

ENGINEERING & CONSTRUCTION Bulletin

Issue No. 2008-03

25 September 2008

Type: Policy

Subject: **Acceptance Testing of Critical Systems**

Reference: (a) ECB 2007-01 Proper use of Military Construction Funds, 13 October 2006

Enclosure: (1) Roles and Responsibilities (R&R) Matrices

Cancelled: NAVFAC Instruction 12271.1: NAVFAC Total Building Commissioning Policy, dated 23 October 2003

1. Purpose.

To focus NAVFAC's technical oversight of acceptance testing during construction on five critical areas (electrical, fire and life safety, mechanical, roofing, and underwater structures) to ensure the constructed facility performs as intended and meets the needs of the supported commands; to define the use of Post Construction Award Services (PCAS) funding as it applies to the Capital Improvements Business Line (CIBL) in-house acceptance testing and technical support efforts.

2. Background.

NAVFAC has identified five critical areas that have consistently caused problems in facilities delivered to its supported commands. These areas are electrical, fire and life safety, mechanical, roofing systems, and underwater structures. These five critical areas were identified as requiring ongoing, thorough construction technical oversight in support of acceptance testing. A NAVFAC Team of technical experts determined how to apply responsible oversight to these five critical areas using one-half of PCAS funds. Each Team compiled all systems / sub-systems and developed R&R matrices (enclosure (1)). Each matrix identifies responsibilities of each of the contributors to the quality and functionality of the completed project, including the contractor, Facilities Engineering Command's (FEC) Integrated Product Team (IPT) and Facilities Engineering and Acquisition Division (FEAD) technical staff. The matrices served as the basis for determining the level of effort (man hours) to perform the technical support for acceptance testing. The following table shows the format in the R&R matrices. Each heading is provided with a description of each column's intent:

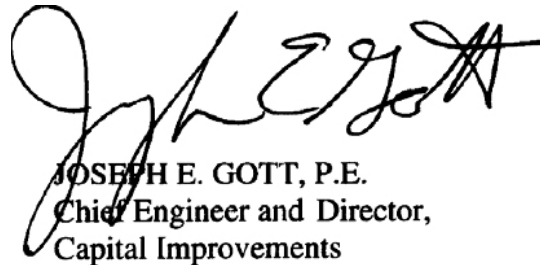
System	Sub-System	Phase	Element	Ktr QC-DOR (Project Req'ts)	FEAD (SIOH)	FEC (PCAS)
Major system grouping	Specific system	Phase of the project where it will occur	The item or task to be accomplished	What actions, if any, need to be taken by the appropriate party? (Indicates funding method)		

The contractor is still responsible for delivering a high quality and properly functioning facility via the Contractor Quality Control (CQC) program and commissioning process (including documentation and training).

3. Policy and Implementation.

The following will apply to the performance of acceptance testing for the five critical areas:

- a. This applies to Military Construction (MILCON) and all Special Projects with costs over \$750,000 for design-build and design-bid-build contracts.
- b. The Project Manager (PM) shall manage, in coordination with the Construction Manager (CM), the project PCAS funds. The PM shall ensure that PCAS funding is used in accordance with reference (a).
- c. The average funds available to support the CIBL acceptance testing in-house effort will be one-half the total PCAS funds.
- d. Enclosure (1) defines the roles and responsibilities of the contractor, FEC's IPT and FEAD technical staff.
- e. While the FEAD will be responsible for managing the overall construction project, the FEC's IPT will be responsible for the technical support for the acceptance testing effort associated with the five critical areas. Technical support from the FEAD can be leveraged as capabilities and resources allow, and must be coordinated between the FEC IPT and FEAD. The support for the five critical areas will be provided by engineers that have been trained and are experienced in that area.
- f. The CM will manage the day-to-day coordination with the contractor and coordinate the necessary reach back to the FEC IPT for technical support for acceptance testing.
- g. PCAS must be budgeted and included in the project costs. The PCAS costs must be shown in the budget estimate summary sheets (BESS) on the DD 1391.
- h. The Public Works Business Line (PWBL) has agreed to designate representatives who are responsible for facility maintenance and sustainment to perform the following:
 - i. Participate in the submittal review process by providing comments on submittals for the critical areas.
 - ii. Be present for the final inspections and tests.
 - iii. Be present for all system training.
 - iv. Provide feedback and lessons learned to the FEC CI4.
- i. It is recommended that the designated representatives, who are responsible for maintenance and sustainment visit the site during construction to become familiar with the building systems.
- j. The efforts in paragraph 3.h above will not be funded using PCAS or supervision, inspection and overhead (SIOH).



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Note: This ECB has been coordinated with Headquarters, U.S. Marine Corps (Code LFF).

ELECTRICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	EE QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
All Systems	Submittals & Plans	Pre-Construction	Qualifications of Installer, Shop Drawings, Data Sheets, and Calculations (as applicable)	A	C	S	
			QC Plan		A	S	
			Performance Verification Plan		A	S	
	Certificates & Reports	Construction	Functional Acceptance Test Procedure	A	C	S	
			Preliminary Test Reports	A	RA	S	
			Final Acceptance Test Reports	A	C	S	
Power Generators	Single Operation Generator Sets	Test Preparation	Perform fuel oil piping tests	V	C	-	
			Perform acceptance checks and tests	V	W	C	
			Perform preliminary operations	V	W	C	
		Final Test	Test all engine protective shutdown devices	V	—	W	
			Test all pre-shutdown alarm devices	V	—	W	
			Test crank cycle/terminate relay	V	—	W	
			Test automatic and manual operations in all possible scenarios involving loss of utility, return of utility, manual starting, and emergency stop	V	—	W	
			Perform load test	V	—	W	
	Automatic Transfer Switches	Test Preparation	Perform acceptance checks and tests	V	W	C	
			Simulate loss of normal power	—	—	W	
			Simulate return of normal power	V	—	W	
			Simulate loss of emergency power	V	—	W	
		Final Test	Simulate all forms of single-phase conditions	V	—	W	
			Verify operation of normal power voltage-sensing relays	V	—	W	
			Verify engine start sequence	V	—	W	
			Verify time delay upon transfer	V	—	W	
			Verify operation of alternate power voltage-sensing relays	V	—	W	
			Verify automatic transfer operation	V	—	W	
	400-Hertz Solid State Frequency Converter	All	Test Preparation	Perform acceptance checks and tests	V	W	C
				Verify equipment nameplate information with specifications and approved shop drawings	V	W	—
Inspect physical and mechanical condition				V	W	—	
Verify correct equipment grounding				V	W	—	
Perform resistance measurements through all bolted connections				V	W	—	
Final Test			Perform preliminary operations	V	W	C	
			Test all control devices	V	—	W	
			Test all protective shutdown devices	V	—	W	
			Perform load test	V	—	W	
			Perform transient tests	V	—	W	
			Perform harmonic distortion tests	V	—	W	
Perform automatic line drop compensation test	V	—	W				

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ELECTRICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	EE QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Uninterruptible Power Supply (UPS)	All	Test Preparation	Verify ventilation equipment in UPS and battery rooms are operational	V	W	—
			Verify battery cells are filled with electrolyte	V	W	—
			Verify polarity of DC connections and phase rotation of AC connections	V	W	—
			Verify AC power to all equipment	V	W	—
			Verify remote monitors and control wiring	V	W	—
			Verify UPS system and battery system is properly grounded	V	W	—
			Verify operation of emergency shower and eye wash	V	W	—
			Verify control connections between UPS and emergency engine generator signal contacts	V	W	—
			Verify control connections between UPS module and UPS maintenance bypass cabinet	V	W	—
			Perform acceptance checks and tests	V	W	C
		Final Test	Perform load tests	V	—	W
			Perform full-load burn in test	V	—	W
			Perform battery discharge test	V	—	W
			Perform battery performance test	V	—	W
			Perform UPS in conjunction with emergency generator service (if applicable)	V	—	W
Lighting	Interior Lighting	Final Test	Verify electronic dimming ballasts operation over full range of dimming capability without any visually detectable flicker	V	W	—
			Verify occupancy sensors operation	V	W	—
			Verify lighting controls operation	V	W	—
			Verify lighting output levels	V	W	—
	Exterior Lighting	Final Test	Verify photocell aiming and operation	V	W	—
			Verify lighting controls operation	V	W	—
			Verify lighting output levels	V	W	—
Transformers	Single-Phase Pad-Mounted Transformers	Factory Routine Tests	Perform resistance measurements, polarity, ratio, no-load losses and excitation current, load losses and impedance voltage, dielectric, leak (liquid-filled), and dissolved gas analysis (liquid-filled) tests	—	—	W
		Field Tests	Perform acceptance checks and tests	V	W	C
	Three-Phase Pad-Mounted Transformers	Factory Routine Tests	Perform resistance measurements, polarity, ratio, no-load losses and excitation current, load losses and impedance voltage, dielectric, leak (liquid-filled), and dissolved gas analysis (liquid-filled) tests	—	—	W
		Field Tests	Perform acceptance checks and tests	V	W	C
	Secondary Unit Substations	Factory Routine Tests	Perform resistance measurements, polarity, ratio, no-load losses and excitation current, load losses and impedance voltage, and dielectric tests	—	—	W
		Field Tests	Perform acceptance checks and tests	V	W	C
	Primary Unit Substations	Factory Routine Tests	Perform resistance measurements, polarity, ratio, no-load losses and excitation current, load losses and impedance voltage, dielectric, leak (liquid-filled), and dissolved gas analysis (liquid-filled) tests	—	—	W
		Field Tests	Perform acceptance checks and tests	V	W	C

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ELECTRICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	EE QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Switchgear/ Switchboards	Metal-Clad Switchgear / Switchboards and Busway	Factory Production Tests	60 Hz dielectric, mechanical operation, electrical operation and control wiring, and ground fault sensing equipment tests	—	—	W
		Test Preparation	Perform acceptance checks and tests	V	W	C
Cable	Medium-Voltage Cable, Terminations, and Splices	Test Preparation	Perform acceptance checks and tests	V	W	—
		Field Tests	Perform shield continuity and very low frequency (VLF) tests	V	W	—
SF6 Switch - Padmount	Medium Voltage Pad-mounted Switches	Factory Production Tests	60 Hz dielectric, mechanical operation, electrical operation and control wiring, and ground fault sensing equipment tests	—	—	W
		Test Preparation	Perform acceptance checks and tests	V	W	C
Airfield Lighting	Airfield Lighting Circuits	Field Tests	Airfield lighting circuits low voltage continuity and high voltage insulation resistance tests	V	W	—
		Field Tests	Airfield lighting circuit operating test	V	W	—
	Counterpoise	Field Tests	Counterpoise system test	V	W	—
	Constant	Field Tests	Perform open circuit protector and load tests	V	W	—
	All	Field Tests	Perform airfield lighting system operation test	V	W	—
Cathodic Protection	Cathodic Protection by Galvanic Anodes	Field Tests	Perform non-destructive testing of anodes	V	W	—
			Perform destructive testing of anodes	V	W	—
			Perform base potential tests, insulation joint testing, electrical continuity testing, pipe casing testing, anode-to-soil potential tests, anode output tests, protected potential measurement tests, and interference testing.	V	W	—
			Perform field operation tests.	V	—	W
	Cathodic Protection by Impressed Current	Field Tests	Perform non-destructive testing of anodes	V	W	—
			Perform destructive testing of anodes	V	W	—
		Field Tests	Perform base potential tests, permanent reference electrode calibration, insulation joint testing, electrical continuity testing, rectifier system testing, pipe casing testing, protected potential measurement tests, and interference testing.	V	W	—
		Field Tests	Perform field operation tests.	V	—	W

