

DATE: June 7, 2013

FROM: The Schemmer Associates  
1044 North 115th Street  
Omaha, Nebraska 68154-4436  
Phone: (402) 493-4800  
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TO: Prospective Bidders and Plan Holders

RE: Addendum No. 1 to the Bidding Documents for:  
Boiler Replacement  
VA Project No. 636A6-11-916  
Schemmer Project No. 06054.001

This addendum is issued by the Architect to the Contractor. This Addendum shall be made a part of the Contract Documents. Acknowledge receipt of this Addendum shall be provided on the Bid Form. Failure to do so may subject Bidder to disqualification.

Prior approval of manufacturers is a general approval only for bidding purposes. Final approval of the products is contingent upon the submittal of product data and/or shop drawings which will have to meet the specific design requirements and the specifications.

This addendum consists of five (5) pages of written addendum items, three (3) project manual sections, and eight (8) pages of supplemental drawings.

THE SCHEMMER ASSOCIATES INC.  
ARCHITECTS | ENGINEERS | PLANNERS

# **PROJECT MANUAL**

## **GENERAL**

### **Item No. SG-1**

Section 010000 1.19.B Replace the entire first sentence of the paragraph with the following:

"Manual: Maintenance and operating manuals (four hard copies and one electronic copy in searchable PDF format) for each separate piece of equipment shall be delivered to the Resident Engineer coincidental with the delivery of the equipment to the job site."

### **Item No. SG-2**

Add attached Commissioning Plan in its entirety to the end of Section 019100

## **ARCHITECTURAL**

### **Item No. SA-1.**

Replace door hardware at Door 1 with the following:

<u>Each [AC, EL, REX, DPS] Pair to Have:</u>		<u>HW-SH-9</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Transfer Hinge	4-WIRE TYPE AS REQUIRED	
1	Set Auto Flush Bolts	TYPE 25	
1	Dust Proof Strike	L04021	
1	Electrified Lock	F07 (E01-REX, E06) 24VDC	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Kick Plates	J102 (@ STORAGE ROOMS ONLY)	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
2	Alarm Contacts	1078-G (G.E. SECURITY), OR EQUAL	
120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.			
CARD READER BY DIVISION 28.			

**Item No. SA-2.**

Replace door hardware at Door 5 with the following:

<u>Each [AC, EL, REX, DPS] Door to Have:</u>		<u>HW-SH-3</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Transfer Hinge	4-WIRE TYPE AS REQUIRED	
1	Electrified Lock	F07 (E01-REX, E06) 24VDC	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 – HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL	
120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.			
CARD READER BY DIVISION 28.			

**Item No. SA-3.**

Replace Section 078400 with revised Section 078400 (attached).

**MECHANICAL****Item No. SM-1**

Section 232500 HVAC Water Treatment: replace this specification section with one included with this addendum.

**ELECTRICAL****Item No. SE-1**

Section 260511 1.14, replace paragraph with the following:

“The contractor shall hire the service of an independent NETA certified testing agency to fulfill the Field Quality Testing requirements of the project.”

**Item No. SE-1**

Section 263213 2.1.C. Add/Modify the following list items:

Motor Starting kVA (maximum): 880kVA

Frequency Bandwidth (steady state): + .33%

Voltage Regulation: + .25% (maximum) (No Load to Full Load)

Minimum Generator Subtransient Reactance: .15%

Transient Recovery Time with Step Load Increase (Voltage): 3.6 sec

Transient Recovery Time with Step Load Increase (Frequency): 3.6 sec

Maximum Frequency Deviation with 100% Step Load Increase: 15.2% of rated frequency

Maximum Allowable Backpressure: 10kPa (40.2in water).

**Item No. SE-1**

Section 263213 2.7.G Change the first sentence to read “Coordinate final exhaust piping height to extend piping above the top of overhead door openings.”

## **DRAWINGS**

### **GENERAL**

#### **Item No. DG-1:**

Replace 2/GI001 with attached supplemental drawing SDG-1

### **ARCHITECTURAL**

#### **Item No. DA-1 3/AE201:**

Where an opening is being provided at the South Elevation of the Existing Boiler Plant for the removal of the existing boilers, add note, "Contractor is responsible for protecting existing downspouts as required during demo/remodel of opening."

#### **Item No. DA-2 3/AE201:**

Replace drawing 3/AE201 with supplemental drawing SDA-2 (text was overlapping in original detail)

#### **Item No. DA-3 2/AE407:**

Replace drawing 2/AE407 with supplemental drawing SDA-3 (text was overlapping in original detail)

#### **Item No. DA-4 3/AE501:**

Replace "Room Schedule – Basement" and "Room Schedule – First Floor" with supplemental drawing SDA-4.

#### **Item No. DA 1/AE102 :**

The new wall separating "Open to Below" and "Existing Entrance" has Referenced Plan Note 8 pointing to it, that wall is to be Type E.

### **STRUCTURAL**

#### **Item No. DS-1:**

Replace 9/SF505 with attached supplemental drawing SDS-1

### **MECHANICAL**

#### **Item No. DM-1, Sheet MP101:**

At Referenced HVAC Piping Note #11, add the following: "SEE DETAIL 6/MH502. PROVIDE MULTIFUNCTIONAL BOILER WATER CONTROLLER (CAPABLE OF CONTROLLING ALL 4 BOILERS) AS PART OF CHEMICAL TREATMENT SYSTEM."

See supplemental drawing SDM-2 for chemical feed system modifications.

#### **Item No. DM-2, Sheet MH502:**

Replace Detail 6, Chemical Feed System – Pumped Type, with detail shown on SDM-1.

### **ELECTRICAL**

#### **Item No. DE-1, Sheet EP101:**

Provide a duplex receptacle at the boiler chemical feed control panel, located approximately on gridline D and between gridlines 3 and 4. Connect to circuit 11-LPB-42. Add referenced electrical note marker #12 to receptacle location.

Add referenced electrical note #11 to read "PROVIDE RECEPTACLE FOR BOILER FEED CONTROL PANEL. MOUNT TO STRUT SUPPORTING PANEL. VERIFY LOCATION PRIOR TO INSTALLATION."

**Item No. DE-1, Sheet EP102:**

Add referenced electrical note marker #5 at north door by grid line A, and east door between gridline 3 and 4 (doors 1 and 5). Add referenced electrical note #5 to read "PROVIDE 120V POWER CONNECTION FOR DOOR LOCK, AS REQUIRED. CONNECT TO CIRCUIT 11-LPB-44. COORDINATE REQUIREMENTS WITH DOOR HARDWARE SUPPLIER."

**Item No. DE-1, Sheet EP103:**

At the ground bar location on the one line diagram, add a referenced note marker #6. In the referenced notes, add the following note #6 : "GROUND ELECTRICAL SYSTEM PER NEC REQUIREMENTS. PROVIDE CONNECTION FROM GROUNDING SYSTEM TO THE LIGHTNING PROECTION GROUND RING (COUNTERPOISE) SHOWN ON EP104. SEE 4/EP101 FOR APPOXAMATE LOCATION OF THE GROUND BAR."

**Item No. DE-1, Sheet EP105:**

See supplemental sheet SDE-1 for changes to 3/EP105.

**Item No. DE-1, Sheet EP106:**

At panel schedule 11-LPB, change circuit 42 description to "BOILER FEED SYSTEM CONTROLLER" and circuit 44 description to "DOOR LOCK POWER".

**Item No. DE-1, Sheet EP108:**

At the Fire Alarm Input/Output Matrix, the last line of the output column should read "WATER CONTROL VALVE TAMPER".

**Item No. DE-1, Sheet EY101:**

Change Referenced Electrical Note #1 to read:

"PROVIDE AVIGILON 360 DEGREE PAN, TILT, ZOOM IP CAMERA FOR SECURITY. PROVIDE CONDUIT, BOXES, NETWORK CABLING BACK TO IT ROOM, ETC. FOR A COMPLETE WORKING CAMERA INSTALLATION. COORDINATE FINAL LOCATIONS WITH RESIDENT ENGINEER/COR PRIOR TO INSTALLATION. SEAL ALL PENETRATIONS THROUGH EXTERIOR WALLS."



VA Center Iowa Health Care System  
VACIHCS Boiler Replacement  
Project #636A6-11-916

## *Commissioning Plan*

*KJWW Engineering*



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## REVISION HISTORY AND PLAN ACCEPTANCE

Issued for Pricing .....April 12, 2013  
Submittal Review Process ..... May 29, 2013  
Issued for Approval ..... [DATE]  
Issued for Record ..... [DATE]

\_\_\_\_\_ date \_\_\_\_\_  
Commissioning Authority                      Owner Representative

\_\_\_\_\_ date \_\_\_\_\_  
Construction Manager                      Designer Representative

\_\_\_\_\_ date \_\_\_\_\_  
Designer Representative                      General Contractor

\_\_\_\_\_ date \_\_\_\_\_  
Mechanical Contractor Representative                      Electrical Contractor Representative

\_\_\_\_\_ date \_\_\_\_\_  
Controls Contractor Representative                      TAB Contractor Representative

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## 1.0 | Overview

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## Project Introduction

KJWW Engineering is the commissioning agent for the Boiler Replacement project (VA#636A6-11-916) at the Veterans Administration Central Iowa Health Care System in Des Moines, Iowa. The construction project consists of the replacement of existing boilers and associated support equipment (feed water pumps, controls, deaeration equipment, compressed air systems, piping, and electrical systems). This expansion takes into consideration future Medical Center design needs for steam consumption. Construction will be phased to maintain the supply of steam for the VA facility, even during commissioning.

## General Building Information

Project:	VACIHCS Boiler Replacement
Location:	Des Moines, Iowa
Building Type:	Boiler Plant
Square Footage:	4970
Number of Stories:	2
Construction Period:	July 2013-July 2015

## Abbreviations and Definitions

The following are common abbreviations, not all of which may be used in this document:

A/E	Architects and Engineers	FPT	Functional Performance Test
BOD	Basis of Design	GC	General Contractor
Cx	Commissioning	IST	Integrated Systems Test
CAL	Commissioning Actions Log	LEED	Leadership in Energy and Environmental Design
CxA	Commissioning Authority	MFR	Manufacturer
CxS	Commissioning Specialist	MC	Mechanical Contractor
CM	Construction Manager	O&M	Operation and Maintenance
CC	Controls Contractor	OPR	Owner's Project Requirements
DB/C	Design Build Contractor	PFC	Pre-Functional Checklist
EC	Electrical Contractor	Subs	Subcontractors to General
FAR	Field Activity Report	TAB	Testing, Adjusting, and Balancing Contractor



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## 2.0 | Commissioning Plan

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## Purpose

The Commissioning Plan is a management and communications tool that defines the scope, standards, processes, roles and responsibilities, expectations, and deliverables for the project. It is a dynamic document that is revised and refined as the phases of the project progress.

The plan also defines the equipment and systems, commissioning requirements, and addresses the integration of commissioning into the overall project delivery process. This plan is intended to assist members of the Project Team in applying a clear and consistent approach to commissioning during all phases of project delivery.

The CxA develops the Cx Plan using input from the commissioning team. The plan includes the following:

- Commissioning Team. Defines the roles and responsibilities of the team members.
- Commissioning Scope of Work. This describes in detail the scope of work and the roles and responsibilities, identifies the equipment and systems to be commissioned and defines the related commissioning specification requirements.
- Commissioning Forms. A description of the checklist and test forms to be completed.

The Owner, Design Consultants, and Contractor shall review the Cx Plan with the CxA. The approved document will be distributed to the Commissioning Team for information and action. As changes or modifications are needed, the CxA will incorporate them and redistribute the Cx Plan for approval.

## Commissioning Definition

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the Owner's operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

Commissioning is not a replacement for good design and construction practices but is seen as a means to enhance the delivery process. The process consists of a series of checks and balances to ensure that the work is designed, installed and proven to operate as intended. Commissioning facilitates the transition from programming through design into construction and operations.

## Systems to be Commissioned

### Mechanical System (and all integral equipment controls)

- Boiler, packaged type (qty 4)
- Pump, boiler feed (qty 3)
- Blowdown tank (qty 1)
- Steam vent silencer (qty 1)
- Pump, chemical feed system (qty 6)
- Ductless split system AC unit (qty 4)
- Exhaust fan (qty 3)
- Variable frequency drive (qty 4)
- Economizer (qty 4)
- Air Handling Unit (qty 1)
- Deaerator tank (qty 1)
- Pump, fuel oil (qty 2)
- Air compressor (qty 2)
- Testing, adjusting, and balancing work
- Direct Digital Control (DDC) system
- Building automation system (controlled devices, control loops, and system integration)

### Electrical Systems

- Automatic transfer switches (qty 2)
- Panelboards (qty 4)
- Transformer, low voltage, dry type (qty 2)
- Generators (qty 1)
- Grounding

### Plumbing Systems

- Gas fired water heater (qty 1)
- Expansion tank (qty 1)
- Pump, hot water circulation (qty 1)

## Sampling and Retesting Strategy

All systems/equipment will be commissioned at 100% with 0% failure limit.

## Commissioned Equipment List

At the conclusion of the project, the CxA will have gathered all equipment from the construction documents and coordinated the applicable information into a database. This database will associate the architectural naming tag, designed physical location and intended manufacturer and model number, if provided. This information will be made

available to the Owner for initial review. At the conclusion of the project and through the Commissioning process, the initial data collection will be updated by the Commissioning Team with as-built information. The database can be exported and provided to the Owner at any time for inclusion in the Owner's Computerized Maintenance Management System (CMMS).

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### 3.0 | Commissioning Team



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VACIHCS Boiler Replacement  
Project #636A6-11-916

Commissioning Team

Role	Company		Point of Contact				
	Name	Address	Name	Title	Phone Number	Cellular Number	Email Address
Owner's Representative	Veterans Health Administration	3600 30 <sup>th</sup> Street, Des Moines, IA	Roger Fry	PM	(515) 699-5564	(515) 689-2807	<a href="mailto:Roger.Fry@va.gov">Roger.Fry@va.gov</a>
			Bruce Mitchell	FM			<a href="mailto:Bruce.Mitchell2@va.gov">Bruce.Mitchell2@va.gov</a>
Architect of Record	Schemmer						
Commissioning Authority	Anderson Engineering	13605 First Ave North, Suite 100, Plymouth, MN 55441	Peter Rauma	Cx PM	(763) 412-4034		<a href="mailto:PRauma@AE-MN.com">PRauma@AE-MN.com</a>
Commissioning Authority	KJWW Engineering	231 S. LaSalle Ave, Suite 600, Chicago, IL 60604	Ryan LePera	CxA, Mech Cx	(515) 334-4318		<a href="mailto:leperarm@kjww.com">leperarm@kjww.com</a>
Commissioning Specialist	KJWW Engineering	231 S. LaSalle Ave, Suite 600, Chicago, IL 60604	Lincoln Pearce	Cx PE	(515) 334-7937	(309) 781-1653	<a href="mailto:pearceld@kjww.com">pearceld@kjww.com</a>
			Derek De Jesús	Elec Cx	(312) 931-3703	(312) 632-0401	<a href="mailto:dejesusdw@kjww.com">dejesusdw@kjww.com</a>
			Jeff Jameson	Mech Cx	(630) 753-8520	(630) 370-0514	<a href="mailto:jamesonjj@kjww.com">jamesonjj@kjww.com</a>
			Todd Barrett	Structural	(515) 334-4308		<a href="mailto:barretta@kjww.com">barretta@kjww.com</a>
Mechanical Engineer	Schemmer	1044 N. 115 <sup>th</sup> Street, Suite 300, Omaha, NE 68154	Rene Meyersick	Mech Engr	(402) 431-6374		<a href="mailto:rmeyersick@schemmer.com">rmeyersick@schemmer.com</a>
Electrical Engineer	Schemmer	134 S. 13 <sup>th</sup> Street, Suite 1100, Lincoln, NE 68508	Joe Binge	Elec Engr	(402) 431-6209		<a href="mailto:jbinge@schemmer.com">jbinge@schemmer.com</a>
General Contractor							
Mechanical Contractor							
Electrical Contractor							
Plumbing Contractor							
Controls Contractor							
Testing, Adjusting, Balancing Contractor							
Technology Contractor							
Fire Protection Contractor							

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## 4.0 | Commissioning Process

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## Commissioning Process

The following sections sequentially detail the commissioning process by task through each phase of the project while incorporating the Roles and Responsibilities of the Commissioning Team.

### Design Phase

Task	Owner	Architect	CxA	Engineer
Design Documents	Review & Approve	Develop & Respond	Review & Comment	Develop & Respond
Cx Plan	Review & Approve	Review & Approve	Develop & Manage	Review & Approve
Cx Specifications	Review	Incorporate	Develop & Manage	Incorporate
Cx Meetings	Attend	Attend	Lead	Attend

### Design Documents

The CxA shall review the design documents prior to the Issued for Documents phase. This review will focus on the following:

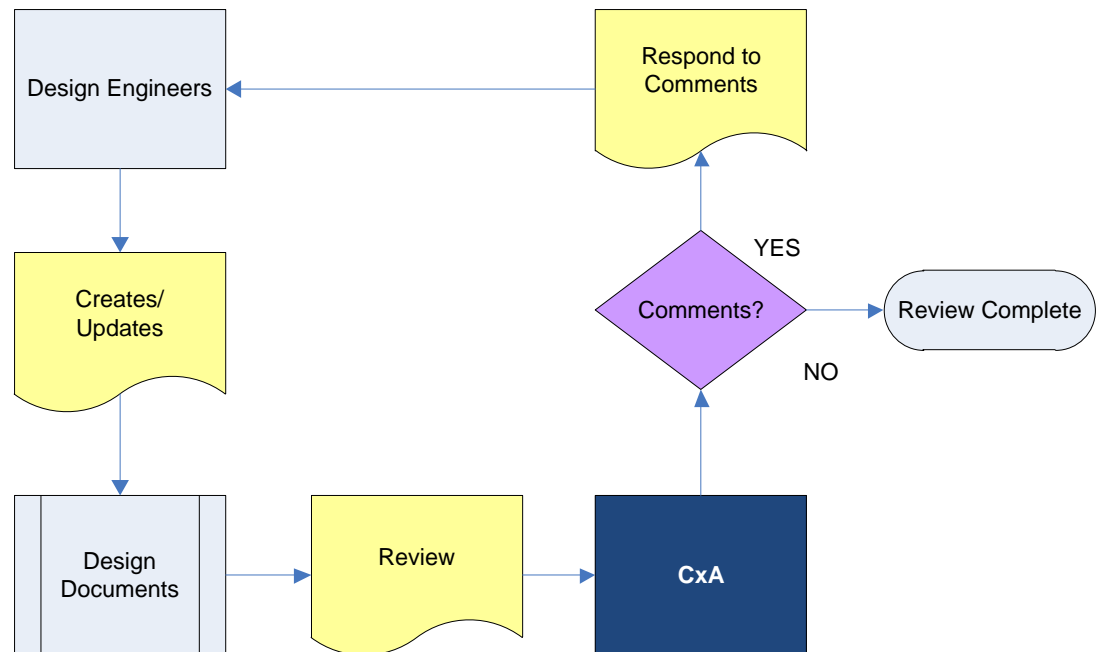
- Ability for systems to be commissioned
- Ensure that the O&M and testing requirements are incorporated
- Review the ability of the Owner to operate and maintain equipment
- Previous experience for consideration by the team

The main purpose for performing a design review of the construction documents is to ensure the design meets the Owner's requirements. Typical reviews will address, but are not limited to, accessibility, maintainability, and energy efficiency with respect to sensors, gauges, BAS points, valves, dampers, etc.

Although the CxA may provide design related review comments, the CxA is not responsible for design concept, design criteria, or compliance with codes. The CxA does not verify the designers' calculations, proof schematics or layouts in detail nor perform constructability reviews.

Additional reviews by the CxA throughout the design process may be desired. A follow-up review of the construction documents is required, at a minimum, to confirm the previously issued comments were incorporated by the design engineers. Their responses to the initial comments supplement this review. The CxA maintains a list of all

review comments and their resolution is included in the final report. The CxA will send all comments directly to the Owner who will distribute them to the A/E as required.



*Diagram 1 - Design Review Process*

## Commissioning Plan

As detailed earlier, the CxA develops and manages any updates to the Commissioning Plan. It is the responsibility of each Cx Team member to review and comment on the process and expectation of each individual and company defined in the Cx Plan. Acceptance prior to project completion is a requirement.

## Commissioning Specifications

The CxA develops the commissioning specification sections and coordinates the integration of the commissioning requirements into the remainder of the project specifications. This will ensure that all systems and equipment to be commissioned are clearly identifiable by the general contractor and their subcontractors for accurate pricing. Coordination of training and O&M manuals will be a part of the commissioning specifications and design reviews. This coordination is achieved through the design review process with the Architect and Engineer.

## Commissioning Meetings

As required by the Owner and Scope of Work for the project, the CxA shall lead the design phase commissioning meetings.

A typical agenda for the meeting would include:

- a. Commissioning Process
- b. Commissioning Plan
- c. Commissioning Deliverables
- d. Commissioning Activities
- e. Peer Review Comments

Exact scope shall be determined by the CxA and documented in an agenda and subsequent meeting minutes. The CxA will document meeting minutes and distribute by the end of the next business day from the meeting for comment and revision by the Commissioning Team.



