

PROJECT MANUAL
Volume 4 of 4

Construct Combined Heat and Power Boiler Plant

**420 North James Rd.
Columbus, OH 43219**

Verification and Functional Performance Test Plan
for
CHP Systems
including
Pre-Startup Inspection Checklist
Verification Test Checklist
and
Functional Performance Test Checklist

Final Revised 100%
10/07/2015

PREPARED FOR:

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VERIFICATION

and

FUNCTIONAL PERFORMANCE TEST PLAN

for

CHP SYSTEMs

including

**PRE-STARTUP INSPECTION CHECKLIST,
VERIFICATION TEST CHECKLIST,**

and

**FUNCTIONAL PERFORMANCE TEST
CHECKLIST**

Commissioning Process Summary

The commissioning process for the Columbus VAMC includes pre-startup inspections of installed components, subsystems, systems and the execution of the verification and functional performance testing of the CHP system and related system controls. The fundamental performance parameters to be verified through the testing include the ability of:

- 1) The system to respond to instructions from the system controls to regulate according to preset enthalpy/temperature requirements,
- 2) The system controls to send the correct instructions and,
- 3) The sensors to accurately detect the conditions of the system.

In addition, the overall quality of the air supply, return and exhaust ductwork systems, boiler, transformers and regulators will be inspected and verified to be installed in accordance with the drawings.

The commissioning field work for this dynamic CHP system is conducted in accordance with the project-specific verification and functional performance test plan taken from the Whole Building Commissioning Process Manual and the Project Specifications written by the project Designer. This test plan must include a clear description of the design specifications and information which pertains to the CHP operation and controls sequence, manufacturer cut sheets and equipment performance specifications, installation instructions and O&M manuals in addition to the pre-startup inspection checklists and the functional performance test checklist. This information will form the basis of the commissioning acceptance criteria and is necessary to evaluating the results of the inspections and tests. The commissioning test plan must incorporate all the details required to describe the particular application and the operation of the CHP unit being commissioned.

The pre-startup inspections of subsystems verify, through visual examination, simple measurements and reference to contractor's reports, that the components are installed in accordance with manufacturer's specifications and contract documents, meet design criteria and are ready for system start-up. The pre-startup checklist addresses verification of the physical installation, electrical system, system controls, system test and balance, collection of equipment nameplate data and documentation. In addition, related pre-startup inspection checklists, non-compliance and corrections of components which do not meet the acceptance criteria and inspection certification are addressed. The checklists provided are intended to serve as a guideline in the preparation of the project-specific pre-startup inspection checklists. The project-specific pre-startup inspection checklists must be finalized and approved by the Columbus VAMC RE and Project Designer prior to performing any inspections.

Following the completion of the pre-startup inspection, the verification checks and tests can commence. There is no specific order to follow during the execution of the pre-functional checks, although the project-specific character of the testing must be

considered. The checklist provided is not intended to replace the contractor's normal and accepted procedures for installing and pre-testing equipment or relieve the contractor of the standard check-out and start-up responsibilities. These verification test checklists should be refined, as required, with the information gathered during the pre-startup inspections. This testing is intended to verify that all components, equipment, systems, and interfaces between systems operate in accordance with contract documents.

Prior to the functional performance testing, the Prime Contractor may need to coordinate with the building operator to modify the system controls set points to facilitate the operation of connected equipment for the duration of the testing. Once stable system operation has been established, the Prime Contractor can proceed to gather the required data. Any equipment found not to be in compliance with the acceptance criteria must be repaired or corrected and then retested until satisfactory results are obtained.

Following the completion of the verification tests, the functional performance testing can commence. This testing should follow the order presented in the functional performance test checklist provided in this section, although the project-specific character of the testing must be considered. The functional performance test checklist should be refined, as required, with the information gathered during the pre-startup inspections and verification tests. This testing is intended to measure the energy-efficient performance of the CHP systems as defined in the final design-intent document.

Following the on-site testing, the test results must be prepared, documentation compiled and the verification and functional performance test checklists certified in accordance with the WBCPM Guidelines. The testing procedures and results of all tests must be clearly documented in the final commissioning report.

These appendixes contains sample systems verification and start-up checklists for a selection of equipment used frequently in typical HVAC systems. There is no intention in the appendixes to provide sample checklists for all possible equipment included in any design. These checklists are intended to illustrate a level of detail that is appropriate in good commissioning practice, and to suggest a practical format. As such, they contain typical items that are often required to be included in the inspections and checks carried out, and documented, prior to and during equipment start-up.

The sample checklists are generic; thus they do not apply to any specific project, and so the list of check items is generic, not specific. Commissioning Agent will develop systems verification and start-up checklists for every piece of equipment within the scope of any commissioning project, and those checklists will include all items included in the specific design that require checking.

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

**Cogeneration Engine Generator
Functional Performance Test**

System Description

CHP Configuration, Natural Gas – In this configuration one (1) ~1.1 MW gross capacity CHP machine will be operated in a load follow mode producing power and operating continuously. Facility power requirements greater than that produced by the CHP plant, also known as Supplemental Power, is purchased from the regional electric utility. Heat from the engine exhaust is utilized to generate saturated steam at 80 psig. Heat recovered from the engine jacket is captured and utilized to heat the boiler makeup water procured from city water sources to a temperature of approximately 148°F.

VA-ACC Columbus is planning to relocate its central boiler plant from its current location in the main building to the parking lot north of the building. This area is a parking lot at this time. The CHP systems and equipment could be co-located with the boilers in the new central boiler plant. Parking lot space available is about 246 ft by 246 ft.

Operational Assumptions:

The VA-ACC Columbus' existing energy consumption patterns over a 12-month period showed an electric demand peak usage of approximately 2,341 kW (summer) to a low of approximately 500 kW (winter) and an associated steam usage between 1219.27 lb/hr and 100 lb/hr with a yearly average of 3,44 lb/hr.

Test Dates and Results

Initial Test		Start Date	End Date	Initials
Results (Check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/Corrective Actions <input type="checkbox"/> Complete Test w/Corrective Actions <input type="checkbox"/> Other	Explanation:			

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Re-Test 1		Start Date	End Date	Initials
Results (Check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/Corrective Actions <input type="checkbox"/> Complete Test w/Corrective Actions <input type="checkbox"/> Other	Explanation:			
Re-Test 2		Start Date	End Date	Initials
Results (Check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/Corrective Actions <input type="checkbox"/> Complete Test w/Corrective Actions <input type="checkbox"/> Other	Explanation:			

Deferred/Seasonal Test		Start Date	End Date	Initials
Results (Check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/Corrective Actions <input type="checkbox"/> Complete Test w/Corrective Actions <input type="checkbox"/> Other	Explanation:			

Test Participants

Organization	Name	Required	Optional
General Contractor		<input type="checkbox"/>	<input type="checkbox"/>
Mechanical Contractor		<input type="checkbox"/>	<input type="checkbox"/>
Electrical Contractor		<input type="checkbox"/>	<input type="checkbox"/>
TAB Contractor		<input type="checkbox"/>	<input type="checkbox"/>
Controls Contractor		<input type="checkbox"/>	<input type="checkbox"/>
VA Columbus O&M Staff		<input type="checkbox"/>	<input type="checkbox"/>

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Test Equipment Required (to be provided by the Contractor)

Test Name	Equipment Description
Voltage/Continuity	Digital Voltage Meter (DVM)
Bolted Connection or Contact Resistance	Four-probe Digital Low Resistance Ohmmeter (DLRO)
Insulation Resistance	Battery or line-powered (Hand-crank not acceptable).
Primary Current Injection	Current Injection Test Device rated for 2X the ground fault pickup setting of the breaker
2 and 4 Hour Load Bank Test	Resistive load bank with capacity equal to or greater than rated load. Rated at 2% accuracy for voltage, current and kW.
Phase Rotation	Verify proper phasing
Volt. & Freq. Regulation	Computer to record voltage and frequency from the output of the generator control panel.
Decibel	Measure sound pressure
Back Pressure	Manometer with a scale of greater than 40" water
Bolt Torque	Calibrated torque wrench

System Readiness Summary Checklist

Description	Yes	No	Date
System Ready for Test	<input type="checkbox"/>	<input type="checkbox"/>	
Required Personnel Available	<input type="checkbox"/>	<input type="checkbox"/>	
Required Tools/Test Equipment/Supplies Available	<input type="checkbox"/>	<input type="checkbox"/>	
Required Safety Equipment Available	<input type="checkbox"/>	<input type="checkbox"/>	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Functional Performance Test –

Verify all components are ready before energizing or operating the system.

The Commissioning Authority will make and document any changes/addition/deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.).

R = Retest (Check (✓) retest required)

C = Corrected (Check (✓) when correction verified)

Y= Checked and Passed

N = Not Passed

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
PRE-TEST VISUAL MECHANICAL INSPECTION						
1. Safe conditions (protective gear in-place, available & procedures observed)	Verify conditions	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						
2. Verify that the	kW: _____.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in data	<input type="checkbox"/>	<input type="checkbox"/>

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
Engine, Generator, Battery, and Battery Charger nameplate data matches shop drawings and construction documents.	Rating: _____.	<input type="checkbox"/>	<input type="checkbox"/>	table.	<input type="checkbox"/>	<input type="checkbox"/>
	Frequency: _____.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Phase/Wire: _____.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Power Factor: _____.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Voltage Output: _____.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
3. Verify generator circuit breaker settings.	Circuit breaker size and phase: _____.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table.	<input type="checkbox"/>	<input type="checkbox"/>
	Ground fault protection is disabled.	<input type="checkbox"/>	<input type="checkbox"/>	Ground fault indication and alarm is recommended	<input type="checkbox"/>	<input type="checkbox"/>
	Circuit breaker is set per the coordination study.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
4. Inspect physical and mechanical condition.	No visible damage to generator or enclosure.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Engine generator exterior is clean and dry.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Generator control panel interior is clean and dry.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
	Generator control panel mounted at an accessible height.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Vibration isolation is installed at engine and at radiator.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	All external connections are made with flexible connections.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Verify remote monitoring wiring is connected and labeled.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Verify control wiring is connected and labeled.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Feeder cable/bus routing doesn't obstruct access for operation or maintenance.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Control wiring harness(es) does not rub against vibrating or moving parts.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
5. Verify anchoring	Anchor bolts are provided in locations shown on manufacturer's drawings.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
6. Verify equipment grounding	Verify ground rod is installed with connection to engine generator frame.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Generator neutral bonded to ground with conductor sized per NEC 250-20. -OR- For separately derived systems, generator neutral is NOT bonded to ground.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Measured diameter of bare copper conductor corresponds to diameter of specified conductors.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Ground strap from engine to frame.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Ground strap from generator enclosure to frame.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Ground bus provided in termination cabinet with properly terminated ground conductors.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
7. Verify lube oil levels are within manufacturer's recommended limits	Lube oil level is filled to proper level.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
					<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
8. Verify fuel system installation and integrity	Day tank is full of fuel (90% for diesel).	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Fuel level in day tank matches fuel gauge.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Remote fueling station is installed and operating properly.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	There are not clearance issues with the remote fueling station.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	All alarms are operating properly from remote fueling station to Building Automation System (BAS).	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Fuel system is free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Flexible fuel lines are installed at engine.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
9. Verify cooling system installation and integrity	Coolant level is filled to proper level.	<input type="checkbox"/>	<input type="checkbox"/>	Record radiator name plate data in data table.	<input type="checkbox"/>	<input type="checkbox"/>
	Verify coolant system freeze protection level.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Cooling system is free from leaks.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Flexible coolant lines are installed between engine and radiator.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
10. Verify exhaust system installation and integrity	Exhaust system, silencer and flexible connector installed and supported.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system expansion is not transferred to engine components such as turbocharger.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Silencer is equipped with condensate drain plug and turn valve.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system is equipped with rain cap.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system is properly insulated within building.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system has at least 9" clearance from combustible materials.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues	Issue Log Item:					
	Initial	Date				
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
ELECTRICAL INTEGRITY						
11. Verify operation of coolant line heater.	Verify that valves to the water jacket heater are open.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table.	<input type="checkbox"/>	<input type="checkbox"/>
	Verify thermostats switch at their setpoint temperatures (110°F).	<input type="checkbox"/>	<input type="checkbox"/>	Record supply voltages and amperage with heaters and pump in operation.	<input type="checkbox"/>	<input type="checkbox"/>
	Verify pump runs continuously independent of heater operation.	<input type="checkbox"/>	<input type="checkbox"/>	Calculate heater and pump wattage based on line voltage and current. Verify wattage calculated is same as shop drawing data. Manufacturer's Specifications: Heater: Watts _____ Volts _____ Phase _____ Pump: Watts _____ Volts _____ Phase _____	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
(Test continues on the following page.)				Initial	Date	



Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
12. Verify operation of battery and starting system.	Loss of Power Alarm is operable.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table.	<input type="checkbox"/>	<input type="checkbox"/>
	Low Battery Volt Alarms at: 18.6V-25.7V.	<input type="checkbox"/>	<input type="checkbox"/>	Record cell voltages for all cells with terminals available, total battery charging voltage and charging current.	<input type="checkbox"/>	<input type="checkbox"/>
	High Battery Volt Alarms at: 26.9V-36.3V.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Power On led in on.	<input type="checkbox"/>	<input type="checkbox"/>	Manufacturer's Specifications:	<input type="checkbox"/>	<input type="checkbox"/>
	Battery Heater Pad: 120VAC input.	<input type="checkbox"/>	<input type="checkbox"/>	Nom. Batt. Voltage: _____ Rec. Float Charge Voltage: _____ Float Voltage: _____ Equalize Voltage: _____ Max over float Ampere Taper (Max to Min): _____ Nominal Output Voltage: _____ Input Voltage: _____ Ambient Temp: -40°F to 122°F	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
13. Verify operation of generator space heaters	Space heaters operate when generator is not running and not operating while generator is running.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Record supply voltages and amperage with heater in operation. Calculate heater wattage based on line voltage and current. Verify wattage calculated is same as shop drawing data. Manufacturer's Specifications: Heater: Watts _____ Volts _____ Phase _____	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
14. Perform an insulation resistance test at 1000 VDC on generator windings.	Minimum insulation resistance value is 100 Megohms.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Take reading at 1 minute. Take reading at 10 minutes. Record ambient temperature and relative humidity. Test Name: Insulation Resistance. Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
15. With the breaker in the closed position, measure the contact resistance of each phase of the primary circuit.	Readings are within 50% of the lowest value.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test Name: Contact Resistance Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
16. Perform an insulation resistance test on the Generator Circuit Breaker at 1000VDC, phase-to-phase and phase to ground, connected to the bus in the closed position, in accordance with NETA Table 100.1.	Minimum insulation resistance shall be 100 Megohms.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test for one minute in accordance with NETA Table 100.1. Test Name: Insulation Resistance Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
17. Test the Long Time Delay (LTD) (seconds) and Long Time Pickup current (LDPU) (amperes) setting of the breaker, by using primary current injection.	Long delay current pick up and time delay per coordination study.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test Name: Primary Current Inject. Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
18. Test the Short Time Delay (STD) (seconds) and Short Time Pickup current (SDPU) (amperes) setting of the breaker, by using primary current injection.	Short delay current pick up and time delay per coordination study.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test Name: Primary Current Inject. Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
19. Test the Instantaneous Time Delay (ITD) (seconds) and Instantaneous Time Pickup current (INSTPU) (amperes) setting of the breaker, by using primary current injection.	Instantaneous pick up per coordination study.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test Name: Primary Current Inject. Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
20. Test the Ground Fault Delay (GFD) (seconds) and Ground Fault Pickup current (GFP) (amperes) setting of the breaker, by using primary current injection.	Ground Fault pick up per coordination study.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test Name: Primary Current Inject. Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
	For Paralleled Generators, verify Ground Fault protection is set to ALARM ONLY, and the breaker does not trip.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
ALARMS AND CONTROL PANEL TEST						
21. Verify control wiring between generator and ATS are correctly terminated.	Terminations match shop drawings.	<input type="checkbox"/>	<input type="checkbox"/>	Note: this step applies to field landed terminations only	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
22. Record all setpoints at Engine Generator Control Panel.	Data recorded	<input type="checkbox"/>	<input type="checkbox"/>	Manufacturer's checklist can be attached to this form in lieu of recording	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						



Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
23. Verify all warning/pre-alarms per manufacturer's instructions and verify operation and local annunciation at Engine Generator Control Panel.	Overcrank.	<input type="checkbox"/>	<input type="checkbox"/>	1-13 NFPA 110 Spec Section 16231	<input type="checkbox"/>	<input type="checkbox"/>
	Low Water Temp.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	High Water Temp.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Oil Pressure.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Overspeed.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Coolant Level.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	EPS Supplying Load.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Control switch not in Auto.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	High Battery Voltage.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Battery Voltage.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Battery Charger AC Failure.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Lamp Test.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Contacts for local and remote common alarm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
24. Verify all shutdown conditions per manufacturer's instructions and verify operation and local annunciation at Engine Generator Control Panel.	Overcrank.	<input type="checkbox"/>	<input type="checkbox"/>	1-5 NFPA 110 Spec Section 16231	<input type="checkbox"/>	<input type="checkbox"/>
	High Water Temp.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Oil Pressure.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Overspeed.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Coolant Level.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
25. Verify remote audible annunciation of all status, warning/pre-alarm, and shutdown conditions per manufacturer's instructions.	Overcrank.	<input type="checkbox"/>	<input type="checkbox"/>	1-9 NFPA 110 Spec Section 16231	<input type="checkbox"/>	<input type="checkbox"/>
	Low Water Temp.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	High Water Temp.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Oil Pressure.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Overspeed.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Low Coolant Level.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Control switch not in Auto.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Contacts for local and remote common alarm.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Audible alarm silencing switch.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
26. Verify installation of remote E-Stop	Located outside of generator room door.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Near each exit/entrance to genset room.					
	Located locally on the genset package.					
	Cover not damaged, scratched, or broken.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
27. Verify remote annunciation of engine conditions at building automation system	Annunciator panel lights & alarms function by initiating test switch.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
28. With generator in a "cold start" condition, conduct a load performance test, by initiating a NORMAL failure and transfer of ATS's for time specified in the remarks column.	Engine starts and runs.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table.	<input type="checkbox"/>	<input type="checkbox"/>
	Air intake louvers open fully.	<input type="checkbox"/>	<input type="checkbox"/>	Load generator for a maximum of 2 hrs using available building load and/or a load bank	<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust damper opens fully.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Fuel is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>	During test, verify exhaust, coolant, and fuel system is functioning properly.	<input type="checkbox"/>	<input type="checkbox"/>
	Coolant is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Lube oil is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>	Test Name: 2 Hour Load Bank Test Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system expansion is not transferred to engine system components.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
29. Restore normal sources to ATS's (or turn off load bank) and transfer ALL load off of generator and allow to cool down for 5 minutes	Generator runs in cool down mode for 5 min.	<input type="checkbox"/>	<input type="checkbox"/>	Test Name: 2 Hour Load Bank Test Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
					<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
30. Disconnect emergency feeders to ATS and connect load bank directly to load side of generator	Verify cables are disconnected	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:	<input type="checkbox"/>	<input type="checkbox"/>
				Initial	Date	
31. With a load bank connected to the load side terminals of the generator, start generator at local control panel with engine control switch	Engine starts and runs.	<input type="checkbox"/>	<input type="checkbox"/>	Test Name: 4 Hour Load Bank Test Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
	Air intake louvers open fully.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust damper opens fully.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Fuel is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Coolant is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Lube oil is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system expansion is not transferred to engine system components.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Exhaust system is not leaking.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:	<input type="checkbox"/>	<input type="checkbox"/>
				Initial	Date	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
32. Conduct a load performance test utilizing a load bank to achieve 100% rated load of generator for time specified in the remarks column.		<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Load generator at 50% for 15 min. Load generator at 75% for 15 min. Load generator at 100% for 3.5 hrs During test, verify exhaust, coolant, and fuel system is functioning properly. Test Name: 4 Hour Load Bank Test Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
33. In conjunction with load performance test, verify voltage regulation by recording RMS voltage while increasing load on generator.	Voltage regulation is $\pm 1\%$.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table Record voltage at no load. Record voltage at 50% load. Record voltage at 75% load. Record voltage at 100% load. Calculate voltage regulation percentage. Test Name: Volt. & Freq. Regulation Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
34. In conjunction with load performance test, verify frequency regulation by recording frequency while increasing load on generator.	Frequency regulation is $\pm 1\%$	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table Record frequency at no load. Record frequency at 50% load. Record frequency at 75% load. Record frequency at 100% load. Calculate voltage regulation percentage. Test Name: Volt. & Freq. Regulation Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
35. During load performance test, verify engine operation is within normal operating limits.	Engine parameters are within manufacturer's specifications.	<input type="checkbox"/>	<input type="checkbox"/>	Manufacturer's Specifications: RPM @ 60Hz: 1800 RPM Coolant Amb. Temp: 190°F	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
36. During load performance test, verify correct phase rotation.	Phase rotation at generator matches NORMAL power source.	<input type="checkbox"/>	<input type="checkbox"/>	A(U), B(V), C(W) Test Name: Phase Rotation Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
37. During step 3, while generator is running at 100% load, measure sound level.	Measured sound pressure level in rooms directly adjoining the generator room, as well as above and below, if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Test Name: Sound Level Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
38. While generator is running at 100% load, conduct Exhaust-System Back Pressure Test	Maximum backpressure at full-rated load is within manufacturer's written maximum allowable limits of 6.7 kPa or 26.9" H2O for the engine.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table. Connect test instrumentation to exhaust line close to engine exhaust manifold. Test Name: Back Pressure Test Reference Equip. Table	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
39. Decrease load to 0% and allow the generator to cool down for 5 minutes	Generator cools down.	<input type="checkbox"/>	<input type="checkbox"/>	Test Name: 4 Hour Load Bank Test	<input type="checkbox"/>	<input type="checkbox"/>
	No leaks from any system are found.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
40. After the cool down, once the prime mover has reached rated voltage and frequency, transfer full rated load onto the engine generator in a single block.	Engine continues to run without shutdown or overspeed trip and recovers to steady state voltage and frequency ranges within 5 seconds.	<input type="checkbox"/>	<input type="checkbox"/>	Test Name: Block Load Test	<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
41. Decrease load to 0% and shutdown generator with local E-Stop.	Generator shuts down.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Remote annunciator alarms with E-Stop.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
42. Disconnect fuel solenoid and simulate start to engine.	Engine cycle cranks a minimum of three 15-second cranking cycles with 15 seconds between cycles.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	At completion of third cycle engine stops cranking and “overcrank” shutdown alarm is annunciated locally and remotely.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	
FINAL INSPECTION						
43. After testing is performed on the generator, verify tightness of field landed feeder terminations.	Primary feeder cable connections properly torqued and marked.	<input type="checkbox"/>	<input type="checkbox"/>	Record results in Data Table.	<input type="checkbox"/>	<input type="checkbox"/>
				Bolted torque should comply with NETA Table 100.12 unless manufacturer specified values are listed on the equipment. Secondary distribution feeder connections are not included in the test. Test Name: Bolt Torque Reference Equip. Table		
Record issues				Issue Log Item:		
				Initial	Date	
(Test continues on the following page.)						