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FIRE PROTECTION ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	FP QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
All Systems	Required Submittals	Test Prep & Preliminary Certifications	QC Plan	—	A	S
			Performance Verification Plan	—	A	S
			Field Visit/Construction Surveillance Reports	—	S	QA
			Final Acceptance Test Reports	A	S	QA or A
			Final Life Safety/Fire Protection Certification	—	S	A
Sprinkler Systems	Wet Pipe Sprinkler Systems	Test Preparation	Process/review system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Process/review Preliminary Test Reports & Certifications	—	RA	S
			Witness hydrostatic test.	A	C	—
			Witness flush test.	V	W	—
			Visually inspect system for adherence to plan, completeness, and adequacy of installation.	A	QA	QA
			Visually inspect pipe penetrations	A	QA	QA
			Visually inspect sprinklers for location and that they are not painted / taped.	A	QA	QA
			Visually inspect seismic bracing	A	C	QA
			Operate control valves {Other than main service entrance riser}	A	C	QA
			Visually inspect check valve installation	A	C	QA
			Visually inspect test/drain discharge locations	A	C	QA
			Witness backflow preventer forward-flow test (NFPA 13, §16.2.5).	V	W	W
			Inspect/test alarm valve assembly and water service entrance(pipe sleeves, thrust rods, etc.), including valves, flow switch & tamper switches)	V	C	W
	Inspect/test flow control valve assembly	V	C	W		
	Additional requirements for Dry Pipe, Preaction - Deluge	Final Test	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Witness hydrostatic test.	A	C	—
			Witness flush test.	V	W	—
			Verify Low-point drains are provided	V	—	QA
			Visually inspect air supply and piping	A	S	QA
Witness backflow preventer test.			V	W	W	
Test high-low pressure air switch operation			V	—	W	
Inspect/Test deluge or dry valve riser assembly (including control valves, alarm switch & tamper switches), and functional operation	A	S	W			
Inspect/test detection and releasing system	See Fire Alarm System					

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FIRE PROTECTION ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	FP QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Water Distribution	Fire hydrants, distribution piping, & control valves	Final Test	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	—
			Preliminary Test Reports & Certifications	—	RA	S
			Visually inspect all thrust blocks.	A	QA	—
			Witness hydrostatic test.	A	C	—
			Witness flush testing of hydrant	A	C	QA
			Operate all control/isolation valves (each)	V	S	QA
			Operate fire hydrants and check for proper drainage (each)	V	S	QA
	Water storage	Construction	Preliminary Test Reports & Certifications	—	RA	S
			Verify suction piping w/in tank is installed in accordance with design	A	C	S
	Pumps for Fire Protection (Water & Foam)	Pumps & Controllers	Test Preparation	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C
Preliminary Test Reports & Certifications				—	RA	S
Test Preparation			Visually inspect system for adherence to plan, completeness, and adequacy of installation.	A	QA	QA
			Witness pump controller functional tests (including automatic transfer switch operation & battery transfer as applicable).	A	QA	W
Final Test			Witness flow test to generate performance curve (pressure vs discharge, rpms, amps, shaft alignment)	V	QA	W
			Witness automatic and manual starts & stops	V	QA	W
			Verify that controller supervisory signals are received by the fire alarm control panel	V	C	W

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FIRE PROTECTION ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	FP QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Fire Alarm Systems	Evacuation / Notification Detection & Releasing Systems.	Test Preparation & Final Test	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Visually inspect system for adherence to plan, completeness, and adequacy of installation. (30,000 SQ. FT.)	A	QA	QA
			Test initiating devices for proper operation. (Activate 15% of smoke or heat detectors with no failures {30,000 sq. ft.}/(625 sq. ft/ detector)(0.15)=7}	A	QA	QA
			Test initiating circuits for shorts, ground faults, and general operation	A	C	QA
			Test signaling circuits for shorts, ground faults, and general operation	A	C	QA
			Verify audible and visual devices operate properly and audible devices can be heard throughout the facility	A	C	QA
			Test peripheral devices (door hold opens, etc)	A	C	QA
			Witness functional test of the main control panel	V	C	W
			Test interface with other systems (i.e., preaction, gaseous, etc.)	V	C	W
			Test that correct signals are being sent to the base receiving station	V	C	W
			Test recall for elevators - See "Others - Elevators" {Bldg 2 stories or more}	V	S	W
			Test AHU shut down - See "Others - HVAC"	V	S	W
			Test power shut down - See "Others - {Elevators} Electrical"	V	C	W
			Control Panels used for Releasing Service		Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A
	Preliminary Test Reports & Certifications	—			RA	S
	Test releasing circuits for shorts, ground faults, and general operation	V			C	W
	Test power shut down - See "Others - Electrical"	V			S	QA
	Test automatic closing of dampers/doors	V			S	W
	Base-Wide Fire Reporting System		Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Test transmitting devices to ensure the signals are received at the main console {per bldg}	V	C	W
			Test the main console for redundancy requirements	V	S	W

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FIRE PROTECTION ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	FP QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Miscellaneous Extinguishing Systems	Gaseous Systems	Final Test	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Visually inspect system for adherence to plan, completeness, and adequacy of installation.	A	S	QA
			Verify correct nozzles were installed	A	S	W
			Witness room pressurization test	V	S	W
			Witness full functional test to verify cylinder head functions properly and all control/interface functions operate accordingly.	V	S	W
			Inspect/test detection and releasing system	See Fire Alarm System		
	Wet Chemical & Dry Chemical Systems	Test Prep	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Verify piping and nozzles are installed in accordance with manufacturer's listing requirements	A	S	W
		Final Test	Witness discharge test - ensure nozzles are bagged if discharging water in a wet chemical system	V	S	W
			Verify alarm and supervisory signals are sent to the FACP	V	S	W
			Verify power and gas are disconnect when system activates (if applicable)	V	S	W
			Verify exhaust system either continues to run or shuts down depending on listing (if applicable)	V	S	W
	Foam Systems (All types)	Test Preparation	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Review test plan	—	C	QA
			Review the contractor's test plan for environmental and other compliance	—	S	QA
			Inspect/test detection and releasing system	See Fire Alarm System		
			Visually inspect system for adherence to plan, completeness, and adequacy of installation. Conduct functional test of entire system. Submit report.	A	QA	QA
		Final Test	Verify correct foam generators / discharge devices are installed and properly piped	A	—	QA
			Verify correct size pipe and installed properly	A	—	QA
			Verify riser assembly (deluge valve) is installed properly	A	—	QA
		Final Test	Verify strainer has proper mesh	V	QA	W
			Conduct performance test to ensure proper setting and operation of foam control valves and discharge devices. <i>(multiply by the number of risers)</i>	V	QA	W
			Conduct functional test of each generator, ratio controller, or proportioner. <i>(multiply by the number of risers)</i>	—	QA	W

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FIRE PROTECTION ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	FP QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Passive	Fire / Smoke Barriers IBC Inspections (Section 109)	Preliminary and Final Inspections	Process system submittal (Qualifications of Installer, Shop Drawings, Data Sheets & Calcs)	A	C	S
			Preliminary Test Reports & Certifications	—	RA	S
			Inspect Lath & gypsum board installation	A	QA	QA
			Inspect fire-rated / smoke wall and/or floor penetrations	A	S	QA
			Inspect wall/ceiling/roof joint	A	S	QA
			Inspect/test fire & smoke damper installation and performance	A	S	QA
			Inspect fire doors and frames	A	QA	QA
Life Safety Features	Exit Signs and Emergency Lighting	Preliminary	Verify installed locations of exit signs.	A	S	QA
		Final Test	Verify installed locations of emergency lighting	A	S	QA
			Check performance of emergency lighting systems and battery back-up.	A	S	QA
	Emergency Generators		Check to ensure all life safety features on the emergency generator are provide with power in the required amount of time	A	S	QA
Other Systems	Elevators	Test	Verify elevator re-call to primary floor	A	S	QA
			Verify elevator re-call to alternate floor	A	S	QA
			Test power disconnect upon water flow	V	S	QA
			Verify signal in elevator cab activates	V	S	QA
	Smoke Control / Exhaust Systems	Preliminary Test	Verify smoke exhaust / smoke control system activates via appropriate initiating devices (IBC §1704)	A	S	QA
			Verify location of duct detectors and for proper installation	A	S	QA
		Final Test	Perform operational test to show smoke exhaust / smoke control system functions as designed	V	S	QA
			Special Inspections for smoke control (IBC §1704) (See NFPA 92A & 92B, Chap. 8.)	A	W	W
			Perform operational test to verify detector functions properly and shuts down the correct AHU	V	S	QA
	Electrical	Pre-Test	Verify each detector associated with the electrical equipment disconnects power	A	S	QA
Final Test		Test power disconnect for associated electronic equipment	V	S	QA	