### Construction Phase

Task	Owner	Design Team	CxA	GC	Sub/Vendors
Cx Schedule	Review	--	Maintain	Coordinate	Comply
Commissioning Meetings	Attend	Attend	Lead	Attend	Attend
Submittals	Review	Approve	Review & Comment	Submit	Submit
Site Observations	Attend	--	Perform & Document	Coordinate	Support
Pre-Functional Checklists	--	Review	Develop & Approve	Review & Perform	Review & Perform
Equipment Startup	Attend	Review & Approve	Witness & Review	Coordinate	Perform & Document
Field Quality Control Testing	--	Review & Approve	Witness & Review	Approve & Submit	Perform & Document
Testing, Adjusting and Balancing	--	Review & Approve	Witness & Review	Coordinate	Perform & Document
BAS Point to Point	--	Review & Approve	Witness & Review	Coordinate	Perform & Document

### Commissioning Schedule

The CxA will develop and maintain a tracking and monitoring system for commissioning services. Additionally, a schedule will be developed which incorporates the following:

- Description of Cx activity
- Prerequisite construction task required to execute Cx activity
- Elapsed time duration of each activity
- Documentation associated with each task/document responsibility.

### Commissioning Kickoff Meeting

The respective representatives of the GC, CxA, Owner's Representative, A/E, and the mechanical, electrical, controls, and TAB subs should be in attendance as required. At the inception of the Commissioning activities in the Construction Phase, our team will organize and hold a Kickoff Meeting with all interested parties. The intent of this meeting is to introduce the contractors to the accepted commissioning process as determined in

the Design Phase. This is done through a presentation overview of the process and distribution of the Cx Plan that was provided in the Issued for Construction Documents.

A typical kickoff meeting agenda would include:

- a. Commissioning Team introductions
- b. Team introductions with roles related to the project
- c. KJWW Commissioning Process
- d. Scope of Services Review
- e. Communication Reporting lines
- f. Schedule discussion
- g. Questions
- h. Site walkthrough (after meeting)

The goal of the meeting is to promote 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 Commissioning Plan, including the project schedule and commissioning points of contact.

### Commissioning and Project Meetings

The CxA will attend regular planning and job site meetings to remain informed of the construction progress and to update the parties involved in commissioning. The GC and A/E provide the CxA with information regarding substitutions and change orders that may affect commissioning equipment, systems, or the commissioning schedule.

The CxA will coordinate with the Contractor and Owner to schedule Commissioning meetings in conjunction with regular progress meetings. An agenda will be developed by the CxA and distributed to the Commissioning Team.

A typical Cx project meeting agenda would include:

- a. Schedule review
- b. PFC status
- c. Equipment start-up status
- d. FPT status
- e. Recap of upcoming activities relating to commissioning
- f. Commissioning Actions Log review
- g. Site visit (before or after the meeting)

Dates, times and prerequisites for upcoming Commissioning checks, start-ups, or tests will be established. Issues will be raised and problems identified with required action decided, and a date for completion determined. Commissioning Team members are

responsible for attending Commissioning meetings and for completing assigned action items by the assigned dates. The CxA will document meeting minutes and distribute by the end of the next business day following the meeting for comment and revision by the Commissioning Team.

### Equipment Submittals and Documentation

The CxA will review and comment on equipment submittals after the design team has reviewed the initial submittal. Should the design team reject the submittal, they will provide their submittal comments to the Owner for submission to the contractor. If the initial submittal would be approved, the design team passes the submittal with their comments to the CxA for review. The CxA will review the submittal and pass along any comments via the CAL required to the design team to incorporate into the final comments. This submittal will then be submitted to the Owner for their review and comments. Just like the rejected submittal, this submittal will also be submitted to the contractor.

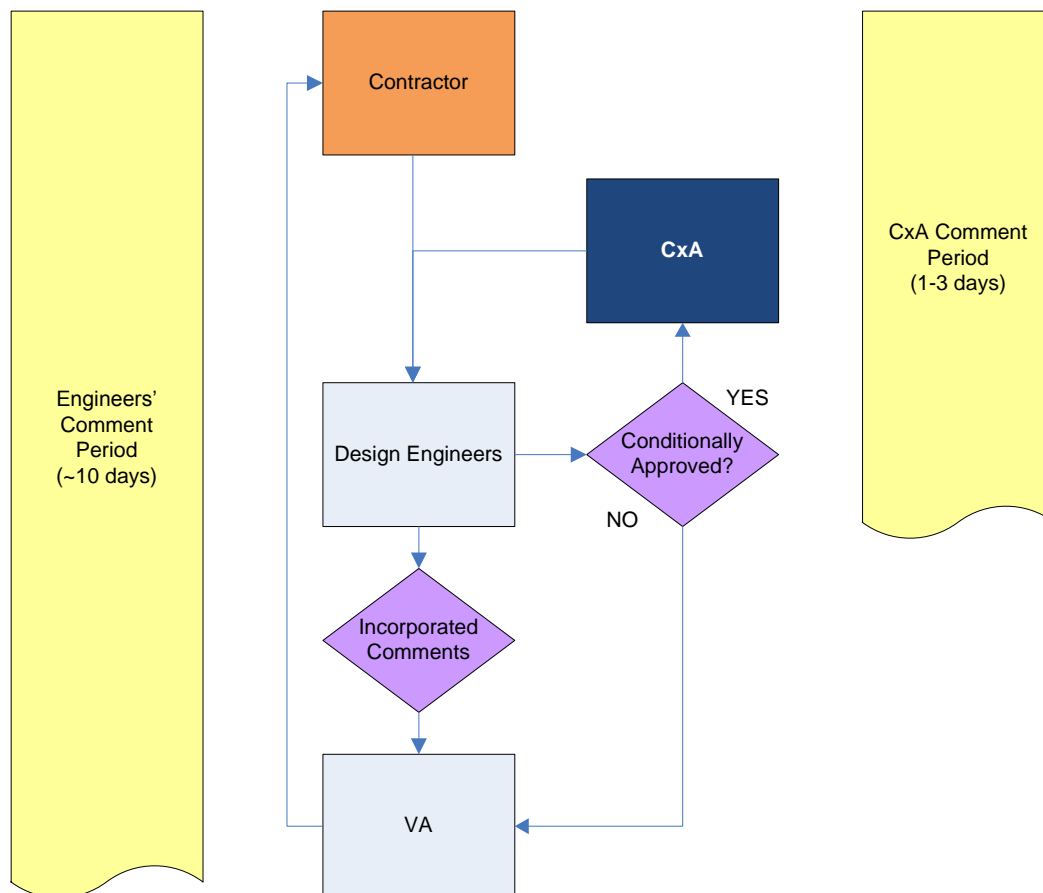


Diagram 2 - Submittal Review Process

## Special Submittals, Notifications, and Clarifications

The subcontractors, GC, or A/E shall notify the CxA of any new design intent, operating parameter changes, added control strategies and sequences of operation, or other change orders, RFI's, ASI's, etc. that may affect commissioned systems. The controls contractor provides the CxA a full points list with descriptions. 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 approved TAB report is provided to the CxA upon completion.

The CxA will issue RFIs to the A/E and the VA regarding questions that impact system/equipment operations, maintenance or functional testing. The CxA will review these and issue any comments to the Owner and the A/E for their review.

## Site Observations

The CxA makes weekly visits to the site to witness equipment and system installations. Field Activity Reports (FARs) will be issued to document activities, observations and any issues or deficiencies. These will be issued to the Owner and the rest of the construction team as necessary.

## Pre-Functional Checklists, Tests, and Startup

Pre-Functional Checklists (PFC) are important to ensure that the equipment and systems are installed, operational and that functional performance testing may start without any unforeseen delays. Each piece of equipment receives full pre-functional checkout by the contractor. The PFC for a given piece of equipment must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

PFC's are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels, fan belt tension, labels affixed, gages in place, sensor calibration, etc.). However, some PFC items entail simple testing of the function of a component, a piece of equipment, or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The PFCs are made up of (4) four parts: equipment data, nameplate data, installation checks and startup/documentation checks.

- **Equipment Data:** Used to capture information a maintenance management system would typically require, i.e.: tag no., make, model, serial no., location.

- **Nameplate Data:** Used to capture relevant nameplate data from the actual equipment installed. This can be compared to the approved equipment to ensure that the proper piece of equipment has been installed.
- **Installation Data:** Used to verify that the equipment has been properly installed and is ready for startup.
- **Documentation Data:** Used to confirm that the equipment has been started in accordance with the manufacturer's and specified requirements and that where required the associated startup and test reports are provided.

Contractors typically already perform some, if not most, of the PFC items the CxA will require. However, few contractors document in writing the execution of these checklist items. This process requires that the procedures be documented in writing by the installing technician. The CxA does not witness many of the PFCs, except for the larger or more critical pieces of equipment and random samples of other equipment and systems.

The GC is responsible for maintaining and gathering all PFC's for return to the CxA. An on-site binder may be used that can be checked out from the GC to complete checks, and then returned to be available to other contractors. The project-approved method is shown below in Diagram 3.

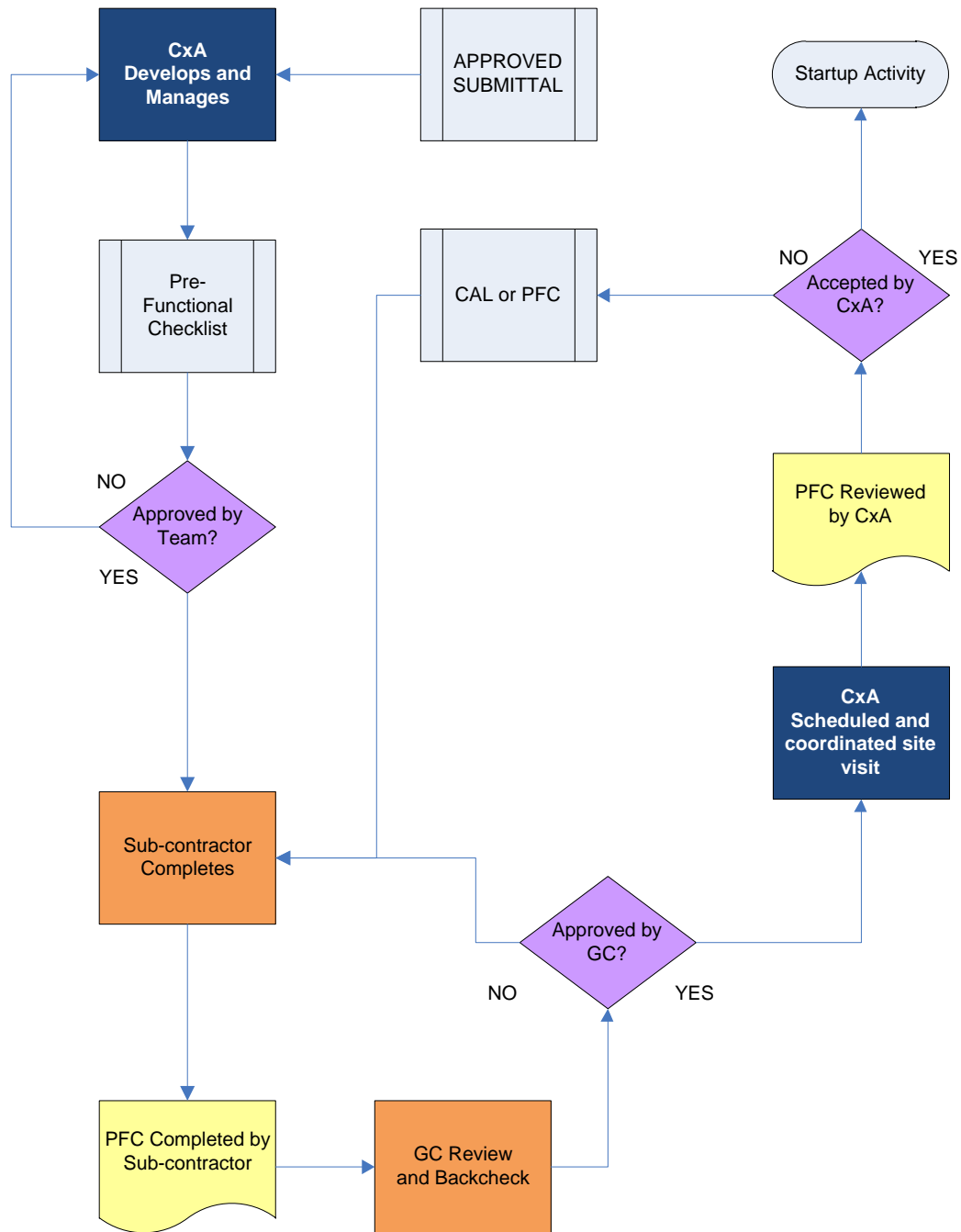


Diagram 3 - Pre-Functional Checklist Process

## Equipment Startup

The start-up process is scheduled by the subcontractor responsible for the equipment and the systems being started. The subcontractor incorporates into the overall schedule the startup activities for the team to review. The CxA witnesses the startup of equipment and systems, as well as coordinates the schedule to allow the Owner staff the ability to witness the process as well.

The subcontractor executes equipment startup according to the startup plan and provides the CxA with a signed and dated copy of completed start-up plan documents. The subcontractor must notify the CxA in writing within 2 weeks of any outstanding items from the initial start-up process. The CxA will document these items in the CAL so their resolution can be tracked and recorded. Outstanding items must be satisfactorily addressed and documented within 2 weeks of start-up. All startup procedures must be satisfactorily executed before functional testing begins and before the equipment is operated, even temporarily.

Once the equipment and systems are started, the subcontractor is responsible for maintaining the warranty of the equipment. At a minimum, the subcontractor shall develop and submit a temporary use plan for the equipment that shows the hours of operations, routine maintenance plans and a sign-off form documenting who and when maintenance was performed. The plan will be kept on site and available for review by the team as needed. The plan will be turned over to the CxA at the completion of the project for inclusion with the Final Cx Report.

## Field Quality Control Testing

The subcontractor is responsible for coordinating and preparing any field quality control testing for the CxA to witness. Examples of this type of testing would be pipe and duct pressure testing, NETA testing and generator load bank testing. These tests are typically identified in the project specifications under Part 3. These activities should be scheduled with the General Contractor and included in the overall project schedule. The CxA will witness the test or review test reports from these activities.

## Testing, Adjusting and Balancing

The CxA will review the Testing, Adjusting and Balancing (TAB) report as compiled by the contractor. The CxA will review preliminary, hand written copies as documented by the contractor during site observations. Any comments will be directed to the GC and TAB contractor via the CAL. The CxA will also observe TAB activities to ensure that flow rates are adjusted to the design values and to verify the procedure used to balance the systems with diversity is adequately described.

The final TAB report shall be submitted as a standard submittal per the project requirements and the review process shall be as the other submittals.

## BAS Integration

In order to assist in mitigating miscommunication from the design sequence of operations and the approved sequence of operations submittal, the CxA will meet with the designer and controls contractor. This purpose of this meeting is to review that the design intent is met through the algorithms residing in the controllers, determine if the sequences match, and are compatible with the functional performance test procedures written. Often this detailed review of the a sequence of operation program will raise questions regarding the clarity and completeness of the approved sequence of operations and whether the actual process control program can implement the design intent. When these kinds of issues arise, they are documented in the CAL and RFIs are generally issued to officially change a project document. These RFIs can be generated by the CxA or the controls contractor and are responded to by the designer.

After the meeting is completed and programming ensues, the controls subcontractor will begin to prove device control, calibration and accuracy. This activity is commonly referred to as “point to point” and is a key startup activity by the contractor. The CxA will review the BAS points list; incorporate the points into the PFC for the BAS or specific equipment PFC for review and acceptance. The BAS contractor will also document the points on their own form and submit as part of the official project submission process. Proving that the analog or digital point operates as intended is crucial for proving the equipment or system will operate as intended and documented as per the sequence of operations.



## Acceptance Phase

Task	Owner	Design Team	CxA	GC	Sub/Vendors
Commissioning Meetings	Attend	Attend	Host	Attend	Attend
Site Observations	Attend	--	Perform & Document	Coordinate	Support
Functional Performance Test - Documentation	Review & Comment	Review & Comment	Develop	Review & Comment	Review & Comment
Functional Testing	Attend	Support	Witness & Document	Coordinate	Support & Perform
Deficiencies (Cx Actions Log)	Support	Support	Witness & Document	Coordinate & Document	Perform & Document
Re-Testing	Attend	Support	Witness & Document	Coordinate	Support & Perform

### Commissioning Meetings

Commissioning meetings will be as described in the above section.

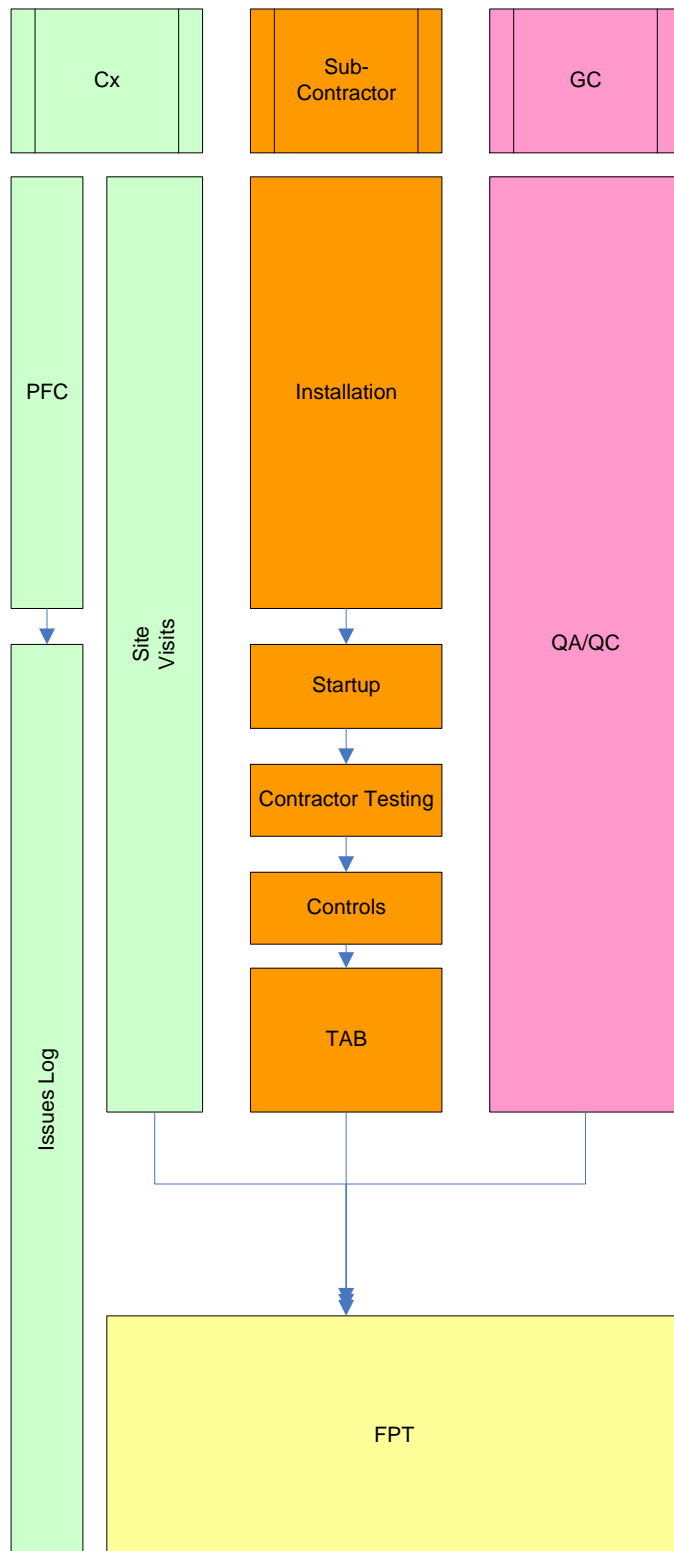
### Site observations

Site observations will be as described in the above section.

### Functional Performance Tests

Functional testing is the dynamic testing of equipment and systems 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 the control system's sequences of operation, and components are verified to be responding as the sequences state. The CxA develops the Functional Performance Test procedures in a sequential written form, and coordinates, witnesses, and documents the actual testing, which are performed by the installing contractor or vendor.

## FPT 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 develops specific test procedures to verify proper operation of each piece of equipment and system to be commissioned. The CxA obtains clarification, as needed, from contractors and the A/E regarding sequences and operation to develop these tests.

Functional testing 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-logging capabilities. Standalone data loggers may also be utilized.

### Execution of Functional Performance Testing

The CxA schedules functional tests through the Owner's Representative, GC, and affected subs. We encourage the contractors to attempt to perform the FPT prior to the Cx team witnessing them. This pre-functional testing will reduce documented deficiencies and allow the contractor to prove the system and/or equipment operate as documented.

The CxA coordinates, witnesses, and documents the functional testing of the equipment and systems according to the Commissioning Plan. The subcontractors execute the tests. The control system is tested before it is used to verify performance of other components or systems. The air and

water balancing is completed and debugged before functional testing of air-related or

water-related equipment or systems. Testing proceeds from components to subsystems, to systems, and finally to interlocks and connections between systems.

