APPENDIX B

OUTLINE FOR THE PREPARATION OF

SYSTEMS COMMISSIONING SPECIFICATION

OUTLINE SPECIFICATION **31 July 1995**

SYSTEMS COMMISSIONING

NOTE: Only systems commissioning activities which occur during project construction will be defined in the contract specifications. This specification section may be inserted into the General Provisions of the Contract Specifications, or the Technical Provisions as determined by the design engineer. Other specification sections having activities affecting systems commissioning will make reference to this section, and will direct that those activities be coordinated to permit overall systems commissioning as specified herein. Each project will require adaption of this specification to meet requirements of design intent, project location, construction methods, and construction team organization and management structure.

PART 1 GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

1.1.1 The “System” as referred to in this section of the specifications shall include, but not be limited to, the following subsystems and components of subsystems: _____
_____.

1.1.2 The Contractor shall verify operational and functional performance of the System for compliance with the “Design Intent” as described (in the following Section(s) of the Contract Specifications: _____
_____.]
[and] [below for the following subsystems: _____.]

NOTE: The design engineer will include in the specifications a complete description of system operation and performance data for informational purposes only. “Design Intent” information specified herein shall include: (a) the general philosophy and goals of the total system, (b) an explanation of selected components of the overall system and the expected interaction between components and subsystems, (c) data on performance requirements of the total system, (d) performance requirements of designated zones, and (e) an overview of control systems and their integration with other systems.

1.1.3 The Contractor shall document all tests and inspections performed on the System as part of the commissioning process.

1.1.4 The Contractor shall verify the existence and application of operation and maintenance (O&M) manuals, as-built or record drawings and documents, spare parts lists, special tools lists, and other items as may be specified herein for support of the System. Contractor shall make any and all necessary corrections to O&M manuals and procedures if errors are discovered during the commissioning process.

1.1.5 The Contractor shall coordinate and direct training of personnel for the operation and maintenance of the System in accordance with detailed requirements found in the technical and execution sections of this specification.

1.1.6 The “Systems Commissioning Team” as referred to in this section of the specifications shall be composed of the team members listed below. The Contractor shall be added to the Team after contract award, and shall designate members from the Contractor Group to participate in the precommissioning activation inspection and the functional performance testing specified herein. In addition, the Government will be represented by an official of the Contracting officer, the Designer or Design Agent Representative, and the Using Agency. All commissioning inspections and testing will be accomplished in the presence of a representative of the Contracting officer.

NOTE: Where possible, the Designer, or a Design Agent Representative, shall be included as a member of the Commissioning Team. The planning and programming of either Title II services or in-house support will be required for the participation of the Design Agent Representative. For certain highly complex systems, it may be appropriate to include a manufacturer*s representative as a member of Contractor Group on the Commissioning Team. Designer shall consider the degree to which such participation is required to assure fulfillment of the full contract requirements. Due to the added costs, this option should be only utilized where absolutely necessary to assure provision of a fully functioning system in accordance with design intent.

NOTE: Provision of a fully commissioned system is the responsibility of the Contractor. Therefore, Contractor Group members of the Systems Commissioning Team, through participation in the planning, management and oversight of all construction activities related to equipment approvals, performance testing and comissioning of the systems identified herein, must be able to assure the Government that all systems have been properly tested and commissioned. The Government, User, construction and design elements are intended to participate fully as an adjunct to the Contractor Group Team members. It is intended that through this participation, the Contractor Group Team members will be provided timely access to all design information necessary to resolve questions as to intended performance of the systems specified. In addition, the Government will be sufficiently involved in the development of commissioning and performance testing programs to assure timely review of plans and procedures submitted by the Contractor. The purpose of this will be to provide fully functional systems which interact to meet all contract performance requirements. The participation of the Government Commissioning Team members shall not relieve contractor of any responsibility for compliance with the requirements of the contract.

The team shall include the following members:

a. Contractor--The Contractor Group representatives shall include but not be limited to tyhe following individuals:

Chief Quality Control Representative
Mechanical Representative
Electrical Representative
Testing, Adjusting, and Balancing Representative
Instrumentation and Controls Representative

b. Contracting Officer Representative

c. Using Agency Representative (Optional)

d. Designer or Design Agent Representative (Optional)

NOTE: The design engineer will list special requirements (if any) for qualification of the Commissioning Team, such as previous work experience, licensing, registration, membership in societies, etc. See Appendix A for guidance in selecting special requirements.

1.2 THE COMMISSIONING PROCESS

1.2.1 The Contractor shall review and verify the commissioning schedule and requirements for the interface between all building and construction trades in order to prevent delays in the commissioning process. Contractor*s verification shall be indicated by his signed approval.