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MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems	Fuel Oil - ALL	Field Visit	Complete System - Verify contractor provided complete fuel oil system to the facility, including applications and permits	A	QA	—
			Piping - Verify fuel oil piping meets requirements of International Mechanical Code.	A	QA	—
			Testing - Verify oil system testing meets requirements of NFPA 31.	V	W	—
	Fuel Oil - Exterior	Submittal Process	Piping - Verify fuel piping is either ASTM A 53 Type E (electric-resistance welded, Grade A or B) black steel; or ASTM A 53 Type S (seamless, Grade A or B) black steel; or API SPEC 5L, seamless, submerged-arc weld or gas metal-arc weld, Grade B, black ste	A	RA	—
			Fuel Pumps - Verify fuel pumps comply with NEMA MG 1, NFPA 70, and are designed for use with hydrocarbon fuels.	A	RA	—
			Fuel Pumps - Verify fuel pumps have a working pressure of 1896 kilopascals (275 psig) at 38 degrees C (100 degrees F).	A	RA	—
			Fuel Meters - Verify fuel meters are continuous duty, positive displacement type, with electronic thermal compensation capability, suitable for outdoor installation.	A	RA	—
			Fuel Meters - Verify fuel meters are designed for use with hydrocarbon fuels and have a working pressure of 1896 kilopascals (275 psig) at 38 degrees C (100 degrees F).	A	RA	—
			Storage Tanks - Verify aboveground liquid fuel storage tanks are concrete encased or double wall in accordance with UL 142 and UL 2085 with secondary containment and leak monitoring of a capacity to meet the system requirements. Verify overflow/spill con	A	RA/ QA	S
	Fuel Oil - Interior	Submittal Process/ Field Visit	Dispensing Tanks - Verify Liquid fuel dispensing tanks are concrete encased or double wall in accordance with UL 142 and UL 2085 with secondary containment and leak monitoring of a capacity to meet the system requirements. Verify overflow/spill containme	A	RA/ QA	S
			Pumps - Verify pumps that are not part of the burner assembly are positive displacement type	A	RA	—
			Oil Filter - Verify an oil filter is provided prior to oil entering appliance or pump.	A	QA	QA
			Drip Legs - Verify drip legs are provided and properly installed prior to oil entering appliance or pump.	A	QA	—
	Natural Gas - ALL	Field Visit	Storage Tanks - Verify all storage tanks meet NFPA 31 requirements.	A	RA	—
Complete System - Verify contractor provided complete natural gas system to the facility, including applications and permits			A	QA	—	
		Field Visit	Testing - Verify system was tested at 1.5 times maximum working pressure, but not less than 350 kPa (50 PSI) per NFPA 54	V	W	—

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System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems (continued)	Natural Gas - Exterior (Contractor installed piping)	Field Visit	Piping - Verify exterior gas piping meets requirements of local natural gas utility	A	QA	—
		Submittal Process	Piping - Verify piping meets requirements of ASME B31.8, Gas Transmission and Distribution Piping Systems	A	RA	—
		Submittal Process	Piping - Verify the natural gas piping is either ASTM A 53, Type E (electric-resistance welded, Grade A or B) black steel piping or ASTM A 53 Type S (seamless, Grade A or B) black steel piping or ASTM D 2513, Grade PE2406 or PE3408 polyethylene piping an	A	RA	—
		Field Visit	Meter and Pressure Regulator - Verify meter and pressure regulator are provided in accordance with local utility requirements.	A	QA	—
		Field Visit	Piping Identification - Verify polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines are provided for non-metallic underground piping systems	A	QA	—
	Natural Gas - Interior	Submittal Process	Piping - Verify interior gas piping meets requirements of NFPA 54, National Fuel Gas Code	A	RA	—
	Propane - ALL	Field Visit	Complete System - Verify contractor provided complete propane system to the facility, including appropriate applications and permits.	A	QA	—
	Propane - Exterior	Submittal Process	Piping - If piping is not provided by propane supplier, verify the propane piping is either ASTM A 53, Type E (electric-resistance welded, Grade A or B) black steel piping or ASTM A 53 Type S (seamless, Grade A or B) black steel piping or ASTM D 2513, Gr	A	RA	—
		Submittal Process	Fittings - Confirm Polyethylene fittings meet ASTM D 2683 for socket fittings or ASTM D 2513 for molded butt-fusion fittings	A	RA	—
		Field Visit	Tank - Verify propane tank capacity conforms to tank capacity submitted in shop drawings.	A	QA	—
		Submittal Process	Tank - If tank is not provided by propane supplier, verify propane tank material and installation comply with NFPA 58.	A	RA	—
		Submittal Process	Tank - If tank is not provided by propane supplier, verify propane tank is ASME labeled.	A	QA	—
		Field Visit	Piping Identitiication - Verify polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines are provided for non-metallic underground piping systems	A	QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems (continued)	Propane - Interior	Field Visit	Verify the propane installation meets the requirements specified in NFPA 58.	A	QA	—
		Submittal Process	Piping - Verify standard pipe dimension ratio is not more than 11.5	A	RA	—
	Steam - Exterior Underground	Submittal Process	Confirm the submission of a Certificate of Satisfactory Operation certifying that at least 3 systems installed by the piping system manufacturer within the previous 10 years have and are operating satisfactorily for not less than 5 years.	A	RA	S
		Submittal Process	Confirm the submission of a written certification by the piping system manufacturer that the distribution system installer is technically qualified and experienced in the installation of the system.	A	RA	S
		Submittal Process/ Field Visit	Verify underground steam and condensate piping in separate conduits is direct buried, factory pre-fabricated, pre-insulated, and consist of a steel service pipe with polyurethane insulation and a high-density polyethylene (HDPE) jacket.	A	RA/ QA	—
		Submittal Process/ Field Visit	Confirm piping system fittings and components are factory fabricated and no field insulated fittings are provided.	A	RA/ QA	—
		Field Visit	Verify asbestos cement or plastic conduit piping is not provided.	A	QA	—
		Field Visit	Piping Insulation - Verify the piping system insulation thickness is in accordance with contract requirements.	A	QA	—
		Submittal Process	Isolation Valves - Verify ASME class 150 isolation valves are provided in manholes for system supply and return lines at take-offs for service to each building .	A	QA	—
		Submittal Process/ Field Visit	Expansion Loops - Verify expansion loops are utilized to compensate for piping expansion.	A	RA/ QA	S
		Submittal Process/ Field Visit	Expansion Anchors - Verify piping expansion anchors are located outside manholes.	A	RA/ QA	—
		Field Visit	Manholes - Verify system manholes are constructed of reinforced, 206.8 bar (3000 psi) concrete. Verify manhole floor and sides are watertight and were made in one monolithic pour. Verify manhole top extends a minimum of 300 mm (6 inches) above grade. V	A	QA	—
		Submittal Process	Verify a sump pit and a vertical sump pump designed for an operating temperature design of 93 degrees C (195 degrees F) minimum are provided in each system manhole.	A	RA	—
		Submittal Process	Sump Pump - Float Control - Verify a 2-pole float control is provided for each manhole sump pump.	A	RA	—
		Submittal Process/ Field Visit	Valves - For system valves located outside of manholes, verify a cast-iron or ductile-iron valve box and cover of a suitable size are provided. Verify the box cover has the word(s) describing the utility cast on the cover.	A	RA/ QA	—

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MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems (continued)	Steam - Exterior Aboveground	Submittal Process	Piping - Verify steam piping is either ASTM A 53 Type E (electric-resistance welded, Grade A or B) black steel pipe or ASTM A 53 Type S (seamless, Grade A or B) black steel pipe or, for pipe sizes through 250 mm (9 inches), ASTM A 106 (Grade A or B) black	A	RA	—
		Submittal Process	Piping - Verify condensate piping is either ASTM A 53 Type E (electric-resistance welded, Grade A or B) black steel, Weight Class XS (Extra Strong); or ASTM A 53 Type S (seamless, Grade A or B) black steel, Weight Class XS (Extra Strong); or ASTM A 106, G	A	RA	—
		Field Visit	Piping Insulation - Verify piping insulation is either fibrous glass, calcium silicate, or cellular glass as indicated in submitted shop drawings. Verify pipe insulation matches existing or surrounding insulation if applicable.	A	QA	—
		Field Visit	Piping Insulation - Verify the piping system insulation thickness is in accordance with contract requirements.	A	QA	—
		Field Visit	Insulation - Verify insulation is covered with an with aluminum jacket painted to conform with the Base Architectural Plan.	A	QA	—
		Submittal Process/ Field Visit	Verify the use of either MSS SP-58 or MSS SP-69 adjustable supports with insulation protection saddles. Verify roller supports utilize stainless steel axles.	A	RA/ QA	—
		Field Visit	Support Poles - Verify support poles are installed with guy wires and necessary hardware.	A	QA	—
		Submittal Process/ Field Visit	Pipe Expansion - Verify pipe expansion is compensated by utilizing either expansion loops, guided sliexpansion joints, or flexible ball type expansion joints.	A	RA/ QA	S
	Steam - Interior	Submittal Process	Steam piping - Verify is ASTM A106 or A53, Grade B, Schedule 40, black steel, electric-resistance welded or seamless	A	RA	—
		Submittal Process/ Field Visit	Steam piping - Verify insulated with mineral fiber or cellular glass insulation with all-purpose jacket	A	RA/ QA	—
		Submittal Process	Condensate return piping - Verify is ASTM A106 or ASTM A53, Grade B, Schedule 80, black steel, electric-resistance welded or seamless	A	RA	—
		Submittal Process/ Field Visit	Condensate return piping - Verify insulated with mineral fiber or cellular glass insulation with all-purpose jacket	A	RA/ QA	—
		Submittal Process	Steel pipe fittings - For piping 50 mm (2 inch) and smaller, verify is ANSI/ASME B16.3 malleable iron screwed fittings or ASME B16.11 socket welding (Class 3000) or ASME B16.11 threaded type (Class 2000)	A	RA	—
		Submittal Process	Steel pipe fittings - For piping 63 mm (2-1/2 inch) and larger, verify is ANSI/ASME B16.9 butt-welding fittings or ANSI/ASME B16.5 flanged type	A	RA	—
Field Visit		Steam pressure reducing station - Verify provided for each building	A	QA	—	

