National Audubon Society

COMMISSIONING PLAN
CONSTRUCTION PHASE

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National Audubon Society

AKF Commissioning Plan
AKF Project No. Y070378

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Commissioning Plan-Construction Phase

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1 Overview

1.1 Introduction

AKF Engineers, LLP was contracted by FXFOWLE to perform commissioning services at **National Audubon Society at 225 Varick Street, 7th Floor**. AKF's and the commissioning team member's responsibilities are detailed in the project specifications.

Commissioning (Cx) is a systematic process of ensuring that building systems perform interactively in accordance with the owner's project requirement (OPR) as represented in the basis of design (BoD), design plans and specifications. The Commissioning of **National Audubon Society** is achieved by developing and implementing the commissioning process specific to this project with respect to the commissioning specifications outlined in the plans, specifications and US Green Building Council's LEED Rating System Version 2.0 for Commercial Interiors (CI). To define the commissioning process, the Commissioning Authority (CxA), AKF develops a commissioning plan to provide direction to the commissioning team for the commissioning tasks during the construction phase and for additional seasonal testing requirements. The plan focuses on providing support to the specifications and provides forms for the application of the commissioning process.

1.2 General Building Information

Project: **National Audubon Society**

Location: **225 Varick Street, 7th Floor**

Building Type: **Commercial Building**

Occupancy: **National Audubon Society**

Construction Period: **TBD**

1.3 Abbreviation and Definition

The following are common abbreviations used in this document.

Tennant Project Manager	
Owner	**Lincoln Property Company**
Owner's Representative	
Tenant	**National Audubon Society**
Architect (Arch)	**FXFOWLE**
Commissioning Authority (CxA)	**AKF Engineers, LLP**
Design Engineer (DE)	**Flack & Kurtz**
LEED Consultant (LEED AP)	**YRG Sustainability Consultant**
Lighting Design (LD)	**Illumination Art, LLC**
General Contractor (GC)	**Citadel Construction Group**
Commissioning Plan	(Cx Plan)
Pre-Functional Checklist	(PFC)
Functional checklist	(FT)
Basis of Design	(BoD)
Owner's Project Requirements	(ORP)
Operations & Maintenance Manuals	(O&M's)
As Built Drawings	(As B's)
Vertical Transportation	(VT)

1.4 Team Members/Data

Refer to Appendix 1.0

2 Commissioning Plan

2.1 Purpose of Commissioning

The purpose of the commissioning plan is to:

- Provide direction for the commissioning team with the implementation of the commissioning process in accordance with the plans, specifications and contract documents.
- Define the roles and responsibilities of all team members.
- Provide a schedule of commissioning activities.
- Develop the schedule for verification, pre-functional and functional performance test.
- Define the process for reporting and correcting any deficiencies identified.
- Define training requirements for operations and maintenance personnel.

This plan does not provide a detailed explanation of required testing procedures. The detailed testing requirements and procedures will be developed by AKF in accordance with the plans, specifications and manufacture's requirements. Manufactures requirements will be derived from the Operations and Maintenance Manuals (O&M's) submitted by the contractors.

2.2 Commissioning Scope

Commissioning is a systematic process of ensuring that all building systems perform interactively according the owner's project requirements. This is achieved by beginning in the design phase, ensuring OPR is met, and continuing through construction, acceptance and the warranty period with actual verification of performance.

Commissioning during the construction of this project is intended to achieve the following specific objectives in accordance with the Contract Document:

- Comment on all submittals that pertain to system that are to be commissioned.
- Assist in providing answers to RFI's that pertain to the commissioning process.
- Ensure that applicable MEP equipment and systems are installed properly and in accordance with design documents and OPR.
- Verify and document proper performance of equipment and systems.

- Ensure that O&M documentation is complete.
- Ensure that all as-built documentation is complete and accurate.
- Integrate various sub-systems and major systems that are dependant on each other.
- Ensure that the Owner's operating personnel are adequately trained.
- Verify manufactures and contractors warranties meet requirements as outlined in the specification and contracts documentation.

2.3 Commissioning System

The following equipment/systems will be commissioned during this project:

HVAC System (and all integral equipment controls):

- A/C Unit
- Air Handling Unit
- Air Towers
- Centrifugal Chiller
- Chilled Water Pump
- Cooling Tower
- Exhaust Fan
- General Exhaust
- Condenser Water Pump
- Condensate Pump
- Hot Water Pump

Electrical Systems:

- Day Light Sensors
- Dimming Ballasts (20% Sampling)
- Lighting Fixture Control

2.4 Forms

The Forms will be developed by AKF in accordance with the construction schedule. Forms will be submitted to the commissioning team for their input/comments, prior to implementation. As forms are developed and approved, they will be added to Appendix 2.0 of the commissioning plan. Examples of commissioning forms in Appendix 2.0 include, but are not limited to the following:

- **Site Inspection Forms**- AKF will conduct site inspections dictated by construction schedule for verification by AKF that systems/equipment are installed in accordance with plans, specifications, manufacturers requirements and shop drawings.
- **Miscellaneous Test Verification Forms**- AKF will document tests required by the specifications and conducted by the responsible contractor. For example, Hydrostatic Tests for piping systems.
- **Pre-functional inspections** refer to Appendix 2.0.
- **Functional inspections** refer to Appendix 2.0.
- **Weekly Reports** – AKF will submit on a weekly basis a report to all Commissioning team members of the items that have been complete in the commissioning process the past week, as well as the upcoming week.
- **Field Observation Report**- In some cases such as Fire Alarm Tests and/or Emergency Generator tests, AKF will issue Field Observation Reports.
- **Deficiency Report**- AKF will periodically update the Web-based deficiency listing, dependant on completion of items and correspondence between the trades. This report is accessible at any time to all parties involved in the Commissioning of the project on the internet.
- **Acceptance Forms**- AKF to develop acceptance forms used by the Commissioning Team to document system/equipment is/are installed in accordance with plans, specifications and manufacturers requirements. This form is to date when contractor and/or manufacturer warranties/guarantees are to commence.