NOTE: The extent to which each commissioning activity is required on a particular project shall be clearly defined in the Commissioning Plan.

1.2.2 Commmissioning Plan. The commissioning plan shall be prepared by the Contractor. It shall describe how the commissioning process will be organized, scheduled, and documented. The plan shall include:

a. The composition of each Subcontractor*s group representation to the Commissioning Team.

b. A list of activities required to commission the system and its subsystems.

c. A schedule for each activity linked to the master project schedule to make possible the coordination necessary between trades and trade divisions.

1.2.3 Precommissioning Meeting. _____ [days] [months] prior to start of the scheduled systems activation inspection, the Contractor shall hold a precommissioning meeting with all Team members in attendance. The purpose of the meeting is to prepare for the systems activation inspection, and to ensure that all Team members are ready to begin full-scale commissioning. In the event that the Contractor is unable to hold the precommissioning meeting, or conduct the systems activation inspection, at the scheduled times as shown in the Commissioning Plan, the following remedies will apply: _____ _____.

Note: Designer must ensure that the time provided between the precommissioning meeting and the systems activation inspection is adequate to allow each Commissioning Team member to assemble representatives of their group and prepare for full-scale commissioning. For a complex project this may require more than 30 days. Therefore, a minimum of 30 days will be specified. Sufficient notification time will be also allowed for the precommissioning meeting.

1.2.4 Systems Activation. After the physical installation of all systems and subsystems has been completed, the Contractor shall insure that all building services, such as electrical power, central steam supply, natural gas, water, sewer, etc., have been connected and started. The System shall be activated after the following building services have been connected and started: _____ _____.
The Commissioning Team shall perform a system activation inspection to ensure that the system is operational and ready for testing and balancing. All subsystems shall have been inspected, started by trained personnel, and tested by the Contractor to ensure that they function as required, and that all subsystems are operational at the time commissioning activities begin.

1.2.5 Testing, Balancing and Adjusting. Testing, balancing and adjusting of the System shall be accomplished by [the Contractor) [_____] in accordance with Section[s] _____ of the contract

specifications. The Testing, Balancing and Adjusting Report shall be submitted to the Contracting Officer, and members of the Commissioning Team who have not received the information.

NOTE: Testing, balancing and adjusting of the System shall be performed by a single organization approved by the Contractor as having the knowledge and experience to carry out the work. The scope of testing, balancing and adjusting shall be clearly defined in the contract specifications and on the drawings, and shall include Ca) details of all systems to be tested and balanced, (b) specific performance requirements, and (c) required documentation.

Procedures for testing, balancing and adjusting shall be performed in accordance with the standards set forth in Sections _____ of the specifications.

NOTE: Designer shall include standards such as (a) “HVAC: Testing, Adjusting & Balancing” published by the Sheet Metal and Air Conditioning Contractors National Association, Inc., (b) “National Standards” published by the Associated Air Balance Council, (c) “ASHRAE Standards” published by the American Society of Heating, Refrigeration and Air Conditioning Engineers, (d) “National Fire Protection Standards” published by the National Fire Protection Association, and (e) “Operation of Municiple Wastewater Treatment Plants--MOP 11” published by the Water Environment Federation.

1.2.6 System Performance Verification, System performance verification shall be accomplished in accordance with the System and Subsystem performance check lists which are included herein. The verification procedure shall include:

a. Testing and verification that all systems and subsystems perform to the standards in Sections _____. A report indicating that testing has been performed and has verified the system to be in conformance with the contract shall be made available to the Commissioning Team.

b. Completion of the verified check lists signed by the Contractor, and the required Commissioning Team members..

c. Joint investigation and correction of problem conditions where a system, sub-system, or equipment component does not achieve specified performance standards.

d. Recording seasonal and occupancy conditions in effect at time of the verification described heretobefore.

1.2.7 Demonstration and Instruction. A systems demonstration and operating instructional (D&I) program shall be organized and developed by the Contractor, and presented to the Using Agency operating and maintenance staff. The Program shall include, but not be limited to, the following:

a. Detailed schedule of instruction periods for specific sections of the installation.

b. Introduction to the operating and maintenance manuals.

The Contractor shall assign each element of instruction to specialist members of the Commissioning Team who were involved in the installation and are familiar with the details of the System being commissioned. The time required to provide the demonstration of the System and full instruction on operating and maintenance of the installation shall be as follows: _____.

NOTE: The D&I program will be scheduled over a period of time that will be commensurate with the size and complexity of the project.