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MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems (continued)		Submittal Process/ Field Visit	Steam traps - Verify steam traps and accessories are in accordance with UFC 3-400-10N	A	RA/ QA	—
		Field Visit	Verify all valves, traps, and PRV's are accessible for service & maintenance	A	QA	—
	Hot Water - Exterior Underground	Submittal Process/ Field Visit	Piping - Verify underground hot water supply & return piping in separate conduits is direct buried, factory pre-fabricated, pre-insulated, and consist of a steel service pipe with polyurethane insulation and a high-density polyethylene (HDPE) jacket.	A	RA/ QA	—
		Submittal Process/ Field Visit	Confirm piping system fittings and components are factory fabricated and no field insulated fittings are provided.	A	RA/ QA	—
		Field Visit	Verify asbestos cement or plastic conduit piping is not provided.	A	QA	—
		Submittal Process	The UHDS representative shall be certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system. Provide a Certificate of Satisfactory Operation certifying that at least 3 systems installed by	A	QA	S
		Field Visit	Piping Insulation - Verify the piping system insulation thickness is in accordance with contract requirements.	A	QA	—
		Submittal Process/ Field Visit	Isolation Valves - Verify ASME class 150 isolation valves are provided in manholes for system supply and return lines at take-offs for service to each building .	A	RA/ QA	—
		Submittal Process/ Field Visit	Expansion Loops - Verify expansion loops are utilized to compensate for piping expansion.	A	RA/ QA	S
		Submittal Process/ Field Visit	Manholes - Verify system manholes are constructed of reinforced, 206.8 bar (3000 psi) concrete. Verify manhole floor and sides are watertight and were made in one monolithic pour. Verify manhole top extends a minimum of 300 mm (6 inches) above grade. V	A	RA/ QA	—
		Submittal Process	Verify a sump pit and a vertical sump pump designed for an operating temperature design of 93 degrees C (195 degrees F) minimum are provided in each system manhole.	A	RA	—
		Submittal Process	Sump Pump - Float Control - Verify a 2-pole float control is provided for each manhole sump pump.	A	RA	—
		Submittal Process/ Field Visit	Valves - For system valves located outside of manholes, verify a cast-iron or ductile-iron valve box and cover of a suitable size are provided. Verify the box cover has the word(s) describing the utility cast on the cover.	A	RA/ QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
En	Hot Water - Exterior Aboveground	Submittal Process	Piping - Verify hot water piping is either ASTM A 53 Type E (electric-resistance welded, Grade A or B) black steel, Weight Class XS (Extra Strong); or ASTM A 53 Type S (seamless, Grade A or B) black steel, Weight Class XS (Extra Strong); or ASTM A 106, Gr	A	RA	—
		Field Visit	Piping Insulation - Verify piping insulation is either fibrous glass, calcium silicate, or cellular glass as indicated in submitted shop drawings.	A	QA	—
		Field Visit	Piping Insulation - Verify the piping system insulation thickness is in accordance with contract requirements.	A	QA	—
		Field Visit	Insulation - Verify insulation is covered with an with aluminum jacket painted to conform with the Base Architectural Plan.	A	QA	—
		Submittal Process/ Field Visit	Pipe Expansion - Verify pipe expansion is compensated by utilizing either expansion loops, guided slip expansion joints, or flexible ball type expansion joints.	A	RA/ QA	S
		Submittal Process/ Field Visit	Verify the use of either MSS SP-58 or MSS SP-69 adjustable supports with insulation protection saddles. Verify roller supports utilize stainless steel axles.	A	RA/ QA	—
		Field Visit	Support Poles - Verify support poles are installed with guy wires and necessary hardware.	A	QA	—
	Hot Water - Interior	Submittal Process	Piping - Verify hot water piping is electric resistance, welded or seamless, schedule 40, black steel pipe conforming to ASTM A53. Piping 100mm (4 inch) and smaller may be ASTM B 88 Type K or L copper.	A	RA	—
		Submittal Process	Steel fittings - For piping 50mm (2 inch) and smaller, verify provided ANSI/ASME B16.3 malleable iron screwed fittings OR ASME B16.11 socket welding (Class 3000) fittings OR ASME B16.11 threaded type (Class 2000)	A	RA	—
		Submittal Process	Steel fittings - For piping 63 mm (2-1/2 inch) and larger, verify provided ANSI/ASME B16.9 butt-welding fittings OR ANSI/ASME B16.5 flanged type	A	RA	—
		Submittal Process	Copper fittings - Verify ANSI B16.18 cast bronze solder joint type or ASME/ANSI B16.22 wrought copper solder joint type	A	RA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
Energy Supply Systems (continued)		Submittal Process/ Field Visit	Insulation - Verify hot water piping insulated with mineral fiber insulation with factory-applied all-purpose jacket	A	RA/ QA	—	
		Field Visit	Isolation valves - Verify equipment provided with isolation valves for service and repairs	A	QA	—	
		Submittal Process/ Field Visit	Valves - Verify appropriately sized	A	RA/ QA	—	
		Submittal Process/ Field Visit	Balancing valves - Verify provided and appropriately sized to balance water flow	A	RA/ QA	QA	
		Field Visit	Appurtenances - Verify provided (such as air separators, expansion tanks, suction diffusers, strainers, etc)	A	QA	—	
		Field Visit	Test ports - Verify provided in piping at inlet and outlet of all major system components including boilers, pumps, etc)	A	QA	QA	
		Field Visit	Verify all valves and test ports are accessible for service and maintenance	A	QA	—	
		Chilled Water & Condenser Water - Exterior Underground	Submittal Process	Verify system provided is direct buried, factory-prefabricated, pre-insulated, chilled water piping systems. Verify all fittings and accessories are designed and factory-fabricated to prevent moisture from entering into the system by manufacturer.	A	RA	S
			Field Visit	Verify backfill and overall installation meets the requirements of the piping system manufacturer.	A	QA	—
			Field Visit	Isolation Valves - Verify supply and return line isolation valves are provided at take-offs for service to each building in valve boxes.	A	QA	—
			Submittal Process/ Field Visit	Verify expansion loops are provided to compensate for piping expansion. Verify anchors are provided outside manholes.	A	RA/ QA	S
		Chilled Water & Condenser Water - Exterior Aboveground	Submittal Process	Piping - Verify chilled and condenser water piping are either electric resistance welded or seamless Schedule 40 black steel pipe conforming to ASTM A 53 or, for piping 100 mm (4 inch) and smaller, ASTM B 88 Type K or L copper.	A	RA	—
			Submittal Process	If steel piping is used, verify for piping 50 mm (2 inch) and smaller, ANSI/ASME B16.3 malleable iron screwed fittings or ASME B16.11 socket welding (Class 3000) or threaded type (Class 2000) fittings are provided. For piping 63 mm (2-1/2 inch) and large	A	RA	—
			Submittal Process	If copper piping is used, verify ANSI B16.18 cast bronze solder joint fittings or ASME/ANSI B16.22 wrought copper solder joint fittings are provided.	A	RA	—
	Submittal Process/ Field Visit		Piping Insulation - Verify piping insulation is either Mineral fiber, Urethane, cellular glass, Faced Phenolic Foam, or Flexible Cellular pipe insulation as indicated in submitted shop drawings.	A	RA/ QA	—	

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MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems (continued)		Field Visit	Piping Insulation - Verify the piping system insulation thickness is in accordance with contract requirements.	A	QA	—
		Field Visit	Piping Insulation - Verify piping insulation is covered with an aluminum jacket.	A	QA	—
		Submittal Process/ Field Visit	Verify the use of either MSS SP-58 or MSS SP-69 adjustable supports with insulation protection saddles. Verify roller supports utilize stainless steel axles.	A	RA/ QA	—
		Field Visit	Support Poles - Verify support poles are installed with guy wires and necessary hardware.	A	QA	—
		Submittal Process/ Field Visit	Pipe Expansion - Verify pipe expansion is compensated by utilizing either expansion loops, guided slip expansion joints, or flexible ball type expansion joints.	A	RA/ QA	S
		Submittal Process	Aboveground chilled & condenser water piping - Verify aboveground chilled water piping is electric resistance welded or seamless schedule 40 black steel pipe conforming to ASTM A 53. Piping 100mm (4 inch) and smaller may be ASTM B 88 Type K or L copper.	A	RA	—
		Submittal Process	Steel pipe fittings - For piping 50mm (2 inch) and smaller - Verify provided ANSI/ASME B16.3 malleable iron screwed fittings or ASME B16.11 socket welding (Class 3000) or threaded type (Class 2000).	A	RA	—
		Submittal Process	Steel pipe fittings - For piping 63mm (2-1/2 inch) and larger - Verify provided ASME/ANSI B16.9 butt-welding fittings or ASME/ANSI B16.5 flanged type.	A	RA	—
		Submittal Process	Steel pipe fittings - Grooved joint pipe coupling systems of appropriate pressure rating are acceptable in lieu of welded or screwed fittings	A	RA	—
		Submittal Process	Copper fittings - Verify provided ANSI B16.18 cast bronze solder joint type or ASME/ANSI B16.22 wrought copper solder joint type	A	RA	—
		Field Visit	Isolation valves - Verify isolation valves provided on supply and return lines at take-offs for service to each building	A	QA	—
		Field Visit	Isolation valves - Verify isolation valves located in valve boxes	A	QA	—
		Submittal Process/ Field Visit	Insulation - Verify above-ground chilled water piping insulated with cellular glass insulation. Flexible unicellular insulation may be used on small piping runouts.	A	RA/ QA	—
		Submittal Process/ Field Visit	Insulation - Verify above-ground condenser water piping insulated with mineral fiber insulation	A	RA/ QA	—
	Submittal Process/ Field Visit	Insulation - Verify all-purpose jacket with vapor retarder provided for above-ground chilled water and condenser piping	A	RA/ QA	—	
(continued)		Submittal Process/ Field Visit	Valves - Verify appropriately sized	A	RA/ QA	—

