3.4 Programming logic diagrams and flow charts, which clearly describe using English Language the logic used to implement each sequence of operation
A2.1.3.5 Programming code with English Language comment statements indicating the beginning and end of each sequence of operation and each control function within the sequences of operation
A2.1.3.6 As-built ladder diagrams with hardware interlocks
A2.1.3.7 Reduced floor plans showing sensor, terminal and panel locations

A2.1.4 Inspection and Maintenance

Inspection schedule and checklist including each component

A2.2 Reference documents. Include the following:

A2.2.1 Construction drawings list
A2.2.2 Construction specifications
A2.2.3 As-built record drawings
A2.2.4 Copies of certificates and test reports, for example: Plumbing sanitization, hydraulic system water analysis, steam boiler water analysis, electric inspection, fire marshal inspection, elevator inspection, piping system pressure tests.
A2.2.5 Manufacturers' startup reports indexed by specifications location and equipment schedule designation (from the project documents).
A2.2.6 List of A/E, sub-consultants, contractors, and sub-contractors with addresses and telephone numbers.

A2.3 Equipment Division. The equipment division is composed of manufacturers' and fabricators' data on equipment and materials. It is to be organized into sections by type of equipment, referencing the specification section. Within each section organize sub-sections for each specific item of equipment, referencing its equipment schedule designation from the project documents. One section is to be dedicated to the controls system.

Each section includes the following information for each equipment item as appropriate:

A2.3.1 Descriptive Literature
A2.3.1.1 Supplier, including address and phone number
A2.3.1.2 Catalog cuts
A2.3.1.3 Shop drawings (including dimensions)
A2.3.1.4 Materials of construction
A2.3.1.5 Parts designations

A2.3.2 Operating Characteristics
A2.3.2.1 Performance tables and charts
A2.3.2.2 Performance curves
A2.3.2.3 Pressure, temperature, and speed limitations
A2.3.2.4 Safety devices
A2.3.2.5 Normal and abnormal operating temperatures, pressures, and speed limits

A2.3.3 Operating Instructions
A2.3.3.1 Pre-start checklist
A2.3.3.2 Start-up procedures
A2.3.3.3 Inspection during operation
A2.3.3.4 Adjustment and regulation
A2.3.3.5 Testing
A2.3.3.6 Detection of malfunction
A2.3.3.7 Precautions
A2.3.3.8 Software programming manuals

A2.3.4 Maintenance Instructions and Procedures
A2.3.4.1 Schedule of routine and preventive maintenance

A2.3.4.2 Description of routine and preventive maintenance procedures including procedures for lubrication, replacements, adjustment, calibration, cleaning, painting, protection, and testing
A2.3.4.3 Troubleshooting procedures
A2.3.4.4 Overhaul specifications for major equipment

A2.3.5 Parts List

A2.3.5.1 Complete parts list
A2.3.5.2 Essential spare parts inventory
A2.3.5.3 Distributor directory

A2.3.6 Service and Dealer Directory

A2.3.7 Warranties

A2.3.8 Service Contracts

ATTACHMENT 3
SYSTEMS TO BE COMMISSIONED
FIELD TESTS TO BE WITNESSED BY THE CA
TEST REPORTS TO BE REVIEWED BY THE CA
12/20/99

A3.1 Systems to be commissioned. The following list includes examples of systems that may be fully commissioned in accordance with the State of Idaho Commissioning Guidelines. (**The systems to be commissioned will be specified for each project on an individual basis by editing this list.**):

HVAC Systems

- Automated energy management and temperature controls, including sensors and instrumentation (gauges, thermometers, etc.)
- Air handlers
- Packaged units (AC and HP)
- Terminal units (air)
- Unit heaters
- Heat exchangers
- Computer room units
- Fume hoods
- Lab pressures
- Specialty fans
- Variable frequency drives
- Indoor air quality
- Equipment sound control
- Equipment vibration control
- Egress pressurization
- Fire and smoke dampers
- Pumps
- Boilers
- Chillers