1.3 CONDITIONS OF WORK

The Contractor shall furnish all labor, equipment and materials to accomplish complete systems commissioning as specified in this section of the specifications.

NOTE: Design engineer will describe any special requirements for commissioning due to unique work conditions, labor requirements, availability of equipment and materials, project location, etc. See Appendix A for guidance on selecting special requirements for work conditions. In some cases, for example where a long commissioning period is required for a wastewater treatment plant, it may be feasible to utilize existing installation manpower under contractor/A-E supervision.

1.4 WORK SCHEDULE

NOTE: Design engineer will develop a schedule or “Work Plan” for commissioning to include start-up, testing, and adjustment of all components of the System. See Appendix A for guidance on developing a commissioning schedule.

1.5 COMMISSIONING START-UP AND COMPLETION

The Contractor shall complete interim systems commissioning during the initial start-up and operations phase, and shall complete follow-up and final systems commissioning during the final construction inspection and acceptance phase.

NOTE: Designer will estimate the approximate dates of commissioning and describe any special requirements for the commissioning process such as special loading conditions and seasonal variations in weather or climatic conditions. These dates may change as the date of contract award approaches. Note that on larger projects, commissioning will begin only after beneficial occupancy of the project.

1.6 REFERENCES

NOTE: Designer will list applicable publications with dates to be used in systems commmissioning and which will be referenced within this specification section. An example is “ASHRAE Guideline 1-1989, Guidelines for Commissioning of HVAC Systems” published by the American Society of Heating, Refrigeration and Air Conditioning Engineers.

1.7 DOCUMENTATION

The Construction Contractor shall provide to each member of the Systems Commissioning Team six (6) copies of the following items as soon as they become available:

1.7.1 Certified and approved start-up and testing reports for all subsystem equipment that comprise the System. Commissioning documentation shall include control schematics of the total system and all subsystems.

1.7.2 Records of required inspections for code compliance, and documentataion of approved permits and licenses to operate components of the System.

1.7.3 Operating data which shall include all necessary instructions to the Owner*s operating staff in order to operate the system to specified performance standards.

1.7.4 Maintenance data which shall include all necessary information required to maintain all equipment in continuous operation, such as the testing, balancing and adjusting report and the as-built drawings.

NOTE: The required documentation for a particular project will be detailed in this section of the specifications.

1.8 SUBMITTALS

The Contractor shall submit to the Contracting Officer for approval the following items prior to starting the commissioning process:

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

1.8.1 Contractor Commissioning Representatives. A list of Contractor representatives on the Commissioning Team and their qualifications shall be submitted at least _____ [weeks] (months] prior to the start of pre-commissioning checks. Any proposed revision to this list must be submitted prior to the start of the impacted work.

1.8.2 Commissioning Plan

NOTE: Designer will identify all components of the plan for conducting and completing systems commissioning. See Appendix A for guidance in developing the systems commissioning plan.

1.8.3 Training Plan

NOTE: Designer will identify all elements of the plan to train personnel from the Using Agency in the operation and maintenance of the System. See A for guidance in developing the training plan.

1.8.4 Testing Equipment

NOTE: Designer will identify and specify all testing equipment, apparatus, related tools, etc., the systems to be tested with such equipment, the reason the equipment is required, the source for obtaining the equipment, and the price and delivery date of each component or element. The contractor will be required to provide all such items.

1.8.5 Test Procedures. Detailed procedures for precommissioning checks and functional performance tests shall be submitted at least _____ [weeks] (months] prior to the start of precommissioning checks.

1.8.6 Test Schedules. Schedule for precommissioning checks and functional performance tests shall be submitted at least _____ [weeks] [months] prior to the start of precommissioning checks.

1.8.7 Test Reports. Completed precommissioning checklists and functional performance test checklists shall be organized by system and by subsystem and submitted together. The results of failed tests shall be included along with a description of the corrective action taken.

1.9 CONTRACTOR RESPONSIBILITIES

1.9.1 The Contractor shall deliver a commissioned installation to the Government that meets all performance requirements in accordance with the contract documents.

1.9.2 The Contractor shall provide all necessary access facilities to those working on the installation of all systems so that the Commissioning requirements can be fulfilled completely.

1.9.3 The Contractor shall consult with subcontractors to ensure that sufficient time is allowed and fully identified on the Master Schedule for the proper commissioning of all systems.

1.9.4 The Contractor shall plan, organize and implement the commissioning process as identified in the Contract Specifications.

1.9.5 The Contractor shall arrange consultation with the Contracting Officer to provide clarification of the design described in the specifications, if the subcontractor deems such a meeting necessary.