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MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Energy Supply Systems (cont)		Submittal Process/ Field Visit	Balancing valves - Verify provided and appropriately sized to balance water flow	A	RA/ QA	QA
		Submittal Process/ Field Visit	Relief valves - Verify provided and appropriately sized	A	RA/ QA	—
		Field Visit	Test ports - Verify test ports provided in piping at inlet and outlet of all major system components including chillers, pumps, etc	A	QA	QA
		Field Visit	Verify all valves and test ports are accessible for service and maintenance	A	QA	—
	AHU's - ALL	Field Visit	DDC Sensors - Confirm location of DDC sensors (temp, SP, Freeze, High pressure SP, AFM), if required	A	QA	QA
		Field Visit	Smoke Detectors - Confirm location of smoke detectors (if over 2000 cfm)	A	QA	QA
		Field Visit	Testing - Filters - Confirm filters are clean prior to testing	A	QA	QA
		Field Visit	Filters - Confirm filters are installed	—	—	—
		Field Visit	Belts - Confirm belt tightness and alignment	A	QA	QA
		Field Visit	Coils - Confirm all coils are clean	A	QA	QA
		Field Visit	Vibration Isolators - Confirm vibration isolators installed according to contract docs and unit secured	A	QA	QA
		Field Visit	Damper - Confirm damper operation and assembly tightness	A	QA	QA
		Field Visit	Motor - Confirm motor size (HP), voltage, amperage, and rpm	A	QA	QA
		Submittal Process	Fans - Verify provided have AMCA 210 certified fans with AMCA seal	A	QA	—
		Field Visit	Fans - Confirm fan rpm and rotation direction	A	QA	QA
		Field Visit	OA Intake Plenum - Confirm OA intake plenum configuration provides for drainage	A	QA	QA
		Field Visit	AFM - Confirm air flow monitoring station location in conformance with manufacturer requirements	A	QA	QA
		Field Visit	Size - Confirm unit matches schedule req	A	QA	QA
		Submittal Process/ Field Visit	Fan bearings - Verify fan bearings were greased (if req) and have min average life of 200,000 hours at design operating conditions	A	RA/ QA	—
		Field Visit	Birdscreens - Verify birdscreens provided for outdoor inlets and outlets	A	QA	QA
		Field Visit	Verify all filter and access doors are accessible for service and maintenance	A	QA	—
		Field Visit	Verify provided are modular construction, double wall AHU's with min of 25mm (1 inch) casing insulation	A	QA	—
		Submittal Process	Verify provided have ARI 430 certified fans and ARI certified coils	A	RA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)		Submittal Process/ Field Visit	Drain pan - Verify provided has stainless steel, positive draining condensate drain pan	A	RA/ QA	—
		Submittal Process	For 100% OA units - Verify capability provided for cooling, heating, dehumidification, and reheat	A	RA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - Verify central station ahu's provided with an ultraviolet c-band (UVC) disinfection system for mold, bacteria, and odor control in each air handler that has a chilled water or DX cooling coil	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - Verify irradiation emitters and fixtures installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain pan	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - Verify the UVC energy produced has the lowest possible reflected and shadowed losses (To maintain energy efficiency)	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - For energy efficiency, verify power supplies are of the high efficiency electronic type and matched to the emitter	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - For intensity, verify the minimal UVC energy striking the leading edge (if installed upstream) or trailing edge (if installed downstream) of all the coil fins is not less than 820 uW/cm ² at the closest point and through pl	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - Verify equal amounts strike the drain pan, either directly or indirectly through reflection	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - For installation, verify emitters and fixtures are installed at right angles to the conforming lines of the coil fins, such that through incident angle reflection, UVC energy bathes all surfaces of the coil and drain pan	A	RA/ QA	—
		Submittal Process/ Field Visit	Ultraviolet disinfection system - Verify one complete set of spare bulbs supplied	A	RA/ QA	—
	AHU's - Split System	Submittal Process	Verify provided is factory assembled, packaged AHU rated in accordance with ARI 210/240 or ARI 340/360	A	RA	—
		Field Visit	Verify matching components provided are from the same manufacturer	A	QA	—
	AHU's - Rooftop	Submittal Process/ Field Visit	Verify provided is factory packaged unit in accordance with ARI 430 and suitable for outdoor installation	A	RA/ QA	—
		Field Visit	Roof Curb - Verify provided with manufacturer's roof curb	A	QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
ment & Components (continued)	Roof Curbs	Field Visit	Mounting Surface - Confirm fan or unit mounting surface is parallel to the horizon, not the roof deck if sloped	A	QA	—
		Field Visit	Waterproofing - Confirm curb has been flashed properly and seal to the roofing material (no leaks) (waterproofing)	A	QA	—
		Field Visit	Lightning Rods - Confirm lightning rods have been attached to units and run to ground	A	QA	—
		Field Visit	Insulation - Confirm roof curb is insulated	A	QA	—
		Field Visit	Size - Confirm curb is the same size or smaller as the unit being placed on it (tight fit)	A	QA	—
	Fans - ALL	Submittal Process/ Field Visit	Verify fans are AMCA 210 certified with AMCA seal	A	RA/ QA	—
		Submittal Process	Fan bearings - Verify fan bearings have min average life of 200,000 hours at design operating conditions	A	RA	—
		Field Visit	Rotation - Confirm rotation and alignment	A	QA	QA
		Field Visit	Belts - Confirm belt tightness (if provided)	A	QA	QA
		Field Visit	Motor - Confirm HP, voltage, amperage	A	QA	QA
		Field Visit	Size - Confirm size matches schedule req	A	QA	QA
		Field Visit	Verify fans are accessible for service and maintenance	A	QA	
		Field Visit	Birdscreens - Verify bird screens provided for outdoor inlets and outlets	A	QA	QA
		Field Visit	DDC - Verify fans provided with means for verifying operation via DDC system	A	QA	QA
	Exhaust Fans (Roof)	Field Visit	Roof Curb - Confirm lag bolted to roof curb	A	QA	QA
		Field Visit	Dome Top - Confirm dome top is secured	A	QA	QA
		Field Visit	Type - Verify centrifugal fans provided	A	QA	
	In-line Fans	Field Visit	Vibration Isolators - Confirm hangers & isolation devices	A	QA	QA
		Field Visit	Flex Connection - Confirm flexible connection to ductwork	A	QA	QA
		Field Visit	Speed Controller - Confirm speed controller installation (if provided)	A	QA	QA
		Field Visit	Access Panel - Confirm access panel located properly	A	QA	QA
		Field Visit	Type - Verify centrifugal fans provided	A	QA	—
	Wall Fans	Field Visit	Type - Verify wall fans provided are propeller fans with fan guards	A	QA	—
		Field Visit	Type - Verify wall fans provided are centrifugal fans with backdraft dampers and wall bracket	A	QA	—
	Bathroom Fan	Submittal Process/ Field Visit	Verify provided are UL 507 and UL-Listed, Home Ventilating Institute (HVI) certified, and with AMCA seal for ceiling installation	A	RA/ QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equip	Range Hoods	Submittal Process/ Field Visit	Verify provided are UL 507 and UL-Listed, with AMCA seal	A	RA/ QA	—
		Submittal Process/ Field Visit	Light - Verify provided with light over stove	A	RA/ QA	—
		Submittal Process	Verify min fan capacity is 160 cfm with max sound level of 5.6 sones	A	RA	—
	Louvers & Hoods - ALL	Submittal Process	Louver rating - Verify louvers bear AMCA ratings seal for air performance and water penetration in accordance with AMCA 500 and AMCA 511	A	RA	—
		Submittal Process/ Field Visit	Construction - Verify hoods and louvers constructed of anodized aluminum alloy or stainless steel	A	RA/ QA	
		Submittal Process/ Field Visit	Birdscreens - Verify provided for louvers and hoods	A	RA/ QA	QA
	Intake Hood (Roof)	Submittal Process/ Field Visit	Type - Confirm type as specified	A	RA/ QA	QA
		Field Visit	Confirm top is secured	A	QA	QA
		Submittal Process/ Field Visit	Size - Confirm size matches schedule req (free area)	A	RA/ QA	QA
	OA Intake Louvers (Wall)	Submittal Process/ Field Visit	Type - Confirm type as specified	A	RA/ QA	QA
		Submittal Process/ Field Visit	Size - Confirm size matches schedule req (free area)	A	RA/ QA	QA
		Submittal Process/ Field Visit	Confirm waterproof (when req) and velocity when water carry-over occurs	A	RA/ QA	QA
		Field Visit	Intake Plenum - Confirm intake plenum is sloped back to louver or drain has been provided	A	QA	QA
		Field Visit	Damper - Confirm opposed blade damper with actuator has been provided	A	QA	QA
		Field Visit	AFM - Confirm air flow monitoring type louver has been provided, if req	A	QA	QA

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)	Ductwork	Field Visit	Construction - Except as specified herein, verify ductwork constructed, braced, reinforced, installed, supported, and sealed per SMACNA standards	A	QA	QA
		Field Visit	Verify all dampers are accessible for service and maintenance	A	QA	—
		Field Visit	Confirm general construction conforms to contract documents	A	QA	QA
		Field Visit	Confirm correct pressure rating of ductwork has been conformed to SMACNA	A	QA	QA
		Field Visit	Confirm ductwork has been sealed in accordance with specified seal class	A	QA	QA
		Field Visit	VAV inlet - Confirm minimum straight duct is 6 duct diameters and same size as VAV terminal inlet	A	QA	QA
		Field Visit	Confirm DALT allowables are met	A	QA	QA
		Submittal Process/ Field Visit	Access Doors - Confirm access doors have been provided before every elbow with turning vanes	A	RA/ QA	QA
		Submittal Process/ Field Visit	Access Doors - Confirm access doors provided at appropriate locations	A	RA/ QA	QA
		Field Visit	Flexible duct - Verify insulated flexible duct used only to adapt to minor offsets for connections to air distribution devices	A	QA	QA
		Submittal Process	Flexible duct - Verify is UL 181 listed and per SMACNA DCS with minimum R value of 4	A	RA	—
		Field Visit	Flexible duct - Verify maximum length is 2 meters (6 feet)	A	QA	QA
		Field Visit	Flexible Duct - Confirm, where flexible ductwork is specified, that the length of flex ductwork is provided to the max req length or less and is supported properly with no abrupt turns (ie: as straight as possible)	A	QA	QA
		Field Visit	Flexible connectors - Verify provided between fans and ducts	A	QA	QA
		Submittal Process/ Field Visit	Damper - Confirm balancing damper at branch take-off's, not at diffuser neck	A	RA/ QA	QA
		Submittal Process/ Field Visit	Damper - Confirm balancing damper construction conforms to the specified seal class	A	RA/ QA	QA
		Submittal Process/ Field Visit	Damper - Confirm discharge damper installed on VAV terminal discharge, if req	A	RA/ QA	QA
		Field Visit	Damper - Confirm control damper type and location along with actuator type	A	QA	QA
		Submittal Process	Dampers - Verify conforms to SMACNA DCS	A	RA	—
		Submittal Process	Fire dampers - Verify are rated per UL 555	A	RA	—
Submittal Process	Fire dampers - Verify are dynamic type rated for closure against a moving airstream	A	RA	—		

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
ent & Components (continued)		Submittal Process/ Field Visit	Fire dampers - Verify do not intrude into air stream when in open position	A	RA/ QA	—
		Submittal Process	Smoke dampers - Verify are rated per UL 555S	A	RA	—
		Submittal Process/ Field Visit	Elbows - Confirm correct elbow type (ie: double wall turning vane, 1.5 radius curved, etc)	A	RA/ QA	QA
		Field Visit	Bracing - Confirm proper bracing of high pressure ductwork in accordance with SMACNA	A	QA	QA
		Field Visit	Filters - Confirm access to filter rack for ease of filter change out in duct mounted assemblies	A	QA	QA
		Submittal Process/ Field Visit	Insulation - Confirm ductwork insulated properly (ext batt, hard, int lined, double wall insulated, etc)	A	RA/ QA	QA
		Field Visit	Insulation - Inspect vapor barrier of insulation	A	QA	—
		Field Visit	Hangers - Confirm proper duct hangers have been utilized in accordance with spec req	A	QA	QA
		Field Visit	Vibration Isolators - Confirm the use of vibration isolation material at unit connection to ductwork free of holes (no leakage)	A	QA	QA
		Submittal Process	Sound attenuators - Verify fabricated sound attenuators reduces the rated sound pressure level of the fan down to at least 65 decibels in the 250 Hz (third octave band) center frequency by using a reference sound source calibrated in decibels of sound pow	A	RA	—
		Submittal Process/ Field Visit	Sound attenuators - Verify pressure drop does not exceed 157 Pa (0.63 inch of water)	A	RA/ QA	QA
	VAV Boxes - ALL	Submittal Process	Verify units are pressure-independent type and rated per ARI 880	A	QA	—
		Field Visit	Primary air valve - Verify not allowed to fully shut-off	A	QA	QA
		Field Visit	Heating coil - Verify each box provided with heating coil unless not required by space reheat or heating	A	QA	—
		Field Visit	Verify all VAV box control panels are accessible	A	QA	—
		Field Visit	Electronic controls - Verify are provided	A	QA	QA
	VAV Terminal Box (Fan-Powered)	Submittal Process	Type - Verify units are pressure-independent, fan powered, rated per ARI 880, and UL listed	A	QA	—
		Field Visit	Filters - Confirm filter installed and clean	A	QA	QA
		Field Visit	Confirm ductwork on primary inlet is installed with 6 straight duct diameters the same size as the inlet	A	QA	QA
		Submittal Process/ Field Visit	Dampers - Confirm discharge damper has been provided and/or coordinated with sheet metal contractor	A	QA	QA
		Field Visit	Confirm fan size & primary inlet sized in accordance with contract documents	A	QA	—
		Field Visit	Primary Air Valve - Confirm max/min setting of primary air valve	A	QA	QA
		Field Visit	Primary air valve - Verify not allowed to fully shut-off	A	QA	QA