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

ACTION	REQUIRED REACTION	Y	N	COMMENTS	R	C)
44. Refill fuel tanks and verify 90% fuel levels	Fuel level indicator verifies 90% fuel level in day tank.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Fuel level indicator verifies 90% fuel level in storage tank.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues				Issue Log Item:		
				Initial	Date	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Generator Nameplate Data

Parameter	Data
Manufacturer	
Serial Number	
Model Number	
Date Manufactured	
Volts	
Amps	
KVA	
Horsepower	
Frequency	
RPM	
kW	
PF	

Battery Nameplate

Parameter	Data
Manufacturer	
Serial Number	
Model Number	
Quantity	
Volts	
Cold Cranking Amps	

Battery Charger Nameplate

Parameter	Data
Manufacturer	
Serial Number	
Model Number	
Input Amps	
Input Volts	
Output Amps	
Output Volts	

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Circuit Breaker Name Plate Data

Parameter	Data
Manufacturer:	
Type/Model:	
Serial Number:	
Frame Size/Rating	
Interrupting Rating	
Voltage Rating	

Radiator Nameplate

Parameter	Data
Manufacturer	
Serial Number	
Model Number	
Date Manufactured	

Coolant Pump(s) & Heater(s)

Designation	Volts	Amps	Watts

Battery System

Cell Volts	Charging Volts	Charging Amps

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Test Equipment Used:

Test Name	Manufacturer	Model Number	Serial Number	Calibration(Date)

Insulation Resistance (1000 VDC)

Generator Windings	A-B	B-C	C-A	A-G	B-G	C-G
1 Minute (Meg Ohms)						
10 Minutes (Meg Ohms)						
Circuit Breaker						
1 Minute (Meg Ohms)						

Circuit Breaker Contact Resistance

Phase	A	B	C
(Micro Ohms)			

Current Injection

Function	Actual Set.	Test Setting	Test Point	Nominal Val.	A	B	C
LTD							
LDPU							
STD							
SDPU							
INSTPU							
GFD							
GFPU							

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

2 Hour Load Bank Test

Crank Time Until Prime Mover Start and Runs	
Time Required for Prime Mover to Come Up to Operating Speed	
Voltage Overshoot	
Frequency Overshoot	
Time Required to Achieve Steady State Operation	

Time	Load	RPM	Freq.	Amps	Volts	kW	Oil Press	Oil Temp	Exhaust Temp	Cool. Temp	Fuel Level	Batt. Chrg Rate
0 min	100 %											
5 min	100 %											
10 min	100 %											
15 min	100 %											
30 min	100 %											
45 min	100 %											
1 hour	100 %											
1 hour 15 min	100 %											
1 hour 30 min	100 %											
1 hour 45 min	100 %											
2 hour	100 %											

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

4 Hour Load Bank Test

Time	Load	RPM	Freq.	Amps	Volts	kW	Oil Press	Oil Temp	Exhaust Temp	Cool. Temp	Fuel Level	Batt. Chrg Rate
0 min	50%											
5 min	50%											
10 min	50%											
15 min	75%											
30 min	75%											
45 min	100%											
1 hour	100%											
1 hour 15 min	100%											
1 hour 30 min	100%											
1 hour 45 min	100%											
2 hour	100%											

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

2 hour 15 min		100%											
2 hour 30 min		100%											
2 hour 45 min		100%											
3 hour		100%											
3 hour 15 min		100%											
3 hour 30 min		100%											
3 hour 45 min		100%											
4 hour		100%											

Voltage & Frequency Regulation

Function	50% Load	75% Load	100% Load
Voltage (V)			
Frequency (hz)			

Phase Rotation – (Circle Phase Rotation)

Normal Power	A B C	A C B
Emergency Power	A B C	A C B

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Sound Level

Location	Decibel (DB)

Back Pressure Test

System Exhaust Pressure	Location

Block Load Test – Recovery Time:

Bolt Torque (Newton Meters or Foot Pounds)

Bolt/Lug	A	B	C	N	G
Normal					
Emergency Lugs					



Combined Heat & Power (CHP) Plant – Performance Test Checklist

Commissioning Agent Final Sign-Off

The signature of the Commissioning Agent below indicates that the Systems Functional Test Procedure was witnessed by the Commissioning Agent and the results have been documented on this form.

Printed Name	Signature	Initials	Date

Test Notes and Lessons Learned

SAMPLE

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Combined Heat & Power (CHP) Plant – Performance Test Checklist

Test Notes and Lessons Learned

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Department of
Veterans Affairs

VA-ACC Columbus, OH
Cogeneration Energy Project

Combined Heat & Power (CHP) Plant – Performance Test Checklist

SAMPLE

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BOILER PLANT REBUILD PROJECT
VA MEDICAL CENTER, COLUMBUS, OHIO

Pre-Functional Performance Test Checklist - Pumps

For Pump:

Note: Provide for each pump

Checklist Item	A	M	E	T	C	O
Installation						
a. Piping system installed.	___		X	X	X	

Electrical	A	M	E	T	C	O
a. Power available to pump disconnect.	___	X	___	X	X	___
b. Pump rotation verified.	___	X	___	X	X	___
c. Control system interlocks functional.	___	X	___	X	___	___

Testing, Adjusting, and Balancing (TAB)	A	M	E	T	C	O
a. Pressure/temperature gauges installed.	___	___	X	___	X	___
b. TAB Report approved.	___	___	X	___	X	___

BOILER PLANT REBUILD PROJECT
 VA MEDICAL CENTER, COLUMBUS, OHIO

Pre-Functional Performance Test Checklist - Steam Boiler

For Boiler:

Note: Provide for each Boiler

Checklist Item

Installation A M E T C O

a. Boiler steam piping installed. ___ ___ X X X ___

b. Boiler makeup water piping installed. ___ ___ X ___ X ___

Startup A M E T C O

a. Boiler safety/protection devices, including high temperature shut-off, low water cutoff, pre and post purge, have been tested. ___ ___ ___ X ___ ___

b. Verify that PRV rating conforms to boiler rating. ___ ___ ___ X ___ ___

c. Boiler feed water system operational. ___ ___ ___ X ___ ___

d. Boiler water treatment system functional. ___ ___ X X X ___

e. Boiler startup and checkout complete. ___ ___ ___ X ___ ___

f. All steam traps operational. ___ ___ X X X ___

g. All condensate return pumps operational. ___ ___ ___ ___ X ___

Electrical A M E T C O

a. Verify that power disconnect is located within sight of the unit served. ___ X ___ X ___ ___

Testing, Adjusting, and Balancing (TAB) A M E T C O

TAB report approved. ___ ___ X ___ X ___

BOILER PLANT REBUILD PROJECT
VA MEDICAL CENTER, COLUMBUS, OHIO

Pre-Functional Performance Test Checklist - Unit Heater

For Unit Heater:

Note: Provide for each unit heater

Checklist Item

Installation	A	M	E	T	C	O
a. Steam and condensate piping properly connected.	___	___	X	X	X	___

Electrical	A	M	E	T	C	O
a. Power available to unit disconnect.	___	___	___	X	___	___
b. Proper motor rotation verified.	___	___	___	X	X	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
d. Power available to electric heating coil.	___	___	___	X	___	___

Controls	A	M	E	T	C	O
a. Control valves properly installed.	___	___	X	___	___	___
b. Control valves operable.	___	___	X	X	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___

Testing, Adjusting, and Balancing (TAB)	A	M	E	T	C	O
a. TAB Report approved.	___	___	X	___	X	___

BOILER PLANT REBUILD PROJECT
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Pre-Functional Performance Test Checklist - Exhaust Fan

For Exhaust Fan:

Note: Provide for each exhaust fan

Checklist Item

Installation	A	M	E	T	C	O
a. Fan belt adjusted.	___	___	X	___	X	___

Electrical	A	M	E	T	C	O
a. Power available to fan disconnect.	___	___	___	X	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___

Controls	A	M	E	T	C	O
a. Control interlocks properly installed.	___	___	___	X	___	___
b. Control interlocks operable.	___	___	___	X	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___

Testing, Adjusting, and Balancing (TAB)	A	M	E	T	C	O
a. TAB Report approved.	___	___	X	___	X	___

BOILER PLANT REBUILD PROJECT
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Pre-Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: (Provide for each air handling unit)

Checklist Item

Installation	A	M	E	T	C	O
a. Inspection and access doors are operable and sealed.	___	___	X	___	X	___
b. Condensate drainage is unobstructed.	___	___	X	X	X	___
c. Fan belt adjusted.	___	___	X	___	X	___

Electrical	A	M	E	T	C	O
a. Power available to unit disconnect.	___	___	___	X	X	___
b. Power available to unit control panel.	___	___	___	X	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
e. Power available to electric heating coil. (If electric heating coil provided)	___	___	___	X	___	___

Coils	A	M	E	T	C	O
a. Refrigerant piping properly connected.	___	___	X	X	X	___
c. Steam and condensate piping properly connected.	___	___	X	X	X	___

BOILER PLANT REBUILD PROJECT
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Controls

- a. Control valves/actuators properly installed.
- b. Control valves/actuators operable.
- c. Dampers/actuators properly installed.
- d. Dampers/actuators operable.
- e. Verify proper location and installation of thermostat.

A	M	E	T	C	O
___	___	X	___	___	___
___	___	X	___	___	___
___	___	X	___	___	___
___	___	X	___	___	___
___	___	X	___	___	___

Testing, Adjusting, and Balancing (TAB)

- Testing, Adjusting, and Balancing (TAB)
- a. TAB Report approved.

A	M	E	T	C	O
		X		X	
A	M	E	T	C	O

BOILER PLANT REBUILD PROJECT
VA MEDICAL CENTER, COLUMBUS, OHIO

W912HN-09-R-0077

Functional Performance Test - Pump (Provide for each pump)

Notes:

- A. Provide for each Pump.
- B. Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.

a. Verify correct operation in:

HAND _____ OFF _____ AUTO _____

b. Verify pressure drop across strainer:

Strainer inlet pressure _____ psig

Strainer outlet pressure _____ psig

c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

DESIGN	TAB	ACTUAL
--------	-----	--------

Pump inlet pressure psig	_____	_____
--------------------------	-------	-------

Pump outlet pressure psig	_____	_____
---------------------------	-------	-------

d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF	100 percent
---------	-------------

Pump inlet pressure psig

Pump outlet pressure psig

Pump flow rate gpm

Differential Pressure Transmitter	SETPOINT _____
-----------------------------------	-------------------

CHP BOILER PLANT

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Functional Performance Test (cont.) - Pump (Provide for each pump)

e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on variable speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full bypass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

		SHUTOFF	100 percent
Pump inlet pressure psig	_____	_____	
Pump outlet pressure psig	_____	_____	
Pump flow rate gpm	_____	_____	
		SETPOINT	
Differential Pressure Transmitter	_____		

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA

a. Full flow:

Nameplate FLA	_____		
Amperage Phase 1	_____	Phase 2 _____	Phase 3 _____
Voltage Ph1-Ph2	_____	Ph1-Ph3 _____	Ph2-Ph3 _____
Voltage Ph1-gnd	_____	Ph2-gnd _____	Ph3-gnd _____

b. Minimum flow:

Amperage Phase 1	_____	Phase 2 _____	Phase 3 _____
Voltage Ph1-Ph2	_____	Ph1-Ph3 _____	Ph2-Ph3 _____
Voltage Ph1-gnd	_____	Ph2-gnd _____	Ph3-gnd _____

3. Note unusual vibration, noise, etc.

Functional Performance Test (cont.) - Pump (Provide for each pump)

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's TAB Representative	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Design Agency Representative	_____
Using Agency's Representative	_____

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit:

Note: Provide for each Air Handling Unit

1. Functional Performance Test: Contractor shall verify operation of air handling unit in accordance with specifications including the following:

a. Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

a. The following shall be verified when the supply fan operating mode is initiated:

(1) All dampers in normal position prior to fan start_____.

(2) All valves in normal position prior to fan start_____.

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper at minimum position. _____

(5) Steam control valve modulating to maintain space heating temperature set point input from outside air temperature controller. _____

c. Unoccupied mode of operation.

(1) Observe fan starts when space temperature Calls for heating/cooling _____

(2) All dampers in normal position.

(3) Verify low limit space temperature is maintained as specified in sequence of operation. _____

Functional Performance Test Checklist (cont) - Single Zone Air Handling Unit

d The following shall be verified when the supply fan off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point and returning to cooling set point _____.

g. Verify safety shut down initiated by low temperature protection thermostat _____.

h. Verify occupancy schedule is programmed into time clock/EMCS _____.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's TAB Representative _____

Contractor's Controls Representative _____

Design Agency Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Steam Boiler

For Boiler:

Note: Provide for each Boiler

1. Functional Performance Test: Contractor shall demonstrate operation of steam heating system in accordance with specifications including the following: Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start steam heating system. Verify control system energizes boiler start sequence. _____

b. Verify boiler senses steam pressure below set point and control system activates boiler start. _____

c. Shut off building heating equipment to remove load on steam heating system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

d. Verify that water level and makeup water system are operational. _____

2. Verify boiler inlet/outlet pressure reading, compare to boiler design conditions and manufacturer's performance data.

	DESIGN	SYSTEM TEST	ACTUAL
Boiler inlet feed water temp deg F	_____	_____	_____
Boiler outlet pressure psig	_____	_____	_____
Flue-gas temperature at boiler outlet deg F	_____	_____	_____
Percent Carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit inches-wg	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____

3. Record the following information:

Ambient temperature _____ deg F

4. Verify proper operation of boiler safeties. _____

5. Unusual vibration, noise, etc. _____

6. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. _____

Functional Performance Test Checklist (cont) - Steam Boiler

7. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's TAB Representative	_____
Contractor's Controls Representative	_____
Design Agency Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____

Functional Performance Test Checklist - Unit Heaters

The Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters:

- a. Verify unit heater response to room temperature set point adjustment. _____
- b. Check heating mode inlet air temperature. _____ deg F
- c. Check heating mode outlet air temperature. _____ deg F
- d. Record manufacturer's submitted fan Capacity _____ cfm
- e. Calculate unit heater Capacity using manufacturer's fan Capacity and recorded temperatures and compare to design.
- f. Calculated _____ BTU/hr. Design _____ BTU/hr.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's TAB Representative	_____
Contractor's Controls Representative	_____
Design Agency Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____



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Wellons FEI boiler water level testing.

The boiler water level testing sequence below is to be done on the boiler system prior to firing the unit. The level test will be effectuated with a cold boiler. Boiler water levels can be brought up by using the main feed water pumps and they can be brought down by using the bottom blow down valves.

1. Proof of reading of the level transmitter

Level transmitter reading and actual level inside of the gage glass will be visually inspected and confirmed. 0" reading on the transmitter must correspond to the bottom of the gage glass. 9" reading must correspond to the top of the gage glass. Confirmation that readings in between the minimum and maximum levels are linear must be witnessed by measuring a few random levels on the full range and confirming that the level gage and the transmitter are both indicating the same reading.

2. Confirming probe levels

Several conductivity probes are being used on the system in order to detect different levels inside of the boiler. All of the contacts have to be verified to make sure that they come in at the appropriate level. All of these contacts must also show up with the appropriate tagging on the HMI and must be confirmed. The water level inside the boiler is brought up until it reaches the level were the contact for the high water level comes in. Immediately stop filling the boiler. The actual level inside the gage glass is measured and recorded. The same procedure should be repeated for the other conductivity probes by bringing the boiler level down with the bottom blow down valves. The pump stop, pump start, low water alarm and extreme low water alarm levels must all have their respective contacts proven against the actual level within the gage glass and must be recorded. For any levels that deviate by more than %" from the desired levels on the prints, Wellons FEI will decide the corrective measures to apply.

3. Modulating boiler valve

The modulating boiler valve for the feed water will be tested to make sure that it operates in its full range from 0 to 100%. Actual desired output from the PLC will be confirmed with the position of the ball valve.

4. Maintaining boiler water level with the transmitter

The desired boiler level will be inputted into the HMI. The feed water pumps will be placed in automatic and the actual level being maintained inside the boiler using the level transmitter device will be verified inside the gage glass to confirm exactness. Water leaving the boiler is simulated with the bottom blow down valves of the boiler.

5. Maintaining the boiler level with the conductivity probes.

Through the HMI the level transmitter control function will be cancelled in order to test the level control function using the conductivity probes. Boiler blow down valves will be used to simulate water leaving the boiler. With the pumps in automatic, the level at which the pump starts and stops will be recorded and verified within the gage glass.

6. Low water cut out testing

Without a fire inside the combustion chamber all of the system functions must be placed in automatic. To simulate a low water cut out the normal boiler feed water pump must be placed in the off position. Starting from the normal operating level, the level must be gradually brought down by using the bottom blow down valves. Low water cut out must stop all of the boiler combustion and induced draft fans, as well as the fuel feed to the combustion chamber. At the same time confirm that the emergency feed water pump will bring the level back to the pump stop level. At this point confirm that the system cannot be started again without the use of the re-arming key. A second simulation of low water level should be effectuated in order to prove that the emergency feed water pump will come back on and bring the level back to the pump stop level. Once this sequence has been proven re-arm the system with the key to prove all normal system functions have returned.

7. Extreme low water cut out testing

Without a fire inside the combustion chamber all of the system functions must be placed in automatic. To simulate a low water cut out the normal boiler feed water pump must be placed in the off position. A jumper must also be installed so that the control signal from the first low water cut out does not call for the emergency feed water pump. Starting from the normal operating level, the level must be gradually brought down by using the bottom blow down valves. Extreme low water cut out must stop all of the boiler combustion and induced draft fan as well as the fuel feed to the combustion chamber. At the same time confirm that the emergency feed water pump does not come on when its selector switch is in the automatic position. Once at this level, confirm that the emergency feed water pump can be operated by placing its selector switch in the manual position. Return the level to its normal operating level. Re-arm the system with the key to prove all normal system functions have returned.

VHA Boiler Plant Safety Device Testing Manual
Third Edition

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Appendix A STEP BY STEP TEST PROCEDURES

Appendix A.1 INTRODUCTION

This appendix presents step by step test procedures for each safety device. The appendix provides forms for obtaining and recording all necessary data for each safety device being tested. It begins with tables that allow a thorough definition of the testing agency/personnel, responsible parties at the site, and boiler/burner data. This base data is followed by overarching requirements for safety testing. This information is then followed by one sheet for each device being tested to be used by the testing agency personnel as a check list and data form.