2.5 Commissioning Team Roles and Responsibilities

2.5.1 Commissioning Team

Include all the individuals responsible for working together and carrying out the commissioning process.

2.5.2 Team Members

- Landlord – **Lincoln Property Company**
- Landlord Building Operator – **TBD**
- Architect- **FXFOWLE**
- Design Engineer- **Flack & Kurtz**
- Commissioning Authority- **AKF ENGINEERS, LLP**
- General Contractor- **Citadel Construction Corp.**
- Responsible Sub-Contractors (Mechanical, Electrical, Controls, TAB, etc...) – **React Industries**

Refer to Appendix 1.0

2.5.3 Roles and Responsibilities

Specific descriptions of the commissioning team and the roles and responsibilities are as follows:

Owner

- Owner - To develop a team and project requirements that provide a high quality, commercially-effective and reliable end product that will assist our internal clients in achieving their business goals.
- Operations and Engineering Staff – The management operations staff should be an integral part of the testing and commissioning process to ensure that the operation and containment of the facility can be performed in the most efficient manner. Many failure scenarios and subsequent recovery action plans can only be practicably performed during the construction phase and it is imperative that these tests be witnessed and documented by the Operations staff.
- Facilitates and supports the Cx process and gives final approval of the Cx work

Construction Consultant

- To serve as the owner's representative in management of the various team members and the overall project goals.

Commissioning Authority

- To implement, document, and manage the commissioning plan and all deliverables identified to be turned over to building operations, including schedule, procedures, test results, operating & maintenance manuals, and training and to submit the formal plan and results.
- Coordinates the Cx process, write tests, oversee and documents performance tests

Design Consulting Engineer

- To document design intent, to include required testing and deliverables in the drawings and specifications, to perform submittal reviews, construction inspections and other activities, and to work closely with the commissioning team as required to clarify the intent of system design, operation, maintenance, and response to failure modes.
- Perform construction observation, approve O&M manuals and assist in resolving problems

General Contractor

- To coordinate the logistics and execution of the sub-contractor work in a sequential manner that meets the commissioning plan objectives and the overall project schedule, and to provide project deliverables

required from the subcontractor in an organized format outlined by the Commissioning Authority.

- Develop and submit the required scripts and method of procedures (MOP's) for all critical system to CxA and DE for review.
- Facilitates the Cx process. Approves test plans and signs-off on performance.
- Facilitates the Cx process, ensures that Subs perform their responsibilities and integrates Cx into the construction process and schedule

Property Management Agent

- To participate in the commissioning process with the overall objective to be trained to efficiently and reliably operate and maintain the building systems after acceptance of the equipment.

Maintenance and Operations Consulting Engineer

- To independently prepare detailed system descriptions and operating procedures with the intent to validate system operation and provide documentation that will be turned over to building operations personnel.

Contractors and Equipment Vendors

- To perform and document testing outlined in the specifications, as well as work closely with the Commissioning Agent in identifying all different operating, maintenance, and failure modes that must be demonstrated as part of the commissioning process. The identification of system modes and tailoring of the commissioning plan will be updated throughout the commissioning process to ensure the final product reflects actual system responses to all various operational modes.
- Demonstrate proper system performance
- The equipment manufacturers and vendors provide documentation to facilitate the commissioning work and perform contracted startup

3 Commissioning Process

3.1 Meetings

3.1.1 Commissioning Scoping Meetings (Cx Kickoff Meeting)

A commissioning scoping meeting is planned and conducted by the CxA at the beginning of construction. In attendance are the respective representatives of Owner or Owner's Representative, CxA, LEED AP, Arch, DE, SE, and the mechanical, electrical, controls, and TAB subs. At the meeting, commissioning parties are introduced and the commissioning process reviewed with management and reporting lines determined. The flow of documents, how much submittal data the CxA will receive, etc. will also be discussed. The **Cx Plan** is reviewed, process questions are addressed, lines of reporting and communications determined and the work products lists / Final deliverables will be discussed. The general list of each party's responsibilities, which is responsible to develop the startup plan for each piece of equipment and the proposed commissioning schedule will be reviewed and discussed. The intent and outcome of the meeting is an increased understanding by all parties of the commissioning process and their respective responsibilities. The meeting provides the CxA additional information needed to finalize the **Cx Plan**, including the final / proposed construction and commissioning schedule.

Prior to this meeting the CxA is given, by the GC, all drawings and specifications and the construction schedule by trade. The CxA will be responsible for the minutes of the meeting which will be distributed to the Cx team by Arch.

3.1.2 Commissioning Meetings

During the construction progress, AKF will conduct regular scheduled Cx meetings with the commissioning team. An agenda will be developed by AKF, which will identify topics of discussion as well as indicate team

members required to attend. The purpose of this meeting is to discuss issues, resolution of potential conflicts, coordinate commissioning schedules, report on the commissioning status, identify urgent tasks and identify deficiencies. This meeting will be scheduled based on construction progress.

3.1.3 Miscellaneous Meetings

AKF attends selected planning and job-site meetings in order to remain informed on the construction progress and to provide updates on the commissioning progress. **GC - CITADEL CONSTRUCTION CORP** and other team members are to advise AKF to potential issues, which may impact the commissioning process. AKF shall review construction-meeting minutes, bulletins and/or Request for Information's (RFI) prior to attending meeting.

3.2 Site Inspections, Field Observation and Weekly Reports

AKF will conduct site inspections dictated by construction schedule to verify equipment is installed in accordance with the plans and specifications. AKF will report to the **GC** field office prior to conducting inspections to inform **GC** of their presence. **GC** and team members may accompany AKF during a site inspection but are not required to do so. Results of site inspections will be documented on Site Inspection Report. The site inspection report will be distributed to team members attached with a Weekly Report, which summarizes weekly events pertaining to the commissioning process. In some cases, specific inspection sheets may be difficult to develop, for example, hydrostatic pressure tests. For this type of test, AKF shall issue a field observation report.