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment		Field Visit	Size - Confirm size matches schedule req	A	QA	QA
		Field Visit	Motor - Confirm HP, voltage, and amperage of fan motor	A	QA	QA
		Field Visit	Heating coil - Verify each box provided with heating coil, if required	A	QA	—
		Field Visit	Reheat Coils - Confirm reheat coil size, if req	A	QA	—
		Field Visit	Reheat Coils - Confirm reheat coil is piped properly	A	QA	QA
		Field Visit	Sensors - Confirm discharge temp sensor provided, if req	A	QA	QA
		Field Visit	Confirm hangers have provisions for vibration isolation	A	QA	QA
		Field Visit	Electronic controls - Verify provided with speed controller, discharge volume control damper(s), and return/recirculation air frame and filter	A	QA	QA
		Submittal Process	Insulation - Verify in accordance with ASHRAE 90.1	A	RA	—
	VAV Terminal Box (Shut Off)	Field Visit	Confirm ductwork on primary inlet is installed with 6 straight duct diameters the same size as the inlet	A	QA	QA
		Field Visit	Primary Air Valve - Confirm max and min setting of primary air valve	A	QA	QA
		Field Visit	Reheat Coils - Confirm reheat coil size, if req	A	QA	—
		Field Visit	Reheat Coils - Confirm reheat coil in piping properly	A	QA	QA
		Field Visit	Sensors - Confirm discharge temp sensor provided, if req	A	QA	QA
		Field Visit	Confirm hangers have provisions for vibration isolation	A	QA	QA
		Field Visit	Size - Confirm box size matches schedule req	A	QA	QA
	DX VAV Units	Submittal Process	Finish - If indicated in ESR Section D30, verify anti-corrosion coating provided is immersion applied, baked phenolic, or other approved coating. Field applied coatings not acceptable.	A	QA	—
		Submittal Process/ Field Visit	Direct expansion equipment - Verify is specifically designed and manufactured for VAV applications	A	RA/ QA	—
		Submittal Process/ Field Visit	Equipment - Verify from the same manufacturer (central air handling units, VAV boxes/ zone dampers, and zone controls)	A	RA/ QA	—
Field Visit		Evaporator coils - Verify airflow through evaporator coils is not modulated	A	QA	—	
Field Visit		Zone control damper units - Verify duct mounted zone control damper units provided with integral control box designed for use with DX VAV packaged systems	A	QA	—	
Submittal Process/ Field Visit		Air diffusers - Verify self-modulating air diffusers are not used	A	RA/ QA	—	
Condensing Units	Submittal Process/ Field Visit	Finish - If indicated in ESR Section D30, verify anti-corrosion coating provided is immersion applied, baked phenolic, or other approved coating. Field applied coatings not acceptable.	A	RA/ QA	—	
	Submittal Process	Air conditioner - Verify air-cooled, split system air conditioner provided with ducted air distribution	A	QA	—	

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)		Submittal Process	Construction and rating - Verify units are factory assembled, designed, tested, and rated in accordance with ARI 210/ 240 or ARI 340/ 360	A	QA	—
		Submittal Process/ Field Visit	Clearance - Verify manufacturer's minimum recommended clearance around condensing units is provided	A	RA/ QA	QA
		Field Visit	Refrigerant piping size - Verify is per manufacturer's recommendations	A	QA	—
	Heat Pumps - Ground Source	Submittal Process/ Field Visit	Finish - If indicated in ESR Section D30, verify anti-corrosion coating provided is immersion applied, baked phenolic, or other approved coating. Field applied coatings not acceptable.	A	RA/ QA	—
		Submittal Process	Construction and rating - Verify units are factory assembled, designed, tested, and rated in accordance with ARI 330	A	QA	—
		Submittal Process	Heat exchanger - Verify connected to heat exchanger by closed loop ground source vertical well field	A	RA	—
		Submittal Process/ Field Visit	Well field - Verify design and installation of each well field comply with IGSHPA and ASHRAE standards	A	RA/ QA	—
	Heat Pumps - Water Source	Submittal Process/ Field Visit	Finish - If indicated in ESR Section D30, verify anti-corrosion coating provided is immersion applied, baked phenolic, or other approved coating. Field applied coatings not acceptable.	A	RA/ QA	—
		Submittal Process	Construction and rating - Verify units are factory assembled, designed, tested, and rated in accordance with ARI 210/ 240 or ARI 340/ 360	A	QA	—
	Heat Pumps - Air to Air	Submittal Process/ Field Visit	Finish - If indicated in ESR Section D30, verify anti-corrosion coating provided is immersion applied, baked phenolic, or other approved coating. Field applied coatings not acceptable.	A	RA/ QA	—
		Submittal Process	Heat pumps - Verify air-cooled, split system heat pumps provided with ducted air distribution	A	RA/ QA	—
		Submittal Process	Construction and rating - Verify units are factory assembled, designed, tested, and rated in accordance with ARI 210/ 240 or ARI 340/ 360	A	QA	QA
		Field Visit	Clearance - Verify manufacturer's minimum recommended clearance around condensing units is provided	A	QA	—
		Field Visit	Refrigerant piping size - Verify is per manufacturer's recommendations	A	QA	QA
		Field Visit	Insulation - Verify provided for refrigerant piping suction lines and condensate drain	A	QA	—
	Condensate Return Units	Submittal Process/ Field Visit	Verify has floor-mounted receiver and duplex pump unit	A	RA/ QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)	Equipment Thermal Insulation	Submittal Process/ Field Visit	Insulation - Verify insulation provided for hot and chilled water pumps and equipment as suitable for the temperature and service fit as closely as possible to equipment. May be rigid block, semi-rigid board, or flexible unicellular insulation.	A	RA/ QA	QA
			Vapor retarder - Verify provided for chilled water applications	A	QA	—
	Auxilliary Equipment	Submittal Process/ Field Visit	Steam-to-hot-water converter - Verify provided as required for application	A	RA/ QA	—
		Submittal Process	Heat exchangers - Verify factory assembled u-tube units provided constructed in accordance with ASME BPVC for steam or hot water. For hot water, plate type heat exchangers may be provided.	A	RA	—
	Furnaces	Submittal Process/ Field Visit	Construction - Confirm provided furnace is UL-listed, factory assembled, self-contained, and forced circulation	A	RA/ QA	QA
		Submittal Process/ Field Visit	Electronic ignition system - Verify provided	A	RA/ QA	—
		Submittal Process/ Field Visit	Gas furnace rating - Confirm unit is design certified by AGA and GAMA efficiency rating certified for gas furnaces.	A	RA/ QA	—
		Submittal Process/ Field Visit	Oil furnace rating - Confirm unit meets requirements for NFPA 31 for oil furnaces.	A	RA/ QA	—
		Submittal Process/ Field Visit	Cooling coil - Verify provided, if necessary	A	RA/ QA	—
	Unit Ventilators	Submittal Process/ Field Visit	Verify unit is a factory assembled unit ventilator capable of up to 100% OA ventilation and UL-Listed	A	RA/ QA	—
	Unit Heaters	Submittal Process/ Field Visit	See D302004 for gas fired unit heaters	A	RA/ QA	—
	Unit Heaters- Steam	Submittal Process/ Field Visit	Verify provided is UL-Listed and factory assembled	A	RA/ QA	—
	Unit Heaters - Hot Water	Submittal Process/ Field Visit	Verify provided is UL-Listed and factory assembled	A	RA/ QA	—
Unit Heaters - Cabinet	Submittal Process/ Field Visit	Verify provided is UL-Listed and factory assembled	A	RA/ QA	—	

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
	Fuel-Fired Unit Heaters - Gas	Submittal Process/ Field Visit	Verify meets requirements for ANSI Z83.8 and AGA label	A	RA/ QA	—
		Submittal Process/ Field Visit	Discharge louver - Verify each heater equipped with individually adjustable package discharge louver	A	RA/ QA	QA
		Submittal Process/ Field Visit	Thermostat - Verify provided	A	RA/ QA	QA
	Fuel-Fired Unit Heaters - Infrared	Submittal Process/ Field Visit	Verify meets requirements for ANSI Z83.8 and AGA label	A	RA/ QA	—
	Unit Heaters - Electric	Submittal Process/ Field Visit	Verify provided are factory assembled, UL-1025	A	RA/ QA	—
	Heaters - Baseboard	Submittal Process/ Field Visit	Verify provided are factory assembled, UL-1042	A	RA/ QA	—
	Heaters - Wall	Submittal Process/ Field Visit	Verify provided are factory assembled, UL-1025, cabinet heaters	A	RA/ QA	—
	Heaters - Infrared	Submittal Process/ Field Visit	Verify provided are factory assembled, UL-Listed and labeled heaters	A	RA/ QA	—
	Fin Tube Radiators & Convectors	Submittal Process	Verify fin tube radiators and convectors provided with copper tubes and aluminum fins	A	RA	—
		Submittal Process	Control Valves - Verify control valves provided are normally open, spring return	A	RA/ QA	QA
	Duct Heater	Submittal Process/ Field Visit	Verify provided is factory assembled, UL-Listed heater	A	RA/ QA	—
		Field Visit	Verify adequate duct length is provided per manufacturer's recommendations upstream & downstream	A	QA	—
		Submittal Process/ Field Visit	Verify control cabinet and heating coil provided	A	RA/ QA	—
	Pumps - ALL	Submittal Process/ Field Visit	Verify provided are centrifugal circulating pumps with motor, motor starter, and motor enclosure conforming to the appropriate NEMA standards	A	RA/ QA	—
		Field Visit	Insulation - Verify pumps used for hot service and chilled water service are insulated	A	QA	QA