Appendix A.2 BASIC INFORMATION

VISN:

VA Medical Center:

Contact Name:

Phone:

Email:

Evaluators:

Date:

Individuals in Attendance:

Boiler and Burner Description

Boiler #	
Manufacturer:	
Model and Capacity:	
Serial #: National Board No.:	
Typical Operating Pressure:	
Design Pressure:	
Date of Manufacture:	
Boiler Controls:	
Burner	
Manufacturer:	
Type of burner:	
Fuels:	
Date of Manufacture:	

Appendix A.3 GENERAL REQUIREMENT'S FOR TESTING

The following test procedures make certain assumptions that are listed below.

- After each test, equipment should be returned to normal operating condition and the boiler should be fired to confirm its operability.
- "Jumping" means disabling the switch electrically
- Any electric "jumper" application requires that all power to the device being "jumped" be shut off.
- All pressure gages used in a test must be recently Calibrated.
- Any valve that disables a safety device should be lockable only in the operating position.
- The set point is the value at which the switch indicator is set. The trip point is the actual value at which the switch activates. Some language used in the test procedures assumes that the set point equals the trip point.
- Potentiometers used as safeties should be evaluated to determine if they are also used as the control. This is not acceptable.

Appendix A.4 Detailed Test Procedures - Checklists

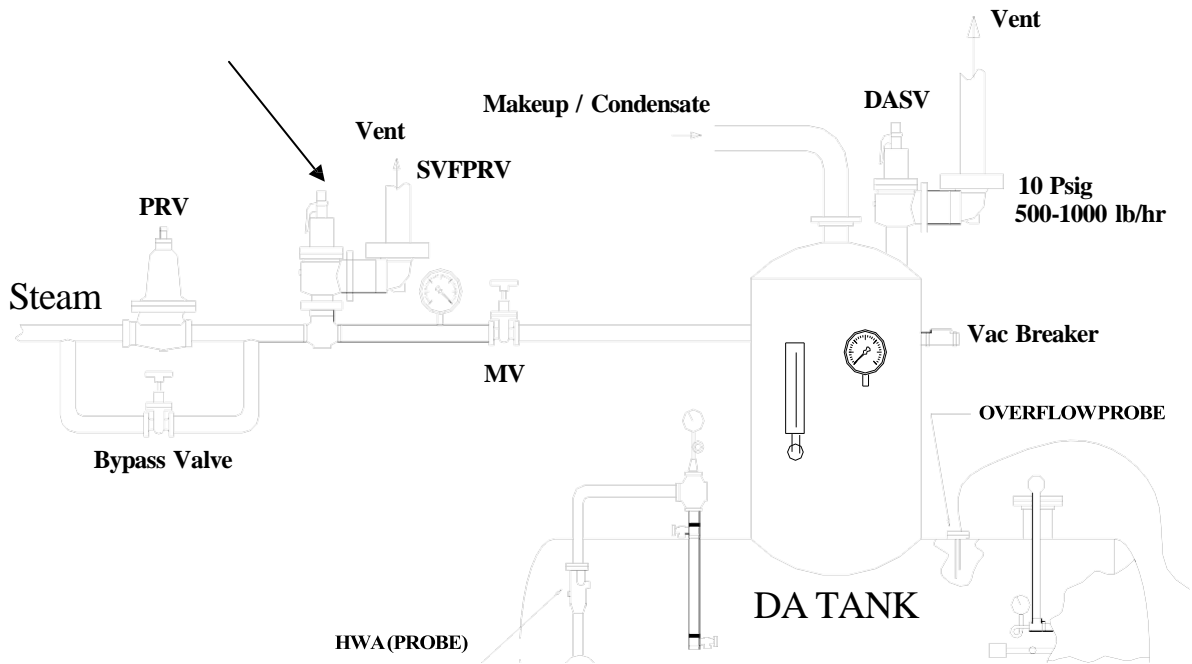
Checklist for Safety Valve Following PRV (SVFPRV) - Steam

Item	Make	Capacity (lb/hr)	Range	SVFPRV Setpoint	DA PRES (psig)	Correct Installation
SVFPRV						
Pressure Gage						

*Set point should be about 5 PSIG higher than DA safety lift point.

Item	Make/ Type	Size (in)	Pressure upstream	Pressure downstream	Wide Open Flow Capacity lbs./hr
PRV					
Bypass					

*SVFPRV must relieve largest wide open flow Capacity, PRV or bypass valve.



- Pour water into drip pan and confirm that it is open.
- Close the manual valve in steam line following the safety valve.
- Slowly open bypass valve to raise pressure until safety lifts. **DO NOT RAISE PRESSURE MORE THAN 2 PSIG ABOVE SETPOINT PRESSURE**
- Re-seat pressure should be about 6% less than lift pressure.
- Open larger of the bypass valve or PRV completely and perform accumulation test. The pressure should rise no more than 6% above the set point pressure.
- After lifting valve, close bypass valve, open manual valve in steam line after PRV and allow safety to reseat.

Result	Y/N	Pressure
Did the safety valve work correctly?		
What was the safety valve relief pressure?		
What is the re-seat pressure?		

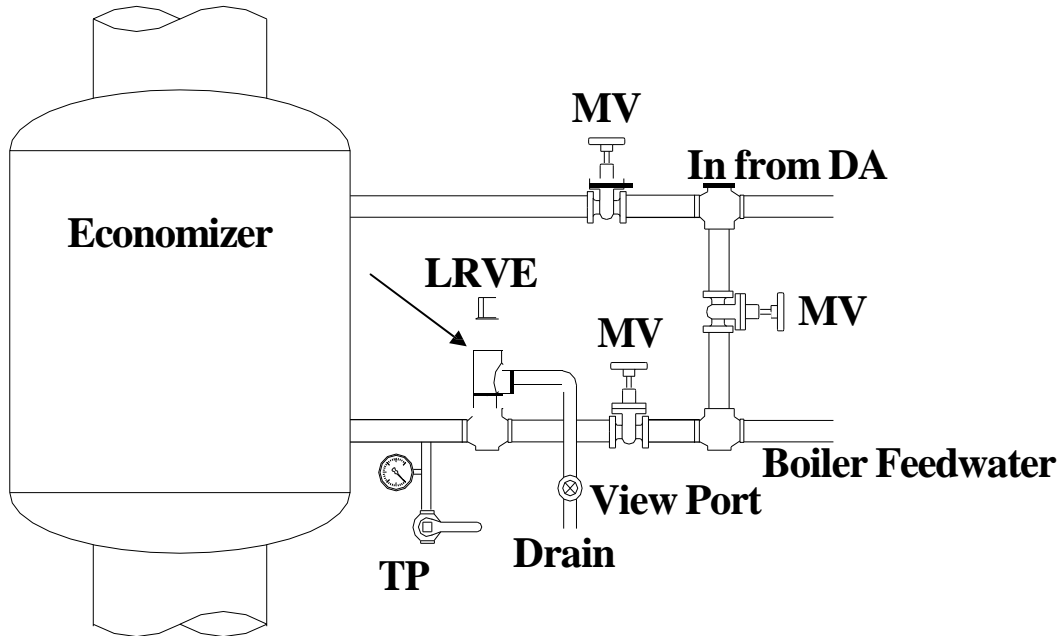
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Checklist for Liquid Relief Valve on Economizer (LRVE)

Item	Make	Capacity (gal/hr)	Range	LRVE Setpoint	Feedwater Pressure	Correct Installation
LRVE						
Pressure Gage						

*Setpoint should be less than the max allowable economizer pressure and more than maximum feedwater pressure.

Item	Make	Max Stack Temp	MAWP
Economizer			



- With boiler offline use manual valves to isolate economizer and relief valve. Use hydrostatic tester to raise pressure and open relief valve (use view port to determine when valve is open). **DO NOT RAISE PRESSURE MORE THAN ALLOWABLE ECONOMIZER PRESSURE!**
- An alternate method is to raise economizer pressure by operating boiler with isolation valves closed.

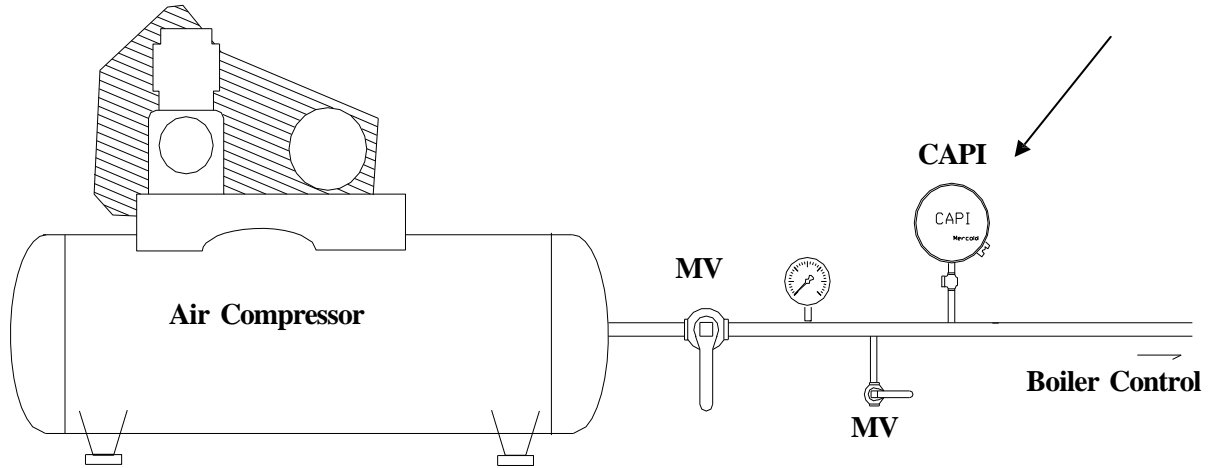
Result	Y/N	Pressure
Did the LRVE work correctly?		
What was the safety valve relief pressure?		
Maximum allowable economizer pressure?		
What is the re-seat pressure?		
View port in place to view water flow thru relief valve?		

Comment:

Checklist for Control Air Pressure Interlock (CXPI)

Item	Make	Range (psig)	Switch Setpoint	Regulated Pressure	Required Pressure	Correct Location Y/ N
CXPI						
Pressure Gage						

*Setpoint should be more than pressure required to actuate any pneumatic control device.



- Slowly close manual test valve to lower air supply pressure. Observe the pressure at which boiler shuts down. **DO NOT LOWER PRESSURE BELOW REQUIRED PRESSURE TO ACTUATE ANY PNEUMATIC CONTROL DEVICE!**

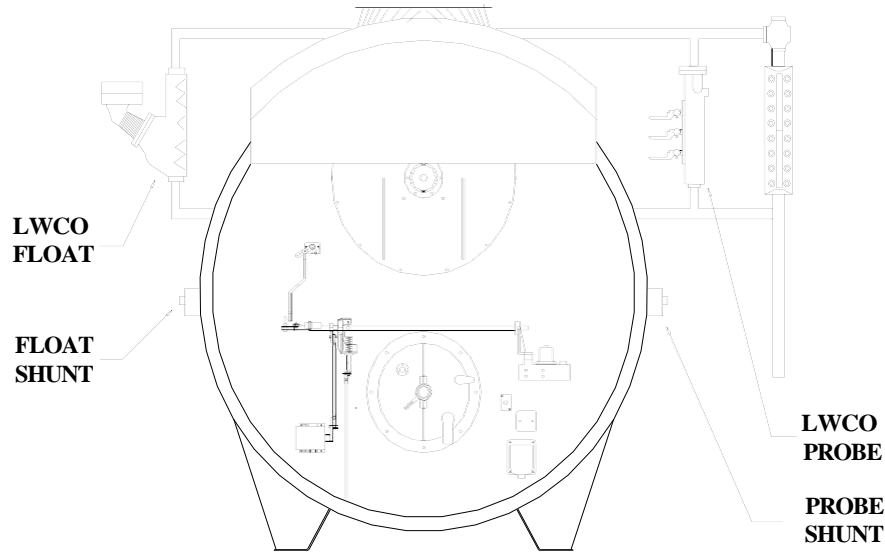
Result	Y/N	Trip Point
Did the CXPI work correctly?		
Is a lockable manual test valve in place as shown in figure?		
What was the interlock trip point?		
Is the set point higher than pressure required to actuate any pneumatic control device		

Comment:

Checklist for Low Water Alarm and Cutoffs on Boiler (LWA/LWCO/ALWCO)

Item	Make	Float / Probe	Correct Installation
LWA			
LWCO			
ALWCO			

*Independent shunt switches should be installed for each LWCO



- IN PERFORMING TEST NEVER LET WATER LEVEL LEAVE SIGHT GLASS!!!
- Drain sight glass without draining alarm column and quickly close drain valve. Water level should quickly rise in sight glass indicating good communication with tank.
- With boiler in manual at low fire, close the feedwater valve to generate a slow drain. You may “crack” the blowdown valve but do not exceed a drain rate of 1 inch per minute. Use water level in sight glass to observe alarm point. The alarm should sound first.
- Continue to drain until the primary cutoff activates.
- If shunt exists verify that it **ONLY** isolates the LWCO.
- Jumper or shunt the primary cutoff, restart the boiler, and set up drain as described above.
- Continue the drain until the secondary cutoff activates.

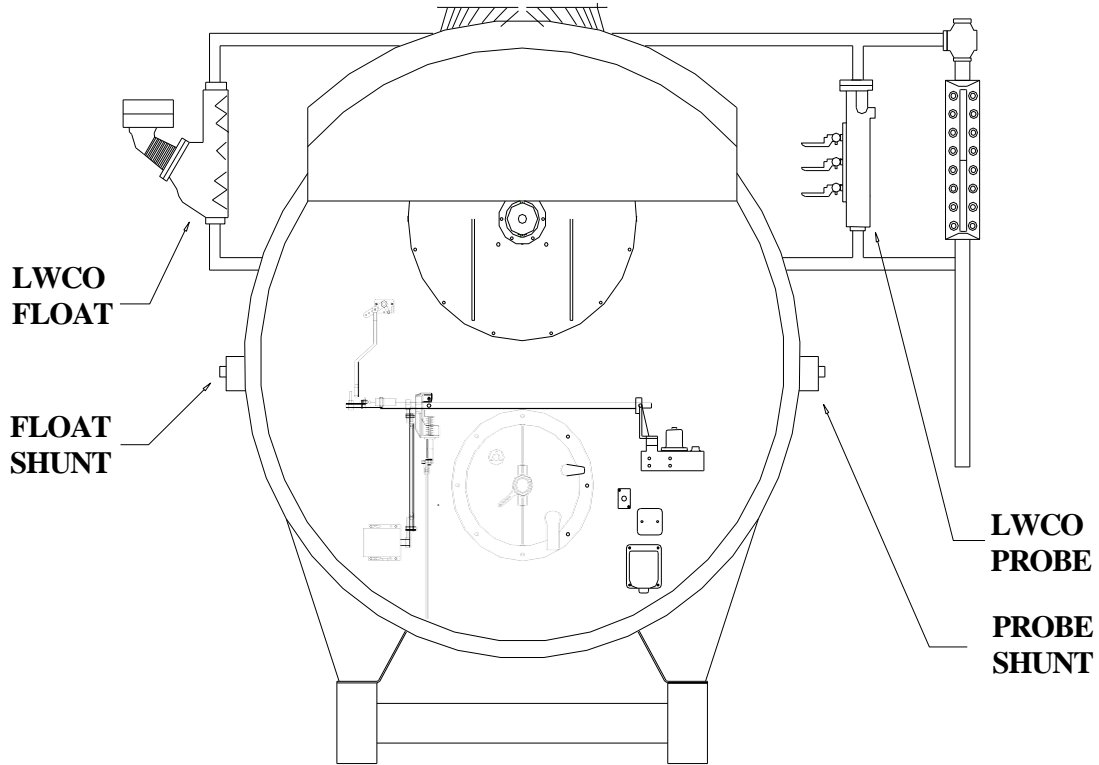
Result	Y/N	Water Level
Did the LWA work correctly? Record Level.		
Did the Primary cutoff work correctly? Record Level.		
Did the secondary cutoff work correctly?		
Was the alarm point above the primary and secondary cutoff point?		
Overall, did alarm and 2 low water cutoffs work correctly?		

Comment:

Checklist for High Water Alarm on Boiler (HWAB)

Item	Make	Float / Probe	Correct Installation
HWA			

*Sight glass water level should be 1" or more below top of sight glass at alarm.



- Drain sight glass without draining alarm column and quickly close drain valve. Water level should quickly rise in sight glass indicating good communication with tank.
- With boiler off, open the bypass feedwater valve to fill the boiler. Use water level in sight glass to observe alarm point. The alarm should sound before water level leaves sight glass. **DO NOT ALLOW WATER LEVEL TO LEAVE SIGHT GLASS**
- Close the bypass on feedwater line

Result	Y/N	Water Level
Did the alarm work correctly?		
What was the water level in sight glass at alarm point?		

Comment:

Checklist for Recycle and Non-Recycle Boiler Steam Pressure Limit Switches (RBSPLS & NRBSPLS)

Item	Make	Range (psig)	Switch Setpoint	Normal Steam Pressure (psig)	Lowest SVB Setpoint (psig)	Correct Setpoint Y / N
RBSPLS						
NRBSPLS						
Pressure Gage						

*RBSPLS setpoint should be 10 psig or more of normal steam pressure.

*NRBSPLS setpoint should be 5 psig or more of the RBSPLS setpoint & 5 psig or more less than the lowest SVB setpoint.

-
- Never exceed the boiler MAWP during this test.
 - Place boiler in minimum fire and manually close the steam supply valves from the boiler.
 - Raise the steam pressure slowly by firing the boiler.
 - Raise until RBSPLS activates – record activation pressure in table below.
 - Jumper the recycle switch out of the circuit.
 - Fire boiler and raise the steam pressure slowly.
 - Raise until NRSBPLS activates – record activation pressure in table below.

Result	Y/N	Pressure
Did the RBSPLS work correctly? Record Pressure.		
Did the NRSBPLS work properly? Record Pressure.		

Comment:

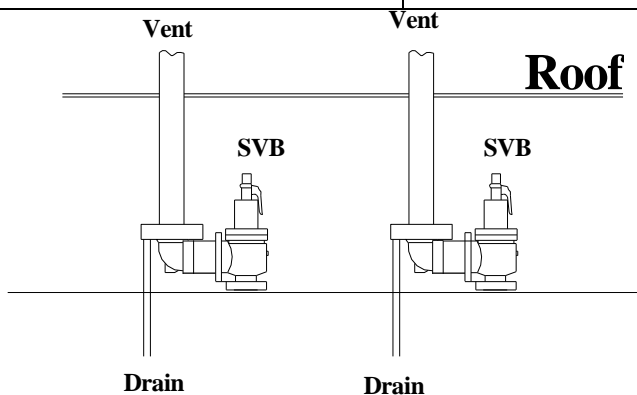
Checklist for Steam Safety Valves on Boiler (SVB)

Item	Make	Capacity (Lb/hr)	Range	SVB Setpoint	Normal Steam Pressure	Correct Installation / Capacity
SVB 1						
SVB 2						
SVB 3						
Pressure Gage						

*SVB1 should be set 5 psig higher than NRBSPLS & 10 psig below boiler MAWP.

*SVB2 should be set 5 psig or higher than SVB1 & 5 psig or more below boiler MAWP.

Item	MAWP (psig)	Capacity (lb/hr)
Boiler		



- NEVER ALLOW BOILER PRESSURE TO EXCEED MAWP
- With boiler off, jumper recycle and non-recycle steam pressure switches.
- Close the steam supply valves from the boiler and test the drains on the safety valve drip pan ells by pouring water into them and noting that water flows freely. Unstop drains before proceeding.
- Raise the steam pressure slowly by firing the boiler at low fire.
- Note the pressure that the first & second safety valve opened. (may require increasing firing rate).
- Place boiler in high fire and determine if steam pressure rises with both SVB open.
- Shut boiler off and note the pressure that the safety valves close.

Result	Y/N	Lift (P)	Reseat (P)
Did the first SVB correctly? Record Pressure.			
Did the second SVB work correctly? Record Pressure.			
Did the third SVB work correctly? Record Pressure.			
Maximum pressure observed during accumulation test?			
Is SVB vent plumbing adequate?			

*Max lift pressure of 3% higher than rated lift pressure. Blowdown should be less than the greater of 2 psig or 2% of the set pressure, and shall not exceed 6% of set pressure.

*Maximum accumulation pressure seen should not exceed 110% of highest SVB setpoint and never exceed boiler rated pressure.