### Deficiencies, Re-testing, and Acceptance

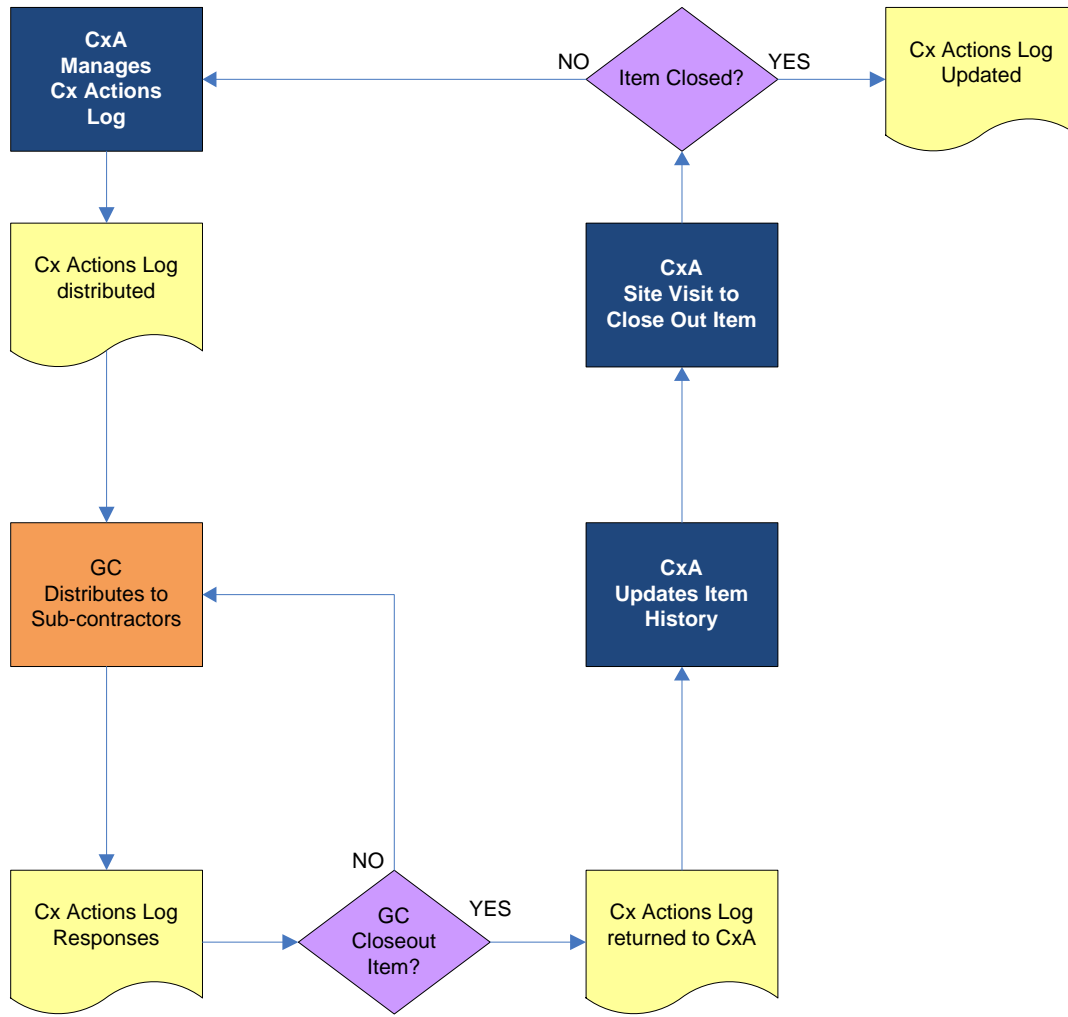
Incomplete work or deficiencies discovered in PFCs or FPTs will be corrected by the responsible contractors and re-tested or witnessed to produce satisfactory results prior to proceeding to the next stage of the Commissioning process. The Contractor is responsible for deficient or incomplete work and will be responsible to ensure corrections necessary for full and complete system operation as specified are completed. One re-test for a given system or component will be performed within the scope of normal commissioning. Additional re-tests required due to contractors not having the system or component functional for successful re-testing will result in charges to the contractors for additional re-testing time (beyond one re-test).

Once all major deficiencies regarding equipment and system functionality are addressed, the CxA will recommend to the Owner that the building is ready for acceptance. In accordance with the contract documents, acceptance of the building by the Owner typically initiates specified warranties. Commissioning clarifies requirements for initiation of the warranty period.

### Commissioning Actions Log (CAL)

The CxA keeps a log of all commissioning-related issues that require current or future attention. The Commissioning Actions Log (CAL) provides a sortable form for tracking the status of all commissioning-related issues, including possible cause, recommendations, and action taken. As an item is identified, it is assigned to a responsible team member for championing its resolution. Through correspondence, such as Requests for Information (RFIs), emails, phone calls, site visits, etc., items will be updated with status updates on an as-required basis, depending on the level of importance. Items that directly impact an activity or milestone will be required to be addressed sooner rather than later. Responsible team members will change as the item is updated and the CxA documents this evolution.

The CAL is not meant to be utilized as a “punch list” or deficiency report for action at the end of the project. For the Commissioning Process to be successful, the items on the CAL need to be addressed and removed as soon as possible with updates on progress made as requested. The CAL is one of the main agenda topics at the regularly held Commissioning Meetings.



*Diagram 5 - Actions Log Management Process*

### Occupancy Phase

Task	Owner	Design Team	CxA	GC	Sub/Vendors
Training Plans	Approve	--	Review & Comment	Coordinate	Develop
Training	Attend	--	Coordinate & Attend	Coordinate	Perform
O&M Manuals	Review & Comment	Approve	Review & Comment	Develop	Develop
As-Built Drawing Review	Approve	Support	Review	Support	Support
Final Summary Report	Approve	--	Develop	--	--
Deferred Testing	Coordinate & Attend	Support	Witness & Document	Coordinate	Support & Perform
Decommissioning	Coordinate & Attend	Support	Lead	Coordinate	Support & Perform

### Training and Orientation of Owner's Personnel

After reviewing the specifications and interviewing facility staff, if necessary, the Owner and CxA fill out the following table listing all the equipment for which training or orientation will be provided. The Overall Staff Training and Orientation Plan lists included in the Appendix of the Cx Plan, lists among other things, the type and number of trainees, rigor of training desired by the Owner, the primary responsible subcontractor, the trainer's company, and columns for tracking training agendas. This document is to be used for each training session planned in the following table. This activity is performed in the Design Phase and has been coordinated through the Commissioning Specification and the Demonstration and Training Specification. The contractor and vendor will accommodate alternate shifts and repetitive training sessions for the Owner as part of the bid.

The CxA shall, with the help of the owner, draft an RFP to the Engineer of Record to ensure that system level training services are provided and performed. The CxA shall attend all training sessions with the Owner. At the conclusion of each training session, the CxA, Owner, staff and vendor will review the program for adequate information. At this time acceptance will be determined and any additional training will be delivered or scheduled.

VACIHCS Boiler Replacement  
Project #636A6-11-916

Section	Description	Duration (hrs)
22 11 23	Domestic Water Pumps	4
22 34 00	Fuel-Fired Domestic Water Heaters	4
23 08 11	Demonstrations and Tests for Boiler Plant	56
23 09 11	Instrumentation and Control for Boiler Plant	8
23 09 23	Direct-Digital Control System for HVAC	8
23 10 00	Facility Fuel Systems	8
23 21 23	Hydronic Pumps	4
23 22 23	Steam Condensate Pumps	4
23 34 00	HVAC Fans	2
23 50 11	Boiler Plant Mechanical Equipment	4
23 52 33	Water-Tube Boilers	16
23 73 00	Indoor Central-Station Air-Handling Units	4
23 81 00	Decentralized Unitary HVAC Equipment	4
23 82 00	Convection Heating and Cooling Units	4
26 09 23	Lighting Controls	4
26 22 00	Low-Voltage Transformers	4
26 24 16	Panelboards	4
26 32 13	Engines-Generators	8
26 36 23	Automatic Transfer Switches	4

### Operations and Maintenance Manuals

O&M Manuals are prepared by the contractors for all maintainable equipment. They are organized by specification section as per the requirements of the Operations and Maintenance Manual's specification section. These are reviewed and comments are provided per the Submittal process described earlier.

### As-Built Drawing Review

At the end of the project, the G/C shall submit the as-built drawings to the CxA for review. We will review the as-built drawings regularly throughout the construction and acceptance phases of the project for accuracy. Discrepancies will be addressed directly and tracked on the CAL for resolution.

### Final Summary Report

A Final Summary report by the CxA will be provided to the Owner. This document summarizes the results of the commissioning process and discusses variances between design intent and the as-tested conditions and identifies any special operational or maintenance issues noted during commissioning. It also provides an evaluation of the

systems operations and can serve as a future reference document during the operation of the facility systems.

The report will include, but is not limited to, the following:

- I. Sections
  - A. Executive Summary
  - B. Commissioning Actions Log
  - C. Commissioning Plan
  - D. Commissioning Specs
  - E. Design Reviews
  - F. Submittal Reviews
  - G. O&M Reviews
  - H. Commissioning Coordination Meeting Minutes
  - I. Commissioning Field Reports
  - J. Master Equipment List
  - K. Completed Pre-Functional Checklists
  - L. Completed Startup Reports
  - M. Blank Functional Performance Tests
  - N. Completed Functional Performance Tests
  - O. Training Plans, Agendas and Sign-in rosters
  - P. As-Built reviews
  - Q. Re-Commissioning Manual

### Deferred Testing

The CxA coordinates, witnesses, and documents the completion of seasonal equipment and system testing by the contractors. The CxA works with the contractors in resolving issues identified during testing. The CxA incorporates comments into the Final Summary Report and provide a final copy to the Owner.

### Decommissioning

The CxA shall coordinate the decommissioning of the existing boiler system. The CxA will perform required site visits and issue FARs outlining observations and results, documenting that the demolished system does not affect the performance and installation of the new system is the goal of this activity. The exact nature of the scope of work for this task will be determined with the CxA and Owner, as will the roles and responsibilities of the team during this work.

## 5.0 | Appendix



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### Example Commissioning Activities

Milestone	Duration	Predecessor	Successor
Commissioning Kickoff Meeting	1 day	All contractors onboard including Controls and TAB	MEP Equipment Installation
Pre-Functional Checklist Coord. Mtg	1 Day	Develop PFCs	PFCs (at least 2 weeks after)
Develop System Functional Performance Tests	3 weeks	CD & Equipment submittal reviews & PFCs complete	TAB & FPT
Complete Pre-Functional Checks	3 months	Equipment installation & startup is complete	TAB & FPT
Re-occurring Cx Coordination Meetings	Monthly	Pre-Functional Checklist Meeting	
Equipment Mfg Startup	3 weeks	PFC Acceptance	Controls, Contractor Testing
Control System Startup & Checkout	4 weeks	PFC Acceptance	TAB & Functional testing
Testing, Adjusting, & Balancing (TAB)	2 weeks	Controls Checkout, HVAC PFCs	Functional testing (at least 2 weeks after)
Pre-FPT Meeting	1 day	TAB, Contractor Testing	FPT
Functional Performance Testing	3 months	TAB & all PFCs complete	Integrated Systems Test / Owner Acceptance
Final Operations & Maintenance Manuals Submission	1 week	Functional Testing	Operator Training
Systems Training Pre-Conference	1 day	Functional Testing	Training (at least 4 weeks after)
Systems Operations & Maintenance Training	2 weeks	Final O&M Delivery	Owner Acceptance
Decommissioning	3 months	Owner Acceptance/ Operation New Boiler	Owner Acceptance

## Overall Staff Training and Orientation Plan

### OPERATION AND MAINTENANCE TRAINING PLAN

The Contractors and Vendors shall provide training per specification 01 79 00-2.1. The Training Sessions provided by the responsible Contractors shall be customized for this project and reflect all the installed equipment and systems. Training of the materials, components, systems and equipment shall, at the minimum, incorporate the items listed in this specification section for the equipment and systems installed for this project.

#### Section A (to be completed by the Contractor/Vendor)

Training to be conducted by (attach qualifications of instructor):

Name:	Title:
Company:	Phone:

Intended Audience (skill level, experience, etc...):

Time Required (per Cx Plan):	Primary Date:     /     /
Alternate Date 1:     /     /	Alternate Date 2:     /     /
Videotaping: yes / no	Location of Training:
Special Requirements:	

Use specification 01 79 00-2.1-B as the basis for subject. Define briefly a description of the subject.

Subject Covered	Description	Approx. Duration
1.		_____ hrs
2.		_____ hrs
3.		_____ hrs
4.		_____ hrs
5.		_____ hrs
6.		_____ hrs
7.		_____ hrs
8.		_____ hrs

Attach additional pages if necessary, number of attached pages:  
Send original to the Commissioning Agent for approval

#### Section B (to be completed by the Owner and Commissioning Agent)

Training Plan Approval (by Commissioning Agent) Approved? <input type="checkbox"/> Yes <input type="checkbox"/> No	Training Plan Approval (by Owner) Approved? <input type="checkbox"/> Yes <input type="checkbox"/> No
---	---

Comments:

Name:	Company:	Date:     /     /
Name:	Company: KJWW Engineering	Date:     /     /

Attach additional pages if necessary, number of attached pages:

## OPERATION AND MAINTENANCE TRAINING PLAN ATTENDANCE ROSTER

## Section C (to be completed by the Attendees)

[illegible]

## Section D (to be completed by the Owner and/or Commissioning Agent)

The training has satisfactorily provided the Owner's personnel with the knowledge to operate and maintain the equipment discussed during the training session?

Facility O&M Representative ☐ Yes ☐ No Name: \_\_\_\_\_ Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Commissioning Agent      ☐ Yes   ☐ No      Name: \_\_\_\_\_      Date:      /      /

If No, briefly describe the additional training required:

Attach additional pages if necessary, number of attached pages:

Send original to Commissioning Agent and copies to Facilities O&M Representative

### **Pre-Functional Checklists**

The following PFCs are examples and are provided for the contractor to have an understanding of the level of rigor required to perform the work. The equipment listed is a sampling from the Systems to be Commissioned List. Once equipment submittals have been provided to the CxA, per the Cx Plan process these documents will be updated and finalized for the contractor to complete. These are for SAMPLE use only.

The following PFCs are included:

- Air Compressors
- Water Heater
- Controls
- Fuel Oil System
- Hydronic Piping
- Pumps - Boiler
- Pumps - Chemical Feed System
- Steam Condensate Piping
- Fans
- Boilers
- AC Split System
- Air Handling Unit
- Grounding
- Transformer, Dry Type
- Panelboard
- Generator
- Automatic Transfer Switch

The CxA will develop a Commissioning Tracking Matrix which will identify the inventoried equipment and how they are related to each PFC. This tracking tool will be managed by the CxA but reports, such as completion status will be issued to the team as required. The Master Equipment List and Tracking Matrix will be updated as required and the quantities of documents can change without notice as the project requirements are revised.

### **Functional Performance Tests**

The following FPTs are examples and are provided for the contractor to have an understanding of the level of rigor required to perform the work. The equipment listed is a sampling from the Systems to be Commissioned List. Once equipment submittals have been provided to the CxA, per the Cx Plan process these documents will be updated and finalized for the contractor to complete. These are for SAMPLE use only.

The following FPTs are included:

- Boiler
- Air Handling Unit
- Generator

The CxA will develop a Commissioning Tracking Matrix which will identify the inventoried equipment and how they are related to each PFC. This tracking tool will be managed by the CxA but reports, such as completion status will be issued to the team as required. The Master Equipment List and Tracking Matrix will be updated as required and the quantities of documents can change without notice as the project requirements are revised.

**Functional Performance Test:  
FPT-06 - Generator****Sample  
Sample  
Chicago, IL****KJWW #xx.xxxx.xx**

Revision		
Level	Date	Description
0	12/03/12	Issued for Review

**1. Participants:**

Date	Person	Organization	Acceptance Signature

**2. Test Prerequisites:**

Prerequisite	Complete Y / N	Notes:
These functional test procedures have been reviewed and approved by the installing contractor		



### 3. DDC System Point Review / Check

#### A. Equipment Points

Point No.	Point Description	Type	Point Values	Pass (Y / N)	Notes
1)	Generator shutdown.				
2)	Generator running.				
3)	Generator pre-alarm or alarm.				
4)	Generator low fuel level				

### 4. Sequence of Operation Review / Test

A. Refer to contract documents and control shop drawings for sequence of operation.

### 5. Functional Testing Record

#### A. Pre-Test Checkout

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Verify PFC has been completed and accepted by the Commissioning Agent.	<ul style="list-style-type: none"> <li>a. Most of the items are complete</li> <li>b. Items with deficiencies will not hinder testing.</li> </ul>		
2)	Briefly inspect the generator to verify equipment has not been damaged, worked on, or tampered with after PFC acceptance by the CxA.	<ul style="list-style-type: none"> <li>a. No evidence of damage.</li> <li>b. Engine generator exterior (not enclosure) is clean and dry.</li> <li>c. All external connections are made with flexible connections.</li> <li>d. Feeder cable/bus routing doesn't obstruct access for operation or maintenance.</li> <li>e. Control wiring harness(es) does not rub against vibrating or moving parts.</li> <li>f. Local breaker enclosure is installed with the one main breaker and cabling.</li> <li>g. Engine is bonded to the frame with a ground strap.</li> <li>h. Grounding is complete with neutral and ground bus NOT connected at generator enclosure.</li> </ul>		



Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
3)	Verify the generator circuit breaker is installed.	<ul style="list-style-type: none"> <li>a. 2500AF/2500AT is set to engineer's settings</li> <li>b. Shunt trip to OPEN on other generator protective device</li> <li>c. Ground fault indication</li> </ul>		
4)	Verify lube oil levels are within manufacturer's recommended limits.	<ul style="list-style-type: none"> <li>a. Lube oil level is filled to proper level.</li> </ul>		
5)	Verify fuel system installation and integrity.	<ul style="list-style-type: none"> <li>a. Day tank is full of fuel or at least 90% for diesel to allow for expansion.</li> <li>b. Fuel system is free of leaks.</li> <li>c. No damage to rupture basin.</li> <li>d. Fuel level in day tank matches fuel gauge.</li> <li>e. Flexible fuel supply and return lines are installed at engine.</li> <li>f. 1-1/2 IN fuel level gauge.</li> <li>g. 2 IN fill-locking fill cap.</li> <li>h. Double wall with alarm contact for rupture basin alarm</li> <li>i. Low level alarm float switch to indicate when operating supply is under 3 hours.</li> <li>j. Minimum 24 hour full load capacity.</li> </ul>		
6)	Verify cooling system installation and integrity.	<ul style="list-style-type: none"> <li>a. Coolant level is filled to proper level.</li> <li>b. Verify coolant system freeze protection level.</li> <li>c. Cooling system is free from leaks.</li> <li>d. Flexible coolant lines are installed between engine and radiator.</li> </ul>		

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
7)	Verify engine exhaust system installation and integrity.	<ul style="list-style-type: none"> <li>a. Exhaust system, silencer and flexible connector installed and supported.</li> <li>b. Exhaust system expansion is not transferred to engine components such as turbocharger.</li> <li>c. Exhaust system is equipped with rain cap.</li> <li>d. Exhaust system has at least 9" clearance from combustible materials.</li> <li>e. A condensate trap and drain valve shall be provided at the low point of the piping</li> </ul>		
8)	Verify air intake and exhaust system is installed.	<ul style="list-style-type: none"> <li>a. Air intake louvers are not damaged.</li> <li>b. Linkages are installed and free to operate.</li> <li>c. Engine mounted air cleaner with a "blocked filter" indicator.</li> <li>d. Motor operated dampers are spring operated to open and motor closed.</li> </ul>		
9)	Verify installation of load center and convenience services.	<ul style="list-style-type: none"> <li>a. Circuit directory is updated for loads installed</li> <li>b. 208V, 3ph source is clearly identified</li> <li>c. Lights work</li> <li>d. Outlets work and are properly grounded</li> </ul>		
10)	Verify installation of the battery charger and batteries.	<ul style="list-style-type: none"> <li>a. Local notification of the following alarms:</li> <li>b. Loss of AC input</li> <li>c. Loss of charge</li> <li>d. Loss of high rate charge</li> <li>e. Low battery voltage</li> <li>f. High battery voltage</li> <li>g. Power On - (green)</li> <li>h. Battery starting system is 24VDC via (2)-12VDC batteries.</li> <li>i. Charger is installed securely in a NEMA 250, type 1 enclosure on the generator enclosure wall.</li> </ul>		

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
11)	Verify installation of the coolant line heater.	a. 208V, single phase AC input power supply as measured at the input of the heater. b. Integral thermostat control		
12)	Verify installation of the enclosure space heater.	a. Thermostatically controlled to maintain temperature above condensation		
13)	Verify generator is labeled per the contract documents.	a. Indoor/outdoor, scratch proof, sunlight resistant, 4 mil flexible pressure sensitive adhesive backed vinyl labels. b. 1/2" high letters c. Black label with white lettering		

B. Electrical Integrity - Generator

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Verify operation of coolant line heater.	a. 208V, single phase AC input power supply as measured at the input of the heater.	<ul style="list-style-type: none"> <li>Record results in "Accessory Device" Table</li> </ul>	
2)	Verify operation of generator strip heaters	a. Heaters operate when generator is NOT running and NOT operating while running.	<ul style="list-style-type: none"> <li>Record results in "Accessory Device" Table</li> <li>Record supply voltages and amperage with heater in operation.</li> <li>Calculate heater wattage based on line voltage and current.</li> <li>Verify wattage calculated is same as shop drawing data.</li> </ul>	
3)	Measure charging voltage and voltages between terminals for full charge and floating charges.	a. Values are per manufacturer's recommendations.	<ul style="list-style-type: none"> <li>Record results in "Battery System" Table</li> </ul>	

C. Alarm and Control Panel Verification

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Verify installation and provisions for the local mounted generator control panel.	<ul style="list-style-type: none"> <li>a. Interior is clean and dry.</li> <li>b. Mounted at an accessible height with required 36" clearance in front of panel.</li> <li>c. Anti-vibration installed between generator and control panel</li> <li>d. AC voltmeter and phase selector switch.</li> <li>e. AC ammeter and phase selector switch.</li> <li>f. Hand-off-auto engine, start-stop control switch.</li> <li>g. Frequency meter.</li> <li>h. Running time meter.</li> <li>i. Indicating wattmeter with on-off switch.</li> <li>j. Governor control rheostat</li> <li>k. Green light</li> <li>l. Red light</li> <li>m. Amber light</li> <li>n. Dry contacts for remote alarms wired to terminal strips.</li> <li>o. Voltage level adjustment rheostat.</li> <li>p. Panel illumination lights and switch.</li> </ul>		
2)	Verify all setpoints at Engine Generator Control Panel.		<ul style="list-style-type: none"> <li>Manufacturer's checklist can be attached to this form in lieu of recording</li> </ul>	