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)	Pumps - Base-mounted	Field Visit	Confirm size and nameplate data matches schedule req	A	QA	QA
		Field Visit	Verify voltage service matches nameplate	A	QA	QA
		Field Visit	Verify provided are single-stage end suction pumps suitable for chilled, condenser, and hot water heating systems	A	QA	QA
		Field Visit	Isolation Base - Confirm isolation base is provided where req	A	QA	QA
		Field Visit	Insulation - Confirm insulation enclosure is provided where req	A	QA	QA
		Field Visit	Confirm pressure taps, gages, and shutoffs have been provided in the specified locations	A	QA	QA
		Field Visit	Balancing Valves - Confirm the balancing valves have been provided in accordance with manufacturers recommendations and/or in accordance with the appropriate contract document detail	A	QA	QA
		Field Visit	Balancing Valves - Confirm balancing valves provided with proper clearances	A	QA	QA
		Field Visit	Rotation - Verify rotation direction is correct	A	QA	QA
		Field Visit	Suction diffusers - Verify suction diffusers provided on base-mounted pumps	A	QA	QA
	Pumps - In-line	Field Visit	Location - Confirm location is correct(ie: in accordance with the contract documents)	A	QA	QA
		Field Visit	Verify constructed of manufacturer's standard materials suitable for chilled, condenser, and hot water heating systems	A	QA	QA
		Field Visit	Confirm voltage provided is correct	A	QA	QA
		Field Visit	Valve Arrangement - Confirm valve arrangement around the pump is correct	A	QA	QA
		Field Visit	Balancing Valve - Confirm balancing valve has been provided in accordance with the contract documents, if req	A	QA	QA
		Field Visit	Balancing Valve - Confirm balancing valves provided with proper clearances	A	QA	QA
	Diffusers, Registers, & Grilles	Field Visit	Confirm location, size, and type have been provided in accordance with the contract documents	A	QA	QA
		Field Visit	Dampers - Confirm branch balancing dampers have been provided and dampers, if any, provided with the air device are in the wide open position	A	QA	QA
		Field Visit	Finish - Verify are factory-finished	A	QA	—
		Field Visit	Exterior and exposed edges - Verify are rolled, or otherwise stiffened and rounded	A	QA	—
	Pipe Sleeves	Field Visit	Verify pipe sleeves provided at each wall and floor penetration	A	QA	—
		Field Visit	Verify sleeves are of a material suitable to protect the carrier pipe (2 pipe sizes larger) and sealed with an appropriate flexible material	A	QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)		Submittal Process/ Field Visit	Fire Stopping - In fire rated walls, verify fire stopping provided in accordance with IBC	A	RA/ QA	—
	Piping Identification	Field Visit	Verify piping provided with identification labels or stencil names or code letters for piping systems in clearly visible letters and symbols	A	QA	—
		Field Visit	Verify arrow-shaped markings provided to indicate direction of flow	A	QA	QA
	Piping - Condensate Drain	Submittal Process/ Field Visit	Verify condensate drain piping provided is ASTM B 88, Type M or L, hard drawn copper	A	RA/ QA	—
	Piping	Field Visit	Flushing - Confirm/ witness pipe flushing (make sure water is clear prior to putting final chemicals into water system)	V	W	—
		Field Visit	Strainers - Confirm start-up strainer has been removed from all strainers (hang at location)	A	QA	—
		Field Visit	Air Vents - Confirm air vents are at specified locations and are auto type, if req	A	QA	QA
		Submittal Process/ Field Visit	Pressure Relief Valves - Confirm pressure relief valves are sized properly and installed where specified	A	RA/ QA	QA
		Field Visit	Confirm make-up water pressure setting is sufficient for facility (adjust if req for pressure req at highest point)	A	QA	QA
		Field Visit	Expansion Tanks - Where diaphragm expansion tanks are provided, confirm tank pressure is set in accordance with nameplate	A	QA	QA
		Field Visit	Confirm valve arrangements for each unit coil are as specified on the contract documents	A	QA	QA
		Field Visit	Confirm all valve clearance req's, manufacturer, and/or contract have been adhered to	A	QA	QA
		Field Visit	Layout - Confirm piping layout conforms to the contract documents (physically walk all pipe runs to make sure there are no cross connections)	A	QA	QA
		Field Visit	Confirm traps have been provided on condensate lines per the contract documents	A	QA	
		Field Visit	Confirm slope of condensate lines meets spec req	A	QA	
		Field Visit	Supports - Confirm piping supported properly (ie: hangers, saddles, seismic (if req))	A	QA	QA
		Field Visit	Insulation - Confirm pipe insulated with specified insulation and vapor barrier is intact	A	QA	QA
		Submittal Process/ Field Visit	Fittings - Confirm dielectric fittings have been provided where piping of dissimilar metals connect	A	RA/ QA	—
		Field Visit	Confirm condensate piping from equip has been run to floor drains, if req	A	QA	QA
		Field Visit	Identification - Confirm piping is marked properly with water type and direction of flow	A	QA	QA
Field Visit	Confirm provisions have been made in the piping arrangement at each coil for isolation of flow and ease of coil removal	A	QA	QA		

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Components (continued)		Field Visit	Confirm steam piping relief valve has been piped to the exterior of the building in a safe location to personnel	A	QA	QA
		Field Visit	Confirm hazard warning and/or hot surface signage is in place at steam piping, equip. (This also applies to hot water systems)	A	QA	—
		Field Visit	Flow Meters - Confirm location of flow meters meets factory req for straight, unobstructed inlet and outlet piping	A	QA	QA
	Chillers	Field Visit	Leaving Water Temp - Confirm the leaving chilled water temp is below temp specified for terminal equip to compensate for pump heat gain (approx 1.8F/1.0C) (chiller leaving should never be same as temp req at terminal unit)	A	QA	QA
		Submittal Process/ Field Visit	Confirm piping/valve arrangement matches contract documents and balancing valve and flow monitoring device have been provided in accordance with manufacturers req and/or detail	A	RA/ QA	QA
		Submittal Process/ Field Visit	Decoupler - Confirm decoupler leg is tied into chilled return piping before entering chilled water return header (for multiple chillers)	A	RA/ QA	QA
		Field Visit	Confirm piping arrangement has allotment for access to the cooling and condensing bundles	A	QA	QA
		Field Visit	Flow Switch - Confirm flow switch has been provided to protect the chiller from low or lack of flow	A	QA	QA
		Submittal Process/ Field Visit	Confirm BACNET compatible (if req in contract docs) and that the connection has been made to the DDC control system	A	RA/ QA	QA
	Chiller Systems Closed Circuit Coolers	Submittal Process	Construction and rating - Confirm provided is factory assembled conforming to NFPA 214	A	RA	—
		Submittal Process	Fire hazard rating - Verify fire hazard rating for plastic impregnated materials does not exceed 25	A	RA	—
		Submittal Process	Certification - Verify Cooling Technology Institute 201 certification of tower capability and performance is provided	A	RA	—
		Submittal Process	Cooler performance - Verify meets or exceeds that listed in ASHRAE 90.1	A	RA	—
		Submittal Process/ Field Visit	Hardware - Verify stainless steel hardware provided	A	RA/ QA	—
	Submittal Process	Vibration cutout switch - Verify interlocked with fan motor	A	RA	—	
	Submittal Process	Fan motors - Verify 2-speed or adjustable frequency drive fan motors provided	A	RA	—	
	Field Visit	Safety - Verify OSHA safety requirements for stairs and handrails are met	A	QA	—	

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Controls	Chiller Systems Water Cooled Chillers	Submittal Process	Construction and rating - Verify self-contained chiller provided meeting requirements of ARI 550/590-98	A	RA	—
		Field Visit	Control panel - Verify provided with manufacturer's standard controls and protection circuits	A	QA	—
		Submittal Process/ Field Visit	DDC system - If DDC system required in project, verify control interface provided for remote monitoring of chiller's operating parameters, functions, and alarms from DDC control system central workstation	A	RA/ QA	QA
		Submittal Process	Automatic capacity-reduction system - Verify provided for stable operation from 100 to 10 percent of full load capacity	A	RA	—
	Chiller Systems Air Cooled	Submittal Process	Construction and rating - Verify provided air-cooled chillers are type indicated in Project Program and meet requirements of ARI 550/590-98	A	RA	—
		Submittal Process	Control panel - Verify provided with manufacturer's standard controls and protection circuits	A	RA	—
		Submittal Process/ Field Visit	DDC System - If DDC system required in project, verify control interface provided for remote monitoring of chiller's operating parameters, functions, and alarms from DDC control system central workstation	A	RA/ QA	QA
		Submittal Process	Reciprocating chillers - Verify minimum of four stages of unloading provided at 25% per stage minimum	A	RA	—
		Submittal Process	Reciprocating chillers - Verify provided with hot gas bypass	A	RA	—
		Submittal Process	Head pressure control - Verify provided for cold temperature operation	A	RA	—
		Submittal Process/ Field Visit	Freeze protection - Verify provided for chiller and piping	A	RA/ QA	QA
		Submittal Process/ Field Visit	Condenser coils - Verify provided are copper tube with aluminum fins unless specified otherwise	A	RA/ QA	QA
		Submittal Process/ Field Visit	Condenser coils - If condenser coil coatings indicated in ESR Section D30, verify provided with copper tube/ copper fin construction or immersion applied, baked phenolic, or other approved coating. Field applied coatings not acceptable.	A	RA/ QA	QA
		Submittal Process/ Field Visit	Condenser coils - Verify condenser coils provided with manufacturer's optional louvered covers or hail guards for protection against vandalism, debris, or hail	A	RA/ QA	—
	Cooling Tower	Field Visit	Confirm tower size HP, voltage per contract docs	A	QA	QA
Submittal Process/ Field Visit		Confirm tower constructed in accordance with specs (ie: galvanized, stainless steel, fiber-glass)	A	RA/ QA	QA	
Submittal Process/ Field Visit		Sump - Confirm height of cooling tower sump is above intake of condenser water pumps (min of 3 to 4 feet)	A	RA/ QA	QA	