Comment:

Checklist for Water Treatment

Sample	TDS ()	Sulfite (ppm)	Phosphate (ppm)	()-Alk (ppm)	Hardness (ppm)	pH
Boiler						
Feedwater						
Condensate						
Makeup						

$$\% \text{Makeup} = \frac{\text{Conductivity of Feedwater} - \text{Conductivity of Condensate}}{\text{Conductivity of MU} - \text{Conductivity of Condensate}} * 100$$

$$\% \text{Blowdown} = \frac{\text{Conductivity of Feedwater}}{\text{Conductivity of Boiler} - \text{Conductivity of Feedwater}} * 100$$

Checklist for General Plant Safety & Reliability

Item	Present Y/N
Deaerator Tank Bypass.	
Condensate Tank Bypass.	
Softener Bypass.	
Auxiliary makeup to Deaerator.	
Emergency water to Boilers.	

SAMPLING AND ANALYTICAL PROCEDURES

Compliance particulate emissions evaluation on the Electro Static Precipitator (ESP) Exhaust of the wood-fired boiler at *The Columbus, Ohio Veterans Administration Medical Center.*

IEEE 1547 INTERCONNECTION TEST PLAN

COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

PRIMARY TEST SECTION

5.4 COMMISSIONING TESTS – Part 1

All commissioning tests shall be performed based on written test procedures. The following visual inspections shall be performed.

a. TEST REQUIREMENT

- A visual inspection shall be made to ensure that the grounding coordination requirement of 4.1.2 has been implemented.

REFERENCE TEST

4.1.2 Integration with Area EPS grounding

The grounding scheme of the DR interconnection shall not cause overvoltage that exceed the rating of the equipment connected to the Area EPS and shall not disrupt the coordination of the ground fault protection on the Area EPS.

TEST PROCEDURE

Provide device coordination and arc flash study for proper labeling and setting of protective devices

b. TEST REQUIREMENT

- A visual inspection shall be made to confirm the presence of the isolation device if required by 4.1.7.

REFERENCE TEST

4.1.7 Isolation device

When required by the Area EPS operating practices, a readily accessible, lockable, visible-break isolation device shall be located between the Area EPS and the DR unit.

TEST PROCEDURE

Verify lockable isolation device present (Induction Generator circuit breaker)

PRIMARY TEST SECTION

5.4 COMMISSIONING TESTS – Part 2

Initial commissioning tests shall be performed on the installed DR and interconnection system equipment prior to the initial parallel operation of the DR. The following tests are required:

c. TEST REQUIREMENT

- Operability test on the isolation device

TEST PROCEDURE

Test Induction Generator (IG) circuit breaker to confirm settings

IEEE 1547 INTERCONNECTION TEST PLAN

COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

d. TEST REQUIREMENT

- Unintentional-islanding functionality as specified in 5.4.1

REFERENCE TEST

5.4.1 Unintentional islanding functionality test

5.4.1.2 Non-islanding functionality test

For non-islanding interconnection systems, 5.4.2 satisfies this requirement.

TEST PROCEDURE

Refer to section 5.4.2

Section 5.4.2 applies since induction generators require connection to utility source to provide excitation and voltage creations. BeCxuse of this, the induction generator will not operate in the islanding mode. Additionally, an input contact and logic has been provided to prevent operation of the induction generator when the 480V ATS is connected to the emergency generator.

e. TEST REQUIREMENT

- Cease to energize functionality as specified in 5.4.2

REFERENCE TEST

5.4.2 Cease to energize functionality test

Check the cease to energize functionality by operating a load interrupting device and verify the equipment ceases to energize its output terminals and does not restart/reconnect for the required time delay. The test shall be performed on each phase individually.

TEST PROCEDURE

1. Connect 3 \emptyset power monitor device at IG circuit breaker
2. Remove LOTO from BM MCC IG feeder circuit breaker
3. Close BM MCC IG feeder circuit breaker
4. Verify nominal voltage and frequency at Schweitzer 300 display
5. Start turbine on steam process per normal operation
6. Allow PLC to close IG circuit breaker and record power
7. Increase output to 25% and hold -record power output and compare to PLC
8. Increase output to 50% and hold -record power output and compare to PLC
9. Increase output to 75% and hold -record power output and compare to PLC
10. Increase output to 95% and hold -record power output and compare to PLC
11. Reduce power output to 10% and hold
12. Open BM MCC IG feeder circuit breaker
13. Verify IG circuit breaker opens immediately (0.16 sec or less)
14. Perform normal shut down

IEEE 1547 INTERCONNECTION TEST PLAN

COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

f. TEST REQUIREMENT

- Any tests of 5.1 that have not been previously performed on a representative sample and formally documented

TEST PROCEDURE

Perform applicable section 5.1 tests as indicated below.

PRIMARY TEST SECTION

5.1 DESIGN TEST

a. TEST REQUIREMENT

5.1.1 Response to abnormal voltage and frequency

This test shall demonstrate that the DR ceases to energize the Area EPS when the voltage or frequency exceeds the limits as specified in 4.2.3 and 4.2.4. Interconnection systems provided with field adjustable set points shall also be tested at the minimum, midpoint, and maximum of the adjustable set point ranges. These tests shall be conducted using either the simulated utility or secondary injection method.

REFERENCE TEST 1

4.2.3 Voltage

When any voltage is in a range given in Table 1, the DR shall cease to energize the Area EPS within the clearing time as indicated. Clearing time is the time between the start of the abnormal condition and the DR ceasing to energize the Area EPS.

Table 1—Interconnection system response to abnormal voltages

Voltage range (% of base voltage ^a)	Clearing time(s) ^b
$V < 50$	0.16
$50 \leq V < 88$	2.00
$110 < V < 120$	1.00
$V \geq 120$	0.16

^a Base voltages are the nominal system voltages stated in ANSI C84.1-1995, Table 1.

^b DR \leq 30 kW, maximum clearing times; DR $>$ 30kW, default clearing times.

TEST PROCEDURE

LOSS OF VOLTAGE

- Supply nominal voltage to the PT output circuit
- Verify voltage in Schweitzer 300 display
- Close IG circuit breaker
- Reduce voltage below 50% nominal
- Verify IG circuit breaker opens in 0.16 sec or less

UNDER VOLTAGE TEST

- Supply nominal voltage to the PT output circuit
- Verify nominal voltage in Schweitzer 300 display
- Close IG circuit breaker

IEEE 1547 INTERCONNECTION TEST PLAN COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

4. Reduce voltage to 88% nominal
5. Verify IG circuit breaker opens in 2.0 sec or less

OVER VOLTAGE 1 TEST

1. Supply nominal voltage to the PT output circuit
2. Verify voltage in Schweitzer 300 display
3. Close IG circuit breaker
4. Increase voltage to 110% nominal
5. Verify IG circuit breaker opens in 1.0 sec or less

OVER VOLTAGE 2 TEST

1. Supply nominal voltage to the PT output circuit
2. Verify voltage in Schweitzer 300 display
3. Close IG circuit breaker
4. Increase voltage to 120% nominal
5. Verify IG circuit breaker opens in 0.16 sec or less

REFERENCE TEST 2

4.2.4 Frequency

When the system frequency is in a range given in Table 2, the DR shall cease to energize the Area EPS within the clearing time as indicated. Clearing time is the time between the start of the abnormal condition and the DR ceasing to energize the Area EPS.

Table 2—Interconnection system response to abnormal frequencies

DR size	Frequency range (Hz)	Clearing time(s) ^a
≤ 30 kW	> 60.5	0.16
	< 59.3	0.16
> 30 kW	> 60.5	0.16
	< {59.8 – 57.0} (adjustable set point)	Adjustable 0.16 to 300
	< 57.0	0.16

^a DR ≤ 30 kW, maximum clearing times; DR > 30 kW, default clearing times.

TEST PROCEDURE

Under Frequency Test

1. Supply nominal voltage and frequency to the PT output circuit
2. Verify voltage in Schweitzer 300 display
3. Close IG circuit breaker
4. Lower frequency to 59.90 Hz
5. Verify IG circuit breaker opens in 0.16 sec or less

Over Frequency Test

1. Supply nominal voltage and frequency to the PT output circuit
2. Verify voltage in Schweitzer 300 display

IEEE 1547 INTERCONNECTION TEST PLAN

COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

3. Close IG circuit breaker
4. Raise frequency to 60.5 Hz
5. Verify IG circuit breaker opens in 0.16 sec or less

b. TEST REQUIREMENT

5.1.2 Synchronization

TEST PROCEDURE

Induction generators require connection to utility source to provide excitation and voltage creations. Therefore, 25 synchronizing is not utilized and this test requirement does not apply.

c. TEST REQUIREMENT

5.1.3 Interconnect integrity test

5.1.3.1 Protection from EMI

The interconnection system shall be tested in accordance with IEEE Std C37.90.2-1995 to confirm that the results are in compliance with 4.1.8.1. The influence of EMI shall not result in a change in state or misoperation of the interconnection system.

REFERENCE TEST

4.1.8.1 Protection from electromagnetic interference

The interconnection system shall have the Capability to withstand electromagnetic interference (EMI) environments in accordance with IEEE Std C37.90.2-1995. The influence of EMI shall not result in a change in state or misoperation of the interconnection system.

TEST PROCEDURE

The manufacturer of the Induction Generator relay, Schweitzer Engineering Laboratories, has certified the SEL-300G multifunction generator relay to IEEE Std C37.90.2-1995 (ref. page 1-15, SEL-300G Instruction Manual, Date Code 20100430).

d. TEST REQUIREMENT

5.1.3.2 Surge withstand performance

The interconnection system shall be tested for the requirement in 4.1.8.2 in all normal operating modes in accordance with IEEE Std C62.45-2002 for equipment rated less than 1000 V to confirm that the surge withstand Capability is met by using the selected test level(s) from IEEE Std C62.41.2-2002. The results of these tests shall indicate the unit did not fail, did not misoperate, and did not provide misinformation.

REFERENCE TEST

4.1.8.2 Surge withstand performance

The interconnection system shall have the Capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable.

TEST PROCEDURE

1. Perform "decoupled bump test" of induction motor to confirm proper rotation and voltage reaction
2. Record voltage and current magnitude of bump test

IEEE 1547 INTERCONNECTION TEST PLAN COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

e. **TEST REQUIREMENT**

5.1.3.3 Paralleling device

A dielectric test across the open-circuited paralleling device shall be conducted to confirm compliance with the requirements of 4.1.8.3.

REFERENCE TEST

4.1.8.3 Paralleling device

The interconnection system paralleling-device shall be capable of withstanding 220% of the interconnection system rated voltage.

TEST PROCEDURE

This test is covered by the OVERVOLTAGE 2 TEST performed to demonstrate compliance with test section 5.1.1 of IEEE 1547.

f. **TEST REQUIREMENT**

5.1.4 Unintentional Islanding

A test or field verification shall be conducted to confirm that 4.4.1 is met regardless of the selected method of detecting isolation.

REFERENCE TEST

4.4.1 Unintentional islanding

For an unintentional island in which the DR energizes a portion of the Area EPS through the PCC, the DR interconnection system shall detect the island and cease to energize the Area EPS within two seconds of the formation of an island.

TEST PROCEDURE

This test is addressed by steps 12-13 of Reference Test 5.4.2 (*Cease To Energize Functionality Test*).

g. **TEST REQUIREMENT**

5.1.5 Limitation of dc injection

Inverter based DR shall be tested to confirm that the DR does not inject dc current greater than prescribed limits that are listed in 4.3.1.

REFERENCE TEST

4.3.1 Limitation of dc injection

The DR and its interconnection system shall not inject dc current greater than 0.5% of the full rated output current at the point of DR connection.

TEST PROCEDURE

dc Injection current will be measured and recorded during performance of the test outlined in this plan for IEEE 1547 section 5.4.2, *CEASE TO ENERGIZE FUNCTIONALITY TEST*. dc injection current must not exceed $0.005 \times 534.6A \text{ ac} = 2.673 A \text{ dc}$.

IEEE 1547 INTERCONNECTION TEST PLAN

COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

h. TEST REQUIREMENT

5.1.6 Harmonics

The intent of the harmonics interconnection test is to assess that under a controlled set of conditions the DR unit meets the harmonic limits specified in 4.3.3.

REFERENCE TEST

4.3.3 Harmonics

When the DR is serving balanced linear loads, harmonic current injection into the Area EPS at the PCC shall not exceed the limits stated below in Table 3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in the Area EPS without the DR connected.

Table 3—Maximum harmonic current distortion in percent of current (I)^a

Individual harmonic order h (odd harmonics) ^b	h < 11	11 ≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35 ≤ h	Total demand distortion (TDD)
Percent (%)	4.0	2.0	1.5	0.6	0.3	5.0

^a I = the greater of the Local EPS maximum load current integrated demand (15 or 30 minutes) without the DR unit, or the DR unit rated current Capacity (transformed to the PCC when a transformer exists between the DR unit and the PCC).

^b Even harmonics are limited to 25% of the odd harmonic limits above.

TEST PROCEDURE

Harmonic current injection will be measured and recorded during performance of the test outlined in this plan for IEEE 1547 section 5.4.2, *CEASE TO ENERGIZE FUNCTIONALITY TEST*.

Passing performance will be in accordance with Table 3 above.

i. TEST REQUIREMENT

- Any tests of 5.2 that have not been previously performed

PRIMARY TEST SECTION

5.2 PRODUCTION TESTS

Each interconnection system shall be subjected to requirements of 5.1.1 and 5.1.2. Interconnection systems with adjustable set points shall be tested at a single set of set points as specified by the manufacturer. This test may be conducted as a factory test or may be performed as part of a commissioning test (see 5.4).

The applicable tests of 5.1 shall be repeated when:

- Functional software or firmware changes have been made on the interconnection system
- Any hardware component of the interconnection system has been modified in the field, or, replaced or repaired with parts different from the tested configuration.

IEEE 1547 INTERCONNECTION TEST PLAN

COLUMBUS VAMC INDUCTION GENERATOR SYSTEM

Subclauses 5.4.1 and 5.4.2, and the applicable tests of 5.2 shall be repeated if:

- Protection settings have been changed after factory testing.
- Protection functions have been adjusted after the initial commissioning process.

TEST PROCEDURE

All tests in section 5.2 are covered by the previous sections of this test plan.

**Department of
Veterans Affairs**

Memorandum

Date: November 15, 1996

From: Chief Network Officer (1 ONB)

Subj: Construction Projects Fire Code Compliance Process

To: Network Directors (10N1-10N22)

1. Network Directors have the responsibility to ensure that delegated construction projects are designed, constructed and reviewed to meet all applicable VA fire code requirements. This includes Non-Recurring Maintenance (NRM), Minor, and Major construction projects and all design and construction completed with local operating funds. VA must comply with national consensus fire codes and standards for JCAHO (Joint Commission on Accreditation of Healthcare Organizations) accreditation and to comply with Public Law 100-678, Public Buildings Amendment Act of 1988 and Public Law 102-522, Federal Fire Safety Act of 1992, along with other laws and regulatory requirements. Like other federal agencies with real property and construction authority, VA acts as its own building and fire code official.
2. A fire protection engineering (FPE) firm or expertise is recommended on the design and construction of certain projects as part of the Architectural/Engineering (NE) team. The Office of Facility Management (18) has issued guidance on the need for this expertise. They recommend that all minor construction projects and NRM projects where the cost of the fire protection work exceeds 50% of the total project cost use a FPE. For example, any projects to install automatic fire sprinkler systems or new fire alarm systems need a fire protection engineering firm or other NE firm with fire protection engineering expertise to ensure fire code compliance.
3. Each Network shall develop a process to ensure medical center construction projects are reviewed by a qualified engineer knowledgeable with National Fire Protection Association's National Fire Codes (NFC). These individuals shall have had extensive experience in the construction field and be knowledgeable in exit calculations, sprinkler system and fire alarm requirements, Life Safety Code requirements, etc.
4. If your Network has an in-house Safety and Fire Protection Engineer (SFPE) on your staff, these individuals are fully qualified to review design and construction which is affected by fire codes and standards. VA policy in MP-3, Part III, Safety, Occupational Health and Fire Protection, required previous VHA field organizations to use an in-house SFPE to conduct these reviews of all design and construction. If your network does not have qualified in-house resources, we recommend that a private sector fire protection engineering firm be retained to conduct these reviews. In the near future, we anticipate the availability of a contract for this service via the Service Support Center.
5. The point of contact on this matter is Kenneth Faulstich in the Engineering Management and Field Support Office (IONS). He can be contacted at (202) 273-5869 or electronically at FAUKEN@HQ.MED.VA.GOV.

Jule D. Moravec, Ph.D.

**VAMC COLUMBUS, OH
CHP POWER PLANT SYSTEM INSPECTION CHECKLIST**

SECTION A - CUSTOMER DATA

1. PLANT/BUILDING	2. LOCATION	3. JOB NUMBER
4. EQUIPMENT	5. CIRCUIT DESIGNATION	6. DATE (YYYYMMDD)
7. TEST EQUIPMENT AND CALIBRATION DATE		8. TESTED BY

SECTION B - EQUIPMENT DATA

9. MANUFACTURER	10. STYLES/S.O.	11. VOLTAGE RATING	12. CURRENT RATING
13. EQUIPMENT CLASSIFICATION	14. FREQUENCY	15. WET BULB TEMPERATURE	16. DRY BULB TEMPERATURE

SECTION C - VISUAL AND ELECTRICAL/MECHANICAL INSPECTION

17. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
COMPONENT INSPECTION / TESTING			WIRING VISUAL VERIFICATION		
ENERGIZE AND TEST SYSTEM			UTILITY TRIP / GENERATOR BUILDING LOAD TEST		
INSTALLATION INSPECTION / TESTING			TIGHTNESS OF BOLTED CONNECTIONS		
GENERATOR CONTROLS AND FUNCTIONS			CHECK FOR PROPER SIZE BREAKER		
WIRING CONTINUITY TESTING			REFERENCE DRAWINGS		
WORKING CLEARANCE			PROPER PHASING CONNECTIONS AND COLOR CODE		
SWITCH-GEAR CONTROL FUNCTIONS					
PERFORM AUTOMATIC TRANSFER SYSTEM (ATS) FUNCTIONS UNDER THE ADJACENT CONDITIONS.	A. OPERATE NORMAL POWER				
	B. ALL GENERATORS OPERATE				
	C. GENERATORS 1 AND 2 OPERATE				
	D. GENERATORS 2 AND 3 OPERATE				
	E. GENERATORS 1 AND 3 OPERATE				
	F. RETURN TO NORMAL POWER AFTER EACH OF THE ABOVE TESTS				
	G. PARALLEL WITH UTILITY UPON RETURN TO NORMAL POWER				

SECTION D - ELECTRICAL TESTS

18. MEASUREMENT DESCRIPTION	VOLTAGE AND CURRENT MEASUREMENTS										
	VOLTAGE**						CURRENT**				
	A-N	B-N	C-N	A-B	B-C	C-A	A	B	C	N	G
	A-N	B-N	C-N	A-B	B-C	C-A	A	B	C	N	G

19. NOTES

*CONDITION: A=ACCEPTABLE; R=NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C=CORRECTED; NA=NOT APPLICABLE

**NOTE VALUE AND PHASING

Premier Mechanical Group, Inc.