- Cooling towers
- Hydronic and steam distribution systems

Electrical System

- Lighting controls (sweep or scheduled, daylighting dimming, lighting occupancy sensors)
- Motor starters and controls
- Elevators, escalators, automatic doors, dock levelers, etc.
- Emergency power systems
- UPS system
- Power quality
- Communication systems (voice and data systems are usually purchased separately)
- Security systems
- Fire and smoke alarms
- Fire protection system

Other

- Drainage systems
- Water wells
- Refrigeration systems
- Water treatment
- Plumbing systems
- Service water heaters
- Service water booster pumps
- Lab gas systems
- Medical gas systems
- Building Envelope
- Other (**To be edited)**

A3.2 Field Tests To Be Witnessed By The CA

The following list includes examples of field tests conducted by others that may be witnessed be the CA. These field test reports will be included in the Commissioning Report. (**The exact scope of building commissioning will be specified for each project on an individual basis.**):

- Medical gas certification
- HVAC system Test and Balance
- Piping pressure tests (domestic water, HVAC, medical gas)
- HVAC duct system smoke test
- Domestic water system sanitization
- HVAC piping flush-out
- HVAC Equipment manufacturer's startup
- Emergency power system manufacturer's startup
- Fire alarm system manufacturer's certification
- Pure water systems
- Pool filter and chlorinating systems
- Other (**To be edited)**

A3.3 Field Reports To Be Reviewed By The CA

The following list includes examples of field test reports that may be reviewed by the CA. These field test reports will be included in the Commissioning Report. (**The exact scope of building commissioning will be specified for each project on an individual basis.**):

- Medical gas certification
- HVAC system Test and Balance
- Piping pressure tests (domestic water, HVAC, medical gas)
- HVAC duct system smoke test
- Domestic water system sanitization
- HVAC piping flush-out
- HVAC Equipment manufacturer's startup
- Emergency power system manufacturer's startup
- Fire alarm system manufacturer's certification
- Pure water systems
- Pool filter and chlorinating system
- Other (**To be edited)**

ATTACHMENT 4
Commissioning Certificate of Completion Page 1 of 2)
12/20/99
Project No./Date:
Project Title:
Building/Address:
System:

The installation of this system and all of its components is complete. The system and all of its components has been provided in compliance with the project documents and the functional test procedures, and all adjustment, lubrication, alignment and startup procedures have been carried out in accordance with the project documents and the equipment manufacturers recommendations and guidelines. System operation has been tested to the extent necessary to verify that it functions in compliance with the project documents and the functional test procedures.

General Contractor firm name, signature, title, date:

Mechanical firm name, signature, title, date:

Electrical firm name, signature, title, date:

Plumbing firm name, signature, title, date:

Sheet Metal firm name, signature, title, date:

Balancing firm name, signature, title, date:

Controls firm name, signature, title, date:

Fire Protection firm name, signature, title, date:

Elevator firm name, signature, title, date:

Other firm name, signature, title, date:

Commissioning Certificate of Completion (page 2of 2)
Project No./Date:
Project Title:
Building/Address:
System:

The Commissioning Authority has observed the commissioning process and acknowledges that it was carried out according to the contract documents.

Commissioning firm name, signature, title, date:

The Client Agency acknowledges receipt of the following documents and services:

1. Operating and Maintenance Manuals
2. As-Built Drawings
3. All certificates
4. Operator training

Client Agency name, signature, title, date:

ATTACHMENT 5
THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS
12/20/99

1. The Commissioning Authority (CA) is in charge of the commissioning process and makes the final recommendations to the owner regarding functional performance of the commissioned building systems.

2. The CA is the main advocate for the performance and maintainability of building systems, in accordance with the owner's requirements. As such, the CA has no project responsibilities other than commissioning, and the CA's contract is held directly with the owner or with the architect. When the CA's contract is with the Architect, the contract allows the CA to communicate directly with the owner, and requires the CA to copy the owner directly with all commissioning correspondence and documentation.