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
3)	Verify installation of remote annunciator	a. Flush mounted, with flush plate of No.4 finish, stainless steel, 20 x 20 IN x 4-1/4 IN deep: b. Circuits: 24 volts DC powered from starting batteries. Verify circuit voltage to match battery voltage. c. Red and green signal lamps d. Buzzer e. Silencing switch f. Lamp test switch g. Relays h. Solid-state components, i. Engraved function identifications. j. Green light "ON" to indicate generator is operating to supply power to load. k. Separate red light for each shutdown or alarm condition and amber light for each prealarm condition and common buzzer with silence/acknowledge switch.		
4)	Engine Generator Control Panel - verify all warning/pre-alarms per manufacturer's instructions (NFPA 110-7.13.10)	a. Contacts for local and remote common alarm b. Overcrank c. Overspeed d. Low Oil Pressure e. High Water Temp f. Low Water Temp g. Fuel tank low level h. Control switch not in Auto i. Battery Charger AC Failure j. Low Battery Voltage k. Low Coolant Level l. EPS Supplying Load m. High Battery Voltage n. Lamp Test	<ul style="list-style-type: none"> <li>A thru M: NFPA 110</li> </ul>	
5)	Verify all shutdown conditions per manufacturer's instructions and verify operation and local annunciation at Engine Generator Control Panel.	a. Overcrank b. Overspeed c. Low Oil Pressure d. High Water Temp e. Low Coolant Level f. Remote E-Stop	<ul style="list-style-type: none"> <li>A thru F: NFPA 110</li> </ul>	

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
6)	Verify remote audible annunciation of all status, warning/pre-alarm, and shutdown conditions per manufacturer's instructions.	a. Audible alarm silencing switch b. Overcrank c. Overspeed d. Low Oil Pressure e. High Water Temp f. Low Water Temp g. Low fuel h. Control switch not in Auto i. Battery Charger malfunctioning j. Low battery voltage k. Fuel in tank rupture basin  l. Low Coolant Level m. Contacts for local and remote common alarm	<ul style="list-style-type: none"> <li>A thru I: NFPA 110</li> </ul>	
7)	Verify remote audible annunciation of all status, warning/pre-alarm and shutdown conditions on the BMCS.	a. Provide two NO and two NC auxiliary contacts to be monitored by the BMCS system as follows: b. Generator running. c. Generator pre-alarm or alarm. d. Generator shutdown. e. Generator low fuel level	<ul style="list-style-type: none"> <li></li> </ul>	

D. Load Bank Test

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
Note: Allow the generator to cool down for at least 8 hours before performing the following NFPA 110 required load test.				
Note: Perform the following steps AFTER the successful completion of the ATS FPTs.				
1)	The following load testing shall be conducted after completion of the installation with all EPSS accessory and support equipment are in place and operating. (NFPA 110-7.13.2.2)			
2)	The AHJ has been given advance notice of the time at which the final test is to be performed so that the AHJ can witness the test. (NFPA 110-7.13.3)			

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
3)	With generator in a "cold start" condition and the emergency load at standard operating level, a primary power failure shall be initiated by opening all switches or breakers supplying the primary power to the building or facility. (NFPA 110-7.13.4.1-1)	a. Test loads shall be loads that are served by the EPSS. b. The load test with building load or other loads that simulate the intended load shall be continued for the minimum time required for the class rating or 2 hours maximum. c. Exhaust damper opens fully after a maximum of 10 seconds. d. Fuel is not leaking. e. Coolant is not leaking. f. Lube oil is not leaking. g. Exhaust system expansion is not transferred to engine system components. h. Exhaust system is not leaking.	<ul style="list-style-type: none"> <li>Record results in "2 Hour Normal Load Test" Table</li> </ul>	
4)	During step 3, verify engine operation is within normal operating limits.	a. RPM @ 60Hz: 1800 RP b. Coolant Amb. Temp: 90°F		
5)	During step 3, verify correct phase rotation.	a. Phase rotation at generator matches NORMAL power source.	<ul style="list-style-type: none"> <li>Record results in "2 Hour Normal Load Test" Table</li> </ul>	
6)	During step 3, while generator is running at 100% load, measure sound level.	a. Measured sound level at 10' from discharge is 85dBA or less	<ul style="list-style-type: none"> <li>Record results in "Sound Pressure" Table</li> </ul>	
7)	When primary power is returned to the building or facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded. (NFPA 110-7.13.4-12)	a. ATS time delay is 5 min		
8)	Observe the time delay for each EPSS cool down period and shutdown (NFPA 110-7.13.4-13)	a. Generator runs in cool down mode for 5 min. b. Generator shuts down after expiration of cool down time delay.		

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
9)	At the completion of the above cool down, conduct another load test for 2 hours. Building load shall be permitted to serve as part or the entire load, supplemented by a resistive load bank, to equal 100% of the nameplate kW rating. (NFPA 110-7.13.6)	a. Test loads shall be loads that are served by the EPSS. b. The load test with building load or other loads that simulate the intended load shall be continued for the minimum time required for the class rating or 2 hours maximum. c. Exhaust damper opens fully after a maximum of 10 seconds. d. Fuel is not leaking. e. Coolant is not leaking. f. Lube oil is not leaking. g. Exhaust system expansion is not transferred to engine system components. h. Exhaust system is not leaking.	<ul style="list-style-type: none"> <li>Record results in "2 Hour Load Bank Test" Table</li> </ul>	
10)	When primary power is returned to the building or facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded. (NFPA 110-7.13.4-12)	a. ATS time delay is 5 min		
11)	Observe the time delay for each EPSS cool down period and shutdown (NFPA 110-7.13.4-13)	a. Generator runs in cool down mode for 5 min. b. Generator shuts down after expiration of cool down time delay.		
12)	A full load test shall be initiated immediately after the cool down in step 12 <b>Error! Reference source not found.</b> , by any method that starts the EPS in one step. (NFPA 110-7.13.7)	a. Engine continues to run without shutdown or overspeed trip and recovers to steady state voltage and frequency ranges within 5 seconds.		
13)	Decrease load to 0% and shutdown generator with local E-Stop.	a. Generator shuts down b. Remote annunciator alarms with E-Stop		



Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
14)	Verify the following shall be made available to the AHJ at the time of the acceptance test (NFPA 110-7.13.11)	a. Evidence of prototype test b. A certified analysis of the torsional vibration compatibility of the rotating element of the prime mover and generator for the intended use of the energy converter. c. A letter of compliance that the energy converter supplier shall stipulate compliance and performance with this standard for the entire unit when installed. d. A manufacturer's certification of a rated load test at rated power factor with the ambient temperature, altitude, and fuel grade recorded.		
15)	Disconnect fuel solenoid and simulate START to engine.	a. Engine cycle cranks a minimum of three 15-second cranking cycles with 15 seconds between cycles. b. At completion of third cycle engine stops cranking and "OVERCRANK" shutdown alarm is annunciated locally and remotely.		

E. Final Inspection

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
16)	After testing is performed on the generator, verify tightness of field landed feeder terminations.	a. Primary feeder cable connections properly torqued and marked.	<ul style="list-style-type: none"> <li>Record results in "Bolt Torque" Table</li> </ul>	
17)	Refill fuel tanks and verify 90% fuel levels.	a. Fuel level indicator verifies 90% fuel level in day tank. b. Fuel level indicator verifies 90% fuel level in storage tank.		

END OF TEST

Prepared by: KJWW Engineering

DWD/gbe

<http://portal/Projects/10.0180.00/Commissioning/11 FPTs/01 Working/ESB FPT-06 Generator RevX.docx>

### Electrical Tests Data Collection Tables

Ambient Temperature: \_\_\_\_\_

Relative Humidity: \_\_\_\_\_

Circuit Breaker Nameplate Data	
Manufacturer	
Type/Model	
Serial Number	
Frame Size/Rating	
Interrupting Rating	
Voltage Rating	

Sound Pressure	
Location	Decibel

Bolt Torque [Newton-Meters or Foot-Pounds]				
	A	B	C	N
EMERGENCY Lugs				

Accessory Device			
	Coolant Line Heater #1	Coolant Line Heater #2	Strip Heaters
Voltage			
Amperage			
Calculated Wattage			

Battery System				
	Terminals [V]	Charging [V]	Electrolyte	Specific Gravity
Float Charge				
Full Charge				

Single Step Load Test			
Load	Voltage	Frequency	Voltage Regulation Percentage
0%			
50%			
100%			

### 2 Hour Normal Load Test

Crank time until Prime Mover starts and runs

Time required for Prime Mover to come up to operating speed

Voltage overshoot

Frequency overshoot

Time required to achieve steady state operation

Phase rotation

Back Pressure

Time [hr:min]	Load	RPM	Freq. [Hz]	Amps [A]	Volts [V]	kW	Oil Pressure	Oil Temp	Exhaust Temp	Cool Temp	Fuel Level	Batt. Charge Rate
0:00	100%											
0:05	100%											
0:10	100%											
0:15	100%											
0:30	100%											
0:45	100%											
1:00	100%											
1:15	100%											
1:30	100%											
1:45	100%											
2:00	100%											

### 2 Hour Load Bank Test

Time [hr:min]	Load	RPM	Freq. [Hz]	Amps [A]	Volts [V]	kW	Oil Pressure	Oil Temp	Exhaust Temp	Cool Temp	Fuel Level	Batt. Charge Rate
0:00	100%											
0:05	100%											
0:10	100%											
0:15	100%											
0:30	100%											
0:45	100%											
1:00	100%											
1:15	100%											
1:30	100%											
1:45	100%											
2:00	100%											

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

DRAFT



**Functional Performance Test:  
FPT-21 - AHU-1**

**Sample  
Sample  
Chicago, IL**

**KJWW #xx.xxxx.xx**

Revision		
Level	Date	Description
0	12/03/12	Issued for Review
1	xx/xx/xx	Issued for Testing

1. Participants:

Date	Person	Organization	Acceptance Signature

2. Test Prerequisites:

Prerequisite	Complete Y / N	Notes:
These functional test procedures have been reviewed and approved by the installing contractor		
Prefunctional checklists complete and provided to Commissioning Authority		
All control system functions for this and all interlocking systems are programmed and operate		
Manufacturer / equipment start up complete		



3. Parameters:

Record the following parameters prior to start of functional performance testing.

(Date/Time): \_\_\_\_\_

Parameter	Parameter Value	Notes:
Outside Air Temp (Global)		
Outside Air Humidity (Global)		
Outside Air Dewpoint (Global)		

4. DDC System Point Review / Check

A. Equipment Points

Point No.	Point Description	Type	Point Values	Pass (Y / N)	Notes
1)	Mixed Air Temperature	AI			
2)	Heat Recovery Air Temperature	AI			
3)	Preheat Air Temperature	AI			
4)	Discharge Air Temperature	AI			
5)	Heat Recovery Leaving Water T	AI			
6)	Humidifier Cond Temp	AI			
7)	Supply Fan VFD Status	BI			
8)	Return Fan VFD Status	BI			
9)	Supply Fan VFD Command	BO			
10)	Return Fan VFD Command	BO			
11)	Mixing Damper Output	AO			
12)	Exhaust Air Damper Output	AO			
13)	Return Air Damper Output	AO			
14)	Outside Air Damper Output	AO			
15)	Heat Recovery Valve Output	AO			
16)	Preheat Valve Output	AO			
17)	Supply Fan Speed Output to VFD	AO			
18)	Return Fan Speed Output to VFD	AO			
19)	Return Air Temperature	AI			
20)	Return Air Humidity	AI			
21)	Return Air Flow	AI			
22)	Exhaust Air Flow	AI			

Point No.	Point Description	Type	Point Values	Pass (Y / N)	Notes
23)	Supply Air Flow 1	AI			
24)	Supply Air Flow 2	AI			
25)	Low Limit Thermostat Alarm	BI			
26)	Humidifier Iso valve Command	BO			
27)	Supply Smoke Damper Cmd	BO			
28)	Return Smoke Damper Cmd	BO			
29)	Humidifier 1/3 Valve Output	AO			
30)	Humidifier 2/3 Valve Output	AO			
31)	SA Static Press 42x24 (M-100A)	AI			
32)	SA Static Press 40x24 (M-120B)	AI			
33)	SA Static Press 42x24 (M-120B)	AI			
34)	Fire Alarm ZAM Shutdown signal	AI			
35)	Supply Smoke Damper Open	BI			
36)	Return Smoke Damper Open	BI			
37)	Supply Air Iso Damper Command	BO			
38)	Transfer Smoke Damper Cmd	BO			
39)	Discharge Air Humidity High Limit	AI			
40)	Pre-Filter Status	AI			
41)	Final Filter Status	AI			
42)	Transfer Smoke Damper Open	BI			
43)	Airflow Switch for Humidifier I/L	BI			
44)	Supply Fan 1 Status	BI			
45)	Supply Fan 2 Status	BI			
46)	Supply Fan 3 Status	BI			
47)	Supply Fan 4 Status	BI			
48)	Supply Fan 5 Status	BI			
49)	Supply Fan 6 Status	BI			
50)	Supply Fan 7 Status	BI			
51)	Supply Fan 8 Status	BI			
52)	Supply Fan 9 Status	BI			
53)	Supply Fan 10 Status	BI			
54)	Supply Fan 11 Status	BI			

Point No.	Point Description	Type	Point Values	Pass (Y / N)	Notes
55)	Supply Fan 12 Status	BI			
56)	Supply Fan 13 Status	BI			
57)	Supply Fan 14 Status	BI			
58)	Supply Fan 15 Status	BI			
59)	Supply Fan 16 Status	BI			
60)	Supply Fan 17 Status	BI			
61)	Supply Fan 18 Status	BI			
62)	Return Fan 1 Status	BI			
63)	Return Fan 2 Status	BI			
64)	Return Fan 3 Status	BI			
65)	Return Fan 4 Status	BI			
66)	SF VFD Points				Actual points TBD by owner
67)					Verify in field- read from VFD
68)					Verify in field- read from VFD
69)					Verify in field- read from VFD
70)					Verify in field- read from VFD
71)					Verify in field- read from VFD
72)	RF VFD Points				Actual points TBD by owner
73)					Verify in field- read from VFD
74)					Verify in field- read from VFD
75)					Verify in field- read from VFD
76)					Verify in field- read from VFD
77)					Verify in field- read from VFD
78)					
79)	Heating Discharge air temperature setpoint		°F		
80)	Cooling Discharge air temperature setpoint		°F		
81)	Outside air flow setpoint		cfm		
82)	Low demand Supply Air Flow setpoint		cfm		
83)	High demand Supply Air Flow setpoint		cfm		
84)	Return air humidity setpoint		%		
85)	Static Pressure setpoint		in. wg		

FPT-21 - AHU-1

Sample

KJWW #xx.xxxx.xx

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5. Sequence of Operation Review / Test

A. Refer to JCI control drawings 02.01-02.03 Rev. No. 1. (4/2/12)

6. Functional Testing Record

A. Occupied /Unoccupied Cycle

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Verify AHU is in Occupied mode	<ul style="list-style-type: none"> <li>a. OA Damper is open</li> <li>b. Return and Relief dampers are open/closed in opposition to each other</li> <li>c. Supply and Return fans are energized</li> <li>d. Smoke dampers are open.</li> </ul>		
2)	Place unit in Unoccupied mode	<ul style="list-style-type: none"> <li>a. OA and Relief Air dampers close fully</li> <li>b. Return air damper opens fully</li> <li>c. Supply and Return fans shut down</li> <li>d. Heating coil and chilled water coil control valves fully close.</li> <li>e. Smoke Dampers fully close.</li> </ul>		
3)	Place unit in Occupied mode	<ul style="list-style-type: none"> <li>a. AHU supply and return air smoke dampers open</li> <li>b. System supply and return smoke dampers open</li> <li>c. After smoke dampers are fully open, Supply and Return fans start at low speed and accelerate slowly to normal operating speed to permit static pressure controller to maintain control.</li> <li>d. After 2 minute (adj) time delay, outside air and relief air dampers open to minimum position.</li> <li>e. After additional 1 minute (adj) delay, outside, relief and return air dampers are controlled according to sequence.</li> </ul>	Based on inside and outside air temperature and system history of performance, controller calculates lead heating/cooling time necessary to bring building from unoccupied to occupied temperature.	

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
4)	Increase outside air flow setpoint	a. Outside and relief air dampers modulate in unison to maintain setpoint b. As relief air damper opens, return air damper closes proportionately	This control loop may be overridden by temperature cycle to increase outside air up to 100%	

#### B. Temperature Control

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Increase discharge air temperature setpoint such that heating is required.	a. Outside air damper at minimum b. Chilled water control valve closed c. Heat recovery coil control valve modulates toward full open d. When heat recovery valve reaches full open, preheat coil control valve shall modulate toward fully open to coil.	May need to increase setpoint more than once to open both heating valves. When discharge air temp is below 55 deg F, cooling shall not occur	
2)	Decrease discharge air temperature setpoint such that cooling is required.	a. Heat recovery coil valve and preheat coil valve are closed. b. Outside air and relief air dampers modulate from minimum to fully open. c. Return air damper closes proportionately. d. When OA is fully open, chilled water valve modulates open.	Continue decreasing setpoint, if necessary, so that OA damper opens fully. When discharge air temp is above 50 deg F, heating shall not occur	
3)	Override low demand supply air flow setpoint higher than current supply air flow.	a. Discharge air temperature setpoint is reset upward.	Override air terminal units to lower cooling demand, if necessary. Setpoint shall not reset above 60 deg F.	
4)	Reset setpoint. Override high demand supply air flow setpoint below current supply air flow	a. Discharge air temperature is reset downward	Override air terminal units to increase cooling demand, if necessary. Setpoint shall not reset below 55 deg. F.	

### C. Humidity Control

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Increase return air humidity setpoint such that humidification is required.	a. Steam isolation valve opens b. When condensate temperature sensor indicates system has warmed up, humidifier steam 1/3 control valve modulates to maintain setpoint. c. When 1/3 valve is fully open, 2/3 valve opens and both modulate to maintain humidity.	Verify 1/3 - 2/3 sequence. Written sequence suggests that 1/3 valve remains open when 2/3 valve opens.	
2)	Override supply air humidity to 86%.	a. Supply air duct humidity sensor over-rides RA sensor. b. Humidifier control valves modulate closed to reduce humidity.		
3)	Override supply air humidity to 90%	a. Alarm is annunciated at operators workstation		

### D. Supply Fan Speed Control

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Note number of supply fans operating in multi-fan array. If only 1 fan is running, proceed with this test. If multiple fans are running, begin with reducing demand. Increase required supply air flow by increasing static pressure setpoint	a. Operating supply fan shall increase speed from minimum to maximum. b. When fan speed exceeds 80% for longer than 30 seconds, the next fan shall start and shall modulate from minimum to maximum.	Eighteen fans in supply fan array. As demand increases, fans will sequence on.	
2)	Reduce static pressure setpoint	a. Supply fan speed modulates slower to maintain setpoint. b. When supply fan speed falls below 40% for longer than 30 seconds, the fan with the highest sequence number shall stop. Remaining fans modulate to maintain airflow		

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
3)	Reset static pressure setpoint. Determine air terminal unit with damper most open. Adjust damper position of unit.	b. Static pressure setpoint modulates between 0.8" and 3" wg to maintain damper position at 90%.		
4)	Change date and time to 4:00 am on first day of a month	a. Sequence number of fans rotates.	Each fan has a sequence number indicating the order the fans will sequence on. This number changes monthly. Fan sequence number can also be changed manually.	
5)	While fans are running, disconnect one fan to simulate failure.	a. Remaining fans will ramp up or sequence on to maintain static pressure setpoint.		

#### E. Return Fan Speed Control

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Note number of return fans operating in multi-fan array. If only 1 fan is running, proceed with this test. If multiple fans are running, begin with reducing demand. Increase required return air flow	a. Operating return fan shall increase from minimum to maximum. b. When fan speed exceeds 80% for longer than 30 seconds, the next fan shall start and shall modulate from minimum to maximum.	Four fans in array. As demand increases, fans will sequence on.  Return Air Flow = Supply Air Flow + Relief Air Flow - Outside Air Flow	
2)	Decrease required air flow	a. Fan speed is reduced. b. When fan speed falls below 40% for longer than 30 seconds, the fan with the highest sequence number shall stop. Remaining fans modulate to maintain airflow.		
3)	Change date and time to 4:00 am on first day of a month	a. Sequence number of fans rotates.	Each fan has a sequence number indicating the order the fans will sequence on. This number changes monthly. Fan sequence number can also be changed manually.	

F. Alarms and Safeties

Step No.	Test Procedure	Expected Results	Remarks/ Actual Response	Pass (Y/N)
1)	Trip low limit thermostat or reduce temperature at stat to 34 deg F.	<ul style="list-style-type: none"> <li>a. Supply and return fans stop.</li> <li>b. Outside air damper is closed.</li> <li>c. Alarm is generated at operator workstation.</li> <li>d. Alarm remains until manually reset.</li> </ul>		
2)	Blow test smoke on duct-mounted smoke detector.	<ul style="list-style-type: none"> <li>a. Fans are stopped</li> <li>b. Associated smoke dampers close.</li> <li>c. Fire alarm system notified</li> <li>d. Alarm remains until manually reset.</li> </ul>	Coordinate test with fire department.	