3.3 Reporting Deficiencies and Issues Logs

During the course of AKF's site visitation, pre-installation, installation, pre-function, and functional inspections, deficiencies shall be documented when inspection results are not

in accordance with the design document, plans and specifications. AKF will document new deficiencies in an issues log and issues to the Cx team at the beginning of Cx meeting. Deficiencies, which are corrected by the contractor, re-inspected and approved by AKF, **GC** and team members, will be marked as closed in the issues log. An issues log report including new and outstanding deficiencies will be updated regularly. In the issues log report, each deficiency shall include a description, location, and compliance reference.

3.4 Guideline to Follow

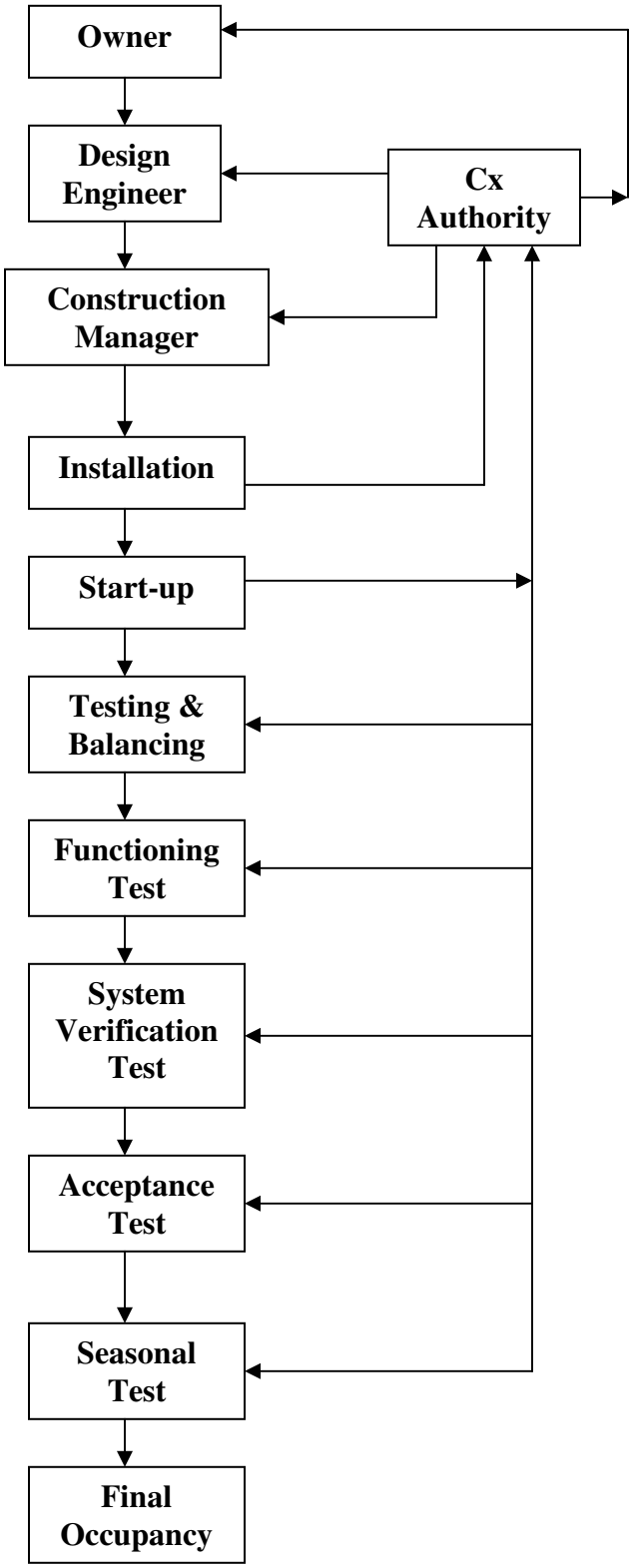
3.4.1 Miscellaneous Management Protocols

The following protocols should be followed during the commissioning process:

For requests for information (RFI) or formal documentation requests:	The CxA will go through the GC for the required information.
For minor or verbal information and clarifications:	The CxA will go directly to the informed party for the required information.
For notifying contractors of deficiencies:	The CxA will document the deficiencies through the GC, but may discuss deficiency issues with contractors prior to notifying the GC.
For scheduling functional tests or training:	The CxA will coordinate directly with the GC for all scheduling of the functional tests and training.
For scheduling commissioning meetings:	The CxA will select the date and will schedule the meeting through the GC..
For making a request for significant changes:	The CxA has no authority to issue change orders, but will identify issues to the owner and design team for review and consideration.
For making small changes in specified sequences of operations:	The CxA may <u>not</u> make changes to specified sequences without approval from the A/E.
Subcontractors disagreeing with requests or interpretations by the CxA shall:	The CxA will initially attempt to resolve the situation directly. The CxA will then work through the GC who will work with CxA directly to resolve the situation.

3.4.2 Commissioning Sequence

The following protocols should be followed during the commissioning process:



- Equipment should not be started (for Heating or cooling), until all Pre-Installation, Installation and Check-Test-Start items are verified complete. Also, ensure all of the manufacturer's pre-start procedures are completed and moisture, dust and other environmental and building integrity issues have been addressed.
- Functional testing is not to begin until pre-functional (Check-Test-Start), start-up and TAB are completed, for a given system.
- The controls system and associated equipment should not undergo functional performance tests until all points have been calibrated, pre-functional testing completed and deficiencies corrected.
- In a specific area, TAB for a system shall proceed once the respective controls system, envelope, ceilings, diffusers; registers and all associated equipment are substantially complete

3.4 Initial Submittals and Documentation

3.4.1 Standard Submittal

The CxA provides all Subs responsible for commissioned equipment with draft commissioning documentation requirements for their respective equipment and systems through the GC. This data request will consist of a MOP for testing the respective system. Within the MOP will be the required pre-functional checklists, system checklists and functional tests for the type of equipment to be Cx as part of Cx plan requirements.

The CxA will review submissions relative to commissioning issues expressed in the contract documents, not for general contract compliance (which is the A/E's responsibility), unless specifically directed by the GC to do so.