1507 East Valley Pkwy, Suite #3-481, Escondido, CA 92027

Office: (760) 402-5420

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Commissioning Team Members

Cx Project Manager	Quality Assurance Engineer	Prime Contractor	Mechanical Subcontractor	Electrical Subcontractor	Balancing Subcontractor	Controls Subcontractor	Owner's O&M Staff
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Action Item

Action Item	Cx Project Manager	Quality Assurance Engineer	Prime Contractor	Mechanical Subcontractor	Electrical Subcontractor	Balancing Subcontractor	Controls Subcontractor	Owner's O&M Staff
Verification Activities								
Prepare Inspection Checklists								
Approve Inspection Checklists								
Coordinate with Team Members								
Pre-Start up Inspection								
Conduct Pre-Start up Inspections								
On-site for Inspection								
Louvers, Controllers, Sensors, Connected Eqpt & Wiring								
Luminaires, Sensors, Controls, Connected Eqpt & Wiring								
Electrical Panels, Motors, Power Packs, etc.								
Power Available to Components								
System Controls								
Equipment Nameplate Data								
Documentation & Submittals								
Obtain Vendor Cutsheets and Performance Specs								
Obtain Manufacturer's Installation Instructions								
Obtain Manufacturer's O&M Manuals								
Prepare Related Checklists								
Non-Compliance & Corrections								
Determine Non-compliance components								
Corrections and Repairs								
Pre-Start up Inspection Follow-up								
Record Inspection Results								
Certify Pre-Start up Checklists								
Approve Pre-Start up Checklists								
Verification Testing								
Prepare Verification Test Checklists								
Initiate Start-up of System Components								
Verify Test and Balance Report								
Certify Readiness for Conducting Verification Testing								
Authorization to Proceed with Verification Testing								
Conduct Verification Testing								
Functional Performance Testing								
Prepare Functional Performance Checklists								
Authorization to Proceed with FPT								
Conduct Functional Performance Testing								
On-Site for Verification & Functional Performance Testing								
Documentation and Non-Compliance								
Record Results of Testing								
Determine Non-Compliance Components								
Corrections and Repairs								
Verify Results of Testing								
Approve Results								
Prepare Final Commissioning Report								
Prepare System Manual								

**VERIFICATION AND FUNCTIONAL PERFORMANCE
TEST PLAN FOR HVAC AIR-SIDE**

PROJECT SPECIFIC INFORMATION

Project Name: _____ Project Number: _____
Building Occupancy Type: _____ Gross Floor Area: _____
Prime Contractor: _____
Required Operating Permits Obtained Prior to Commissioning: Yes No

INSTALLATION ACCEPTANCE CRITERIA

EEM Description: _____
Required Specification: _____
Construction Installation Drawing (Sheet #, Detail #): _____
Manufacturer's Installation Requirement: _____
Special Installation Considerations: _____
(per Contract Documents)

PERFORMANCE ACCEPTANCE CRITERIA

Statement of Design Intent for EEM: _____
(Definition of Performance Acceptance Criteria)
System Description: _____
Design Parameters (applicable to acceptance of performance): _____
Global priorities established by design intent which affect performance acceptance criteria
(Refer to Guideline Section 2.2.2.3): _____

Describe the expected results of each test procedure: _____

HVAC System Description:

Building Cooling System Description:
Cooling coils capacity (Tons): _____
Total design air flow (cfm): _____
Additional information: _____

**VERIFICATION AND FUNCTIONAL PERFORMANCE
TEST PLAN FOR HVAC AIR-SIDE**

Description of System Controls and Sequence of Operation:

Controls Operating Setpoints:

Is Energy Management System (EMS) used? Yes No

Are control dampers connected to EMS? Yes No

If yes, identify dampers:

EQUIPMENT DESCRIPTION

Air Side Economizer

Manufacturer: _____

Model Number: _____

Options Code: _____

Type: Integrated: _____ Non-integrated: _____

Number of Economizers: _____

Symbol/Designation from Drawings: _____

Location: _____

Additional Information: _____

Outside Air Damper:

Manufacturer: _____

Model Number: _____

Type: _____

Design Parameters: _____

Motor Voltage/Phase/Hz: _____

Number of Dampers: _____

Symbol/Designation from Drawing: _____

Additional Information: _____

**VERIFICATION AND FUNCTIONAL PERFORMANCE
TEST PLAN FOR HVAC AIR-SIDE**

Return Air Damper:

Manufacturer: _____

Model Number: _____

Type: _____

Design Parameters: _____

Motor Voltage/Phase/Hz: _____

Number of Dampers: _____

Symbol/Designation from Drawing: _____

Additional Information: _____

Exhaust Air Damper:

Manufacturer: _____

Model Number: _____

Type: _____

Design Parameters: _____

Motor Voltage/Phase/Hz: _____

Number of Dampers: _____

Symbol/Designation from Drawing: _____

Additional Information: _____

Schedule Requirements:

- Start-up testing
- Pre-startup inspections
- Verification testing
- Functional performance testing

VERIFICATION AND FUNCTIONAL PERFORMANCE TEST PLAN FOR HVAC AIR-SIDE

Required Tools and Instruments:

- Multimeter for electrical measurements
- Ammeter
- Power measurement transducer (PMT)
- Calibrated thermometer
- Calibrated enthalpy meter
- Air velocity meter for in-duct measurements
- Miscellaneous hand tools

Description Of Calibration Procedures:

For all instruments which require calibration, provide the following information:

- Instrument description/identification
- Manufacturer's calibration requirements
- Copy of most recent calibration certificates
- Date of most recent calibration
- Description of calibration procedure

Field-Initiated Modifications to Approved Testing Procedure:

- Describe the conditions which invalidate the approved testing procedure.
- Identify the specific steps or tests in the approved procedures which are invalidated.
- Describe the modified steps to the procedures.
- Explain how these new steps address the unanticipated on-site conditions without altering the intent or the outcome of the testing.
- For responsible subcontractors, obtain the written agreement of the Prime Contractor.
- Obtain the written agreement of the Quality Assurance Engineer.
- Proceed with the modified testing procedure.

PRE-STARTUP INSPECTION CHECKLIST — HVAC AIR-SIDE

CHECKLIST ITEM	YES	NO
1.0 Physical Installation of Economizer, Sensors and Ductwork		
1.1 Economizer installed in accordance with manufacturer's specifications and drawings	_____	_____
1.2 Thermostat correct for economizer (i.e., two-stage cooling control required for integrated economizer)	_____	_____
1.3 Dampers installed in accordance with drawings	_____	_____
1.4 Dampers and operating linkage installed correctly in accordance with drawings, move freely without binding and are fully operational	_____	_____
1.5 Dampers installed match specification	_____	_____
1.6 Dampers close tightly	_____	_____
1.7 Dampers lubricated (as required)	_____	_____
1.8 Outside air and return air dampers mounted to promote thorough mixing of the two airstreams prior to entering coils	_____	_____
1.9 Ductwork installed in accordance with design drawings	_____	_____
1.10 All duct connections to economizer complete	_____	_____
1.11 Fittings in ductwork properly specified and appropriate for the application	_____	_____
1.12 Ductwork complete and leak tested	_____	_____
1.13 Outside air enthalpy/temperature sensor installed in correct location and out of direct sunlight	_____	_____
1.14 Outside air sensor installed matches specification and out of direct sunlight	_____	_____
1.15 Return air enthalpy/temperature sensor installed in correct location	_____	_____
1.16 Return air sensor installed matches specification	_____	_____
1.17 Mixed airstream enthalpy/temperature sensor located correctly to ensure proper mixing of airstream ahead of sensor	_____	_____
1.18 Mixed airstream sensor installed matches specification	_____	_____
1.19 Air filters installed and clean	_____	_____
1.20 For high-rise installations: All economizers and associated air-handling units are located on the first floor or within the neutral zone of the building. (Note: Experience has shown that incorrect use of air-side economizers in high-rise buildings has resulted in serious performance problems.)	_____	_____
1.21 Comments and Observations: _____		

PRE-STARTUP INSPECTION CHECKLIST — HVAC AIR-SIDE

CHECKLIST ITEM	YES	NO
2.0 Electrical		
2.1 Disconnect panels installed, labeled and functional	_____	_____
2.2 Fuse rating correct for connected equipment	_____	_____
2.3 Power available to panels	_____	_____
2.4 Motor protection devices installed and functional	_____	_____
2.5 Control system contactors functional	_____	_____
2.6 Control system interlocks functional	_____	_____
2.7 Shielded wiring used on electronic controls	_____	_____
2.8 Comments and Observations: _____		

3.0 Controls		
3.1 Factory start-up and check-out complete	_____	_____
3.2 Solid-state sensors used	_____	_____
3.3 Outside air sensor calibrated in accordance with manufacturer's instructions	_____	_____
3.4 Return air sensor calibrated	_____	_____
3.5 Mixed air sensor calibrated	_____	_____
3.6 Relative humidity sensor calibrated	_____	_____
3.7 Comments and Observations: _____	_____	_____

4.0 Test and Balance		
4.1 Air balance complete with design maximum flow verified	_____	_____
4.2 Test and balance report submitted	_____	_____
4.3 Comments and Observations: _____		

5.0 Equipment Nameplate Data		
5.1 Economizer:		
Manufacturer: _____		
Model Number: _____		
Serial No.: _____		
Option Codes: _____		
Type: _____		
Other: _____		

PRE-STARTUP INSPECTION CHECKLIST — HVAC AIR-SIDE

5.2 Outside Air Damper:

Manufacturer: _____
Model Number: _____
Serial No.: _____
Type: _____
Electrical Data: _____
Other: _____

5.3 Return Air Damper:

Manufacturer: _____
Model Number: _____
Serial No.: _____
Type: _____
Electrical Data: _____
Other: _____

5.4 Exhaust Air Damper:

Manufacturer: _____
Model Number: _____
Serial No.: _____
Type: _____
Electrical Data: _____
Other: _____

6.0 Documentation	YES	NO
6.1 Vendor cut sheets	_____	_____
6.2 Manufacturer's product design data	_____	_____
6.3 Operation and maintenance manuals	_____	_____
6.4 Manufacturer's installation specifications:	_____	_____
6.5 Comments and Observations: _____		

7.0 Related Pre-startup Checklists

7.1 Variable Air Volume System _____

7.2 Energy Management System _____

8.0 Non-Compliance and Corrections

The following items did not comply with manufacturer's or contract specifications and require correction:

8.1 _____

8.2 _____

8.3 _____

8.4 _____

8.5 _____

PRE-STARTUP INSPECTION CHECKLIST — HVAC AIR-SIDE

9.0 Certification

We the undersigned participated in this pre-startup inspection, acknowledge that the pre-startup process for the HVAC air-side EEM has been completed and that all corrections have been made.

Date: _____

9.1 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

9.2 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

9.3 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

9.4 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

Commissioning Guidelines

VERIFICATION TEST CHECKLIST — HVAC AIR-SIDE SYSTEMS

Verification Tests: The Prime Contractor shall demonstrate *operation* of the HVAC air-side systems in accordance with manufacturer's and contract specifications.

The following checklist shall serve as a general guideline for verification testing, although the project-specific character of the tests required must be considered. This checklist should be refined by the Prime Contractor to address project-specific details and the information gathered during the pre-startup inspections.

VERIFICATION TEST CHECKLIST – HVAC AIR-SIDE

1.0 Activate System Controls

1.1 Modify system controls setpoints, as required, to activate system responses for testing purposes.

1.2 Verify outside and return dampers for proper setting.

Result: _____

1.3 Verify that system safeties allow operation of dampers if safety conditions are met.

Result: _____

2.0 Initiate system operation according to contractor’s normal start-up procedures or the verification test checklist for variable air volume system.

2.1 Verify that outside air damper is completely closed during fan off, night cycle and warm-up modes of system operation.

Result: _____

2.2 Verify that system controls for the fire- and life-safety system requirements override economizer.

Result: _____

2.3 Outside air and return air dampers operate in correct response to controls.

Result: _____

2.4 Test operation of dampers in all fan modes and for all enthalpy/temperature conditions, such as system calling for cooling with outside air enthalpy less than and greater than return air enthalpy, no call for cooling with outside air less than 55°F, no call for cooling with outside air greater than 55°F, etc. Revise combinations of these parameters as required for integrated and non-integrated economizer.

Result: _____

2.5 Verify that control-sequence operation of economizer does not adversely affect the energy-efficient performance of other HVAC system equipment. (For example, perimeter heating with a water-loop heat-pump system uses the mechanical cooling of interior zones as a heat source.)

Result: _____

2.6 Reset system controls setpoints for proper operation of system after test is completed and verify that system responds correctly to existing conditions.

Result: _____

2.7 Record the following information:

Ambient Outside DB Air Temperature (°F): _____

Outside Air Relative Humidity (%): _____

Outside Air Wet Bulb Temperature: Calculated Measured

3.0 Check and report unusual vibration, noise, etc. _____

VERIFICATION TEST CHECKLIST – HVAC AIR-SIDE

4.0 Compare equipment's observed response to manufacturer's and contract specifications:

5.0 Record Results:

- 5.1 Prime Contractor shall record and submit results of the verification testing to CES Project Manager.
- 5.2 If specified equipment operation is not confirmed, Contractor shall report remedial action required, propose changes and reschedule verification tests.

6.0 Non-Compliance and Corrections

The following items did not comply with manufacturer's and contract specifications and require correction:

- 6.1 _____
- 6.2 _____
- 6.3 _____
- 6.4 _____
- 6.5 _____

Commissioning Guidelines

FUNCTIONAL PERFORMANCE TEST CHECKLIST — HVAC AIR-SIDE

Functional Performance Tests: The Prime Contractor shall demonstrate *performance* of the HVAC air-side systems in accordance with the final design-intent document and manufacturer's and contract specifications. The building operator's assistance will be required to change setpoints for the duration of the testing and restore them to their original settings after the tests have been completed.

The following checklist shall serve as a general guideline for the functional performance testing, although the project-specific character of the tests required must be considered. This checklist should be refined by the Prime Contractor to address project-specific details and information gathered during the pre-startup inspections and verification testing.

FUNCTIONAL PERFORMANCE TEST CHECKLIST — HVAC AIR-SIDE

1.0 Activate System Controls

1.1 Modify system controls setpoints, as required, to activate system responses for testing purposes.

1.2 Verify outside and return dampers for proper setting.

Result: _____

1.3 Verify that system safeties allow operation of dampers if safety conditions are met.

Result: _____

2.0 Establish stable operation of HVAC air-side system and verify performance of components, subsystem and system through all design conditions in accordance with final design-intent document.

3.0 Compare equipment's observed response to the final design-intent document:

4.0 Record Results:

4.1 Prime Contractor shall record and submit results of the functional performance testing to CES Project Manager.

4.2 If specified equipment performance is not verified, Prime Contractor shall report remedial action required, propose changes and reschedule functional performance tests.

5.0 Non-Compliance and Corrections

The following items did not comply with manufacturer's and contract specifications or final design-intent document and require correction:

5.1 _____

5.2 _____

5.3 _____

5.4 _____

5.5 _____

6.0 Documentation required in complete Final Commissioning Report:

6.1 Certified pre-startup checklists

6.2 Certified verification and functional performance test checklists

6.3 Test and Balance Report

6.4 Vendor cut sheets

6.5 Manufacturer's product design data

6.6 Operation and maintenance manuals

6.7 Manufacturer's installation specifications

6.8 Final as-built drawings and specifications

FUNCTIONAL PERFORMANCE TEST CHECKLIST — HVAC AIR-SIDE

7.0 Certification

We the undersigned witnessed the verification and functional performance tests and certify that the testing procedures for the HVAC air-side EEM identified above have been completed, that the equipment tested has met the established operational and performance requirements and that all corrections required due to non-compliance with the contract documents, manufacturer's specifications and final design-intent document have been made.

Date: _____

7.1 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

7.2 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

7.3 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____

7.4 Name: _____

Company name: _____

Role in inspection: _____

Signature: _____



**Low-Voltage Switchgear – Data Center
Pre-Functional Checklist**

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer’s recommended checkout and startup procedures or report.

Responsible Contractor Signoff

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

EQUIPMENT DATA

Switchgear Nameplate	
Parameter	Data
Equipment ID	
Manufacturer	
Model	



Type	
Order Number	
Date Manufactured	
Serial Number	
Nominal kVA	
Voltage	
Phase	
Wire	
Continuous Current	
Number of Sections	
Enclosure Type	

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
As-Built Drawings complete, available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment shop drawings available.	<input type="checkbox"/>	<input type="checkbox"/>			
Operation and Maintenance manuals available.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation and startup manual available.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment warranty information completed and provided in O&M Manual.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify receipt and acceptance of manufacturer's factory test reports.	<input type="checkbox"/>	<input type="checkbox"/>			
Doors to electrical room installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Egress routes from electrical room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
Electrical room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction.	<input type="checkbox"/>	<input type="checkbox"/>			
Warning Signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment and switchgear grounding and bonding installed for each section.	<input type="checkbox"/>	<input type="checkbox"/>			
All grounding connections made with either exothermic process or with non-reversible compression fittings.	<input type="checkbox"/>	<input type="checkbox"/>			
Cabinet/compartments doors allow for full swing; latch open and close without binding; and no physical damage.	<input type="checkbox"/>	<input type="checkbox"/>			
Bus and units correspond to one-line diagram.	<input type="checkbox"/>	<input type="checkbox"/>			
All internal and field wiring completed and switchgear fully assembled.	<input type="checkbox"/>	<input type="checkbox"/>			
Interior low voltage switchgear bus and compartments vacuumed and wiped clean with manufacturer approved electrical cleaner.	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted connections tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
All wiring installed properly with correct bend radius and no insulation damage.	<input type="checkbox"/>	<input type="checkbox"/>			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with the testing agency.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training Plan approved.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist

Description	Yes	N/A	Initials	Date	Comments
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:

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SAMPLE



Switchboards Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.



Equipment Information

Make		Model Number			
Serial Number		NEMA Enclosure		KVA	
Volts/Phase		AMPS		KW	
Service Area					
Notes:					

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation						
Description	Yes	N/A	Initials	Date	Comments	
As-Built Drawings complete	<input type="checkbox"/>	<input type="checkbox"/>				
Equipment shop drawings available	<input type="checkbox"/>	<input type="checkbox"/>				
Operation and Maintenance manuals available	<input type="checkbox"/>	<input type="checkbox"/>				
Installation and startup manual available	<input type="checkbox"/>	<input type="checkbox"/>				
Equipment warranty information completed and provided in O&M Manual	<input type="checkbox"/>	<input type="checkbox"/>				
Verify receipt and acceptance of manufacturer's factory test reports	<input type="checkbox"/>	<input type="checkbox"/>				
Doors to electrical room installed.	<input type="checkbox"/>	<input type="checkbox"/>				
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>				
Electrical room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>				
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>				
Egress routes from electrical room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>				



General Installation					
Description	Yes	N/A	Initials	Date	Comments
Electrical room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction	<input type="checkbox"/>	<input type="checkbox"/>			
Warning Signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room grounding system complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Ground bus(es) have been installed and terminated to ground system. Grounding electrode connection to building steel completed per design drawings.	<input type="checkbox"/>	<input type="checkbox"/>			
Temporary switchboard circuit directory completed.	<input type="checkbox"/>	<input type="checkbox"/>			
Component/subsystems are clearly and correctly identified with temporary/permanent labels (bus, section, breakers and devices)	<input type="checkbox"/>	<input type="checkbox"/>			
Transient Voltage Suppression System installed per approved shop drawings.	<input type="checkbox"/>	<input type="checkbox"/>			
Switchboard labeled with engraved laminated plastic or metal nameplates mounted with corrosion-resistant screws.	<input type="checkbox"/>	<input type="checkbox"/>			
Shipping bolts and braces removed	<input type="checkbox"/>	<input type="checkbox"/>			
Shipping splits bolted together at proper torque	<input type="checkbox"/>	<input type="checkbox"/>			
All enclosure panels and doors in place, fitted & undamaged	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed	<input type="checkbox"/>	<input type="checkbox"/>			
Current/Potential Transformer fuses are installed and connected.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify neutral connection to ground.	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted electrical connections have been tightened to their proper torque values. (Note: some connections will be disconnected as part of the FPT. These connections will be field torqued to proper settings at the conclusion of the field-testing.)	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
All Overcurrent protective devices have been installed at the proper ampere rating and all settings have been adjusted to match the system Coordination Study.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical testing representative has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with electrical testing representative.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training Plan approved	<input type="checkbox"/>	<input type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:

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Panelboards Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Signoff

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.



Equipment Information

Make		Model Number			
Serial Number		NEMA Enclosure		KVA	
Volts/Phase		AMPS		KW	
Service Area					
Notes:					

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation						
Description	Yes	N/A	Initials	Date	Comments	
As-Built Drawings complete	<input type="checkbox"/>	<input type="checkbox"/>				
Equipment shop drawings available	<input type="checkbox"/>	<input type="checkbox"/>				
Operation and Maintenance manuals available	<input type="checkbox"/>	<input type="checkbox"/>				
Installation and startup manual available	<input type="checkbox"/>	<input type="checkbox"/>				
Equipment warranty information completed and provided in O&M Manual	<input type="checkbox"/>	<input type="checkbox"/>				
Verify receipt and acceptance of manufacturer's factory test reports	<input type="checkbox"/>	<input type="checkbox"/>				
Verify room, enclosure, and equipment are dry and clean. Building is closed in and sealed to prevent entry of moisture due to weather conditions.	<input type="checkbox"/>	<input type="checkbox"/>				
Doors to electrical room installed.	<input type="checkbox"/>	<input type="checkbox"/>				
Locks or temporary security measures installed and operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>				
Electrical room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>				
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>				



General Installation					
Description	Yes	N/A	Initials	Date	Comments
Egress routes from electrical room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical equipment clean of construction debris, dust, and moisture.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents	<input type="checkbox"/>	<input type="checkbox"/>			
Panelboard has been installed and anchored per manufacturer's recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Warning Signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room grounding system complete.	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
Ground bus(es) have been installed and terminated to ground system.	<input type="checkbox"/>	<input type="checkbox"/>			
Panelboard ratings match one-line drawing.	<input type="checkbox"/>	<input type="checkbox"/>			
Temporary panelboard circuit directory completed.	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
Secondary service, feeder and branch circuit conductors per specifications: 208/120 V System as follows: Phase A: Black Phase B: Red Phase C: Blue Neutral: White Ground: Green 480/277 V System as follows: Phase A: Brown Phase B: Orange Phase C: Yellow Neutral: Gray Ground: Green	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
Component/subsystems are clearly and correctly identified with temporary/permanent labels (bus, section, breakers and devices)	<input type="checkbox"/>	<input type="checkbox"/>			
Panelboard Transient Voltage Suppression System (TVSS) installed per construction and approved shop drawings.	<input type="checkbox"/>	<input type="checkbox"/>			
Panelboard labeled with engraved laminated plastic or metal nameplates mounted with corrosion-resistant screws.	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
Panelboard short circuit rating meets construction and approved shop drawing requirements	<input type="checkbox"/>	<input type="checkbox"/>			
Panelboard provided with equipment ground bus per approved shop drawings	<input type="checkbox"/>	<input type="checkbox"/>			
Panelboard equipped with shunt trip if applicable per approved shop drawings	<input type="checkbox"/>	<input type="checkbox"/>			
Filler plates installed in unused spaces.	<input type="checkbox"/>	<input type="checkbox"/>			
Shipping bolts and braces removed	<input type="checkbox"/>	<input type="checkbox"/>			
All enclosure panels and doors in place, fitted, undamaged	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed	<input type="checkbox"/>	<input type="checkbox"/>			
Verify neutral bus isolated from ground.	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted electrical connections have been tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
All field connections have been tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
All Overcurrent protective devices have been installed at the proper ampere rating and all settings have been adjusted to match the system Coordination Study.	<input type="checkbox"/>	<input type="checkbox"/>			
Operating mechanism of each circuit breaker has been mechanically exercised.	<input type="checkbox"/>	<input type="checkbox"/>			
All vent openings are free from obstructions.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical testing representative has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with electrical testing representative.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training Plan approved	<input type="checkbox"/>	<input type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Additional Comments:

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SAMPLE



Engine Generators Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Signoff

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.