END OF TEST

Prepared by: KJWW Engineering

NRT/jjj

L:\D50 Team Documents\11 MASTER FPTs\SAMPLES for Cx Plan\SAMPLE ESB FPT-21 AHU-1 RevX.docx



VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Type: Air Compressor

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Compressor Data			
Capacity at 50PSIG (SCFM):	MC		
Number of Pumps:	MC		
Type:	MC		
Volts / Phase / Hz:	MC		
Motor Manufacturer:	MC		
Motor Serial No.:	MC		
Motor HP:	MC		
Motor FLA:	MC		
Motor RPM:	MC		
Motor Enclosure:	MC		
Motor Service Factor:	MC		
Tank Orientation (Horizontal/Vertical):	MC		
Capacity (Gal):	MC		
Nameplate Information: Belt Data			
Size:	MC		
Quantity	MC		
General Inspection			
Clean and free of debris	MC		
No obvious defects or damage	MC		
Permanent equipment ID tags installed and correct	MC		
Installed in proper location per contract documents	MC		
Unit securely mounted per manufacturer's recommendations	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Isolation equipment installed per contract documents	MC		
All covers and guards in place	MC		
Proper clearance and service access	MC		
Verify seismic bracing installed per contract documents and code requirements	MC		
Unit level	MC		
Shipping lockdowns, packing, etc. removed	MC		
Filter installed at outside air intake	MC		
<b>Piping</b>			
Piping installation complete and properly supported	MC		
Piping labeled with correct ID and flow arrows	MC		
Piping connected to correct suction and discharge of compressor	MC		
Flexible pipe connectors installed	MC		
Isolation valves installed in suction and discharge piping	MC		
Compressed air pressure gauge installed and interlocked alarm	MC		
Condensate piping installed to floor drain	MC		
Vibration isolation installed at inlet and outlet	MC		
Unions installed at each piping penetration	MC		
<b>Electrical</b>			
Local disconnect switch installed and labeled	EC		
All incoming electrical connections match each unit's nameplate data	EC		
Proper grounding installed for each component	EC		
All electrical connections tight and enclosed	EC		
Electrical wiring labeled per contract documents	EC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Controls			
Control wiring complete and checked point-to-point	CC		
Compressor enable, status and alarms sequences completed and verified at BAS	CC		
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes		CAL Item	
		Yes	No
1.			
2.			
3.			
4.			
5.			

 \_\_\_\_\_  
 General Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

 \_\_\_\_\_  
 Mechanical Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

 \_\_\_\_\_  
 Electrical Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

 \_\_\_\_\_  
 Controls Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date



## VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

Equipment Type: Water Heater

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Water Heater			
Manufacturer:	PC		
Model No.:	PC		
Serial No.:	PC		
Volume (GAL):	PC		
Capacity (kW):	PC		
Entering Water Temp. (deg F):	PC		
Leaving Water Temp. (deg F):	PC		
Flow Rate (GPH):	PC		
Volts / Phase / Hz:	PC		
Nameplate Information: Recirculating Pump			
Manufacturer:	PC		
Model No.:	PC		
Serial No.:	PC		
Flow Rate (GPM):	PC		
RPM:	PC		
Motor HP:	PC		
Motor Volts / Phase / Hz:	PC		
General Inspection			
General appearance good, no apparent damage	PC		
Site sufficiently clean for testing	PC		
Equipment labels affixed	PC		
Proper clearance and service access	PC		
System filled	PC		
Circulation pump installed and operating	PC		
Installed in proper location per contract documents	PC		
All covers and guards in place	PC		
Unit level and securely mounted per manufacturer's recommendations	PC		
Seismic isolation installed per contract documents	PC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Adequate base installed to allow drain pan line to route to local drain	PC		
Support legs verified	PC		
<b>Piping</b>			
Piping complete, including safety reliefs, and properly supported	PC		
General appearance good, no apparent damage	PC		
Site sufficiently clean for testing	PC		
Equipment labels affixed	PC		
Proper clearance and service access	PC		
System filled	PC		
Circulation pump installed and operating	PC		
Installed in proper location per contract documents	PC		
All covers and guards in place	PC		
Unit level and securely mounted per manufacturer's recommendations	PC		
Seismic isolation installed per contract documents	PC		
Adequate base installed to allow drain pan line to route to local drain	PC		
Support legs verified	PC		
<b>Electrical</b>			
Power to unit and disconnect installed	EC		
All electrical components grounded	EC		
Safeties energized and tested	EC		
Electrical wiring labeled per contract documents	EC		
<b>Controls</b>			
Control system interlocks hooked up and functional	CC		
All sensors and gages installed securely	CC		
Test ports installed near all control sensors and per spec	CC		
<b>Op Checks</b>			
The HOA switch properly activates and deactivates the unit	PC		
Pump rotation verified correct	PC		
No unusual noise or vibration	PC		
No leaking apparent around fittings	PC		
Measure line to line voltage phase imbalance for each pump:	PC		
(%Imbalance = 100 x (avg. - lowest) / avg.)	PC		
Record imbalance of each pump in cell. Imbalance less than 2%?	PC		
Record full load running amps for each pump. ____ rated FL amps x ____ srvc factor = ____ (Max amps). Running less than max?	PC		
Specified sequences of operation and operating schedules have been implemented with all variations documented	PC		
Heat trace starts and runs	PC		
Record running amps for each circuit.	PC		
Pressure cut-in and cut-out setpoints are as specified.	PC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes		CAL Item	
		Yes	No
1.			
2.			
3.			
4.			
5.			

General Contractor / Company

Date / /

Plumbing Contractor / Company

Date / /

Electrical Contractor / Company

Date / /

Controls Contractor / Company

Date / /

Equipment Type: Building Automation System Floor: \_\_\_\_\_

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Tag No./Description: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_ Room: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

**Note:**

Provide equipment information above for major BAS components on the project such as User Terminal/PC Workstation. It is acceptable to attach a table to document multiple equipment.

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
User Terminal Interface and Subpanel Checks			
General appearance good, no apparent damage	CC		
Permanent labels affixed	CC		
Layout and location of control panels matches drawings	CC		
Wiring labeled inside panels (to controlled components)	CC		
Controlled components labeled / tagged	CC		
BAS connection made to labeled terminal(s) as shown on drawings	CC		
Shielded wiring used on electronic sensors	CC		
110 volt AC power available to panel	CC		
Compressed air available to panel	CC		
Battery backup in place and operable	CC		
Panels properly grounded	CC		
Environmental conditions according to manufacturer's requirements	CC		
Date and time correct	CC		
Control system graphics are complete	CC		
For existing BAS systems there is enough space to accommodate new points	CC		

Category / Inspection Item									Resp. Party	Complete Yes No																																																																																																																																										
<b>Device and Point Checkout</b>																																																																																																																																																				
<p>The following procedures are required to be performed and documented for each point in the control system. These are minimum requirements. The controls contractor is encouraged to identify better and more comprehensive checkout procedures in their submitted plan. These procedures are not a substitute for the manufacturer's recommended start-up and checkout procedures, but are to be combined with them, as applicable. The documentation may be provided on the vendor's standard form, as long as all the information in the sample table below is documented.</p> <p>Similar checkout and calibration requirements are found on the equipment prefunctional checklists. Redundant documentation is not required. Cross reference, by name and form number, to other forms that contain documentation left blank on the current form.</p> <p><b>Procedures</b></p> <p>1 [Wire] Verify wiring is correct to each point.</p> <p>2 [Actu] If the device is, or has an actuator, verify full free movement through its full range.</p> <p>3 [Addr] Verify the software address is correct.</p> <p>4 [Load] For devices with a controller, verify the current software program with proper setpoints has been downloaded.</p> <p>[DevCal] Device stroke / range calibration. This applies to all controlled valves, dampers, fans, pumps, actuators, etc.</p> <p>5 Simulate maximum and minimum transmitter signal values and verify minimum and maximum controller output values and positively verify each and every control device minimum and maximum stroke and capacity range.</p> <p>6 [SensLoc] Verify that all sensor locations are appropriate and away from causes of erratic operation</p> <p>[SensCal] Sensor calibration. Calibrate or verify calibration of all sensors and thermostats, including temperature, pressure, flow, current, kW, rpm, Hertz, etc. Verify that the sensor readings in the control system are within the sensor accuracies specified in this section, using hand-held or other external measuring instruments.</p> <p>7 [OperCk] For controlled devices (dampers, valves, actuators, VAV boxes, etc.), after mechanical equipment control becomes operational, perform an operational test of each control loop. Operational checks are preparatory to the later <i>functional testing</i>.</p> <p>8</p> <p><b>Other Abbreviations:</b></p> <p>[BAS] Building automation system or gage-read value</p> <p>[Instru] Instrument (calibrated) read value.</p> <p>[Ofset] Offset programmed into the point to correct the calibration.</p>																																																																																																																																																				
<p align="center"><b>--SAMPLE FORM--                      CONTROLS CHECKOUT DOCUMENTATION TABLE</b></p> <table border="1"> <thead> <tr> <th rowspan="2">Point ID</th> <th rowspan="2">Object</th> <th rowspan="2">Field Device Type</th> <th colspan="3">Hardware Checks</th> <th rowspan="2">Load</th> <th rowspan="2">Dev Cal</th> <th rowspan="2">Sens Loc</th> <th colspan="3">SensCal</th> <th rowspan="2">Final Check</th> </tr> <tr> <th>Wire</th> <th>Actu</th> <th>Addr</th> <th>BAS</th> <th>Instru</th> <th>Ofset</th> <th>Oper Ck</th> </tr> <tr> <th></th> <th></th> <th></th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>7</th> <th>7</th> <th>8</th> </tr> </thead> <tbody> <tr> <td>AI-1</td> <td>ZN-T (zone T)</td> <td>PhJack</td> <td>√</td> <td>na</td> <td>√</td> <td>na</td> <td>na</td> <td>√</td> <td>70.2F</td> <td>71.4F</td> <td>+1.2F</td> <td>na</td> </tr> <tr> <td>3-2a</td> <td>RA-DPR (damper)</td> <td>PNEU</td> <td>√</td> <td>√</td> <td>√</td> <td>na</td> <td>√</td> <td>na</td> <td>na</td> <td>na</td> <td>na</td> <td>√</td> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>												Point ID	Object	Field Device Type	Hardware Checks			Load	Dev Cal	Sens Loc	SensCal			Final Check	Wire	Actu	Addr	BAS	Instru	Ofset	Oper Ck				1	2	3	4	5	6	7	7	7	8	AI-1	ZN-T (zone T)	PhJack	√	na	√	na	na	√	70.2F	71.4F	+1.2F	na	3-2a	RA-DPR (damper)	PNEU	√	√	√	na	√	na	na	na	na	√																																																																														
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Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Documentation			
Building automation point to point successfully completed. Attach completed points list to this PFC.	BAS		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	BAS		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes		CAL Item	
		Yes	No
1.			
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4.			
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 \_\_\_\_\_  
General Contractor / Company

 \_\_\_\_\_ / /  
Date

 \_\_\_\_\_  
Controls Contractor / Company

 \_\_\_\_\_ / /  
Date

Equipment Type: Fuel Storage and  
Delivery Systems

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Tag No.: \_\_\_\_\_ Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_ Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Fuel Pump			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
General Inspection			
Clean and free of debris	MC		
No obvious defects or damage	MC		
Permanent equipment ID tags installed and correct	MC		
Installed in proper location per contract documents	MC		
Proper clearance and service access	MC		
Pump base plate assembly is level and grouted	MC		
Anchor bolts in place	MC		
Shipping lockdowns, packing, etc. removed	MC		
All covers and guards in place	MC		
Pump			
Angular alignment verified by feelers or taper gauge	MC		
Parallel alignment verified with straight edge	MC		
Pump and driver shafts are level	MC		
Pump shaft rotates freely	MC		
Pump rotates in proper direction as shown on pump casing	MC		
Pump and motor lubricated per manufacturer's recommendations	MC		
Duplex pump controller installed; Indicators installed and operational	MC		
Hand Pump is installed per manufacturer's instructions	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Piping			
Piping installation complete and properly supported	MC		
Piping labeled with correct ID and flow arrows	MC		
Piping connected to the discharge of pump	MC		
Full port ball valve installed in discharge piping	MC		
Union installed in discharge piping	MC		
Check valve installed in correct direction in discharge pipe	MC		
Electrical			
Safety disconnect switch installed and labeled	EC		
All incoming electrical connections match each unit's nameplate data	EC		
Proper grounding installed for each component	EC		
All electrical connections tight and enclosed	EC		
Electrical wiring labeled per contract documents	EC		
Controls			
Panel securely fastened to floor mount stand or wall per manufacturer's recommendations.	CC		
Hand-Off-Auto switch installed and not damaged.	CC		
Relays for each float installed.	CC		
Connection to BAS system provided for status and High Level alarm.	CC		
Local annunciation via bell with silencing switch provided for High Level alarm.	CC		
Floats and switches are installed at appropriate heights.	CC		
Indicating light for High Level provided.	CC		
Indicating light for Power On provided.	CC		
Indicating light for Pump Running provided.	CC		
Oil minder probe installed approx. 3" above inlet to pump.	CC		
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		





Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
		Yes	No
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General Contractor / Company

/ /  
Date

Mechanical Contractor / Company

/ /  
Date

Electrical Contractor / Company

/ /  
Date

Controls Contractor / Company

/ /  
Date

Equipment Type: Hydronic Piping

VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

System: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Piping			
Pipe fittings complete and pipes properly supported	MC		
Pipes properly labeled	MC		
Pipes properly insulated, insulation is not crushed at supports	MC		
Strainers in place and clean, system has been flushed	MC		
Chemical treatment system or plan installed	MC		
ASME pressure vessel data sheet or certification tag posted and inspection complete for each expansion tank	MC		
System completely purged of air	MC		
Air vents and bleeds at high points of systems functional	MC		
P/T plugs, temperature and pressure gauges are installed per drawings.	MC		
Balancing and isolation valves installed per drawings. Valves properly tagged	MC		
Valves stroke fully and easily, handles are accessible. Installation meets manufacturer requirements (e.g. swing check valve properly oriented)	MC		
Valves that require a positive shut-off are verified not leaking when closed at normal operating pressure	MC		
Controls			
Temperature, pressure and flow sensors properly installed in the piping	CC		
Documentation			
Testing, Adjusting and Balancing has been performed.	TAB		
Piping pressure tested according to contract documents.	MC		
Water treatment report submitted according to contract documents	MC		
Flushing and cleaning plan submitted and approved (Minimum flushing velocity in all pipe sections is the greater of 4 Ft/second or 1.5 times the velocity at design flow)	GC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
		Yes	No
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General Contractor / Company

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Date

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Mechanical Contractor / Company

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Date

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Controls Contractor / Company

\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_  
Date

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Type: Pumps (Boiler)

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Pump			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
RPM:	MC		
GPM:	MC		
Impeller Diameter:	MC		
Head:	MC		
Nameplate Information: Motor			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Motor HP:	MC		
Volts / Phase / Hz:	MC		
Nameplate Information: VFD			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
General Inspection			
Label permanently affixed	MC		
Pumps in place and properly supported. Base mounted pumps grouted per design and manufacturer's recommendations.	MC		
Adequate maintenance space for pump and motor	MC		
Vibration isolation equipment installed and functional	MC		
Pump and Motor are properly aligned (attach field alignment results)	MC		
Pump is lubricated	MC		
Pump rotation correct	MC		
No unusual noise or vibration	MC		
HOA switch properly activates and deactivates the unit	MC		

Shaft ground ring or other approved means are installed to prevent motor bearing failures from static and VFD induced currents	MC		
<b>Piping</b>			
Pipe and fittings complete with no apparent leakage, pipes properly supported	MC		
Pipes properly labeled	MC		
Pipes (and pump) properly insulated per contract documents	MC		
Suction diffuser has support foot. Temporary strainer is removed and hangs next to pump.	MC		
Strainers in place and clean	MC		
Piping system properly flushed	MC		
P/T plugs, TI's and PI's, balancing and isolation valves installed per drawings (Ref. M-503) Valves properly tagged	MC		
For pumps with VFD's the balance valve is left wide open to minimize pressure loss	MC		
<b>Electrical</b>			
Power disconnects in place and labeled	EC		
All electric connections tight	EC		
Proper grounding installed for components and unit	EC		
Motor safeties in place and operable	EC		
Measure line to line voltage phase imbalance for each pump. (%Imbalance = 100 x (avg - lowest)/avg.) Verify imbalance is less than 2%.	EC		
Record full load running amps for each pump. Rated FLA x service factor = Max amps. Verify running less than max.	EC		
<b>Controls</b>			
All control sensors (temperature, pressure, flow) properly located	CC		
All control devices and wiring complete	CC		
Specified sequences of operation and operating schedules have been implemented with all variations documented	CC		
VFD interlocked to control system, VFD accepts Start/Stop command, speed command from BAS and BAS reads VFD run status, speed feedback, faults, etc.	CC		
<b>VFD</b>			
VFD location not subject to excessive temperatures, moisture or dirt			
VFD size matches motor size			
Internal setting designating the model is correct			
Input of motor FLA represents 100% to 105% of motor FLA rating			
Appropriate Volts vs Hz curve is being used			
Accel and decel times are around 10 - 50 seconds, except for special applications			
Lower frequency limit set at 0% (note if otherwise)			
Upper frequency limit set at 100% (note if otherwise)			
Unit is programmed with full written programming record on site			
VFD powered (wired to controlled equipment)			
Unit has been started up by authorized factory representative (attach start-up report)			



Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes	CAL Item		
	Yes	No	
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 \_\_\_\_\_  
 General Contractor / Company

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 Date

 \_\_\_\_\_  
 Mechanical Contractor / Company

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 Date

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 Electrical Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

 \_\_\_\_\_  
 Controls Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

Equipment Type: Pumps (Chemical Feed System)

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Tag No.: \_\_\_\_\_ Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_ Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Pump			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
RPM:	MC		
GPM:	MC		
Impeller Diameter:	MC		
Head:	MC		
Nameplate Information: Motor			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Motor HP:	MC		
Volts / Phase / Hz:	MC		
Nameplate Information: VFD			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
General Inspection			
Label permanently affixed	MC		
Pumps in place and properly supported. Base mounted pumps grouted per design and manufacturer's recommendations.	MC		
Adequate maintenance space for pump and motor	MC		
Vibration isolation equipment installed and functional	MC		
Pump and Motor are properly aligned (attach field alignment results)	MC		
Pump is lubricated	MC		
Pump rotation correct	MC		
No unusual noise or vibration	MC		
HOA switch properly activates and deactivates the unit	MC		

Shaft ground ring or other approved means are installed to prevent motor bearing failures from static and VFD induced currents	MC		
<b>Piping</b>			
Pipe and fittings complete with no apparent leakage, pipes properly supported	MC		
Pipes properly labeled	MC		
Pipes (and pump) properly insulated per contract documents	MC		
Suction diffuser has support foot. Temporary strainer is removed and hangs next to pump.	MC		
Strainers in place and clean	MC		
Piping system properly flushed	MC		
P/T plugs, TI's and PI's, balancing and isolation valves installed per drawings (Ref. M-503) Valves properly tagged	MC		
For pumps with VFD's the balance valve is left wide open to minimize pressure loss	MC		
<b>Electrical</b>			
Power disconnects in place and labeled	EC		
All electric connections tight	EC		
Proper grounding installed for components and unit	EC		
Motor safeties in place and operable	EC		
Measure line to line voltage phase imbalance for each pump. (%Imbalance = 100 x (avg - lowest)/avg.) Verify imbalance is less than 2%.	EC		
Record full load running amps for each pump. Rated FLA x service factor = Max amps. Verify running less than max.	EC		
<b>Controls</b>			
All control sensors (temperature, pressure, flow) properly located	CC		
All control devices and wiring complete	CC		
Specified sequences of operation and operating schedules have been implemented with all variations documented	CC		
VFD interlocked to control system, VFD accepts Start/Stop command, speed command from BAS and BAS reads VFD run status, speed feedback, faults, etc.	CC		
<b>VFD</b>			
VFD location not subject to excessive temperatures, moisture or dirt			
VFD size matches motor size			
Internal setting designating the model is correct			
Input of motor FLA represents 100% to 105% of motor FLA rating			
Appropriate Volts vs Hz curve is being used			
Accel and decel times are around 10 - 50 seconds, except for special applications			
Lower frequency limit set at 0% (note if otherwise)			
Upper frequency limit set at 100% (note if otherwise)			
Unit is programmed with full written programming record on site			
VFD powered (wired to controlled equipment)			
Unit has been started up by authorized factory representative (attach start-up report)			





Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes	CAL Item		
	Yes	No	
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General Contractor / Company

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Date

 \_\_\_\_\_  
Mechanical Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Date

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Electrical Contractor / Company