3.4.2 Special Submittals, Notifications and Clarifications

The sub contractors, GC or Arch/DE notify the CxA of any new design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems. The controls contractor provides the CxA a full points list with details as requested by the CxA in the specification for

each trades. As the phases of the TAB are completed, the draft TAB report is provided to the CxA with full explanations of approach, methods, results, data table legends, etc. The final TAB report is provided to the CxA upon completion.

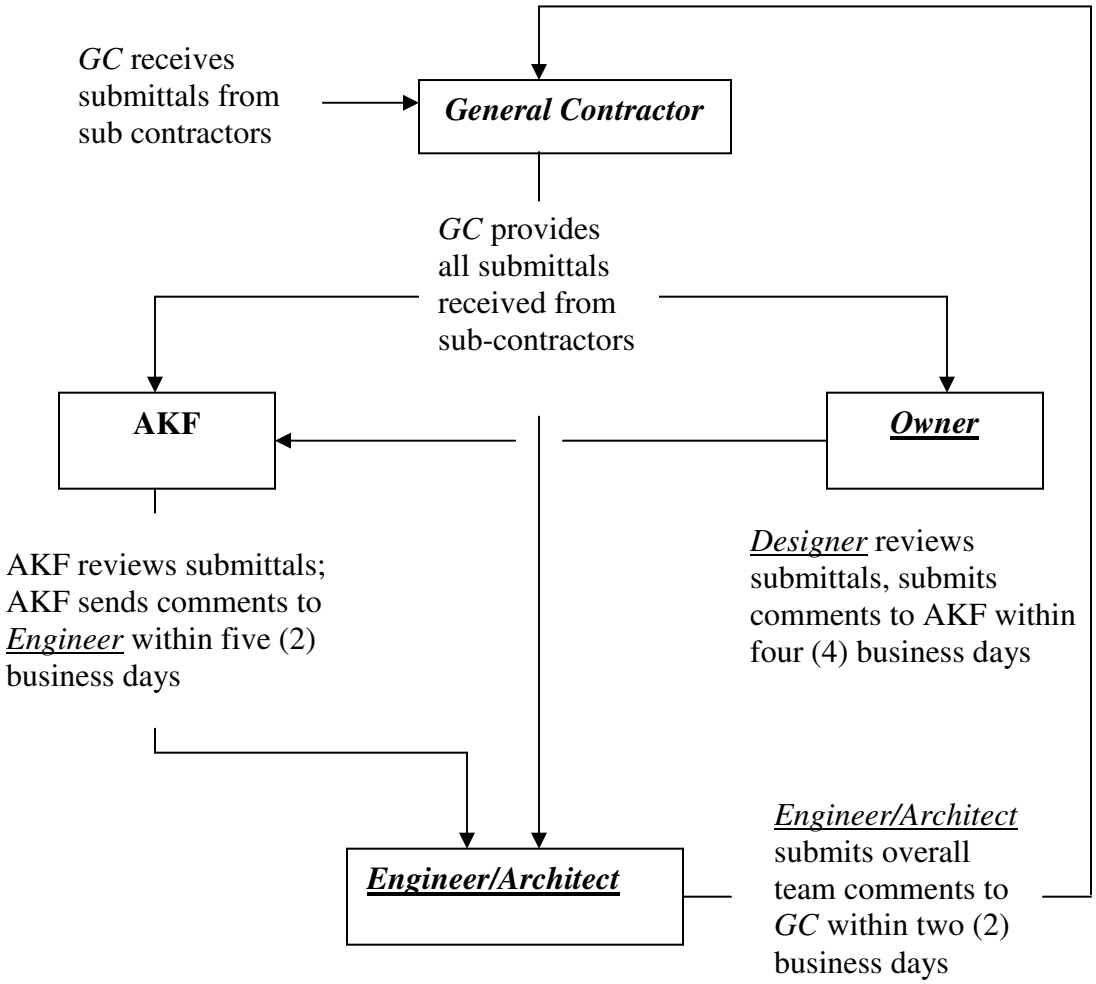
These submittals to the CxA do not constitute compliance for submittals for the O&M manuals. Documentation requirements for the O&M manuals are discussed in Section 4.

The CxA may request additional design narrative from the Arch/DE and from the controls contractor depending on how complete the documentation that was provided. The CxA may submit written RFIs to contractors through the GC or address them directly for clarifications, as needed and as identified in the Management Protocols section of this document (section 4.5).