Equipment Information

Make		Model Number		
Serial Number		NEMA Enclosure		KVA
Volts/Phase		AMPS		KW
Service Area				
Notes:				

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation					
Description	Yes	N/A	Initials	Date	Comments
As-Built drawings complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment shop drawings available.	<input type="checkbox"/>	<input type="checkbox"/>			
Operation and Maintenance manuals available.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation and startup manual available.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment warranty information completed and provided in O&M Manual.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify receipt and acceptance of manufacturer's factory test reports.	<input type="checkbox"/>	<input type="checkbox"/>			
Doors to generator room installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Egress routes from generator room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
Working clearances meet NEC and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction.	<input type="checkbox"/>	<input type="checkbox"/>			
Warning signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room grounding system complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Ground bus (ses) have been installed and terminated to ground grid system.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator neutral bus is not solidly grounded by factory-installed bonding jumper as specified for a four-pole system.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator frame and enclosure bonded to ground.	<input type="checkbox"/>	<input type="checkbox"/>			
All wiring installed properly with correct bend radius and no insulation damage.	<input type="checkbox"/>	<input type="checkbox"/>			
All power conductors have been braced/tied per manufacturer's installation instructions.	<input type="checkbox"/>	<input type="checkbox"/>			
All piping, electrical, and control connections between skid-mounted devices and non-skid-mounted devices made with flexible connections (pipe, conduit, etc.).	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted electrical connections have been tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
Manufacturer's field service personnel have completed preliminary checkout and startup.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine lube oil system is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine coolant system is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine fuel supply system is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel supply system tank is full and ready for operation.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust has rain cap installed at exterior outlet.	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
Engine exhaust has condensate drain installed at silencer.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust has expansion fitting installed in exhaust piping to account for expansion.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust system, silencer and pipe, are fully insulated.	<input type="checkbox"/>	<input type="checkbox"/>			
Intake air and discharge air dampers functional.	<input type="checkbox"/>	<input type="checkbox"/>			
Batteries are fully charged and in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Battery charger electrically connected to power source and control wiring connections to generator control panel completed.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator remote annunciation panel is remotely installed, electrically connected and fully operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator remote E-stop is remotely installed, electrically connected and fully operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator control wiring to switchgear installed, electrically connected, and operational with control wiring installed in separate conduit per manufacturer's recommendations.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator control wiring to building management control panel is installed, electrically connected and fully operational.	<input type="checkbox"/>	<input type="checkbox"/>			
All contacts, devices, etc. for interface with SCADA-system are installed, functional and wired to terminal strips for connection of field wiring.	<input type="checkbox"/>	<input type="checkbox"/>			
Remote annunciator panel is installed, electrically connected and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
All circuit breaker protecting devices have been set and recorded per the protective device coordination study.	<input type="checkbox"/>	<input type="checkbox"/>			
Metering current transformer ratio and accuracy class matches drawings/specs.	<input type="checkbox"/>	<input type="checkbox"/>			
Metering potential transformer ratio and accuracy class matches drawings/specs.	<input type="checkbox"/>	<input type="checkbox"/>			
Metering wiring phase and polarity matches meter instruction manual wiring diagrams.	<input type="checkbox"/>	<input type="checkbox"/>			
Utility power is available and connected for system operation.	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
All sensors have been installed and calibrated according to manufacturing and design specification.	<input type="checkbox"/>	<input type="checkbox"/>			
All status and alarm indicators are installed and functioning properly.	<input type="checkbox"/>	<input type="checkbox"/>			
All field and interconnecting wiring is completed and labeled at each end with visible and readable tags. (Printed markings on the conductors are NOT acceptable.)	<input type="checkbox"/>	<input type="checkbox"/>			
Field landed control wiring terminations are made using ring connectors NOT fork connectors.	<input type="checkbox"/>	<input type="checkbox"/>			
All manufacturing factory and field start-up tests attached to this SRC.	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with the testing agency.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
Installation is complete and ready for verification testing.	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
Training plan approved.	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
All specified tools, equipment & spare parts are on site.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Additional Comments:

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[Back to Cx Plan Appendix B](#)

SAMPLE



**Automatic Transfer Switches
Pre-Functional Checklist**

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer’s recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.



EQUIPMENT DATA

Static Switch Nameplate	
Parameter	Data
Equipment ID	
Manufacturer	
Model	
Catalog Number	
Date Manufactured	

Static Switch Source #1 Isolation Circuit Breaker (CB1) Nameplate	
Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

Static Switch Source #2 Isolation Circuit Breaker (CB2) Nameplate	
Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	



Static Switch Source #2 Isolation Circuit Breaker (CB2) Nameplate	
Parameter	Data
SC Rating	
Current Rating	

Static Switch Output Isolation Circuit Breaker (CB3) Nameplate	
Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

Static Switch Bypass to Source #1 Circuit Breaker (CB4) Nameplate	
Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	



Static Switch Bypass to Source #2 Circuit Breaker (CB5) Nameplate	
Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
As-Built Drawings complete, available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment shop drawings available.	<input type="checkbox"/>	<input type="checkbox"/>			
Operation and Maintenance manuals available.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation and startup manual available.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment warranty information completed and provided in O&M Manual.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify receipt and acceptance of manufacturer's factory test reports.	<input type="checkbox"/>	<input type="checkbox"/>			
Doors to electrical room installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Egress routes from electrical room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
Electrical room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad or properly attached to the structure or wall.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction.	<input type="checkbox"/>	<input type="checkbox"/>			
Warning Signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room grounding system complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Grounding electrode conductor has been attached to the building ground ring.	<input type="checkbox"/>	<input type="checkbox"/>			
Shipping bolts and braces removed.	<input type="checkbox"/>	<input type="checkbox"/>			
ATS doors allow for full swing; latch open and close without binding; and no physical damage.	<input type="checkbox"/>	<input type="checkbox"/>			
All field and interconnecting wiring is completed and labeled at each end with visible and readable tags. (Printed markings on the conductors are NOT acceptable.).	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted connections tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
All wiring installed properly with correct bend radius and no insulation damage.	<input type="checkbox"/>	<input type="checkbox"/>			
All contacts, devices, etc. for interface with SCADA system are installed, functional and wired to terminal strips for connection of field wiring.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify Normal and Emergency line side phase rotation.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify that NORMAL and EMERGENCY sources are available.	<input type="checkbox"/>	<input type="checkbox"/>			
ATS settings have been adjusted per the Engineer/specifications.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
Equipment layout and schematic wiring diagrams available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
System sequence of operation available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Remote STS summary alarm wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>			
Logic and control connections are routed away from power runs for noise prevention.	<input type="checkbox"/>	<input type="checkbox"/>			
Modbus TCP/IP network interface connection made and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Machine room space air conditioning working and available for use.	<input type="checkbox"/>	<input type="checkbox"/>			
Factory-supplied critical spare parts inventory delivered and available on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Factory test and startup documentation provided with copies attached to this SRC.	<input type="checkbox"/>	<input type="checkbox"/>			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with the testing agency.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training Plan approved.	<input type="checkbox"/>	<input type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

WET PIPE SPRINKLER SYSTEM AND FIRE DETECTION SYSTEM INSPECTION CHECKLIST

SECTION A - CUSTOMER DATA

1. PLANT	2. LOCATION	3. JOB NUMBER
4. EQUIPMENT	5. SYSTEM DESIGNATION	6. DATE (YYYYMMDD)
7. TEST EQUIPMENT		8. TESTED BY

SECTION B - EQUIPMENT DATA

9. FIRE DETECTION CONTROL PANEL AND SYSTEM MANUFACTURER	10. MODEL NO	11. SERIAL NO	12. LOCATION
13. FIRE RISER		14. LOCATION	

SECTION C - VISUAL AND MECHANICAL INSPECTION

15. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
EXTERIOR OF EQUIPMENT			EQUIPMENT IDENTIFICATION		
COMPLETENESS OF ASSEMBLY			FREEZE PROTECT, VENTS AND DRAINS		
CONTROL SYSTEM DISPLAY			LABELING AND TAGGING		
ELECTRICAL/MECHANICAL INTERLOCKS			WALLS AND OBJECTS NEAR SPRINKLER HEADS		
SAFETY INTERLOCKS			MATERIALS BEING STORED		
INSTRUMENTS AND ALARMS			OCCUPANCY		
PROPER GROUNDING			PAD LOCKS		
PROPER INSULATION			ACCESS NEAR RISER, PANEL AND FDC		
LOCATION OF SPRINKLER HEADS			ANCHORAGE AND PIPE HANGERS		
CONDITION OF SPRINKLER HEADS			COMPARISON TO DRAWINGS		

SECTION D - CALIBRATION AND SET POINT

16.	DESCRIPTION	NOTES
GAUGES		
BATTERY AND CHARGER		

SECTION E - SYSTEM TESTS

17.	OPERATING MODES	TEMPERATURES	PRESSURES	FLOWS	LEVELS	NOTES
HYDROSTATIC TEST						
ALARM/STROBES						
FLOW AND TAMPER SWITCHES						
PULL STATIONS						
FLOW TEST						
SYSTEM TEST						

18. NOTES

*CONDITION: A = ACCEPTABLE; R = NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C = CORRECTED; NA =NOT APPLICABLE

Premier Mechanical Group, Inc.

1507 East Valley Pkwy, Suite #3-481, Escondido, CA

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www.PremierMechanicalGroup.com

FUEL SYSTEM INSPECTION CHECKLIST

SECTION A - CUSTOMER DATA

1. PLANT	2. LOCATION	3. JOB NUMBER
4. EQUIPMENT	5. SYSTEM DESIGNATION	6. DATE (YYYYMMDD)
7. TEST EQUIPMENT		8. TESTED BY

SECTION B - EQUIPMENT DATA

9. PUMP MANUFACTURER	10. MODEL NO	11. SERIAL NO	12. FLOW RATING GPM
13. TYPE	14. HP @ RPM	15. PRESSURE RATING PSIG	
16. HEATER MANUFACTURER	17. MODEL NO	18. SERIAL NO	19. FLOW RATE GPM
20. COOLER MANUFACTURER	21. MODEL NO	22. SERIAL NO	23. FLOW RATE GPM

SECTION C - VISUAL AND MECHANICAL INSPECTION

24. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
EXTERIOR OF EQUIPMENT			EQUIPMENT IDENTIFICATION		
COMPLETENESS OF ASSEMBLY			BRACING		
EQUIPMENT ROTATION			LABELING AND TAGGING		
ELECTRICAL/MECHANICAL INTERLOCKS			SAFETY INTERLOCKS		
INSTRUMENTS			WORKING SPACE		
PROPER GROUNDING			ANCHORAGE		
PROPER INSULATION			LEAKS		
TIGHTNESS OF BOLTED CONNECTIONS			COMPARISON TO DRAWINGS		
PROPER LUBRICATION			CONTROL SYSTEM		

SECTION D - CALIBRATION AND SET POINT

25.	DESCRIPTION	NOTES
SENSORS		
CONTROLLERS		
ACTUATORS		

SECTION E - DIESEL FUEL SYSTEM TESTS

26.	OPERATING MODES	TEMPERATURES	PRESSURES	FLOWS	LEVELS	NOTES
PUMP						
HEATER						
COOLER						
ENGINE						
HYDROSTATIC TEST						
SYSTEM TEST						

27. NOTES

*CONDITION: A = ACCEPTABLE; R= NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C = CORRECTED; NA =NOT APPLICABLE

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COMMISSIONING MEETING MINUTES

Meeting Information

Project:		Project Number:	
Meeting Date:		Meeting Time:	
Meeting Location:		Notes By:	
Meeting Purpose:			

Attendees

The following individuals attended the meeting. Meeting minutes are distributed to those in attendance and to those scheduled to attend:

Present	Copy	Name	Organization	Email
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
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<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			



Old Business:

Topic 1.	Opened By:	Date Opened:	Closed By:	Date Closed:
Discussion: [(date) – comment]				
Resolution:				
Action items: (Check box when complete)	Date Assigned:	Assigned to:	Due Date:	
<input type="checkbox"/>				

New Business:

Topic 2.	Opened By:	Date Opened:	Closed By:	Date Closed:
Discussion: [(date) – comment]				
Resolution:				
Action items: (Check box when complete)	Date Assigned:	Assigned to:	Due Date:	
<input type="checkbox"/>				



Commissioning Field Report

Project:		Project Number:	
Report Number:		Report Date:	
Prepared by:			
Purpose of Visit:			
Present at Site:			

General Observations

--



Specific Issues / Observations		
Issue ID:		[Insert photo]
Short Title:		
Date Opened:		
Tech Category:		
System:		
Assigned To:		
Reference:		
Opened By:		
Issue Description, Discussion, and Impact:		



Domestic Water Heat Exchangers Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

Equipment Information

Make		Model Number			
Serial Number		Function		Service Area	
GPM Fluid 1			GPM Fluid 2		
MBH Fluid 1			MBH Fluid 2		
Temp In/Out Fluid 1			Temp In/Out Fluid 2		
Notes:					



System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation					
Description	Yes	N/A	Initials	Date	Comments
General appearance good, no apparent damage	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Verified that valves for equipment isolation have been provided per the drawings and specs	<input type="checkbox"/>	<input type="checkbox"/>			
Record drawings updated to reflect the actual installation	<input type="checkbox"/>	<input type="checkbox"/>			
Piping, fittings, valves and equipment properly supported and seismically anchored per the details	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment label permanently affixed	<input type="checkbox"/>	<input type="checkbox"/>			
Pipes are supported independently of the heat exchanger	<input type="checkbox"/>	<input type="checkbox"/>			
Provisions in place for expansion compensation	<input type="checkbox"/>	<input type="checkbox"/>			
Piping, fittings and valves insulated per specification	<input type="checkbox"/>	<input type="checkbox"/>			
In-line equipment insulated per specification	<input type="checkbox"/>	<input type="checkbox"/>			
In-line equipment labeled per specification with flows indicated in the correct direction	<input type="checkbox"/>	<input type="checkbox"/>			
Heat Exchanger pressure tested per manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Heat Exchanger properly flushed and cleaned per manufacturers recommendations (report attached)	<input type="checkbox"/>	<input type="checkbox"/>			
Heat exchanger detail checked against the drawings and all devices gages and appurtenances are in place	<input type="checkbox"/>	<input type="checkbox"/>			
Strainers and low-point drains opened and verified to be clean	<input type="checkbox"/>	<input type="checkbox"/>			
Construction strainers removed	<input type="checkbox"/>	<input type="checkbox"/>			
Test plugs (P/T) installed near all control sensors and as per spec	<input type="checkbox"/>	<input type="checkbox"/>			
Chemical treatment system or plan installed	<input type="checkbox"/>	<input type="checkbox"/>			
No leaking apparent	<input type="checkbox"/>	<input type="checkbox"/>			
Air vents and bleeds at high points of systems functional	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves and balancing valves installed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Valves					
Description	Yes	N/A	Initials	Date	Comments
Isolation valves provided at all branches and main takeoffs to facilitate isolation (as required by contract)	<input type="checkbox"/>	<input type="checkbox"/>			
Valve installation per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			



Valves					
Description	Yes	N/A	Initials	Date	Comments
Valve manufacturer labels permanently affixed	<input type="checkbox"/>	<input type="checkbox"/>			
Manual isolation valves checked for proper seal and operation	<input type="checkbox"/>	<input type="checkbox"/>			
Valves installed in proper direction	<input type="checkbox"/>	<input type="checkbox"/>			
Valves stroke fully and easily and spanning is calibrated (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			
Valves that require a positive shut-off are verified to not be leaking when closed at normal operating pressure	<input type="checkbox"/>	<input type="checkbox"/>			
No leaking apparent	<input type="checkbox"/>	<input type="checkbox"/>			
Valves tagged and valve schedule submitted and displayed as required	<input type="checkbox"/>	<input type="checkbox"/>			
Adequate maintenance clearance in provided and valve is accessible	<input type="checkbox"/>	<input type="checkbox"/>			
Unions installed to allow for easy removal of control valves	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

TAB					
Description	Yes	N/A	Initials	Date	Comments
Installation of system and balancing devices is completed following NEBB or AABC procedures and contract documents	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:



BACnet Verification System Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

Equipment Information

System	Device Type	Location	Manufacturer	Model / number	Serial number
CDDCW	Computer				
	Monitor				
	Printer				
SOFTWARE	Network Protocol				
	CDDCW Operating System				
	CDDCW Applications				



System	Device Type	Location	Manufacturer	Model / number	Serial number
	Controller Applications				
	Graphics				
NETWORK	Gateway				
	Router				
	Bridge				
	Modem				
PNEUMATICS	Air compressor				
	Dryer				
	PRV				
CONTROLLER	AHU				
	Chiller				
	Heating				
UNITARY CONTROL	VAV				
	FCU				
GLOBAL DEVICES	Outside air temp sensor				
	OA humidity sensor				
	Power Surge suppressors				
	Phone line surge suppressors				



System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Configuration and Installation					
Description	Yes	N/A	Initials	Date	Comments
Permanent labels affixed.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent mounting of all components is complete with wires run neatly.	<input type="checkbox"/>	<input type="checkbox"/>			
All wires are terminated and labeled.	<input type="checkbox"/>	<input type="checkbox"/>			
CPU cooling fan and heat sinks are operating and clean.	<input type="checkbox"/>	<input type="checkbox"/>			
Printers are tested and all ink supplies are filled.	<input type="checkbox"/>	<input type="checkbox"/>			
The paper tray is full and the printer is ready to print test results and all requested trend reports.	<input type="checkbox"/>	<input type="checkbox"/>			
All software is installed.	<input type="checkbox"/>	<input type="checkbox"/>			
All software is licensed to the government with an original loadable copy of the software and software license on sight or in a safe storage cabinet selected by the government.	<input type="checkbox"/>	<input type="checkbox"/>			
All graphic displays are created and loaded.	<input type="checkbox"/>	<input type="checkbox"/>			
All points specified to be linked to a graphic display have been associated to that display and appear when the graphic is selected.	<input type="checkbox"/>	<input type="checkbox"/>			
All points are labeled with a unique point descriptor.	<input type="checkbox"/>	<input type="checkbox"/>			
Specific Application parameters defined for all points.	<input type="checkbox"/>	<input type="checkbox"/>			
Power and lighting in place for component servicing and testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Network Infrastructure operational.	<input type="checkbox"/>	<input type="checkbox"/>			
BACnet/IP (annex J) for Internet connectivity	<input type="checkbox"/>	<input type="checkbox"/>			
BACnet (Annex L) Standard devices for OWS, Building Controller, Advanced Application Controller, Application Specific Controller are provided (Annex L is Attached for reference).	<input type="checkbox"/>	<input type="checkbox"/>			
Server is rack-mounted in Ford House Office Building and can read/write to a floppy drive.	<input type="checkbox"/>	<input type="checkbox"/>			
Operator Work Station (OWS) including: Computer configured with sufficient speed and capacity to allow HVAC operations as described in the specifications and related printers, keyboard, mouse and display monitor to provide the required performance.	<input type="checkbox"/>	<input type="checkbox"/>			
Building Controllers programmed and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Advanced Application Controllers programmed and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Application Specific Controllers programmed and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Application and network software for all devices configured and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Operating software licenses and related source installation disks have been provided.	<input type="checkbox"/>	<input type="checkbox"/>			