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Date

 \_\_\_\_\_  
Controls Contractor / Company

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Date


Steam & Condensate  
Equipment Type: Piping

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Steam Pressure Regulating Valve			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Entering pressure (psig):	MC		
Set pressure (psig):	MC		
Nameplate Information: Pressure Reducing Valve			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Entering pressure (psig):	MC		
Set pressure (psig):	MC		
Nameplate Information: Relief Valve			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Set pressure (psig):	MC		
Relieving Capacity (lb/hr):	MC		
Nameplate Information: Pressure Powered Condensate Pumps			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Services:	MC		
Location:	MC		
Capacity (lb/hr):	MC		
Motive Steam Pressure (psig):	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Piping			
Piping complete and properly supported	MC		
Pipe support and routing adequate for operating loads and thermal expansion	MC		
Pipes properly labeled	MC		
Pipes properly insulated	MC		
Piping system properly flushed and cleaned and temporary piping removed, strainers are clean (report attached)	MC		
Chemical treatment system installed (clean steam system)	MC		
Pipe pressure testing has been performed (attach test report)	MC		
Pressure gauges installed per contract documents with pigtail siphons and isolation valves	MC		
Steam flow meters installed per manufacturer's instructions with sufficient upstream and downstream straight piping lengths	MC		
Air vents and bleeds at high points of systems functional, system completely purged of air	MC		
Pressure reducing valves (PRV) are installed and operable. Valves do not leak past at no load condition.	MC		
PRV safety valves installed and set per design	MC		
Vent piping from valve is minimum length, vent to safe location outside. Drip pan elbows installed and condensate piped to drain.	MC		
Make-up water backflow preventers installed (clean steam system)	MC		
Steam traps operable and installed per manufacturer instructions and Engineer's detail on M-504	MC		
Steam pressure powered condensate pumps are operable	MC		
AHU Humidifier manifolds properly installed and operable (clean steam system)	MC		
Clean steam system is operable	MC		
Softened water make-up system installed and operable (clean steam system)	MC		
Valves properly tagged	MC		
Controls			
Steam system pressure sensors/switches installed and reading at the BAS	CC		
Any steam and condensate system controls (e.g., equipment alarms) are functional at the BAS	CC		
Steam flow meters installed per manufacturer's instructions and reading at BAS	CC		
Documentation			
Piping system properly flushed and cleaned and temporary piping removed	MC		
Piping pressure tested according to contract documents.	MC		
Water treatment report submitted according to contract documents	GC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
		Yes	No
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General Contractor / Company

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Date

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Mechanical Contractor / Company

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Date

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Controls Contractor / Company

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Date

## VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

Equipment Type: Fans

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Fan			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Volume (CFM):	MC		
TSP (IN. WG):	MC		
Supply Fan Rotation (CW, CCW):	MC		
Fan Class:	MC		
Drive:	MC		
HP:	MC		
Fan RPM:	MC		
Nameplate Information: Fan Motor			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Volts / Phase / Hz:	MC		
Enclosure:	MC		
Frame Size:	MC		
Service Factor:	MC		
Nameplate Information: Belt			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Size:	MC		
Quantity:	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Damper			
Manufacturer:	MC		
Model No.:	MC		
Type:	MC		
Size:	MC		
Voltage:	MC		
Nameplate Information: VFD			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
General Inspection			
Permanent labels affixed	MC		
Casing condition good	MC		
Proper roof curb installation complete	MC		
Vibration isolation equipment installed and functional	MC		
Roof mounted fans installed per Engineer's detail (M-xxx) and manufacturer's instructions	MC		
Fasteners, set screws and locking collars on fan, wheel, bearings, drive, motor base and accessories are tight.	MC		
Maintenance access acceptable	MC		
Weatherhood provided and installed	MC		
Birdscreen provided and installed	MC		
Equipment guards installed	MC		
Pulleys aligned	MC		
Belt tension correct	MC		
Bearings are aligned and lubricated	MC		
Plenums clear of debris (Mixed-Flow Exhaust Fans)	MC		
Fans rotate freely in correct direction, with no unusual noise or vibration	MC		
Fire dampers installed	MC		
Backdraft dampers installed per drawings and operate freely	MC		
Duct system complete	MC		
Stack extensions installed (Mixed-Flow Exhaust Fans)	MC		
Plenums (Mixed-Flow Exhaust Fans) provided with bypass and isolation dampers (low-leakage type)	MC		
Plenums (Mixed-Flow Exhaust Fans) provided with sound attenuator	MC		
Mountings checked and shipping bolts removed	MC		
After 24 hours of operation, recheck belt tension and alignment	MC		
Grease fittings (Zerk) provided with bearings	MC		
Shaft ground ring or other approved means are installed to prevent motor bearing failures from static and VFD induced currents	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Electrical			
Electrical connections complete	EC		
Disconnect switch installed and properly operates	EC		
Motor securely and adequately grounded	EC		
Overload heaters in place	EC		
Electrical interlocks verified	EC		
Actual full load running amps is less than max. (Rated FLA x service factor = Max amps).	EC		
Actual voltage is within 5% of rated voltage	EC		
Controls			
All control sensors properly located	CC		
Control wiring complete, sensors and control devices installed, system interlocks functional	CC		
Specified sequences of operation and operating schedules implemented with all variations documented	CC		
Backdraft damper actuators wired	CC		
VFD interlocked to control system, VFD accepts Start/Stop command, speed command from BAS and BAS reads VFD run status, speed feedback, faults, etc.	CC		
VFD			
VFD location not subject to excessive temperatures, moisture or dirt			
VFD size matches motor size			
Internal setting designating the model is correct			
Input of motor FLA represents 100% to 105% of motor FLA rating			
Appropriate Volts vs Hz curve is being used			
Accel and decel times are around 10 - 50 seconds, except for special applications			
Lower frequency limit set at 0% (note if otherwise)			
Upper frequency limit set at 100% (note if otherwise)			
Unit is programmed with full written programming record on site			
VFD powered (wired to controlled equipment)			
Unit has been started up by authorized factory representative (attach start-up report)			
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
		Yes	No
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General Contractor / Company

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Date

Mechanical Contractor / Company

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Electrical Contractor / Company

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Date

Controls Contractor / Company

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Date



## VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

Equipment Type: Boilers

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Boiler			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
National Board Number:	MC		
Nominal BHP or MBH:	MC		
Output MBH:	MC		
EWT (deg F):	MC		
LWT (deg F):	MC		
MAWP/Maximum Design Pressure:	MC		
Safety (Relief) Valve Set Pressure(s):	MC		
Nameplate Information: Burner			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Fuel type(s):	MC		
Inlet Fuel Fuel Pressure (units):	MC		
Input MBH:	MC		
Output MBH:	MC		
Fan HP:	MC		
Volts / Phase / Hz:	MC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
General Inspection			
General appearance good, no apparent damage	MC		
Site sufficiently clean for testing	MC		
Equipment labels affixed	MC		
Tube pulling, and access door space adequate	MC		
Flue completely installed and sloped properly	MC		
Combustion air supply complete	MC		
System filled	MC		
Pressure and temperature gages installed	MC		
Multiple boiler interlocks completed	MC		
Factory start-up complete (attach start up report)	MC		
Boil out complete (attach report)	MC		
E-Stop installed and operable	MC		
Temperature (Pressure) Controller intalled and operable	MC		
Piping and Coils			
Fuel (Gas, oil) piping installed and tested (supply is at proper pressure)	MC		
Hydronic piping complete, including blowdown system, makeup water piping and safety relief valves	MC		
Hydronic system flushing complete and strainers cleaned	MC		
Piping pressure tested with no leaks	MC		
Boiler trim is installed (water column, gauge glass, etc.)	MC		
Test ports installed near all control sensors and per spec	MC		
Flow switch installed as required	MC		
Flow meters installed as required	MC		
Piping type and flow direction labeled on piping	MC		
Chemical treatment system or plan installed	MC		
ASME pressure vessel data sheet or certification tag posted and inspection complete for each expansion tank	MC		
Expansion tanks verified to not be air bound and system completely full of water	MC		
Air vents and bleeds at high points of systems functional	MC		
P/T plugs, balancing and isolation valves installed per drawings. Valves properly tagged	MC		
Steam, feedwater and condensate piping complete, including blowdown system, make-up water piping and safety valves	MC		
Electrical			
Power wiring installed properly	EC		
All electrical components grounded	CC		
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent	CC		
Power disconnects in place and labeled	CC		
All electric connections tight	EC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Controls			
Control system interlocks hooked up and functional	CC		
All control devices, pneumatic tubing and wiring complete	CC		
Motorized valves, dampers and float switches functional	CC		
Fire and smoke sensing components functional	CC		
Combustion air source is interlocked with boiler (combustion air dampers, make-up air units, etc.)	CC		
Operational Checks			
Boiler safeties energized and tested	EC		
Start up report includes optimal and actual percent CO2, CO, O2, stack temperature; combustion efficiency (as required by contract documents)	EC		
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
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General Contractor / Company

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Mechanical Contractor / Company

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Electrical Contractor / Company

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Date

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Controls Contractor / Company

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Date

## VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

Equipment Type: AC Split System

Equipment Tag No.: \_\_\_\_\_

Room:      /     

Facility Tag No.: \_\_\_\_\_

Floor:     

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Indoor Unit			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Air Flow Rate (CFM):	MC		
Refrigerent Type:	MC		
Total / Sensible Cooling Capacity (MBH):	MC		
Max & Min Entering Air Temp (°F DB/ °F WB):	MC		
Volts / Phase / Hz:	MC		
Minimum Circuit Ampacity (MCA):	MC		
Power Input (kW):	MC		
Nameplate Information: Outdoor Unit			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Refrigerent Type:	MC		
Nominal Capacity (Tons):	MC		
Volts / Phase / Hz:	MC		
Maximum Overcurrent Protection (MOCP):	MC		
Minimum Circuit Ampacity (MCA):	MC		
Fan Motor FLA:	MC		
General Inspection			
General appearance good, no apparent damage	MC		
All covers and guards in place	MC		
Vibration isolation equipment installed and released from shipping locks	MC		
Maintenance access acceptable for unit and components	MC		
Clean up of equipment completed per contract documents	MC		
Permanent labels affixed, including for fans	MC		
Installed in proper location per contract documents	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Unit level and securely mounted per manufacturer's recommendations	MC		
<b>Piping and Coils</b>			
Refrigerant piping sized and piped with valves and components according to manufacturer requirements	MC		
Pipe fittings complete and pipes properly supported	MC		
Pipes properly insulated and labeled	MC		
Piping system properly flushed	MC		
No leakage apparent around fittings	MC		
All coils are clean and fins are in good condition	MC		
All condensate drain pans clean and slope to drain	MC		
Condensate line trap installed per manufacturer	MC		
Refrigerant piping charged (provide report documenting quantities and refrigerant used)	MC		
<b>Compressor and Condenser</b>			
Correct oil level (check site glass during operation, if available)	MC		
Adequate clearance for airflow around condenser	MC		
Crankcase heater (if applicable) energized long enough for startup	MC		
Unit provided with low ambient controls	MC		
<b>Electrical</b>			
Proper power supply for unit	EC		
Unit mounted disconnects in place and labeled	EC		
All electric connections tight	EC		
Proper grounding installed for components and unit	EC		
Safeties in place and operable	EC		
Smoke detectors in place	EC		
Wiring complete between outdoor and indoor unit, controller	EC		
<b>Controls</b>			
Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.)	CC		
Sensors properly located and secure	CC		
Control system interlocks hooked up and functional	CC		
All control devices and wiring complete	CC		
Specified sequences of operation and operating schedules have been implemented with all variations documented	CC		
Indoor unit operable and providing design air flow	CC		
Circuit protection sized and installed properly	CC		
<b>Operational Checks</b>			
Condenser fans rotate freely and correctly	MC		
Measure line to line voltage phase imbalance for the compressor:	MC		
Compressor Phase: $(\% \text{Imbalance} = 100 \times (\text{avg.} - \text{lowest}) / \text{avg.})$	MC		
Record in cell, all three phase voltages. Imbalance less than 2%?	MC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Record full load running amps for the compressor. ____rated FL amps x ____srvc factor = ____ (Max amps). Running less than max?	MC		
Record full load running amps for each fan. ____rated FL amps x ____srvc factor = ____ (Max amps). Running less than max?	MC		
No unusual noise or vibration during operation (condenser fan & compressor)	MC		
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes		CAL Item	
		Yes	No
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General Contractor / Company

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Mechanical Contractor / Company

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Date

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Electrical Contractor / Company

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Controls Contractor / Company

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Date

## VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

Equipment Type: Air Handling Unit

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Air Handling Unit			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Nameplate Information: Supply Fan			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Fan Airflow (CFM):	MC		
Quantity:	MC		
TSP (IN. WG):	MC		
ESP (IN. WG):	MC		
Speed (RPM):	MC		
Max BHP:	MC		
Nameplate Information: Supply Fan Motor Data			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Motor HP:	MC		
Belt Size/Model:	MC		
Belt Quantity:	MC		
Volts / Phase / Hz:	MC		
Nameplate Information: Supply Fan VFD			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		





Category / Inspection Item	Resp. Party	Complete	
		Yes	No
<b>Nameplate Information: Return Fan</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Fan Airflow (CFM):	MC		
Quantity:	MC		
TSP (IN. WG):	MC		
ESP (IN. WG):	MC		
Speed (RPM):	MC		
Max BHP:	MC		
<b>Nameplate Information: Return Fan Motor Data</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Motor HP:	MC		
Belt Size/Model:	MC		
Belt Quantity:	MC		
Volts / Phase / Hz:	MC		
<b>Nameplate Information: Return Fan VFD</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
<b>Nameplate Information: Heating Coil - Hot Water</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Airflow (CFM):	MC		
Quantity:	MC		
Rows:	MC		
Capacity (MBH):	MC		
Entering Air Temp (deg F DB):	MC		
Leaving Air Temp (deg F DB):	MC		
Air Pressure Drop (IN WG) :	MC		
GPM :	MC		
Entering Water Temp (deg F):	MC		
Leaving Water Temp (deg F):	MC		
Water Pressure Drop (FT):	MC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
<b>Nameplate Information: Cooling Coil - Chiller Water</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Airflow (CFM):	MC		
Quantity:	MC		
Rows:	MC		
Capacity Total/Sensible (MBH):	MC		
Entering Air Temp (deg F DB):	MC		
Leaving Air Temp (deg F DB):	MC		
Air Pressure Drop (IN WG) :	MC		
GPM:	MC		
Entering Water Temp (deg F):	MC		
Leaving Water Temp (deg F):	MC		
Water Pressure Drop (FT):	MC		
<b>Nameplate Information: Heat Recovery Coil</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Airflow (CFM):	MC		
Quantity:	MC		
Rows:	MC		
Fins/FT:	MC		
Fluid Type:	MC		
Capacity-Total (MBH):	MC		
Entering Air Temp (deg F DB/ deg F WB):	MC		
Leaving Air Temp (deg F DB/ deg F WB):	MC		
Air Pressure Drop (IN WG):	MC		
Entering Water Temp (deg F):	MC		
Leaving Water Temp (deg F):	MC		
Water Flow Rate (GPM):	MC		
Water Pressure Drop (FT):	MC		
<b>Nameplate Information: Heat Recovery Wheel</b>			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Wheel size (W x H):	MC		
Wheel quantity:	MC		
Wheel media:	MC		
Wheel motor HP:	MC		
Belt Size:	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Humidifier			
Manufacturer:	MC		
Model No.:	MC		
Serial No.:	MC		
Airflow (CFM):	MC		
Required Steam Pressure (psig):	MC		
Nameplate Information: Filter			
Manufacturer:	MC		
Model No.:	MC		
Filter Type:	MC		
Filter Size:	MC		
Filter Quantity:	MC		
Filter MERV rating:	MC		
General Inspection			
Permanent labels affixed, including for fans	MC		
Casing condition good: no dents, leaks, door gaskets installed	MC		
Access doors close tightly with no leaks. Door swing in proper direction based on unit pressure (pressure aids in closing door).	MC		
Flex connection between ducts and unit tight and in good condition and does not leak	MC		
Vibration isolation equipment installed and released from shipping locks	MC		
Maintenance access acceptable for unit and components	MC		
Clean-up of equipment completed per contract documents	MC		
Filters installed and are clean and tight fitting. Replacement type and efficiency permanently affixed to housing. Construction filters removed.	MC		
Panel controller (HOA/VFD) properly activates and deactivates the unit	MC		
Structural support is installed for unit.	MC		
Support structure height sized to allow condensate trap installation	MC		
Anchor bolts in place	MC		
Shaft ground ring or other approved means are installed to prevent motor bearing failures from static and VFD induced currents	MC		
Heat Recovery Wheel			
Wheel and motor alignment correct	MC		
Wheel belt tension & condition good	MC		
Wheel protective shrouds for belts in place and secure	MC		
Wheel area clean	MC		
Wheel and motor properly lubricated	MC		
Rotation sensor is connected, operational, and displaying correct wheel rotation	MC		
Free wheel rotation is smooth and not wobbly	MC		
Wheel acceptable noise and vibration	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Piping and Coils			
Pipe & fittings complete, no leaks, pipes properly supported	MC		
Pipes properly labeled	MC		
Pipes properly insulated	MC		
Strainers in place and piping flushed	MC		
All coils are clean and fins are in good condition	MC		
Electric heating coil properly installed	MC		
All condensate drain pans clean and slope to drain per spec	MC		
Valves properly labeled	MC		
Adequate coil pull space exists. Piping can be removed to permit coil access.	MC		
P/T plugs and isolation valves installed per drawings	MC		
Valves that require positive shut-off are verified not to be leaking when closed at normal operating pressure	MC		
Fans and Dampers			
Supply fan and motor alignment correct	MC		
Supply fan belt tension and condition good	MC		
Supply fan protective shrouds for belts in place and secure	MC		
Supply fan area clean	MC		
Supply fan and motor lube lines installed and lubed	MC		
Supply fan rotation correct	MC		
Supply fan has no unusual noise or vibration	MC		
Return/Exhaust fan and motor alignment correct	MC		
Return/Exhaust fan belt tension and condition good	MC		
Return/Exhaust fan protective shrouds for belts in place and secure	MC		
Return/Exhaust fan area clean	MC		
Return/Exhaust fan and motor lube lines installed and lubed	MC		
Return/Exhaust fan rotation correct	MC		
Return/Exhaust fan has no unusual noise or vibration	MC		
All dampers close tightly and linkages have minimum play	MC		
All dampers stroke fully without binding	MC		
Motors: Premium efficiency verified, if spec'd?	MC		
Ducts			
Sound attenuators installed	MC		
No apparent severe duct restrictions	MC		
Turning vanes installed in square elbows	MC		
Outside Air intakes located away from pollutant sources and exhaust outlets	MC		
Pressure leakage tests complete	MC		
Ducts cleaned as per specifications	MC		
Balancing dampers installed as per drawings and TAB's site visit	MC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Humidifier			
Steam piping and accessories installed securely	MC		
Steam pipe is free of kinks and sags	MC		
Water supply line to humidifier is secure	MC		
Drain is installed according to specification	MC		
Condensate hose secure and slopes to drain	MC		
Humidifier is installed per Engineer's detail (M-xxx) and Manufacturer's instructions.	MC		
Clean steam is available and condensate Pressure Powered pump is operable.	MC		
Electrical			
All electric connections tight	EC		
AHU lights are functioning	EC		
Power disconnects in place and labeled	EC		
Proper grounding installed for components and unit	EC		
Safeties in place and operable	EC		
Starter overload breakers installed and correct size	EC		
Smoke detectors in place	EC		
Electrical wiring labeled per contract documents	EC		
Fans > 5 HP phase checks (%Imbalance - 100 x (avg.-lowest)/avg.) Imbalance less than 2%?	EC		
Record full load running amps for each fan. ____ rated FLA x ____ service factor = ____ (max amps). Running less than max?	EC		
The HOA switch properly activates and deactivates the unit	EC		
Controls			
Instrumentation installed according to contract documents (temperature, pressure, humidity sensors & switches, freezestats, AFMS, etc.)	CC		
Filter pressure differential measuring device installed and functional	CC		
Low limit freeze stat sensor located to deal with stratification and bypass	CC		
All building control system interlocks hooked up with packaged controls and functional	CC		
All control devices and wiring complete	CC		
Specified sequences of operation and operating schedules implemented with all variations documented	CC		
Supply and Return air duct smoke detectors installed; Hardwire interlocked to de-energize fans, close associated smoke dampers and notify fire alarm system when	CC		
AHU graphics are complete and integrated to the BAS	CC		
Actuator spanned, modulate smoothly and proportional to input signal and BAS readout (all dampers, control valves, etc.)	CC		
VFD interlocked to control system, VFD accepts Start/Stop command, speed command from BAS and BAS reads VFD run status, speed feedback, faults, etc.	CC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
VFD			
VFD location not subject to excessive temperatures, moisture or dirt			
VFD size matches motor size			
Internal setting designating the model is correct			
Input of motor FLA represents 100% to 105% of motor FLA rating			
Appropriate Volts vs Hz curve is being used			
Accel and decel times are around 10 - 50 seconds, except for special applications			
Lower frequency limit set at 0% (note if otherwise)			
Upper frequency limit set at 100% (note if otherwise)			
Unit is programmed with full written programming record on site			
VFD powered (wired to controlled equipment)			
Unit has been started up by authorized factory representative (attach start-up report)			
Documentation			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing, Adjusting and Balancing is complete.	TAB		
Trending (as requested by the CxA) for this equipment and system implemented to prove performance. Data file provided for CxA review.	CC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
		Yes	No
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 General Contractor / Company

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 Date

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 Mechanical Contractor / Company

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 Date

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 Electrical Contractor / Company

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 Date

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 Controls Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

Equipment Type: Grounding

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
General Inspection			
Verify cable sizes match one-lines and cable schedules	EC		
All 3/4" x 10' copper clad ground rods are installed a minimum of 24" below grade.	EC		
All exothermic connections completed and solidly connected	EC		
All connections are completed (ground rods to grid, grid to building steel, grid to equipment etc.)	EC		
All bolted connections securely fastened in accordance with recommended torque values	EC		
Verify ground conductors from each electrical room ground bus are installed per contract documents.	EC		
Verify ground bus in electrical rooms are installed per contract documents.	EC		
Test well is set flush with grade or floor in a concrete ring per details	EC		
Test well is installed per details at the ground rod closest to the service entrance.	EC		
Main electric room ground bus bar is installed per details	EC		
Documentation			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	EC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
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General Contractor / Company

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Date

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Electrical Contractor / Company

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Date

VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Type: Transformer, Dry Type