3. In addition to having good written and verbal communication skills, the CA has current engineering knowledge, and extensive and recent hands-on field experience regarding:
   a. Building systems commissioning,
   b. The physical principles of building systems performance and interaction,
   c. Building systems start-up, balancing, testing and troubleshooting,
   d. Operation and maintenance procedures, and
   e. The building design and construction process.

4. For each project, the commissioning purpose and scope are clearly defined in the CA and A/E contracts, and the construction documents.

5. For each project, the commissioning roles and scope for all members of the design and construction teams are clearly defined in:
   a. Each design consultant's contract,
   b. The construction manager's contract,
   c. General Conditions of the Specifications,
   d. Each division of the specifications covering work to be commissioned, and
   e. The specifications for each system and component for which the suppliers' support is required.

6. Each project is commissioned in accordance with a written commissioning plan that is updated as the project progresses. The commissioning plan:
   a. Identifies the systems to be commissioned,
   b. Defines the scope of the commissioning process,
   c. Defines commissioning roles and lines of communications for each member of the project team, and

d. Estimates the commissioning schedule.

7. Prior to design, the owner, agency, building operators, and design team, under the direction of the CA, evaluate and document the facility's requirements regarding such issues as energy conservation, indoor environment, staff training, and operation and maintenance. This is developed into the Systems Concept and Operations Manual, which describes the owner/agency's criteria for systems' performance and maintainability, the design intent, and expected operation of the systems. This document is the basis of design and system acceptance, therefore it must be established early in design and its content must be adequately expressed in the construction documents. The fundamental criteria and concepts are documented during concept design, but this initial document is further developed and updated as design and construction progress.

8. The CA performs a commissioning review of all design and construction document submittals for:
    a. Compliance with design criteria,
    b. Commissioning requirements,
    c. Bidding issues,
    d. Construction coordination and installation concerns,
    e. Performance aspects, and
    f. Facilitation of operations and maintenance, including training and documentation.

9. On new building commissioning projects, the CA reviews the contractors' equipment submittals with respect to commissioning related issues.

10. On new building commissioning projects, the CA reviews systems installation for commissioning related issues throughout the construction period.

11. The HVAC Test and Balance (TAB) firm is under contract to the CA, the owner, or the General Contractor (not as the mechanical subcontractor). The CA reviews the TAB report and verifies that the systems have been balanced in accordance with the construction documents.

12. The CA reviews the manufacturers' equipment and systems' startup reports and verifies that startup has been conducted in accordance with the construction documents.

13. All commissioning activities and findings are documented as they occur. These reports are distributed as they are generated, and included in the final report.

14. The functional testing program objectively verifies that the building systems perform interactively in accordance with the Project Documents. Written, repeatable test procedures, prepared specifically for each project, are used to functionally test systems, components, instrumentation and controls in all modes of operating conditions specified for testing. These tests are documented to clearly describe the

individual systematic test procedures, the expected systems response or acceptance criteria for each procedure, the actual response or findings, and any pertinent discussion.

15. The commissioning authority provides constructive input for the resolution of system deficiencies.

16. Every commissioning project is documented with a commissioning report that includes:
    a. An evaluation of the operating condition of the systems at the time of functional test completion,
    b. Deficiencies that were discovered and the measures taken to correct them,
    c. Uncorrected operational deficiencies that were accepted by the owner,
    d. Functional test procedures and results,
    e. Reports that document all commissioning field activities as they progress, and
    f. A description and estimated schedule of required deferred testing.

17. The CA verifies that the training for the owner's operating staff is specified and conducted in accordance with the State of Idaho Commissioning Guidelines.
18. The CA verifies that the operations & maintenance manual is specified and provided in accordance with the State of Idaho Commissioning Guidelines.
19. Prior to expiration of the construction contract warranty, the CA assists the owner in assessing systems' performance and addressing related issues.