General Configuration and Installation					
Description	Yes	N/A	Initials	Date	Comments
Final data files have been installed, debugged and backed up.	<input type="checkbox"/>	<input type="checkbox"/>			
Manufacturer's BACnet Protocol Implementation Conformance Statement Submitted (refer to ASHRAE standard 135, section 22).	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Test and Balance					
Description	Yes	N/A	Initials	Date	Comments
All system pressure and airflow Setpoints have been determined during the test and balance procedure per specifications.	<input type="checkbox"/>	<input type="checkbox"/>			
All calibration adjustments and set point values determined during the Test and Balance activity have been permanently loaded and saved to nonvolatile memory within this system (at each controller and backed up in a central OWS accessible and down loadable file)	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Direct Digital Controls (DDC) System					
Description	Yes	N/A	Initials	Date	Comments
All DDC panels controlling field equipment are connected to the system	<input type="checkbox"/>	<input type="checkbox"/>			
Each DDC controller has a local port for full access and programming.	<input type="checkbox"/>	<input type="checkbox"/>			
Portable computer with OWS software for direct connection and local configuration, interrogation, and control of field controllers has been provided.	<input type="checkbox"/>	<input type="checkbox"/>			
All analog and digital points such as temperature/pressure reading points, status & alarming points' have been labeled and graphically depicted using a unique nomenclature and representative graphics	<input type="checkbox"/>	<input type="checkbox"/>			
All temperature sensing points are calibrated and read correctly from sensor to graphic display of HVAC system at OWS.	<input type="checkbox"/>	<input type="checkbox"/>			
All temperature/pressure Setpoints have been set to the correct values as determined by the engineer or by the balancing contractor during balancing.	<input type="checkbox"/>	<input type="checkbox"/>			



Direct Digital Controls (DDC) System					
Description	Yes	N/A	Initials	Date	Comments
Current operating software and data base parameters are backed up at all levels of the DDC system. This is critical, as power will be removed during verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
All system failure alarms are programmed with a suitable alarm message sufficient to guide the operator to the appropriate action in the event the alarm is received	<input type="checkbox"/>	<input type="checkbox"/>			
Control device and panel labeling is complete	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Electrical					
Description	Yes	N/A	Initials	Date	Comments
Power is connected to a clean reliable power source including surge protection that is labeled.	<input type="checkbox"/>	<input type="checkbox"/>			
Power disconnects (Circuit breakers) in place and labeled.	<input type="checkbox"/>	<input type="checkbox"/>			
DDC panel controlling OWS and related OWS components are connected to emergency power . Panel number: _____	<input type="checkbox"/>	<input type="checkbox"/>			
All electrical connections (both power and data) are tight	<input type="checkbox"/>	<input type="checkbox"/>			
Proper grounding and polarity (power and data) installed for component and unit	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Final					
Description	Yes	N/A	Initials	Date	Comments
Inspect the interior of the controls enclosures for accumulation of dirt or indications of water. In the event that any of the surfaces are found to be unacceptable or contaminated, the surface(s) and related active products should be cleaned prior to Functional Performance Testing (FPT).	<input type="checkbox"/>	<input type="checkbox"/>			
The entire system is installed and the software revision dates are recorded.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



ANNEX L - DESCRIPTIONS AND PROFILES OF STANDARDIZED BACnet DEVICES (NORMATIVE)

(This annex is part of this Standard and is required of its use.)

This annex provides descriptions of six "standardized" types of BACnet devices. Any device that implements all the required BACnet capabilities for a particular device type and interoperability area may claim to be a device of that particular type. Devices may also provide additional capabilities and shall indicate these capabilities in their PICS. The devices defined herein are: BACnet Operator Workstation, BACnet Building Controller, BACnet Advanced Application Controller, BACnet Application Specific Controller, BACnet Smart Actuator, and BACnet Smart Sensor.

L.1 BACnet Operator Workstation (B-OWS)

The B-OWS is the operator's window into a BACnet system. While it is primarily used for the operation of a system, it may be used for configuration activities that are beyond the scope of this standard. It is not intended to perform direct digital control. It enables the specification of the following:

Data Sharing

- Ability to provide the values of any of its BACnet objects
- Archival storage of data
- Presentation of data (i.e., reports and graphics)
- Ability to monitor the value of all BACnet object types, including all required and optional properties
- Ability to modify setpoints and parameters

Alarm and Event Management

- Operator notification and presentation of event information
- Alarm acknowledgment by operators
- Alarm summarization
- Adjustment of alarm limits
- Adjustment of alarm routing

Scheduling

- Modification of schedules
- Display of the start and stop times (schedule) of scheduled devices

Trending

- Modification of the parameters of a trend log
- Display and archive of trend data

Device and Network Management

- Ability to respond to queries about its status
- Ability to respond to requests for information about any of its objects
- Display of information about the status of any device on the BACnet internetwork
- Display of information about any object in the BACnet internetwork
- Ability to silence a device on the network that is transmitting erroneous data
- Ability to synchronize the time in devices across the BACnet internetwork
- Ability to cause a remote device to reinitialize itself
- Ability to backup and restore the configuration of other devices
- Ability to command half-routers to establish and terminate connections
- Ability to query and change the configuration of half-routers and routers



L.2 BACnet Building Controller (B-BC)

A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks. It enables the specification of the following:

Data Sharing

- Ability to provide the values of any of its BACnet objects
- Ability to retrieve the values of BACnet objects from other devices
- Ability to allow modification of some or all of its BACnet objects by another device
- Ability to modify some BACnet objects in other devices

Alarm and Event Management

- Generation of alarm / event notifications and the ability to direct them to recipients
- Maintain a list of unacknowledged alarms / events
- Notifying other recipients that the acknowledgment has been received
- Adjustment of alarm / event parameters

Scheduling

- Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time

Trending

- Collection and delivery of (time, value) pairs

Device and Network Management

- Ability to respond to queries about its status
- Ability to respond to requests for information about any of its objects
- Ability to respond to communication control messages
- Ability to synchronize its internal clock upon request
- Ability to perform re-initialization upon request
- Ability to upload its configuration and allow it to be subsequently restored
- Ability to command half-routers to establish and terminate connections

L.3 BACnet Advanced Application Controller (B-AAC)

A B-AAC is a control device with limited resources relative to a B-BC. It may be intended for specific applications and supports some degree of programmability.

Data Sharing

- Ability to provide values for any of its BACnet objects upon request
- Ability to allow modification of some or all of its BACnet objects by another BACnet device

Alarm and Event Management

- Generation of limited alarm and event notifications and the ability to direct them to recipients
- Tracking acknowledgments of alarms from human operators
- Adjustment of alarm parameters

Scheduling

- Ability to schedule actions in the local device based on date and time

Trending

- No requirement



Device and Network Management

- Ability to respond to queries about its status
- Ability to respond to requests for information about any of its objects
- Ability to respond to communication control messages
- Ability to synchronize its internal clock upon request
- Ability to perform re-initialization upon request

L.4 BACnet Application Specific Controller (B-ASC)

A B-ASC is a controller with limited resources relative to a B-AAC. It is intended for use in a specific application and supports limited programmability. It enables specification of the following:

Data Sharing

- Ability to provide the values of any of its BACnet objects
- Ability to allow modification of some or all of its BACnet objects by another device

Alarm and Event Management

- No requirement

Scheduling

- No requirement

Trending

- No requirement

Device and Network Management

- Ability to respond to queries about its status
- Ability to respond to requests for information about any of its objects
- Ability to respond to communication control messages

L.5 BACnet Smart Actuator (B-SA)

A B-SA is a simple control device with limited resources; it is intended for specific applications.

Data Sharing

- Ability to provide values for any of its BACnet objects upon request
- Ability to allow modification of some or all of its BACnet objects by another device

Alarm and Event Management

- No requirement

Scheduling

- No requirement

Trending

- No requirement

Device and Network Management

- No requirement



L.6 BACnet Smart Sensor (B-SS)

A B-SS is a simple sensing device with very limited resources.

Data Sharing

- Ability to provide values for any of its BACnet objects upon request

Alarm and Event Management

- No requirement

Scheduling

- No requirement

Trending

- No requirement

Device and Network Management

- No requirement

L.7 Profiles of the Standard BACnet Devices

The following tables indicate which BIBBs must be supported by each device type for each interoperability area.

	B-OWS	B-BC	B-AAC	B-ASC	B-SA	B-SS
Data Sharing	DS-RP-A,B	DS-RP-A,B	DS-RP-B	DS-RP-B	DS-RP-B	DS-RP-B
	DS-RPM-A	DS-RPM-A,B	DS-RPM-B	DS-WP-B	DS-WP-B	
	DS-WP-A	DS-WP-A,B	DS-WP-B			
	DS-WPM-A	DS-WPM-B	DS-WPM-B			
		DS-COVU-A,B				

	B-OWS	B-BC	B-AAC	B-ASC	B-SA	B-SS
Alarm & Event	AE-N-A	AE-N-I-B	AE-N-I-B			
Mgmt	AE-ACK-A	AE-ACK-B	AE-ACK-B			
	AE-INFO-A	AE-INFO-B	AE-INFO-B			
	AE-ESUM-A	AE-ESUM-B				

	B-OWS	B-BC	B-AAC	B-ASC	B-SA	B-SS
Scheduling	SCHED-A	SCHED-E-B	SCHED-I-B			

	B-OWS	B-BC	B-AAC	B-ASC	B-SA	B-SS
Trending	T-VMT-A	T-VMT-I-B				
	T-ATR-A	T-ATR-B				



	B-OWS	B-BC	B-AAC	B-ASC	B-SA	B-SS
Device &	DM-DDB-A,B	DM-DDB-A,B	DM-DDB-B	DM-DDB-B		
Network Mgmt	DM-DOB-A,B	DM-DOB-A,B	DM-DOB-B	DM-DOB-B		
	DM-DCC-A	DM-DCC-B	DM-DCC-B	DM-DCC-B		
	DM-TS-A	DM-TS-B or DM-UTC-B	DM-TS-B or DM-UTC-B			
	DM-UTC-A					
	DM-RD-A	DM-RD-B	DM-RD-B			
	DM-BR-A	DM-BR-B				
	NM-CE-A	NM-CE-A				

Additional Comments:

SAMPLE



Fire-Tube Boilers (Steam L.P.) Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

Equipment Information

Make		Model Number	
Serial Number		Capacity BTUH	PPH
Volts/Phase		Function	Service Area
Notes:			



System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation					
Description	Yes	N/A	Initials	Date	Comments
General appearance good, no apparent damage	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pipe, fittings and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pumps and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Pipe, gas, fittings and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves and balancing valves installed	<input type="checkbox"/>	<input type="checkbox"/>			
Pipes not supported on boiler	<input type="checkbox"/>	<input type="checkbox"/>			
Steam system flushing complete, strainers cleaned and steam traps operational	<input type="checkbox"/>	<input type="checkbox"/>			
Condensate receiver and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Condensate receiver and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Condensate pipe, fittings and pumps complete	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler temperature control installed	<input type="checkbox"/>	<input type="checkbox"/>			
Pressure gages installed	<input type="checkbox"/>	<input type="checkbox"/>			
Test plugs (P/T) installed near all control sensors and as per spec	<input type="checkbox"/>	<input type="checkbox"/>			
Flow switch installed as specified	<input type="checkbox"/>	<input type="checkbox"/>			
Proper boiler fluid level	<input type="checkbox"/>	<input type="checkbox"/>			
Expansion tanks and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Air removal fitting and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment labels affixed	<input type="checkbox"/>	<input type="checkbox"/>			
Tube pull and access door space adequate and to code	<input type="checkbox"/>	<input type="checkbox"/>			
Combustion air supply installed	<input type="checkbox"/>	<input type="checkbox"/>			
No leaking apparent	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler water condensate pumps and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler safeties, burner controls and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Draft Fan (If Applicable)					
Description	Yes	N/A	Initials	Date	Comments
Fan is installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Casing in good condition; no dents	<input type="checkbox"/>	<input type="checkbox"/>			
Mountings checked and shipping bolts removed	<input type="checkbox"/>	<input type="checkbox"/>			
Vibration isolators installed	<input type="checkbox"/>	<input type="checkbox"/>			
Plenums free of debris	<input type="checkbox"/>	<input type="checkbox"/>			
Fan rotates freely and in correct direction	<input type="checkbox"/>	<input type="checkbox"/>			
Bearings lubricated	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment guards and safety devices installed	<input type="checkbox"/>	<input type="checkbox"/>			
Starter installed and size coordinated with motor	<input type="checkbox"/>	<input type="checkbox"/>			
Motor correctly aligned	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Gas Train					
Description	Yes	N/A	Initials	Date	Comments
Gas train Installed in accordance with NFPA, FM and IRI	<input type="checkbox"/>	<input type="checkbox"/>			
Gas train checked for leaks	<input type="checkbox"/>	<input type="checkbox"/>			
Gas piping installed and tested	<input type="checkbox"/>	<input type="checkbox"/>			
Gas train vents are terminated per code	<input type="checkbox"/>	<input type="checkbox"/>			
Gas train safety devices are operational	<input type="checkbox"/>	<input type="checkbox"/>			
Drip leg provided in gas main	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock valve orientation per manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock valve accessible and travels freely	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock checked for leaks in closed position with the other gas train valves open	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator properly located in non-turbulent section of pipe	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator is properly oriented	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator is wired correctly	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator is accessible for test and service	<input type="checkbox"/>	<input type="checkbox"/>			
Gas pressure adjusted and verified within acceptable range	<input type="checkbox"/>	<input type="checkbox"/>			
Confirmed gas PRV operation	<input type="checkbox"/>	<input type="checkbox"/>			
Gas pressure sensor limits are appropriate for application	<input type="checkbox"/>	<input type="checkbox"/>			



Gas Train					
Description	Yes	N/A	Initials	Date	Comments
High gas pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
High gas pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Low gas pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Low gas pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve installed vertical with direction of flow confirmed	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve accessible and travels freely	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve checked for leaks in closed position with the other gas train valves open	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve had no visible damage	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve nameplate readings checked against application and is applied correctly	<input type="checkbox"/>	<input type="checkbox"/>			
Drum relief valve setting adequate for application	<input type="checkbox"/>	<input type="checkbox"/>			
Drum relief valve discharge properly piped	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve pressure rating applicable for duty	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve installed per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Fuel Oil Piping (If Applicable)					
Description	Yes	N/A	Initials	Date	Comments
Fuel Oil Piping Installed in accordance with NFPA, FM and IRI	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Piping checked for leaks	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Piping installed and tested	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Piping safety devices are operational	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pumps and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pumps started up and operational per manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil anamizer and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock checked for leaks in closed position with the other gas train valves open (manufacturers representative has started up burner with fuel oil)	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pressure adjusted and verified within acceptable range	<input type="checkbox"/>	<input type="checkbox"/>			
Confirmed Fuel Oil PRV operation	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil pressure sensor limits are appropriate for application	<input type="checkbox"/>	<input type="checkbox"/>			



Fuel Oil Piping (If Applicable)					
Description	Yes	N/A	Initials	Date	Comments
High Fuel Oil pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
High Fuel Oil pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Low Fuel Oil pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Low Fuel Oil pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve installed per manufacturer's Instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve accessible and travels freely	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve checked for leaks in closed position	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve had no visible damage	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve nameplate readings checked against application and is applied correctly	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve pressure rating applicable for duty	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve installed per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Piping					
Description	Yes	N/A	Initials	Date	Comments
Steam piping complete, elbows minimized, pitched back to condensate receiver, makeup water piping and safety reliefs installed	<input type="checkbox"/>	<input type="checkbox"/>			
Piping supported independently of the boiler	<input type="checkbox"/>	<input type="checkbox"/>			
Piping type and flow direction labeled on piping	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves, balancing valves and piping specialties installed	<input type="checkbox"/>	<input type="checkbox"/>			
Steam system flushing complete and strainers cleaned	<input type="checkbox"/>	<input type="checkbox"/>			
Chemical treatment system or plan installed	<input type="checkbox"/>	<input type="checkbox"/>			
Unions installed to allow for easy removal of control valves	<input type="checkbox"/>	<input type="checkbox"/>			
Steam supply functional (preference is to have the steam system VTP complete and satisfactory).	<input type="checkbox"/>	<input type="checkbox"/>			
Pressure gauges have been installed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Electrical and Controls					
Description	Yes	N/A	Initials	Date	Comments
Power disconnect is located within site of the unit it controls and labeled	<input type="checkbox"/>	<input type="checkbox"/>			
All electric connections tight and installed properly	<input type="checkbox"/>	<input type="checkbox"/>			
Grounding installed for components and unit	<input type="checkbox"/>	<input type="checkbox"/>			
Safeties installed and operational	<input type="checkbox"/>	<input type="checkbox"/>			
Starter overload breakers installed and correct size	<input type="checkbox"/>	<input type="checkbox"/>			
All control devices, pneumatic tubing and wiring complete	<input type="checkbox"/>	<input type="checkbox"/>			
Control system interlocks connected and functional	<input type="checkbox"/>	<input type="checkbox"/>			
Size of over current heater in motor starter correct (where applicable)	<input type="checkbox"/>	<input type="checkbox"/>			
HOA Switch installed per manufacturer's instructions (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>			
Operation of HOA switch checked in all positions	<input type="checkbox"/>	<input type="checkbox"/>			
Proper safeties in control when HOA switch in Hand position	<input type="checkbox"/>	<input type="checkbox"/>			
Sensors calibrated (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			
Multiple boiler interlocks completed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Flue					
Description	Yes	N/A	Initials	Date	Comments
Installed per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Sloped toward boiler	<input type="checkbox"/>	<input type="checkbox"/>			
Clearance to combustibles per code	<input type="checkbox"/>	<input type="checkbox"/>			
Protection in place to prevent burning hazard	<input type="checkbox"/>	<input type="checkbox"/>			
Discharge is protected from rain and blockage	<input type="checkbox"/>	<input type="checkbox"/>			
Provisions in place for expansion compensation	<input type="checkbox"/>	<input type="checkbox"/>			
Discharge is located to preclude re-entrainment back into the building	<input type="checkbox"/>	<input type="checkbox"/>			
Draft checked and meets minimum requirements of boiler manufacturer	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Low Pressure Cutoff					
Description	Yes	N/A	Initials	Date	Comments
Installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Wire terminations checked and correct	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

TAB					
Description	Yes	N/A	Initials	Date	Comments
Installation of system and balancing devices is completed following NEBB or AABC procedures and contract documents	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Operational Checks					
Description	Yes	N/A	Initials	Date	Comments
Measure line to line voltage phase imbalance for all three-phase motors: (%Imbalance = 100 x (avg. - lowest) / avg.) Record imbalance of compressor. Imbalance less than 2%?	<input type="checkbox"/>	<input type="checkbox"/>			
Record full load running amps for all three-phase motors. _____ rated FL amps x _____ srvc factor = _____ (Max amps). Running less than max?	<input type="checkbox"/>	<input type="checkbox"/>			
No unusual noise and vibration when running	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler safeties energized and tested	<input type="checkbox"/>	<input type="checkbox"/>			
Specified sequences of operation and operating schedules have been implemented with all variations documented	<input type="checkbox"/>	<input type="checkbox"/>			
Specified point-to-point checks have been completed and documentation record submitted for this system	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report completed with this checklist attached. (Includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report includes written certification from boiler manufacturer that all specified features, controls and safeties have been installed and are functioning properly and that the installation and application comply with the manufacturer's recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report includes optimal and actual percent CO ₂ , CO, O ₂ , stack temperature; combustion efficiency	<input type="checkbox"/>	<input type="checkbox"/>			
Piping gages, BAS and boiler panel temperature and pressure readouts match (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			



Operational Checks						
Description	Yes	N/A	Initials	Date	Comments	
Notes:						

Additional Comments:

SAMPLE



Centrifugal Water Chiller (Water Cooled) Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

Equipment Information

Make		Model Number	
Serial Number		Capacity BTUH	GPM Condenser ; Evaporator;
Volts/Phase		Function	Service Area
Notes:			