1.9.6 The Contaractor shall assign a Commissioning Team, comprised of qualified sub-trade specialists who are coordinated by a competent, experienced supervisory person.

1.9.7 The Contractor shall supply complete instruction and information relating to the operation and maintenance of all equipment and systems.

1.9.8 The Contractor shall deliver a system that performs within the ability of the equipment and design specified in the contract.

NOTE: Design engineer will list applicable specification sections that identify other responsibilities, including various trades involved in the work, during the systems commissioning process. The Owner or Using Agency will (a) provide an operations and maintenance staff that possesses sufficient skills, education and aptitude to be able to operate and maintain the installation following an appropriate period of instruction, (b) assign selected staff to observe the installation and commissioning prior to final demonstration and turnover, in order to become fully familiar with the installation and the design intent of the system, Cc) ensure that the Design Authority*s contract includes such services that are defined herein as the Design Authority*s responsibility, (d) arrange the schedule of occupancy such that the commissioning process can be carried out without undue interference. The Design Agent or Authority will (a) ensure that the commissioning process is fully identified and specified in contract documents, (b) include in the contract documents a complete descripion of the systems operation and performance and requirements for commissioning the system, Cc) specify equipment and appurtenances to meet the design criteria, (d) verify and certify the performance of systems on completion of the testing, balancing and adjusting process, (e) specify in contract documents check lists for performance testing and verification, (f) assign a qualified person to work with the Contractor and Owner on the entire commissioning process, and Cg) issue a definitive deficiency list at the time of system activation and on completion of the systems performance verification procedure.

PART 2 PRODUCTS

2.1 TESTING AND INSTRUMENTATION

2.1.1 The Contractor shall provide the following testing and instrumentation equipment to be used in the commissioning process: _____ _____.

NOTE: Designer will list applicable equipment to be used for testing and instrumentation during the systems commissioning process, with special emphasis placed on load simulation.

2.1.2 The Contractor shall provide all utilities necessary to carry out testing and instrumentation as part of commissioning process, including such expendible items as water, fuels, chemicals and other materials. The Contractor shall also provide any equipment or device required for access such as platforms, scaffolds, ladders.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall coordinate with the Commissioning Team in the construction phase of the project to assure compliance with all systems commissioning requirements.

3.2 PROCEDURES

3.2.1 The Contractor shall schedule a pre-construction conference meeting to establish requirements for systems commissioning throughout the construction phase.

3.2.2 The Contractor shall submit to the Contracting Officer 30 days after contract award the complete commissioning plan which shall include:

3.2.2.1 Responsibilities of each trade affected by the commissioning process.

3.2.2.2 Requirements for documentation as listed [in this Section] [and] [in Section(s) _____] of the Contract Specifications.

3.2.2.3 Requirements for documentation of commissioning tests and inspections required by code authorities and governing agencies.

3.2.2.4 Requirements for the commissioning program during specific operational seasons with partial and full loads as specified [in this Section] [and] [in Section(s) _____] of the Contract Specifications.

3.2.2.5 Requirements and format for a training program for operations and maintenance personnel.

3.3 INSPECTION AND TESTING

The Contractor shall designate Commissioniong Team members to participate in the pre-commissioning inspection and the functional performance testing specified herein. In addition, the Government shall be represented by an official of the Contracting officer. Each checklist item shall be completed by the Commissioning Team. Acceptance by each Commissioning Team member of each pre-commissioning checklist item shall be indicated by signature and date unless participation by that individual is not required. Acceptance by each Commissioning Team member of each functional performance test checklist shall be indicated by signature and date.

3.3.1 TESTS

The pre-commissioning checks, inspections, startup and performance testing shall be accomplished in detail as specificied in other parts of these specifications, or as recommended by the manufacturer, or as required by a referenced code or standard.

NOTE: Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established and provided in this Section which will provide the information required. Testing and verification requirements in related Sections are independent of the requirements of this Section, and shall not be used to satisfy any of the requirements specified in this Section.

All testing and verification required in this Section shall be performed during the Commissioning phase. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests.

3.3.1.1 Pre-Commissioning Checks

Pre—commissioning checks shall be performed for the items indicated on the checklists in Section(s) _____. Any deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

3.3.1.2 Functional Performance Tests

Functional performance tests shall be performed for the items indicated on the checklists in Section(s) _____. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove that all modes and sequences of operation are correct, and shall verify all other relevant contract requirements. By verify it is meant that contract requirements are satisfied by testing results. Testing shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of a functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. Testing of the checklist shall then be repeated until it has been completed without errors.

END OF SPECIFICATION