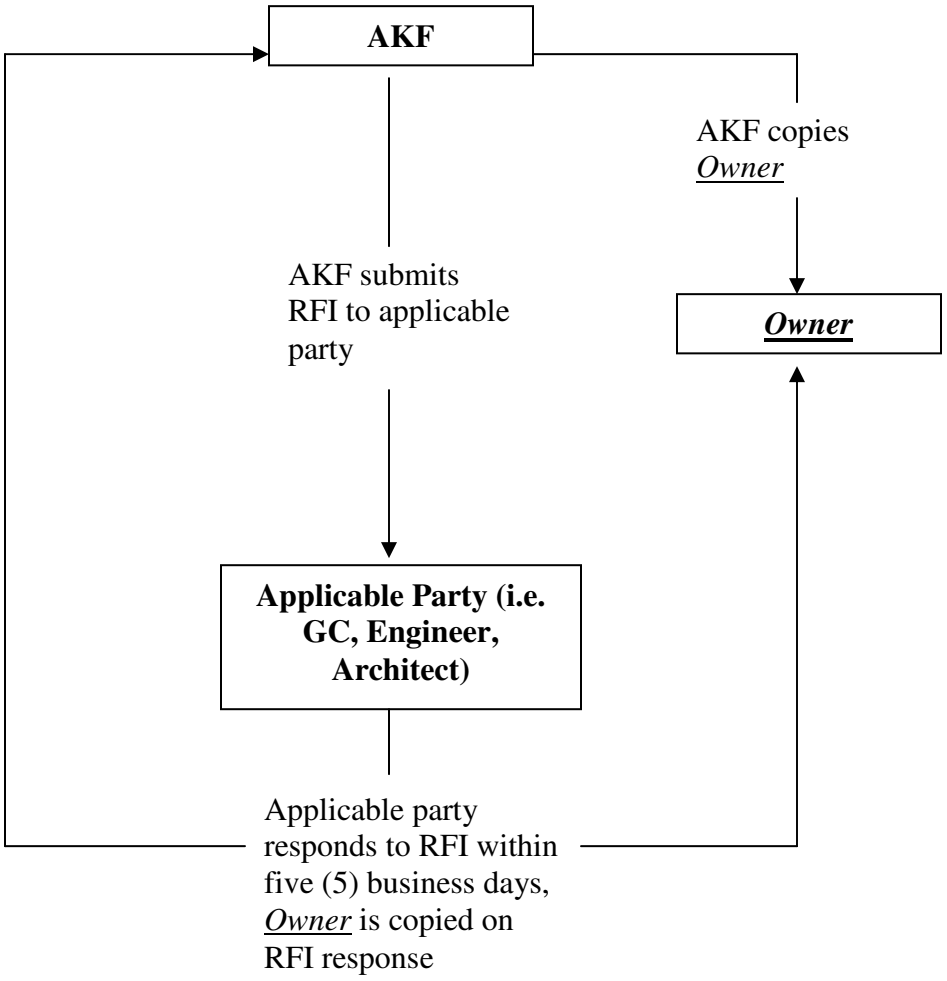
3.4.3 Submittal Review

AKF will receive all necessary submittal documentation required to properly commission this project through **GC - CITADEL CONSTRUCTION CORP**. As the Commissioning Authority, AKF will review these forms, ensure their validity to the project and compare the submitted equipment to design intent. The submittal data may include manufacturer's installation, start-up and test procedures, O&M's, performance data and control drawings. The submittals are used to develop test procedures and inspection forms. The information submitted to AKF does not relieve the contractor of their responsibility to deliver the documentation that is required in the plans and specifications.

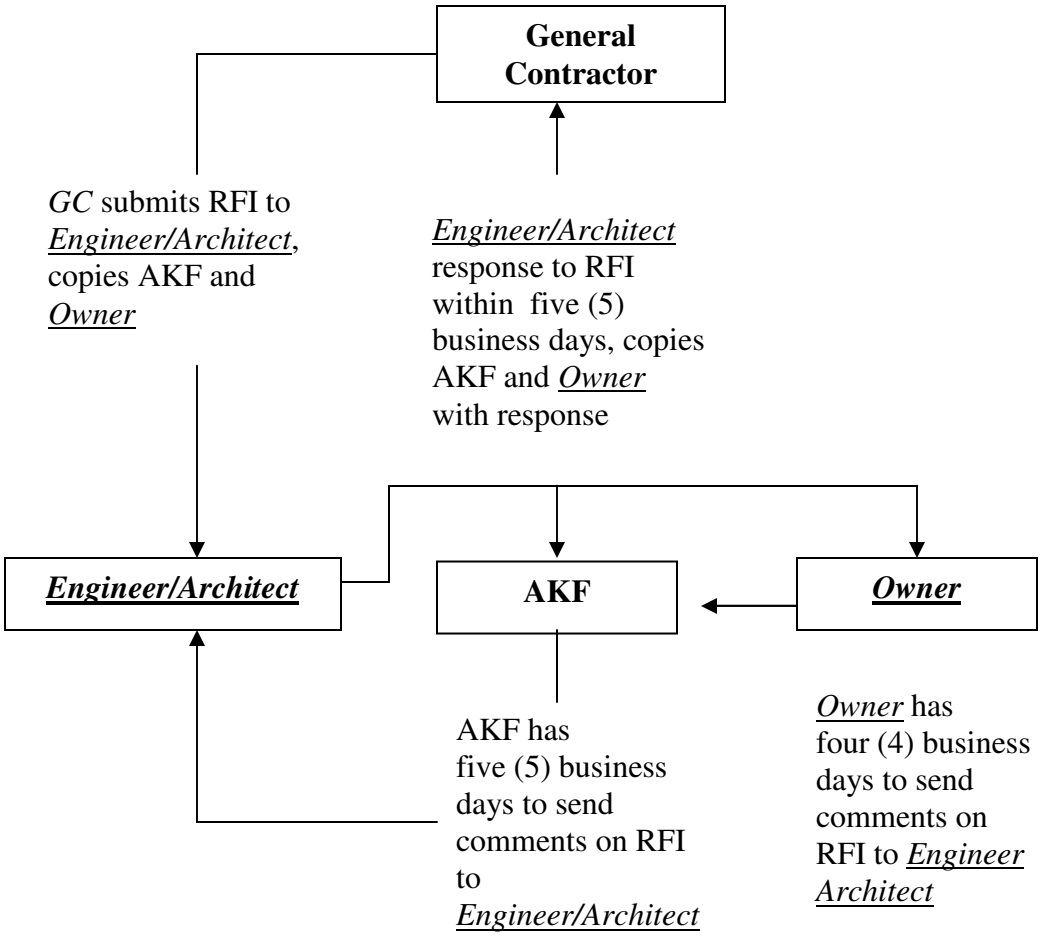
Submittal process: *Seven (7) day cycle*



Request for Information process: *AKF – Source of RFI*



Request for Information process: *C. Manager – Source of RFI*



3.5 Commissioning Checklists

Commissioning Checklists provide a full range of checks to determine that individual components, equipment and systems operate in accordance with the plans and specifications. Each piece of equipment receives full installation check by AKF. This testing must be successfully completed prior to conducting formal functional performance tests. The compilation of the two of these procedures make up the full Commissioning Checklist required to properly commission the equipment and system served. AKF shall record issues and/or deficiencies that may arise during the course of a testing. AKF shall retest or re-inspect deficiencies or uncompleted items when notified of completion by **GC - CITADEL CONSTRUCTION CORP** after **GC - CITADEL CONSTRUCTION CORP** verification that such items are completed.