System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation					
Description	Yes	N/A	Initials	Date	Comments
General appearance good, no apparent damage	<input type="checkbox"/>	<input type="checkbox"/>			
Proper vibration isolators installed and adjusted	<input type="checkbox"/>	<input type="checkbox"/>			
Seismic restraints in place	<input type="checkbox"/>	<input type="checkbox"/>			
Pipe fittings and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves and balancing valves installed	<input type="checkbox"/>	<input type="checkbox"/>			
Pipes not supported on chiller	<input type="checkbox"/>	<input type="checkbox"/>			
Hydronic system flushing complete and strainers cleaned	<input type="checkbox"/>	<input type="checkbox"/>			
Cooling tower or condenser system checked out	<input type="checkbox"/>	<input type="checkbox"/>			
Evaporator air vent provided	<input type="checkbox"/>	<input type="checkbox"/>			
Water cooled condenser air vent provided	<input type="checkbox"/>	<input type="checkbox"/>			
Refrigerant relief pipe extended to outside	<input type="checkbox"/>	<input type="checkbox"/>			
Sequencer controls installed (If specified)	<input type="checkbox"/>	<input type="checkbox"/>			
Pressure gages installed	<input type="checkbox"/>	<input type="checkbox"/>			
Test plugs (P/T) installed near all control sensors and as per spec	<input type="checkbox"/>	<input type="checkbox"/>			
Flow switch installed as required	<input type="checkbox"/>	<input type="checkbox"/>			
Flow meters installed	<input type="checkbox"/>	<input type="checkbox"/>			
Proper refrigerant level	<input type="checkbox"/>	<input type="checkbox"/>			
No refrigerant leaking	<input type="checkbox"/>	<input type="checkbox"/>			
Proper oil level	<input type="checkbox"/>	<input type="checkbox"/>			
Refrigerant monitor installed	<input type="checkbox"/>	<input type="checkbox"/>			
Purge unit installed, if specified	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment labels affixed	<input type="checkbox"/>	<input type="checkbox"/>			
Oil heater installed properly	<input type="checkbox"/>	<input type="checkbox"/>			
Over current motor heater installed and correct size	<input type="checkbox"/>	<input type="checkbox"/>			
Oil filter clean	<input type="checkbox"/>	<input type="checkbox"/>			
No fluid leaking apparent	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Electrical and Controls					
Description	Yes	N/A	Initials	Date	Comments
Power disconnect is located within site of the unit it controls and labeled	<input type="checkbox"/>	<input type="checkbox"/>			
All electric connections tight and installed properly	<input type="checkbox"/>	<input type="checkbox"/>			
Grounding installed for components and unit	<input type="checkbox"/>	<input type="checkbox"/>			
Safeties installed and operational	<input type="checkbox"/>	<input type="checkbox"/>			
Starter overload breakers installed and correct size	<input type="checkbox"/>	<input type="checkbox"/>			
All control devices, pneumatic tubing and wiring complete	<input type="checkbox"/>	<input type="checkbox"/>			
Control system interlocks connected and functional	<input type="checkbox"/>	<input type="checkbox"/>			
Emergency power off (EPO) switch installed as specified	<input type="checkbox"/>	<input type="checkbox"/>			
Operation of EPO switch checked in all positions	<input type="checkbox"/>	<input type="checkbox"/>			
Proper safeties in control when EPO switch is active	<input type="checkbox"/>	<input type="checkbox"/>			
Sensors calibrated (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			
Refrigerant monitor and purge checked	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Piping					
Description	Yes	N/A	Initials	Date	Comments
Piping installation checked against the drawings and all devices gages and appurtenances are in place	<input type="checkbox"/>	<input type="checkbox"/>			
Piping supported independently of the chiller	<input type="checkbox"/>	<input type="checkbox"/>			
Piping type and flow direction labeled on piping	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves, balancing valves and piping specialties installed	<input type="checkbox"/>	<input type="checkbox"/>			
System flushing complete and strainers cleaned	<input type="checkbox"/>	<input type="checkbox"/>			
Hydronic system flushing complete and strainers cleaned	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

TAB					
Description	Yes	N/A	Initials	Date	Comments
Installation of system and balancing devices is completed following NEBB or AABC procedures and contract documents	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



Operational Checks					
Description	Yes	N/A	Initials	Date	Comments
Measure line to line voltage phase imbalance for compressor: (%Imbalance = 100 x (avg. - lowest) / avg.) Record imbalance of compressor. Imbalance less than 2%?	<input type="checkbox"/>	<input type="checkbox"/>			
Record full load running amps for compressor. _____ rated FL amps x _____ srvc factor = _____ (Max amps). Running less than max?	<input type="checkbox"/>	<input type="checkbox"/>			
No unusual noise and vibration when running	<input type="checkbox"/>	<input type="checkbox"/>			
Compressor interlocking with oil pressure	<input type="checkbox"/>	<input type="checkbox"/>			
Adequate oil pressure when compressor shaft is turning	<input type="checkbox"/>	<input type="checkbox"/>			
Pre-rotation vane closed before compressor reaches full speed (centrifuge-modify as required)	<input type="checkbox"/>	<input type="checkbox"/>			
Pre-rotation vane steady when load changes	<input type="checkbox"/>	<input type="checkbox"/>			
Specified sequences of operation and operating schedules have been implemented with all variations documented	<input type="checkbox"/>	<input type="checkbox"/>			
Specified point-to-point checks have been completed and documentation record submitted for this system	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report completed with this checklist attached. (Includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report includes written certification from chiller manufacturer that all specified features, controls and safeties have been installed and are functioning properly and that the installation and application comply with the manufacturer's recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Piping gages, BAS and chiller panel temperature and pressure readouts match (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:



Low-Voltage Switchgear – Data Center Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer’s recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

EQUIPMENT DATA

Switchgear Nameplate

Parameter	Data
Equipment ID	
Manufacturer	
Model	
Type	
Order Number	
Date Manufactured	
Serial Number	
Nominal kVA	



Parameter	Data
Voltage	
Phase	
Wire	
Continuous Current	
Number of Sections	
Enclosure Type	

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
As-Built Drawings complete, available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment shop drawings available.	<input type="checkbox"/>	<input type="checkbox"/>			
Operation and Maintenance manuals available.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation and startup manual available.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment warranty information completed and provided in O&M Manual.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify receipt and acceptance of manufacturer's factory test reports.	<input type="checkbox"/>	<input type="checkbox"/>			
Doors to electrical room installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Egress routes from electrical room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction.	<input type="checkbox"/>	<input type="checkbox"/>			
Warning Signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment and switchgear grounding and bonding installed for each section.	<input type="checkbox"/>	<input type="checkbox"/>			
All grounding connections made with either exothermic process or with non-reversible compression fittings.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
Cabinet/compartments doors allow for full swing; latch open and close without binding; and no physical damage.	<input type="checkbox"/>	<input type="checkbox"/>			
Bus and units correspond to one-line diagram.	<input type="checkbox"/>	<input type="checkbox"/>			
All internal and field wiring completed and switchgear fully assembled.	<input type="checkbox"/>	<input type="checkbox"/>			
Interior low voltage switchgear bus and compartments vacuumed and wiped clean with manufacturer approved electrical cleaner.	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted connections tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
All wiring installed properly with correct bend radius and no insulation damage.	<input type="checkbox"/>	<input type="checkbox"/>			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with the testing agency.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training Plan approved.	<input type="checkbox"/>	<input type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:



Engine Generators Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

Equipment Information

Make		Model Number		
Serial Number		NEMA Enclosure		KVA
Volts/Phase		AMPS		KW
Service Area				
Notes:				



System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation					
Description	Yes	N/A	Initials	Date	Comments
As-Built drawings complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment shop drawings available.	<input type="checkbox"/>	<input type="checkbox"/>			
Operation and Maintenance manuals available.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation and startup manual available.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment warranty information completed and provided in O&M Manual.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify receipt and acceptance of manufacturer's factory test reports.	<input type="checkbox"/>	<input type="checkbox"/>			
Doors to generator room installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Egress routes from generator room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction.	<input type="checkbox"/>	<input type="checkbox"/>			
Warning signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room grounding system complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Ground bus (ses) have been installed and terminated to ground grid system.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator neutral bus is not solidly grounded by factory-installed bonding jumper as specified for a four-pole system.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator frame and enclosure bonded to ground.	<input type="checkbox"/>	<input type="checkbox"/>			
All wiring installed properly with correct bend radius and no insulation damage.	<input type="checkbox"/>	<input type="checkbox"/>			
All power conductors have been braced/tied per manufacturer's installation instructions.	<input type="checkbox"/>	<input type="checkbox"/>			
All piping, electrical, and control connections between skid-mounted devices and non-skid-mounted devices made with flexible connections (pipe, conduit, etc.).	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted electrical connections have been tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
Manufacturer's field service personnel have	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
completed preliminary checkout and startup.					
Engine lube oil system is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine coolant system is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine fuel supply system is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel supply system tank is full and ready for operation.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust is fully operational and free of leaks.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust has rain cap installed at exterior outlet.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust has condensate drain installed at silencer.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust has expansion fitting installed in exhaust piping to account for expansion.	<input type="checkbox"/>	<input type="checkbox"/>			
Engine exhaust system, silencer and pipe, are fully insulated.	<input type="checkbox"/>	<input type="checkbox"/>			
Intake air and discharge air dampers functional.	<input type="checkbox"/>	<input type="checkbox"/>			
Batteries are fully charged and in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Battery charger electrically connected to power source and control wiring connections to generator control panel completed.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator remote annunciation panel is remotely installed, electrically connected and fully operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator remote E-stop is remotely installed, electrically connected and fully operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator control wiring to switchgear installed, electrically connected, and operational with control wiring installed in separate conduit per manufacturer's recommendations.	<input type="checkbox"/>	<input type="checkbox"/>			
Generator control wiring to building management control panel is installed, electrically connected and fully operational.	<input type="checkbox"/>	<input type="checkbox"/>			
All contacts, devices, etc. for interface with SCADA-system are installed, functional and wired to terminal strips for connection of field wiring.	<input type="checkbox"/>	<input type="checkbox"/>			
Remote annunciator panel is installed, electrically connected and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
All circuit breaker protecting devices have been set and recorded per the protective device coordination study.	<input type="checkbox"/>	<input type="checkbox"/>			
Metering current transformer ratio and accuracy class matches drawings/specs.	<input type="checkbox"/>	<input type="checkbox"/>			
Metering potential transformer ratio and accuracy class matches drawings/specs.	<input type="checkbox"/>	<input type="checkbox"/>			
Metering wiring phase and polarity matches meter instruction manual wiring diagrams.	<input type="checkbox"/>	<input type="checkbox"/>			



General Installation					
Description	Yes	N/A	Initials	Date	Comments
Utility power is available and connected for system operation.	<input type="checkbox"/>	<input type="checkbox"/>			
All sensors have been installed and calibrated according to manufacturing and design specification.	<input type="checkbox"/>	<input type="checkbox"/>			
All status and alarm indicators are installed and functioning properly.	<input type="checkbox"/>	<input type="checkbox"/>			
All field and interconnecting wiring is completed and labeled at each end with visible and readable tags. (Printed markings on the conductors are NOT acceptable.)	<input type="checkbox"/>	<input type="checkbox"/>			
Field landed control wiring terminations are made using ring connectors NOT fork connectors.	<input type="checkbox"/>	<input type="checkbox"/>			
All manufacturing factory and field start-up tests attached to this SRC.	<input type="checkbox"/>	<input type="checkbox"/>			
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with the testing agency.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training plan approved.	<input type="checkbox"/>	<input type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input type="checkbox"/>	<input type="checkbox"/>			
All specified tools, equipment & spare parts are on site.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:



Automatic Transfer Switches Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

EQUIPMENT DATA

Static Switch Nameplate

Parameter	Data
Equipment ID	
Manufacturer	
Model	
Catalog Number	
Date Manufactured	



Static Switch Source #1 Isolation Circuit Breaker (CB1) Nameplate

Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

Static Switch Source #2 Isolation Circuit Breaker (CB2) Nameplate

Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

Static Switch Output Isolation Circuit Breaker (CB3) Nameplate

Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	



Static Switch Bypass to Source #1 Circuit Breaker (CB4) Nameplate

Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

Static Switch Bypass to Source #2 Circuit Breaker (CB5) Nameplate

Parameter	Data
Manufacturer/Model	
Frame Amps	
Volts	
GFI Module	
SC Rating	
Current Rating	

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
As-Built Drawings complete, available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment shop drawings available.	<input type="checkbox"/>	<input type="checkbox"/>			
Operation and Maintenance manuals available.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation and startup manual available.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment warranty information completed and provided in O&M Manual.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify receipt and acceptance of manufacturer's factory test reports.	<input type="checkbox"/>	<input type="checkbox"/>			
Doors to electrical room installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Locks or temporary security measures installed & operational. Room can be secured.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room clear of storage, temporary equipment, etc.	<input type="checkbox"/>	<input type="checkbox"/>			
Permanent lighting or 30 foot candle temporary lighting in service.	<input type="checkbox"/>	<input type="checkbox"/>			
Egress routes from electrical room are unobstructed.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
Electrical room & equipment clean of construction debris and dust, and are dry.	<input type="checkbox"/>	<input type="checkbox"/>			
Working clearances meet NEC and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment has been installed on a level housekeeping pad or properly attached to the structure or wall.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment anchored per manufacturer's instruction.	<input type="checkbox"/>	<input type="checkbox"/>			
Warning Signs installed per shop drawings and contract documents.	<input type="checkbox"/>	<input type="checkbox"/>			
All shipped-loose components installed.	<input type="checkbox"/>	<input type="checkbox"/>			
Electrical room grounding system complete.	<input type="checkbox"/>	<input type="checkbox"/>			
Grounding electrode conductor has been attached to the building ground ring.	<input type="checkbox"/>	<input type="checkbox"/>			
Shipping bolts and braces removed.	<input type="checkbox"/>	<input type="checkbox"/>			
ATS doors allow for full swing; latch open and close without binding; and no physical damage.	<input type="checkbox"/>	<input type="checkbox"/>			
All field and interconnecting wiring is completed and labeled at each end with visible and readable tags. (Printed markings on the conductors are NOT acceptable.).	<input type="checkbox"/>	<input type="checkbox"/>			
All bolted connections tightened to their proper torque values.	<input type="checkbox"/>	<input type="checkbox"/>			
All wiring installed properly with correct bend radius and no insulation damage.	<input type="checkbox"/>	<input type="checkbox"/>			
All contacts, devices, etc. for interface with SCADA system are installed, functional and wired to terminal strips for connection of field wiring.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify Normal and Emergency line side phase rotation.	<input type="checkbox"/>	<input type="checkbox"/>			
Verify that NORMAL and EMERGENCY sources are available.	<input type="checkbox"/>	<input type="checkbox"/>			
ATS settings have been adjusted per the Engineer/specifications.	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment layout and schematic wiring diagrams available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
System sequence of operation available and on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Remote STS summary alarm wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>			
Logic and control connections are routed away from power runs for noise prevention.	<input type="checkbox"/>	<input type="checkbox"/>			
Modbus TCP/IP network interface connection made and operational.	<input type="checkbox"/>	<input type="checkbox"/>			
Machine room space air conditioning working and available for use.	<input type="checkbox"/>	<input type="checkbox"/>			
Factory-supplied critical spare parts inventory delivered and available on-site.	<input type="checkbox"/>	<input type="checkbox"/>			
Factory test and startup documentation provided with copies attached to this SRC.	<input type="checkbox"/>	<input type="checkbox"/>			



Inspection Checklist					
Description	Yes	N/A	Initials	Date	Comments
Testing agency has been scheduled to perform the test and the commissioning agent has been notified of the testing date.	<input type="checkbox"/>	<input type="checkbox"/>			
Test equipment requirements have been reviewed with the testing agency.	<input type="checkbox"/>	<input type="checkbox"/>			
Power available for test equipment.	<input type="checkbox"/>	<input type="checkbox"/>			
Installation is complete and ready for verification testing.	<input type="checkbox"/>	<input type="checkbox"/>			
Training Plan approved.	<input type="checkbox"/>	<input type="checkbox"/>			
Training sessions of owner training completed / acceptance granted / training materials submitted to Commissioning Agent.	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Additional Comments:



Systems Manual Outline					
Section	Description	Prepared by			
		Cx Agent	Contractor	VA	Designer
Index of Systems Manuals	Table of Contents/Index of Systems Manuals	X	X		X
Design Narrative	Final Version	X	X		X
Facility Data:					
Floor plans (11x17)	Uncluttered floor plans that include only room numbers, type or function of space, and overall all facility dimensions.				X
Utility Connection and Cutoff Plans	Provide utility site and floor plans that indicate the exterior and main interior connection and cutoff points for all utilities.				X
Extended Warranty Information	List all warranties for products, equipment, components and sub-components whose duration exceeds one year.		X		
Equipment Listing	A table that lists major equipment shown on design equipment schedules, item descriptions, locations, model numbers, name/address/phone of manufacturer, supplier, contractor, sub-contractor.		X		
HVAC Filters	Table that lists the quantity, type, size, and location of each HVAC filter.		X		



Systems Manual Outline					
Section	Description	Prepared by			
		Cx Agent	Contractor	VA	Designer
Supply inventory Requirements	List of maintenance and repair supplies (spare parts, fuels, lubricants) required to ensure continued operation without unreasonable delays. Identify and list parts and supplies that have long purchase lead times. Give special attention to facilities at remote locations.		X		
As-built drawing list	List of all as-built or record drawings and specifications. Include drawing number and title. Identify where the drawings and specifications will be stored and filed.				X
Recommended Operational Record-keeping procedures, forms, logs, rationale for each	Sample blank forms, logs, etc. with basic instructions for use	X			X
System Information					
System Description	Narrative system description, including function, capacity, major components, etc.	X			X
System Schematics, one-line diagrams, flow diagrams, etc.	Flow diagram indicating system liquid, air, or gas flow during normal conditions.	X			X
Diagrammatic Plans	Floor plans indicating location of equipment and configuration of the system installation.	X			X
Safety Information	List of all personnel hazards and equipment safety precautions	X			X



Systems Manual Outline					
Section	Description	Prepared by			
		Cx Agent	Contractor	VA	Designer
Valve List	List of all valves associated with system. Show valve type, identification number, function, location and normal operating position	X	X		X
Start-up and Shut-down procedures	Step-by-step procedures to bring systems from shutdown to operational configurations and from operating to shutdown status.	X	X		X
Operating procedures/sequences for Normal, abnormal, and emergency modes	Discussion of the normal operation and control of the system. Emergency operating instructions in the event of equipment malfunctions, fire, explosions, spills, or other contingencies.	X	X		X
Operating instructions for integrated systems	Discussion of operating procedures for multiple, integrated systems.	X	X		X
Ongoing Optimization Guide	Procedures for analyzing and maintaining optimal system operations	X	X		X



Systems Manual Outline					
Section	Description	Prepared by			
		Cx Agent	Contractor	VA	Designer
Preventive Maintenance					
Preventive Maintenance Plan and Schedule	PM Plan using manufacturer's recommendations and sound engineering practice. Include major pieces of equipment. Provide a check sheet that details maintenance tasks and associated frequencies. Provide an annual schedule indicating when maintenance tasks should be performed such that work is spread as evenly as possible throughout the year.		X		
Preventive Maintenance procedures	Provide Task Card for each individual maintenance task identified on the PM Plan and Schedule. Include all major pieces of equipment. Include Lock out/Tag out precautions, required skill level, number of personnel needed, frequency, special tools, parts needed, and the estimated time required to complete the task.		X		



Systems Manual Outline					
Section	Description	Prepared by			
		Cx Agent	Contractor	VA	Designer
Repair					
Troubleshooting Guides and Diagnostic Techniques	Step-by-step procedures for diagnosing, isolating, and correcting system malfunctions. State indications or symptoms of trouble; sequential instructions, including check and tests to be performed and conditions to be sought, to determine the cause; and remedial measures to return the equipment and system to operating condition. Identify special test equipment required to perform the procedures. Start the troubleshooting guide at the system level and proceed to a level where detailed manufacturer's troubleshooting procedures for the system's components can be referenced.	X	X		X
Repair Procedures	Repair instructions required to restore equipment to proper operating condition and standards.	X	X		X
Removal and Replacement Instructions	Provide or refer to the manufacturer's data for the instructions for the removal and replacement of equipment components.	X	X		X
Schedule for calibrating sensors and actuators	Table of DDC sensors and actuators that require calibration with recommendations for calibration frequency.	X	X		X
Parts and Recommended Spares	Listing of recommended critical spare and long lead parts and spares.	X	X		X



Systems Manual Outline					
Section	Description	Prepared by			
		Cx Agent	Contractor	VA	Designer
Manufacturer's Data					
Operation and Maintenance Data	O&M data package per the technical specifications		X		
Manufacturer's Equipment Information	Drawings, illustrations and product data furnished for the equipment and systems components.		X		
Training Materials	Training plans, materials, and other data used during contractors and systems training.		X		
Commissioning Report	Copy of the Final Commissioning Report.	X			