Equipment Tag No.: \_\_\_\_\_ Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_ Floor: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information			
Manufacture Date:	EC		
kVA Rating:	EC		
Type/K-Rating:	EC		
Frequency: 60hz	EC		
Primary Voltage:	EC		
Secondary Voltage:	EC		
Number of Taps:	EC		
Impedance:	EC		
Temperature Rise:	EC		
Winding Material:	EC		
General Inspection			
Verify equipment is installed in the proper location per contract documents.	EC		
All shipped loose components are installed.	EC		
All enclosure panels and doors in place, fitted, undamaged	EC		
Warning signs installed per manufacturer's recommendations.	EC		
Transformer is clean and free from damage	EC		
Transformer is installed plumb and level on concrete housekeeping pad	EC		
Transformers have been set on resilient pads to prevent noise transmission as specified	EC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Electrical Inspection			
Transformer neutral has been bonded to equipment grounding conductor and transformer enclosure. Grounding electrode conductor has been connected to building steel via exothermic weld	EC		
Line and load side terminations have NOT been landed.	EC		
Coil is "floating" or shipping bolts are loosened but are not wrench tight.	EC		
Documentation			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	EC		
Power available for test equipment.	EC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Typed circuit directory has been provided per as-built panel schedules and floor plans.	EC		
Notes		CAL Item	
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General Contractor / Company

Date

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Electrical Contractor / Company

Date

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VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Type: Panelboard

Equipment Tag No.: \_\_\_\_\_ Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_ Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information			
Manufacturer:	EC		
Model No.:	EC		
Serial No.:	EC		
Nominal Voltage:	EC		
Current Rating:	EC		
Frequency: 60hz	EC		
Phase:	EC		
Wire:	EC		
Neutral Rating:	EC		
Short Circuit Rating:	EC		
Bus Material:	EC		
NEMA Enclosure: NEMA 1	EC		
Number of Breakers:	EC		
General Inspection			
Verify equipment is installed in the proper location per contract documents.	EC		
All shipped loose components are installed.	EC		
All enclosure panels and doors in place, fitted, undamaged.	EC		
Warning signs installed per manufacturer's recommendations.	EC		
Verify panelboard circuit breakers are molded case type and are of the correct sizes and ratings as specified in contract documents.	EC		
Panelboard lock and keys have been provided.	EC		
Panelboard interior has been vacuum cleaned.	EC		
Panelboard has the working space and dedicated space as required by NEC	EC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
<b>Operational Checks</b>			
Grounding installation from ground grid, building steel, and equipment ground bus is complete.	EC		
Verify phase feeder conductors are routed cleanly and neatly without damage	EC		
Phase conductors lugs are properly torqued per manufacturer recommendations as indicated by a mark across the terminals.	EC		
Category / Inspection Item	Resp. Party	Complete	
		Yes	No
<b>Documentation</b>			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	EC		
Power available for test equipment.	EC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Arc Flash Warning labels have been provided per the Arc Flash Study requirements	EC		
Typed circuit directory has been provided per as-built panel schedules and floor plans.	EC		
Notes	CAL Item		
	Yes	No	
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General Contractor / Company

Date / /

Electrical Contractor / Company

Date / /



VACIHCS Boiler Replacement  
Project #636A6-11-916  
KJWW #13.0240.00

Equipment Type: Generator

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Generator			
Manufacturer:	EC		
Model No.:	EC		
Serial No.:	EC		
Manufacture Date:	EC		
Nominal Voltage:	EC		
Phase:	EC		
Frequency:	EC		
Rated Standby kW	EC		
Rated Standby kVA	EC		
Rated Standby Power Factor	EC		
Insulation Class	EC		
Nameplate Information: Engine			
Manufacturer:	EC		
Model No.:	EC		
Serial No.:	EC		
Manufacture Date:	EC		
RPM:	EC		
Horsepower:	EC		
Fuel Grade:	EC		
Nameplate Information: Battery Charger			
Manufacturer:	EC		
Model No.:	EC		
Serial No.:	EC		
Input Voltage:	EC		
Input Amps:	EC		
Output Voltage:	EC		
Output Amps:	EC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information: Battery			
Manufacturer:	EC		
Model No.:	EC		
Type:	EC		
Cold Cranking Amps:	EC		
Voltage:	EC		
Quantity:	EC		
General Inspection: Battery Charger			
Verify battery charger has proper input voltage from panelboard and circuit indicated on contract documents.	EC		
Battery charger does not have physical damage (broken dials, indicating lights, handles, etc...)	EC		
Conduit and conductors are properly supported.	EC		
Battery charger is securely mounted to a support structure and is anchored to the wall or floor.	EC		
General Inspection: Battery			
The installation of an eyewash is located nearby, if applicable	EC		
Battery posts are not bent, broken or otherwise damaged	EC		
Corrosion is absent from battery posts, conductors terminations and other associated equipment.	EC		
Batteries are installed in a tray and secured to generator frame, free from	EC		
Batteries are not leaking	EC		
Verify batteries connected in series with correct polarity.	EC		
General Inspection: Generator			
Generator, enclosure, and all accessories are clean and free from damage	EC		
Generator has been installed plumb and level on concrete pad	EC		
All equipment has been installed and anchored. All bolts have been torqued to manufacturer's recommendations	EC		
All combustible materials are adequately separated from exhaust system and other heat producing components	EC		
Generator enclosure doors can swing freely without binding or obstruction and allow for complete access to the interior.	EC		
Verify air intake louvers are equipped with bird screen and filter arranged to permit air circulation without damage to linkages or damper blades	MC		
Engine exhaust has condensate drain installed at silencer	MC		
Engine exhaust has expansion fitting installed in exhaust piping to account for expansion	MC		
Engine exhaust has rain cap installed at exterior outlet	EC		
Verify fuel system installed, connected, and primed	EC		
Verify that fuel system fittings are tight and system is leak free	EC		

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Electrical Inspections			
Neutral of generator has been bonded to grounding electrode system	EC		
Generator frame and enclosure have been bonded to grounding electrode system	EC		
Remote annunciator has been installed in the specified location	EC		
Power cables have been torqued to manufacturer's recommendations	EC		
Circuits for accessories are routed, secured from panelboard to equipment.	EC		
Local control panel mounted E-Stop is accessible and is NOT located above 72" AFF	EC		
Controls Inspections			
All control wiring has been installed in separate conduits from the power wiring	EC		
All control wiring from ATS's for automatic generator start circuit has been installed and is terminated properly	EC		
All control wiring for BAS has been installed and is properly terminated	CC		
Documentation			
Equipment startup successfully completed. Attach completed startup form(s) to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Remote fuel delivery system has been successfully started.	GC		
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	EC		
Manufacturer startup representative has been scheduled.	EC		
Power available for test equipment.	EC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		





Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Notes		CAL Item	
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 General Contractor / Company

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 Date

 \_\_\_\_\_  
 Electrical Contractor / Company

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 Date

 \_\_\_\_\_  
 Controls Contractor / Company

 \_\_\_\_\_ / \_\_\_\_ / \_\_\_\_  
 Date

Equipment Type: ATS

VACIHCS Boiler Replacement

Project #636A6-11-916

KJWW #13.0240.00

Equipment Tag No.: \_\_\_\_\_

Room: \_\_\_\_\_

Facility Tag No.: \_\_\_\_\_

Floor: \_\_\_\_\_

Revision		
Level	Date	Description
0	4/12/2013	Issued for Pricing

Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Nameplate Information			
Manufacturer:	EC		
Model No.:	EC		
Serial No.:	EC		
Nominal Voltage:	EC		
Current Rating:	EC		
Frequency: 60hz	EC		
Poles:	EC		
NEMA Enclosure: NEMA 1	EC		
General Inspection			
Verify equipment is installed in the proper location per contract documents.	EC		
All shipped loose components are installed.	EC		
All enclosure panels and doors in place, fitted, undamaged	EC		
Warning signs installed per manufacturer's recommendations.	EC		
Red and Green indicating lights with fuses and a test switch are provided on front panel of switch enclosure.	EC		
Test switch shall be a three position momentary type with test/automatic/reset as options.	EC		
There is no visible damage to the main transfer switch assembly.	EC		
There is no visible damage to the bypass transfer switch assembly.	EC		
Verify that separate bypass and isolation handles are utilized and are clearly distiguished between functions.	EC		
Bypass and isolation handles are permanently affixed and operable without opening enclosure door. Insertion of loose operating handles or opening of enclosure door to operate are not acceptable.	EC		
Bypass handle has three operating modes - Closed/Test/Open	EC		
Verify that operation of key interlocks for bypass isolation or ATS's which can not be completely withdrawn when isolated is not provided.	EC		
Operational Checks			
Verify that NORMAL and EMERGENCY sources are available.	EC		



Category / Inspection Item	Resp. Party	Complete	
		Yes	No
Verify field adjustable relay settings, intervals, and delays are set.	EC		
Grounding installation from ground grid, building steel, and equipment ground bus is complete.	EC		
Verify phase feeder conductors are routed cleanly and neatly without damage	EC		
Phase conductors lugs are properly torqued per manufacturer recommendations as indicated by a mark across the terminals.	EC		
Verify remote annunciator and control panel is flush in wall.	EC		
<b>Controls Checks</b>			
All field and interconnecting wiring is completed and labeled at each end with visible and readable tags.	EC		
<b>Documentation</b>			
Equipment startup successfully completed. Attach completed startup forms to this PFC.	GC		
Building automation point to point successfully completed. Attach completed points list to this PFC.	CC		
Testing agency scheduled to perform the test and the commissioning agent notified of the testing date.	EC		
Manufacturer startup representative scheduled.	EC		
Power available for test equipment.	EC		
Functional Performance Testing scheduled and coordinated with the CxA.	GC		
Notes	CAL Item		
	Yes	No	
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General Contractor / Company

Date / /

Electrical Contractor / Company

Date / /

Controls Contractor / Company

Date / /

**SECTION 07 84 00  
FIRESTOPPING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.
- B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

**1.2 RELATED WORK**

- A. Sealants and application: Section 07 92 00, JOINT SEALANTS.
- B. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS, Section 23 37 00, AIR OUTLETS AND INLETS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- C. List of FM, UL, or WH classification number of systems installed.
- D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

**1.5 WARRANTY**

Firestopping work subject to the terms of the Article "Warranty of Construction", except extend the warranty period to five years.

**1.6 QUALITY ASSURANCE**

FM, UL, or WH or other approved laboratory tested products will be acceptable.

**1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

- B. American Society for Testing and Materials (ASTM):
  - E84-10.....Surface Burning Characteristics of Building Materials
  - E814-11.....Fire Tests of Through-Penetration Fire Stops
- C. Factory Mutual Engineering and Research Corporation (FM):
  - Annual Issue Approval Guide Building Materials
- D. Underwriters Laboratories, Inc. (UL):
  - Annual Issue Building Materials Directory
  - Annual Issue Fire Resistance Directory
  - 1479-10.....Fire Tests of Through-Penetration Firestops
- E. Warnock Hersey (WH):
  - Annual Issue Certification Listings

## **PART 2 - PRODUCTS**

### **2.1 FIRESTOP SYSTEMS**

- A. Use either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m<sup>2</sup> (16 sq. in.) in overall cross sectional area.
- C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.
- D. Firestop sealants used for firestopping or smoke sealing shall have following properties:
  - 1. Contain no flammable or toxic solvents.
  - 2. Have no dangerous or flammable out gassing during the drying or curing of products.
  - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
  - 4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

- E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:
  - 1. Classified for use with the particular type of penetrating material used.
  - 2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
  - 3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
- F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
- G. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- H. Materials to be asbestos free.
- I. Where the firestopping will be exposed to traffic or to frequent contact with the public, the material must be durable and undamaged by the normal wear it will be expected to receive.
- J. Where the firestopping may reasonably be expected to experience differential movement, the material must be elastomeric in nature and have a tested elongation equal to or greater than the change in dimension that can be reasonably anticipated.
- K. All materials used in firestopping systems, including packing and anchoring materials, must conform to the requirements of the tested design (FM, UL or WH design) and must conform to all requirements of the primary firestopping material manufacturer.

## **2.2 SMOKE STOPPING IN SMOKE PARTITIONS**

- A. Use silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.
- B. Use mineral fiber filler and bond breaker behind sealant.
- C. Sealants shall have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with E84.
- D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

## **2.3 ACCESSORIES**

- A. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design and as recommended by the manufacturer of the primary firestopping material.
- B. Labels: Red and white self-adhesive label, or plastic or metal plate. As a minimum stating the installation is a "fire rated assembly" or "through-penetration fire stop system," and installation data (UL-Listed or FM-Approved configuration number) date installed, installer and organization. Also state "Modify/remove only with {-installing contractors name-} approval" if space permits.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

### **3.2 PREPARATION**

- A. Prepare surface according to the recommendations of the manufacturer including providing primer where recommended.
- B. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.
- C. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

### **3.3 INSTALLATION**

- A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.
- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.

### **3.4 LABELING**

- A. All firestopping installations are to be labeled as described herein.
- B. Labels shall be frequent and visible enough that future activities requiring penetration of the fire barrier will recognize the need for firestopping.

C. Label on both sides of the penetrated fire/smoke barrier

D. Provide labels as described under PART 2 - MATERIALS

**3.5 CLEAN-UP AND ACCEPTANCE OF WORK**

A. As work on each floor is completed, remove materials, litter, and debris.

B. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the Resident Engineer.

C. Clean up spills of liquid type materials.

- - - E N D - - -



**SECTION 23 25 00**  
**HVAC WATER TREATMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies cleaning and treatment of circulating HVAC water systems, including the following.
  - 1. Cleaning compounds.
  - 2. Chemical treatment for closed loop heat transfer systems.

**1.2 RELATED WORK**

- A. Test requirements and instructions on use of equipment/system: Section 01 00 00, GENERAL REQUIREMENTS.
- B. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- C. Piping and valves: Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.

**1.3 QUALITY ASSURANCE**

- A. Refer to paragraph, QUALITY ASSURANCE in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than 6 service calls and written status reports. Emergency calls are not included. Minimum service during construction/start-up shall be 6 hours.
- C. Chemicals: Chemicals shall be non-toxic approved by local authorities and meeting applicable EPA requirements.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data including:
  - 1. Cleaning compounds and recommended procedures for their use.
  - 2. Chemical treatment, including installation and operating instructions.
  - 3. Chemical solution tanks
  - 4. Injection pumps

5. Plans, elevations, sections, and attachment details.
6. Diagrams for power and control wiring.
7. Water-treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
8. Water analysis: Illustrate water quality available at Project site.
9. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to COR and Architect.
- C. Water analysis provider qualifications: verification of experience and capability of HVAC water-treatment service provider.
- D. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B-005-4.
- E. Emergency, Maintenance and operating instructions for sensors, injection pumps, and controllers to include in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

#### **1.5 QUALITY ASSURANCE**

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):  
70-2008.....National Electric Code (NEC)
- C. American Society for Testing and Materials (ASTM):  
F441/F441M-02 (2008) ... Standard Specification for Chlorinated Poly  
(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules  
40 and 80

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional

performance characteristics, operating personnel capabilities, and requirements and guidelines of the VA.

C. Steam Boiler and Steam Condensate:

1. Steam Condensate

- a. pH: Maintain a value within 7.8 to 8.4.
- b. Total Alkalinity: Maintain a value within 5 to 50 ppm.
- c. Chemical Oxygen Demand: Maintain a maximum value of 15 ppm.
- d. Soluble Copper: Maintain a maximum value of 0.20 ppm.
- e. TSS: Maintain a maximum value of 10 ppm.
- f. Ammonia: Maintain a maximum value of 20 ppm.
- g. Total Hardness: Maintain a maximum value of 2 ppm.

2. Steam boiler operating at more than 15 psig shall have the following water qualities:

- a. "OH" Alkalinity: Maintain a value within 200 to 400 ppm.
- b. TSS: Maintain a value within 600 to 1200 ppm.

**2.2 CLEANING COMPOUNDS**

- A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.
- B. All chemicals to be acceptable for discharge to sanitary sewer.
- C. Refer to Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING, PART 3, for flushing and cleaning procedures.

## **2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT**

### **A. TSS Controller:**

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Section 230900 "Instrumentation and Control for HVAC."
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High- or low-conductance-alarm-light trip points, field adjustable; with silence switch.
6. Hand-off/auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves
  - a. Steam Boilers: Motorized ball valve, steel body, and TFE seats and seals.

### **B. Chemical Solution Tanks:**

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pumps: coordinate with system design.
3. Capacity: 30 gallons.

### **C. Chemical Solution Injection Pumps:**

1. Self-priming, positive displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous duty, single-phase motor. Comply with requirements in Section 230512 "General Motor Requirements for HVAC and Steam Generation Equipment".

- a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.
- E. Injection Assembly:
  - 1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
  - 2. Ball Valve: Two-piece stainless steel, as described in "Stainless-Steel Pipes and Fittings" Article; selected to fit quill.
  - 3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
  - 4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

#### **2.4 STAINLESS-STEEL PIPES AND FITTINGS**

- A. Stainless-Steel Tubing: Comply with ASTM A 269, type 316.
- B. Stainless-Steel Fittings: Comply with ASTM A 815/A 815M, Type 316, Grade WP-S.
- C. Two-Piece, Full Port, Stainless-Steel Ball Valves: ASTM A351/A 351M, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250 psig Steam Working Pressure and 600-psig Cold Working Pressure ratings.
- D. Three-Piece, Full Port, Stainless-Steel Ball Valves: ASTM A351/A 351M, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150 psig Steam Working Pressure and 600-psig Cold Working Pressure ratings.

#### **2.5 CHEMICALS**

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

#### **2.6 EQUIPMENT AND MATERIALS IDENTIFICATION**

- Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.
- B. Install chemical application equipment on concrete bases level and plumb. Maintain manufacturers recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.C.
  - Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:
  - 1. Install water meter in make-up water supply.
  - 2. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
    - a. Pumps shall operate for timed interval when contacts close at water meter in makeup-water supply connection.
  - 3. Install test equipment and furnish test-kit to Owner.
  - 4. Install TSS controller with sensor and bleed valves.
    - a. Bleed valves shall cycle to maintain maximum TSS concentration.
  - 5. Install inhibitor injection timer with injection pumps and solution tanks.
    - a. Pumps shall operate for timed interval on contact closure at water meter in makeup-water supply connection. Injection pump shall discharge into main steam supply header.
  - 6. Provide installation supervision, start-up and operating instruction by manufacturer's technical representative.
- G. Do not valve in or operate system pumps until after system has been cleaned.
- H. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the by-pass valves. Also, clean all strainers.

- I. Perform tests and report results in accordance with Section 01 00 00,  
GENERAL REQUIREMENTS.
- J. After cleaning is complete, and water PH is acceptable to manufacturer  
of water treatment chemical, add manufacturer-recommended amount of  
chemicals to systems.
- K. Instruct VA personnel in system maintenance and operation in accordance  
with Section 01 00 00, GENERAL REQUIREMENTS.