3.6 Pre-installation and Installation Checklists

Pre-Functional checklists (PFC) are important to ensure that the equipment and systems are hooked up and operational and that functional performance testing may proceed without unnecessary delays. Each piece of equipment receives full Pre-functional checkout by the Contractor. No sampling strategies are used. The Pre-Functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system or any systems integration testing.

Pre-Functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels OK, fan belt tension, labels affixed, gages in place, sensor calibration, etc.). However, some Pre-Functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the phase rotation on a three phase pump motor of a chiller system). The word Pre-Functional refers to before functional testing. Pre-Functional checklists augment and are in additional to the manufacturer's start-up checklist. The contractor will provide the required startup information to the CxA.

Contractors typically already perform some, if not many, of the Pre-Functional checklist items the commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. This project requires that the procedures be documented in writing by the installing technician. The CxA does not witness much of the Pre-Functional checklisting, except for testing of larger or more critical pieces of equipment and some spot-checking.

Each contractor will be instructed by the CxA and will be observed performing a single Pre-Functional check once for each type of pre-functional check. Once the initial training is performed on the process, the contractor(s) will be responsible for completing all of the remainder of the pre-functional checklists for the type of equipment (fans, pumps, etc.). The contractor will be required to complete, electronically" the pre-functional forms, obtain all required signatures and submit to the CxA for review and approval. No Functional tests shall be scheduled or performed until the Pre-Functional checks have been approved and signed off by the CxA.

Draft Pre-Functional checklists have been included in Appendix B in the back of this document.

3.7 Startup Plan

The vendors / contractors are responsible for developing the initial equipment start-up plans as required as a pre-requisite to the pre-function check-listing process.

The following procedures will be used for this project by the CxA to assist the contractors in developing the start-up plan.

1. The CxA adapts and enhances, as required, the enclosed draft Pre-Functional checklists (PFC).
2. The CxA transmits them to the GC who designates which trade or contractor is responsible to fill out each line item on the Pre-Functional Checklist from the CxA. The GC then transmits the checklist to the responsible Subs.

3. The Sub designated to develop the Start-up Plan obtains manufacturer installation, start-up and checkout data, including actual field checkout sheets used by the field technicians.
4. The Sub copies all pages with important instructional data and procedures (not covered in manufacturer field checkout sheets) from the start-up and checkout manuals and adds a signature line in the column by each procedure.
5. The copied pages from section 2 above, along with the Pre-Functional checklist provided by the GC (originally from the CxA) and the manufacturer field checkout sheets become the "Start-up and Checkout Plan".
6. For systems that may not have adequate manufacturer start-up and checkout procedures, particularly for components being integrated with other equipment, the Sub should provide the added necessary detail and documenting format to the CxA for approval, prior to execution.
7. The Sub transmits the full Start-up Plan to the CxA for review and approval.
8. The CxA reviews and approves the procedures and plan that is submitted for review. The CxA will note any procedures that need to be added, and conveys the required information to the GC. The GC then transmits the full start-up plan to the Subs for their review and use. (This usually means that the Pre-Functional Checklist, alone, will go to more than one Sub, while the full plan will go to the primary installing contractor – this decision will be left up to the GC's).

3.8 Testing and Balancing (TAB)

The TAB contractor shall submit a written TAB procedure in accordance with the plans and specifications to **GC - CITADEL CONSTRUCTION CORP** for submission to **AKF** and **Flack & Kurtz** for review and acceptance. TAB submittal to **GC** is to be as shop drawings for ease of tracking. The submittal would then be reviewed by **AKF** and **Flack & Kurtz** in this context, and provided with our shop drawing review stamp with comments. The TAB procedure should be specific to the **National Audubon Society** and include a detailed approach to both air and water balancing for each individual system. Procedures should include requirements of the building management system. The controls contractor as required by the plans and specifications shall provide support and coordination. The TAB contractor will be required to attend specific commissioning meetings to review and discuss procedures, coordination, conflicts, strategies etc. with the commissioning team. The commissioning team shall provide guidance to the TAB contractor on which systems are available for balancing. Ideally, the actual balancing of a system shall not begin until all system components such as air handling units, pumps,

controls system, variable frequency drives, VAV boxes, fire/smoke dampers etc., have undergone pre-functional tests. As the TAB contractor completes a system, a final TAB report shall be provided to the Cx Team for review and comments. The final TAB report shall be provided to **GC - CITADEL CONSTRUCTION CORP**, **Flack & Kurtz** and **AKF** upon completion. The TAB contractor shall participate in the verification of the balance report by repeating selected measurements where required by **AKF** for verification and diagnostic purposes.

3.9 Control Checkout Plan

The controls contractor develops and submits a written step-by-step plan to the CxA which describes the process they intend to follow in checking out the control system and the forms on which they will document the process. The controls contractor will also meet with the TAB contractor prior to the start of TAB and review the TAB plan to determine the capabilities of the control system for use in TAB.

The controls contractor will provide the TAB with any necessary unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.). The controls contractor shall also provide a technician qualified to operate the controls to assist the TAB contractor in performing TAB. Additional details are found in Specifications Sections 15 and 16.

All CxA-required controls Pre-Functional checklists, calibrations, start-up and selected functional tests of the system shall be completed and approved by the CxA prior to TAB program. The controls contractor shall execute the tests and trend logs assigned to them in Section 15 and 16, and remain on site for assistance for mechanical system functional tests as specified in the same sections.

3.10 Functional Performance Tests

Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).

Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all of the control system's sequences of operation and components are verified to be responding as the sequences state. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor.

3.10.1 Functional Performance Test Development Process

Before test procedures are written, the CxA obtains all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, control sequences and setpoints. The CxA revises the previously prepared draft functional tests procedures to verify proper operation of each piece of equipment and system, using the testing requirements in the Specifications, and the representative functional test procedure forms found in this document.

The CxA obtains clarification, as needed, from contractors and the Arch/DE regarding sequences and operation to develop these tests. Prior to execution, the CxA provides a copy of the primary equipment tests to the installing Sub (via the GC) who reviews the tests for feasibility, safety, warranty and equipment protection.

Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers as indicated in the functional Test forms. The CxA will review owner-contracted, factory or required owner acceptance tests and determines what further testing may be required to comply with the Specifications. Redundancy is minimized.

3.10.2 Functional Performance Test Procedure

The CxA will schedule the functional tests through the GC. No functional test shall be performed until all requirements of the Pre-Functional checklist have been completed and signed off by the CxA. The CxA will oversee, witnesses and document the functional testing of all equipment and systems identified in the **Cx Plan**. The GC & Subs are responsible execute the tests.

The control system shall be tested before it is used to verify performance of other components or systems as practical. The air balancing and water balancing shall be completed and debugged before functional testing of air-related or water-related equipment or systems.

3.10.3 Deficiencies and Retesting

The CxA documents the results of the test. Corrections of minor deficiencies Identified are made during the tests at the discretion of the CxA. The CxA records the results of the test on the procedure or test form. Deficiencies or non-conformance issues are noted and reported to the GC. Subs correct deficiencies, notify the GC who will then inform the CxA. The CxA schedules retesting through the GC. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between CxA or GC and the Sub. For areas in dispute, final authority resides with the owner. The CxA recommends acceptance of each test to the GC. The GC gives final approval on each test utilizing the Functional Forms sign-off area.

4 Operating & Maintenance (O&M) Manuals and Warranties

4.1 Standard O&M Manuals

The CxA reviews the O&M manuals, documentation and redline as-builts for systems that were commissioned to verify compliance with the Specifications. The CxA recommends approval and acceptance of these sections of the O&M manuals to the GC. We recommend the following details be requested in the O&M manuals:

The vendor / manufacturer shall supply complete operations and maintenance manuals in accordance with the following requirements:

1. The operations and maintenance manual documentations shall be presented in an Avery 3" heavy duty white binder or equivalent at the time of original submission, and record manuals within four weeks of integrated delivery of equipment to the site.

2. The binder shall have a cover page depicting the system(s) covered by the manual, the **National Audubon Society** name, site location, and date.

3. The binder shall contain a detailed table of contents page delineating all major sections of the manual. Each section of the manual shall have an Avery narrow tab type divider placed between sections (properly labeled) to ensure easy access.

4. The major sections of the manual shall include a standard factory operations manual with detailed sequences of operation for all operating modes, maintenance manual, installation manual, shop drawings (for the units installed at this facility-typical drawings of a similar unit will not be acceptable), dimensional drawings with equipment weights, recommended spare parts lists, a copy of any spare parts lists purchased as part of this project, factory test procedures performed, copy of completed factory test procedure, copy of site acceptance tests performed (including both pre-functional and functional forms completed), a copy of the manufacturers warranty documentation, a phone list documenting emergency service contact procedures, and a copy of the maintenance forms utilized by manufacturers field service personnel in maintaining and inspecting the unit. Items required for inclusion in the operations and maintenance manuals that cannot be provided four weeks after delivery of equipment to the site are expected to be submitted within two weeks of completion of the work in a format for insertion into the binder under a pre-fabricated tab that is identified in the table of contents (i.e. The site acceptance test may not be complete at the time this manual is required for submission, in this case the manufacturer shall submit the manual with this section empty, upon completion of the site acceptance testing the forms for this testing will be supplied (punched for the binder)).

5. All documents shall be submitted electronically using CD in a dedicated sleeve within the binder.

4.2 Manufacture Equipment Warranties

AKF shall review Manufacturer's equipment warranties for compliance with the plans and specifications. For each commissioned piece of equipment, AKF shall issue a completed equipment acceptance form to document the official equipment start dates and to record the commencement of the warranty period. **GC - CITADEL CONSTRUCTION CORP** shall record all maintenance performed prior to final equipment turn over and provide documentation to the Owner and to AKF for the purpose of tracking equipment maintenance history.

5 Training and Orientation of Owner Personnel

AKF shall develop a training plan in accordance with the plans and specifications and distribute to the Cx Team for review. All Cx team members shall be informed of the schedule for the training sessions and given the opportunity to attend. The training plan shall include all include:

- Training syllabus
- Manner which training takes place
- Attendees required to attend
- Acceptance criteria

GC - CITADEL CONSTRUCTION CORP shall provide the manufacturer's training outline to assist with the development of the training syllabus. AKF will assist GC - CITADEL CONSTRUCTION CORP with the coordination of training sessions. GC - CITADEL CONSTRUCTION CORP will be responsible for making necessary arrangements with manufacturers and contractors. AKF will record training sessions for future use by building personnel. Training shall take place in a two part segments: Field and classroom side. Comprehensive training classes should be conducted in the field and in the classroom. O & M's and shop drawings must be used in the classroom training.

The following are the prerequisites for training to be scheduled:

- O & M's and as-built drawings must be completed and approved.
- Posted operating procedures must in place in designated areas.
- Corresponding equipment must be labeled and tagged.

6 Written Work Product / Project Deliverables

A final summary report by the CxA will be provided to the GC or PM. The report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

1) Equipment meeting the equipment specifications
2) Equipment installation
3) Functional performance and efficiency,
4) Equipment documentation and design intent
5) Operator training.

All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BMS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

Appendices shall contain acquired sequence documentation, logs, meeting minutes, progress reports, deficiency lists, site visit reports, findings, unresolved issues, communications, etc.

Pre-functional checklists and functional tests (along with blanks for the operators) and monitoring data and analysis will be provided as part of the final Cx report.

The commissioning plan, the Pre-Functional checklists, functional tests and monitoring reports will be part of the final report.