- - - E N D - - -

**SUPPLEMENTAL DRAWING**

DATE: 06/07/13

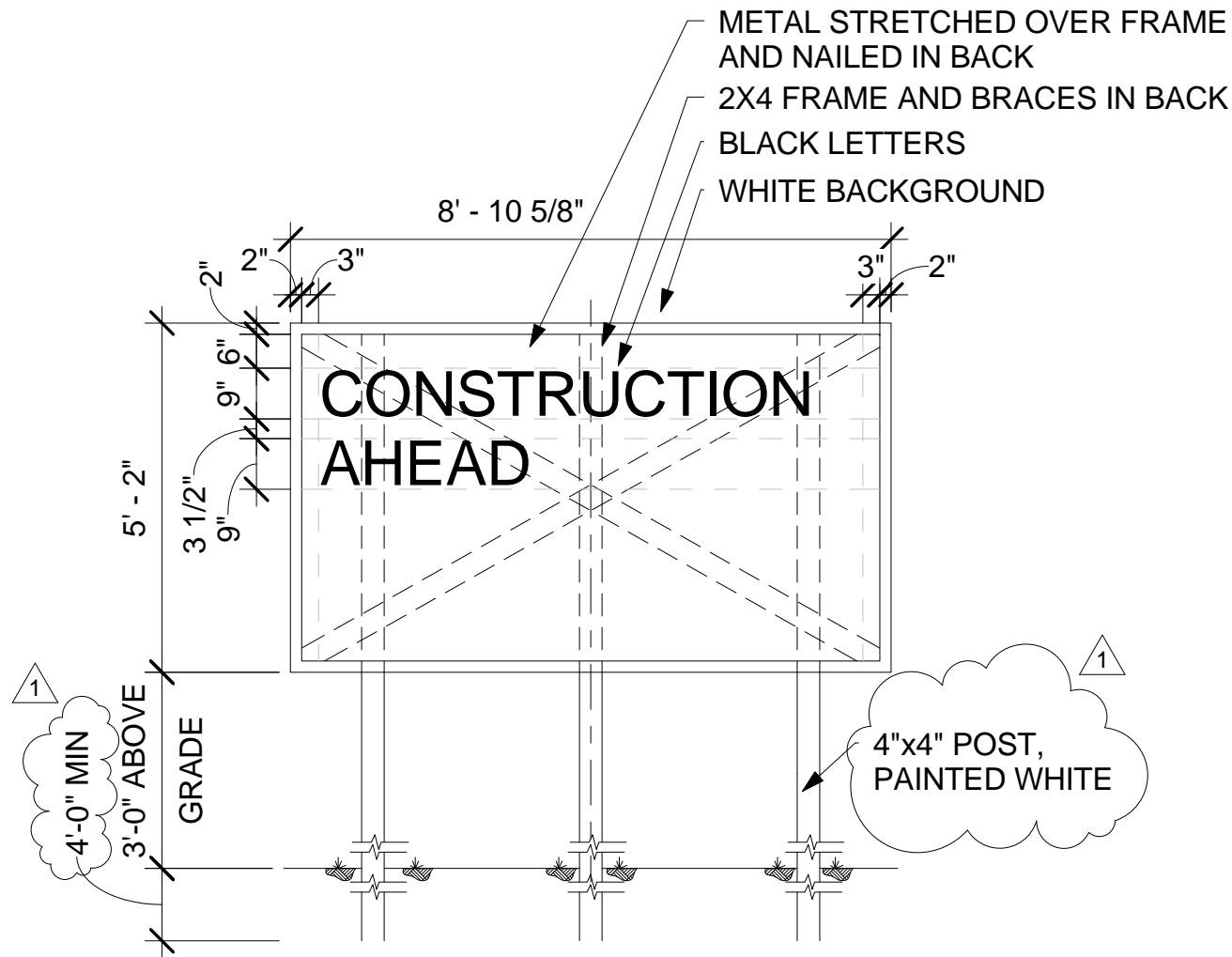
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SCALE: 3/8" = 1'-0"

SHEET NO: SDG-1

SHEET TITLE: TEMP. CONSTRUCT. SIGN

REF: GI001





**SUPPLEMENTAL DRAWING**

DATE: 06/03/13

DRAWN: KAH

SCALE: NOT TO SCALE

SHEET NO: SDA-1

SHEET TITLE: SIGNAGE SCHEDULE

REF: AE201

**SIGNAGE SCHEDULE:**

LEVEL	LOCATION	SIGN TYPE	SIGN TEXT	QUANTITY	NOTES
B	2	IN-03.01	020A	1	SEE 4/AE201
B	3	IN-03.01	021A	1	SEE 4/AE201
B	11	IN-03.01	022	1	SEE 4/AE201
B	13	IN-03.01	021	1	SEE 4/AE201
1	1C	IN-03.01	120	1	SEE 4/AE201
1	1D	IN-03.01	100C	1	SEE 4/AE201

\* SEE EXTERIOR ELEVATIONS FOR EXTERIOR SIGNAGE LOCATION AND TYPE

**SCHEMMER**

ARCHITECTS | ENGINEERS | PLANNERS

PROJECT: BOILER REPLACEMENT

JOB NO: 636A6-11-916 (06054.001)

**SUPPLEMENTAL DRAWING**

DATE: 06/03/13

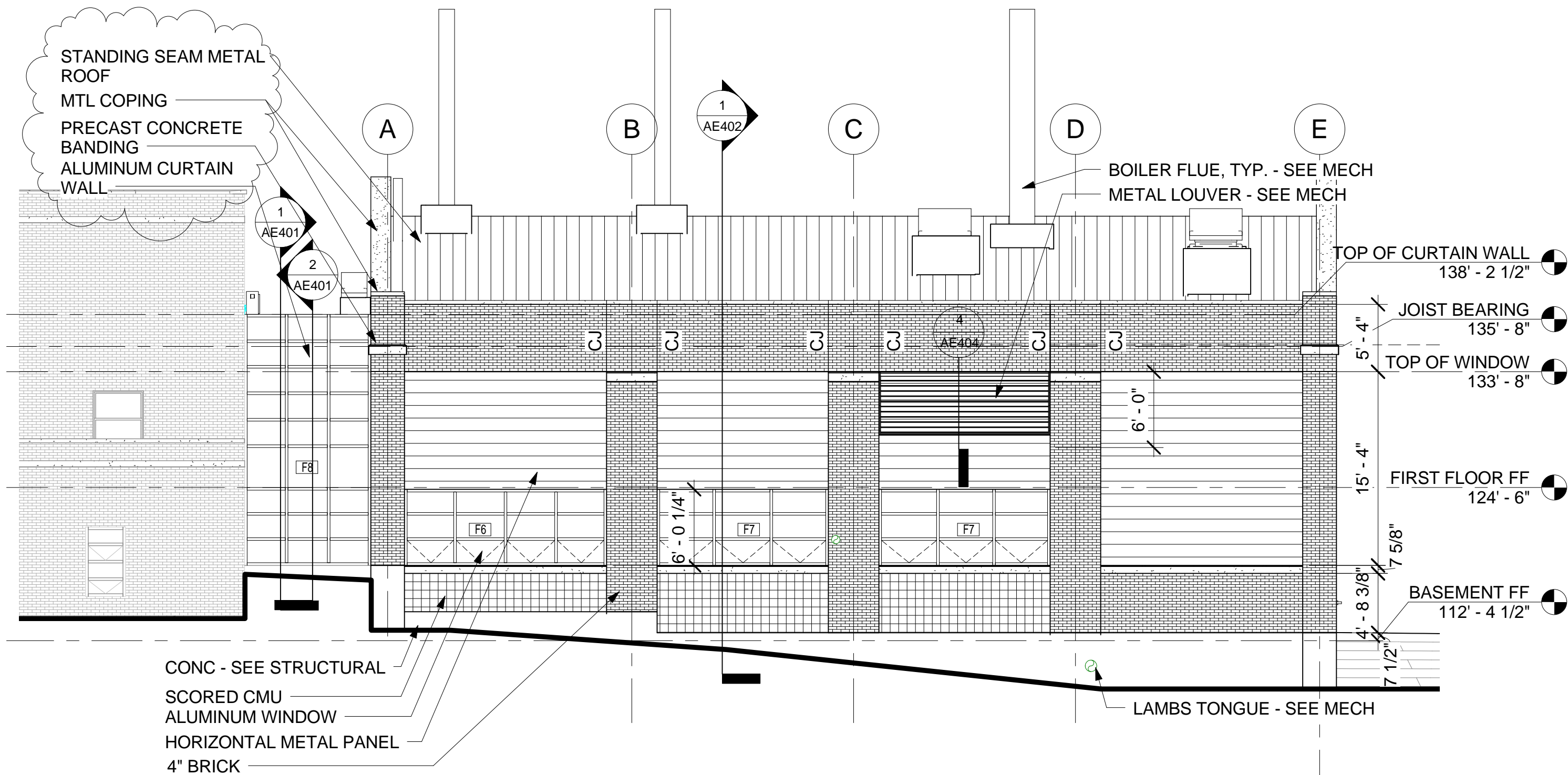
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SHEET NO: SDA-2

SHEET TITLE: PARTIAL SOUTH ELEVATION

REF: 3/AE201



**SUPPLEMENTAL DRAWING**

DATE: 06/03/13

DRAWN: KAH

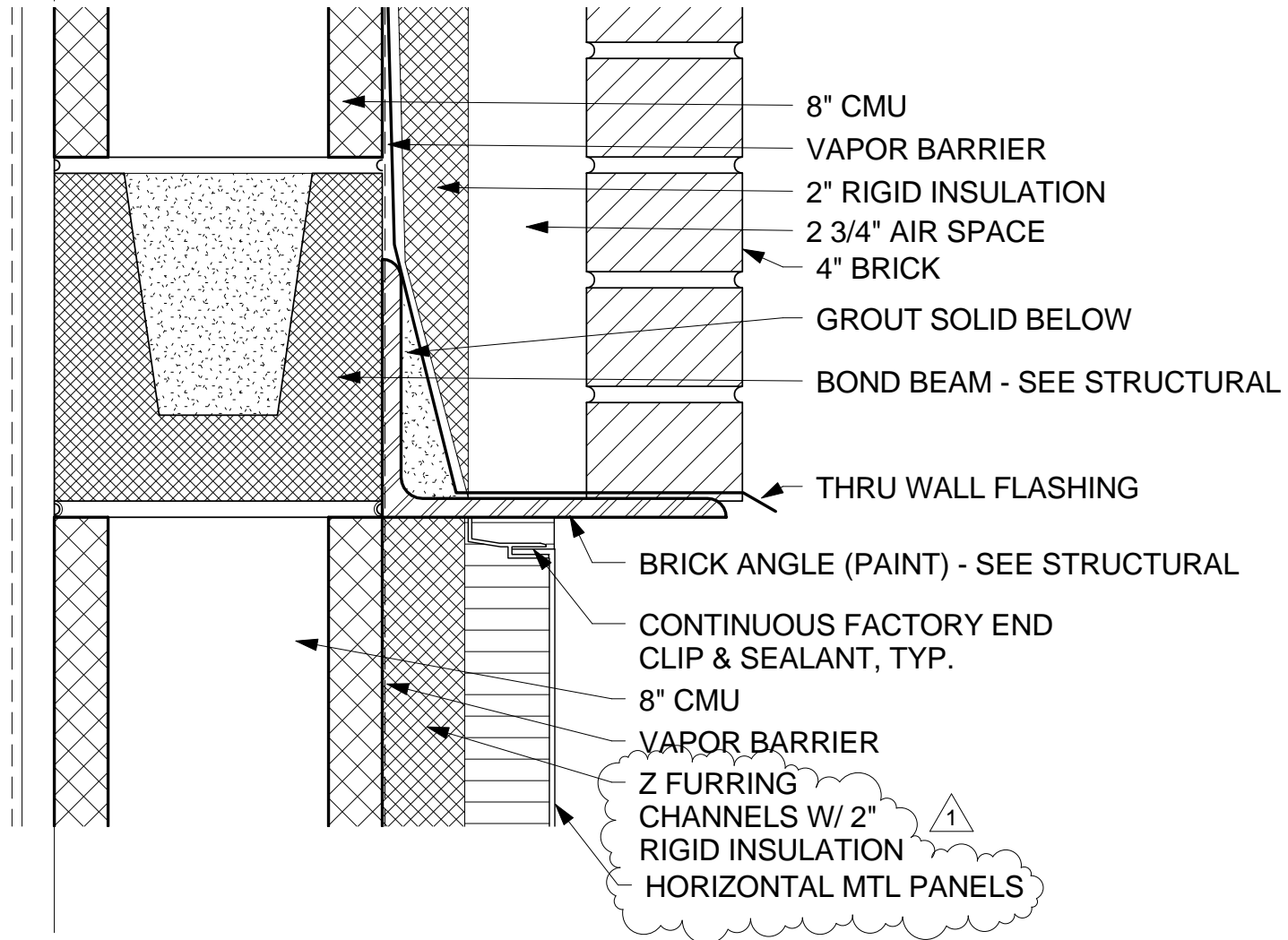
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SHEET NO: SDA-3

SHEET TITLE: METAL PANEL @ BRICK SOUTH

REF: 2/AE407

5



<div>SCHEMMER</div> <div>ARCHITECTS   ENGINEERS   PLANNERS</div>		PROJECT: <u>BOILER REPLACEMENT</u>	
		JOB NO: <u>636A6-11-916 (06054.001)</u>	
SUPPLEMENTAL DRAWING			
DATE:06/03/13	DRAWN: KAH	SCALE: 1/4" = 1'-0"	SHEET NO: SDA-4
SHEET TITLE: ROOM FINISH SCHEDULE			REF: AE501

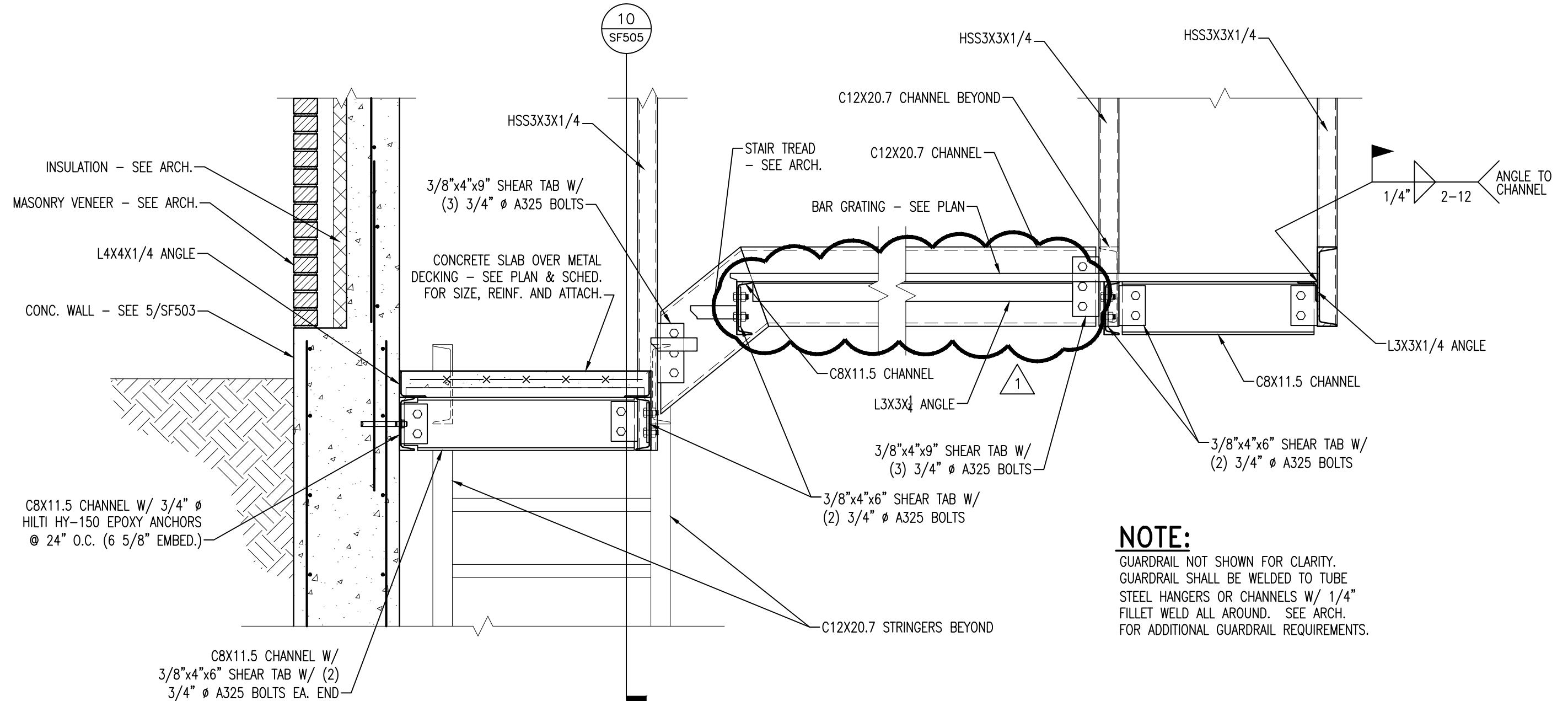
SDA-4 ROOM FINISH SCHEDULE																
ROOM NO	ROOM NAME	FLOOR MAT'L	FLOOR FINISH	BASE MAT'L	CEILING			NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		REMARKS
					HEIGHT	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	
020	NEW BOILER ROOM	CONC	EPOXY	EPOXY		EXPSD	P-1	CONC	P	CONC	P	CONC	P	CONC	P	2, 4
020A	CONTROL ROOM	CONC	EPOXY	EPOXY	8' - 0"	ATC	ATC-1	CONC	P-2	GWB	P-1	GWB	P-1	GWB	P-1	4
021	LOCKER ROOM	CONC	EPOXY	EPOXY	8' - 0"	ATC	ATC-2	CONC	P-1	CMU	P-1	GWB	P-1	EXIST	EXIST	4
021A	TOILET	CONC	EPOXY	EPOXY	8' - 0"	ATC	ATC-2	CMU	CT/P-3	CMU	CT/P-3	CMU	CT/P-3	CMU	CT/P-3	4,7
022	JANITOR	CONC	EPOXY	EPOXY	8' - 0"	EXPSD	P-1	GWB	FRB	GWB	FRB	CMU	FRB	EXIST	FRB	3, 4
100B	BREAK ROOM	EXIST	EPOXY	EPOXY		EXIST	EXIST	EXIST	P-1	GWB	P-1	EXIST	P-1	EXIST	P-1	4
100C	IT ROOM	EXIST	EPOXY	EPOXY	8' - 0"	--	ATC	GWB	P-1	GWB	P-3	EXIST	P-3	GWB	P-3	4
120	OFFICE	CONC	EXIST	EXIST		EXPSD	P-1	CW/GWB	P-1	CW/GWB	--	CW	--	EXIST	EXIST	4,5
121	ENTRY	CONC	EXIST	EXIST		EXPSD	P-1	CW	P-1					EXIST	P-1	4,5

REMARKS or Notes

1. (NOT USED)
2. PT-3 FROM BASEMENT FF TO FIRST FLOOR FF;  
PT-2 FROM FIRST FLOOR FF TO BOTTOM OF  
WINDOW ELEVATION; PT-1 FROM BOTTOM OF  
WINDOW ELEVATION TO STRUCTURE
3. PROVIDE FIBER REINFORCED PANELS FROM FF  
TO 4'-0" AFF
4. 6" EPOXY COVE BASE
5. CW = CURTAIN WALL
6. (NOT USED)
7. CT-1 FROM FF TO 3'-0" AFF. CT-2 FROM 3'-0" TO  
4'-0". P-1 FROM 4'-0" AFF TO CEILING. PROVIDE 6" EPOXY BASE.  
PROVIDE FINISH TILE DETAIL AT TOP EDGE OF TILE.

SUPPLEMENTAL DRAWING

DATE: 6/6/13 DRAWN: JJC SCALE: 3/4"=1'-0" SHEET NO: SDS-1  
SHEET TITLE: SECTION AT CATWALK STAIR REF: SF505



**SCHEMMER**

ARCHITECTS | ENGINEERS | PLANNERS

PROJECT: DEPARTMENT OF VETERANS AFFAIRS CENTRAL IOWA  
HEALTH CARE SYSTEM BOILER REPLACEMENT

JOB NO: 06054.001

SUPPLEMENTAL DRAWING

DATE: 06/07/2013

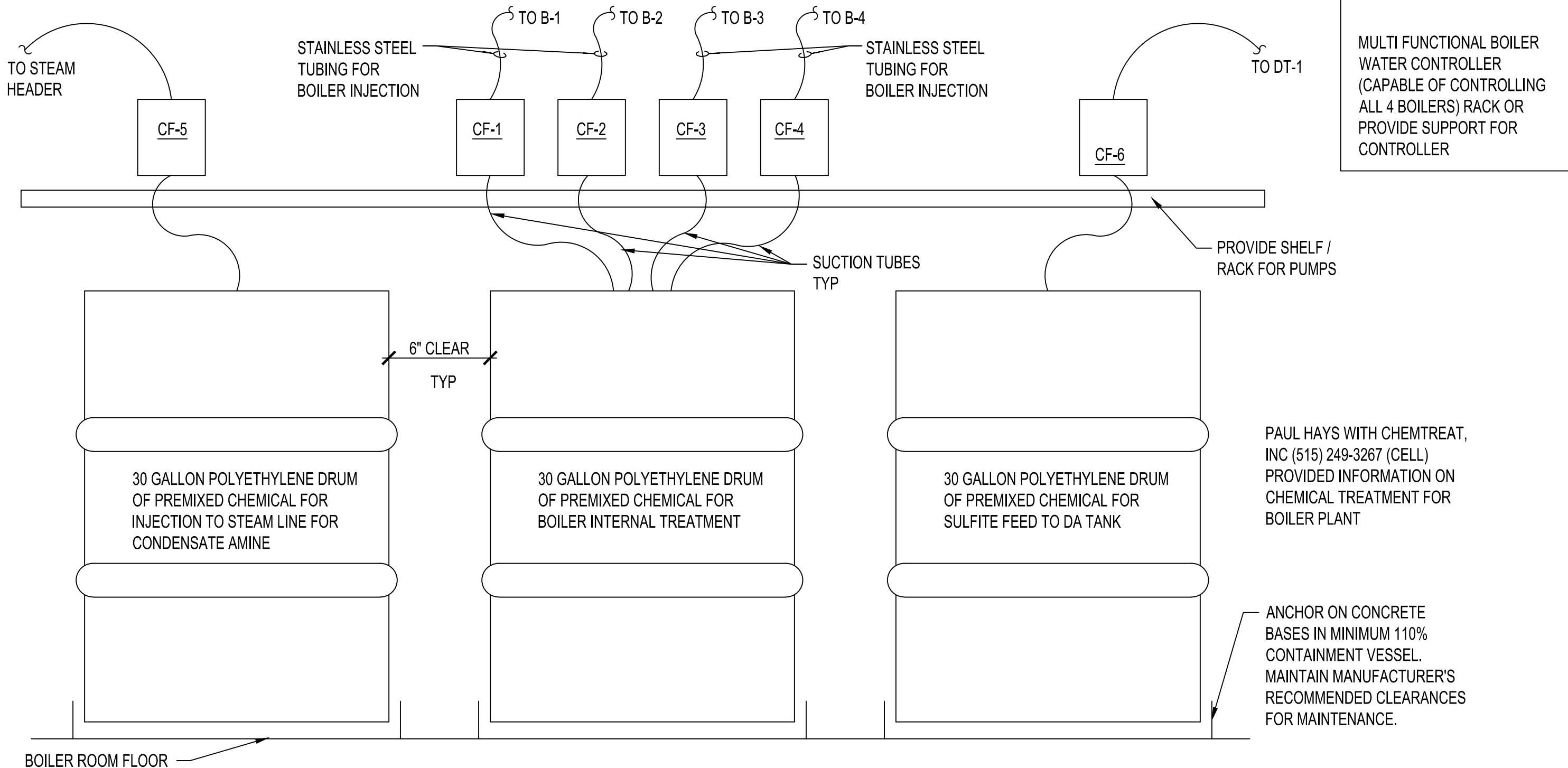
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SCALE: NOT TO SCALE

SHEET NO: SDM-1

SHEET TITLE: CHEMICAL FEED SYSTEM

REF: 6/MH502



**SUPPLEMENTAL DRAWING**

DATE: 06/07/2013

DRAWN: HPT

SCALE: 1/4" = 1'-0"

SHEET NO: SDM-2

SHEET TITLE: BASEMENT FLOOR PLAN - HVAC PIPING

REF: 1/MP101