KEY COMMISSIONING AUTHORITY DELIVERABLES

1. Review of BoD and OPR
2. Review of design documents and report.

3. Develop and update Commissioning Plan.
4. Develop a Commissioning Specification.
5. Develop a list of required Pre-functional, and Functional forms.
6. Compile vendor start-up forms, pump alignment forms, etc and review Method of Procedures.
7. Develop equipment lists and reporting forms for all equipment in detailed and roll up in executive summary format.
8. Provide monthly status reports using the above form that detailing commissioning progress and status, problems, risks, and opportunities.
9. Provide weekly summary report to project team summarizing equipment tested, problems, and punchlist items.
10. Provide meeting minutes for commissioning meetings to track plan.
11. Provide schedule to track and monitor commissioning plan status from the GC's schedule.
12. Review and ensure that all project deliverables in well-organized and professional bound format.

DELIVERABLE FORMAT

1. All forms to be created in format that is usable by most business organizations.
2. All forms to be completed by CxA and vendors prior to formal submission.
3. All forms shall be delivered electronically in pdf format, and shall be the property of JPMorgan Chase in the pdf format only.
4. All deliverables shall be delivered to Goldman Sachs in (2) hard bound copies in a format agreed to by JPMorgan Chase.
5. All bound submittals and deliverables shall be in identical format concerning binder width, spline and cover page titles, table of contents, tabs, etc. as agreed by JPMorgan Chase.

DELIVERABLE REQUIREMENTS TO BUILDING OPERATIONS

The primary objective of the commissioning and quality control plan is to ensure that the intellectual knowledge, decision-making processes, and stakeholder sign-offs during the various phases of the project (e.g. from the schematic design phase to system acceptance phase) are documented in an exact and usable manner that will provide a smooth and transparent transfer of ownership from Design and Construction team to the Building Operations team. The transfer of knowledge must be performed in such a documented manner to allow the sustainment and operation of the facility without impacting the building occupants or deviating from the original design intent.

Deliverables required to be turned over to Building Operations by the construction team prior to the transfer of responsibilities are:

- Design Criteria and Design Narrative Documents form the Design Engineer.
- Engineering and Due Diligence Studies form the Design Engineer
- Factory Acceptance Tests and Factory Inspections
- Site Acceptance Test Results (including Commissioning Plan)
- Pull-The-Plug Test Procedures And Results
- System Acceptance Sign-Off Documents
- Documentation Of Any Training Performed
- Documentation Of Spare Parts
- Documentation Of Warranty Information
- Descriptions Of Systems
- Library Of O&M Manuals
- Contractor Coordination Drawings (Electronic/Hard)
- Contractor As-Built Drawings (Electronic/Hard)
- Architectural Design Specifications And Drawings (Electronic/Hard)
- MEP Design Specifications And Drawings (Electronic/Hard)
- Contact Lists (Vendors/Contractors/Consultants/Etc.)
- Testing and Balancing Reports

The Commissioning Authority verifies these documents have been formally submitted. Many of the documents listed are created by other parties but must be tracked. These deliverables should be delivered to the "Clients Library" which will be utilized by Building Operations.

7 Commissioning Report

7.1 Commissioning Report

A final Commissioning report by AKF will be provided to **National Audubon Society**. The report shall include but not limited to the following:

- Executive summary
- Evaluation of the operating condition of the facility
- Deficiencies that were discovered and the measures taken to correct them
- Uncorrected deficiencies that were accepted by the owner
- Pre-functional test sheets
- Functional Performance test sheets
- Reports that documented all field commissioning activities as they progress.
- Approved test and balance report
- Approved As-built drawings
- Operations and Maintenance manuals

7.2 Re-Commissioning Management Manual

AKF will develop a Re-Commissioning Management Manual which will be delivered to DO with the Commissioning Report. The Re-Commissioning Management Manual will include the following:

- Final version of the owner's requirements and design basis narratives, including brief descriptions of each system
- As-built sequences of operation for all equipment; control drawings
- A list of time of day schedules and a schedule frequency to review them for relevance and efficiency
- A description and rationale for all energy and water saving features and strategies with operating instructions and caveats about their function and maintenance relative to energy use
- Guidelines for establishing and tracking benchmarks for whole building energy use and equipment efficiencies of cooling, AKFting and service hot water equipment
- Seasonal start-up and shutdown, manual and re-start operation procedures, recommendations regarding seasonal operational issues that affect energy use
- Recommendations for re-calibration frequency of sensors and actuators by type and use
- A list of all user adjustable set points and reset schedules with a brief description of the purpose of each and the range of reasonable adjustments with energy implications

- Plans for continuous commissioning or recommended frequency for re-commissioning, by equipment type with reference to tests conducted during initial commissioning
- A schedule frequency to review the various set points and reset schedules to ensure they are at current relevant and efficient values
- Guidelines for energy accounting including assurance that future renovations and equipment upgrades will not result in decreased energy efficiency and maintaining the owner's requirements
- A list of diagnostic tools with use descriptions to assist facility staff
- A copy of the Commissioning Report

Most of these parts are included the standard O&M manuals provided by the general contractor.

8 LEED Requirements

AKF is to perform the following LEED Prerequisites and Credits:

8.1 Prerequisite 1: Fundamental Building Systems Commissioning

- FXFOWLE has engaged AKF as the Commissioning Authority
- Document the owner's project requirements and basis of design
- Include commissioning requirements in the construction documents
- Develop and utilize a commissioning plan
- Verify installation, functional performance to meet the owner's project requirements and basis of design.
- Complete a Commissioning Report

8.2 Credit 2: Enhanced Commissioning

- Conduct a review of tenant's energy-related systems contractor submittals
- Conduct a focused review of the design prior to the construction documents phase
- Conduct a focused review of the Construction Documents when close to completion
- Conduct a selective review of contractor submittals of commissioned equipment
- Develop a re-commissioning management manual
- Develop a contract for an 10^{th} month post occupancy review

****END OF PLAN****

APPENDIX 1 - Team Member Data

FXFOWLE

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Project No: 06053.000 /1610

Issue Date: February 7, 2007
Revised:

Audubon

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Project: Audubon
Project No: 06053.000 /1610

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Project No: 06053.000 /1610

PROJECT DIRECTORY

Issue Date: February 7, 2007
Revised:

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APPENDIX 2 - Sample Forms