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
Equipment & Components (continued)		Submittal Process/ Field Visit	Confirm return line to tower has trap leg below well unless the by-pass is piped directly to cooling tower well	A	RA/ QA	QA	
		Field Visit	Overflow - Confirm tower well overflow is low enough to prevent the well from overflowing	A	QA	QA	
		Field Visit	Make-up Float - Confirm tower well make-up float setting shuts of prior to water level reaching the top of the overflow	A	QA	QA	
		Field Visit	Fan Rotation - Confirm tower fan rotation is correct	A	QA	QA	
		Field Visit	Well Heater - Confirm tower well heater is installed, if req	A	QA	QA	
		Field Visit	Shut-off Valve - Confirm tower shut-off valve has been installed in proper location, if req	A	QA	QA	
		Field Visit	Fan Discharge - Confirm tower fan discharge is unobstructed from above	A	QA	QA	
		Field Visit	Heat Trace - Confirm tower piping above grade is heat traced, if req	A	QA	QA	
		Submittal Process	Construction and rating - Confirm provided is factory assembled conforming to NFPA 214	A	RA	—	
		Submittal Process	Fire hazard rating - Confirm fire hazard rating for plastic impregnated materials does not exceed 25	A	RA	—	
		Submittal Process	Certification - Verify Cooling Technology Institute 201 certification of tower capability and performance is provided	A	RA	—	
		Submittal Process	Cooling tower performance - Verify meets or exceeds that listed in ASHRAE 90.1	A	RA	—	
		Submittal Process/ Field Visit	Construction - Verify construction is as indicated in ESR Section D30 with fill material of PVC formed sheets	A	RA/ QA	—	
		Submittal Process/ Field Visit	Hardware - Verify stainless steel hardware provided	A	RA/ QA	—	
		Submittal Process	Vibration cutout switch - Verify interlocked with fan motor	A	QA	—	
		Submittal Process	Fan motors - Verify 2-speed or adjustable frequency drive fan motors provided	A	QA	—	
		Submittal Process/ Field Visit	Work platforms - Verify provided at all locations in tower that require periodic maintenance	A	RA/ QA	—	
		Submittal Process/ Field Visit	Isolation valves - For multi-cell installations, verify isolation valves provided on inlets and outlets of each cell	A	RA/ QA	—	
		Fan Coil Units	Field Visit	Confirm size and location in accordance with contract docs	A	QA	QA
			Field Visit	Filter Access - Confirm filter accessibility	A	QA	QA
	Field Visit		Confirm vibration isolation provided for on hangers and at ductwork connection	A	QA	QA	
	Field Visit		Confirm installation of auxilliary drain pan (if req) along with respective condensate drain piping	A	QA	QA	

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment & Components (continued)		Field Visit	Confirm valves arranged properly including the straight pipe diameters req before and after the balancing valve	A	QA	QA
		Submittal Process/ Field Visit	Speed Controller - Confirm speed controller has been provided, if req in contract docs	A	RA/ QA	QA
		Field Visit	Fan Access - Confirm fan access is accessible by maintenance staff	A	QA	QA
		Field Visit	Confirm unit tagging has been provided	A	QA	—
		Field Visit	Confirm operational	A	QA	—
		Submittal Process/ Field Visit	Sensors - Confirm leaving air temp sensor has been provided	A	RA/ QA	QA
		Submittal Process	Verify provided are UL-Listed, factory assembled and tested fan coils, ARI 440, and ARI certified	A	QA	—
	Thru Wall Classroom Terminal Units	Field Visit	Confirm size and location in accordance with contract docs	A	QA	QA
		Field Visit	Confirm operational	A	QA	—
		Field Visit	Confirm piping arrangement meets contract docs req's	A	QA	QA
	Packaged Thru Wall Units	Submittal Process	Verify provided is factory assembled air conditioner or heat pump and rated in accordance with ARI 310 or ARI 380 and ARI certified	A	RA	—
		Submittal Process	Verify provided unit includes heat and operates under the standard unit controls (Not sure if worded correctly, D305006 1.4)	A	RA	—
		Submittal Process	Wall Sleeve - Verify unit designed to allow ease of maintenance by use of a wall sleeve	A	RA	QA
		Submittal Process/ Field Visit	Condensate Removal - Verify provided unit includes internal condensate removal (condensate shall not be externally drained)	A	RA/ QA	QA
	Room Air Conditioners	Submittal Process	Verify provided is factory assembled air conditioner or heat pump and rated in accordance with AHAM RAC-1	A	RA	—
		Submittal Process/ Field Visit	Verify auxiliary electric heat included and operates under the standard unit controls	A	RA/ QA	QA
		Submittal Process	Verify provided unit is AHAM certified or listed in AHAM DCRAC	A	RA	—
	Computer Room Units	Field Visit	Confirm size and location	A	QA	QA
		Field Visit	Confirm all features have been provided	A	QA	QA
		Field Visit	Confirm water connection to humidifier	A	QA	QA
		Field Visit	Fan Rotation - Confirm fan rotation	A	QA	QA
		Submittal Process	If computer room unit req'd, verify DOR utilized UFGS Spec section 23 81 23.00 20 (Computer Room Air Conditioning Units) for the project spec and submitted the edited spec section as part of the design submittal for the project	A	RA	—
	Boilers	Field Visit	Confirm size and location	A	QA	—
		Field Visit	Stack - Confirm stack material and arrangement meet contract doc req's	A	QA	QA

KEY = A - Approve, R - Review, W - Witness, RA - Receipt Acknowledge, S - Surveillance Review, V- Verification and Testing, C - Copy, QA - Quality Assurance

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
		Field Visit	Stack - Confirm stack above roof does not touch roof curb and guy wires have been provided	A	QA	QA
		Field Visit	Stack - Confirm stack type is per contract docs and the height above the parapet and/or building meets code req's	A	QA	QA
		Field Visit	Confirm fuel train meets contract docs and code req's with no leaks	A	QA	QA
		Submittal Process/ Field Visit	Make-up Air - Confirm adequate make-up air for the boiler(s) has been provided under positive pressure to the room	A	RA/ QA	QA
		Field Visit	Relief Valve - Confirm relief valve setting and operation	A	QA	—
		Field Visit	DDC - Confirm boilers have been interfaced with the DDC system	A	QA	QA
		Field Visit	Confirm pump/piping arrangement meets contract docs including circulation pump, if req	A	QA	QA
		Submittal Process/ Field Visit	Confirm boiler sequencing panel has been provided by the boiler manufacturer, if req in the contract docs	A	RA/ QA	QA
	Boilers - Hot Water	Submittal Process	Load capacity - Verify boiler type provided meets building load capacity as indicated in ESR Section D30, if required	A	RA	—
		Submittal Process/ Field Visit	Construction and rating - Verify boiler designed, tested, and installed per ASME CSD-1 (Controls and Safety Devices) and ASME BPVC (Boiler and Pressure Vessel Code)	A	RA/ QA	—
		Submittal Process/ Field Visit	Construction - Verify boiler meets requirements of UL 795, ANSI Z83.3, and ASME CSD	A	RA/ QA	—
		Submittal Process/ Field Visit	Burners - Confirm provided are make, model, and type certified and approved by manufacturer of provided boiler	A	RA/ QA	—
		Submittal Process/ Field Visit	Verify burner controls and flame safety equipment conform to either ASME CSD-1 or NFPA 58 as dictated by input	A	RA/ QA	—
		Submittal Process/ Field Visit	Boiler controls - Verify are mounted on a single control panel mounted on the burner or separate from the burner (includes operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of the control system). If separa	A	RA/ QA	—
		Submittal Process/ Field Visit	Trim - Verify boiler trim complies with ASME BPVC SEC IV, ASME CSD-1, and additional appurtenances as specified herein	A	RA/ QA	—
		Submittal Process/ Field Visit	Pressure gages - Confirm provided have scale equivalent to 1.5 times the outlet water pressure on supply water piping and return water piping	A	RA/ QA	—
		Submittal Process/ Field Visit	Thermometers - Piping - Confirm provided have scale equivalent to 1.5 times the outlet water temperature on supply water piping and return water piping	A	RA/ QA	—
		Field Visit	Drain valve - Verify provided and piped to floor drain	A	QA	—

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MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
Equipment & Components (continued)		Submittal Process/ Field Visit	Air vent valve - Verify provided with screwed connection, stainless steel disk, and stainless steel seats to vent entrapped air	A	RA/ QA	—	
		Submittal Process	Boiler stack - Verify provided boiler stack insulated in accordance with manufacturer's recommendations and conform to NFPA 211, or pre-manufactured multi-wall stacks provided complying with NFPA 54 or NFPA 58 and UL-listed	A	RA	—	
		Submittal Process/ Field Visit	Thermometer - Flue gas - Verify provided and mounted in flue gas outlet	A	RA/ QA	—	
		Field Visit	Cleaning - Verify boiler(s) cleaned in accordance with ASME Boiler and Pressure Vessel Code and manufacturer's recommendations prior to startup	A	QA	—	
		Field Visit	Testing - Verify services are furnished of an engineer or technician approved by the boiler manufacturer for installation, startup, and operational and safety testing	V	W	W	
		Field Visit	Testing - Verify boiler demonstrates proper operability of combustion control, flame safeguard control, and safety interlocks	V	W	W	
		Boilers - Steam		Confirm meets same requirements specified for hot water boilers except as follows:			
		Submittal Process/ Field Visit	Pressure gage - Confirm provided have scale equivalent to 1.5 times the outlet water pressure on boiler feedwater supply piping and condensate return water piping	A	RA/ QA	—	
		Submittal Process/ Field Visit	Pressure gage - Confirm provided boiler steam pressure gage has scale equivalent to 1.5 times the boiler rated working pressure	A	RA/ QA	—	
		Submittal Process/ Field Visit	Thermometers - Piping - Confirm provided have scale equivalent to 1.5 times the outlet water temperature on boiler feedwater piping and return water piping	A	RA/ QA	—	
		Insulation - Condensate Drain	Field Visit	Insulation - Verify condensate drain piping insulated with flexible cellular insulation	A	QA	—
		Insulation	Field Visit	Verify all ductwork provided with external thermal insulation	A	QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
Equipment & Components (continued)		Field Visit	Verify all ductwork in concealed spaces insulated with blanket flexible mineral fiber	A	QA	—	
		Field Visit	Verify ductwork in mechanical Rooms and exposed locations insulated with rigid mineral fiber insulation	A	QA	—	
		Field Visit	Verify insulation provided with factory applied all-purpose jacket with integral vapor retarder	A	QA	—	
		Field Visit	In exposed locations, verify jacket provided with white surface suitable for painting	A	QA	—	
		Submittal Process/ Field Visit	Verify flame spread/smoke developed rating for all insulation does not exceed 25/ 50	A	RA/ QA	—	
		Submittal Process	Verify minimum insulation thickness does not violate minimum required by ASHRAE 90.1	A	RA	—	
		Field Visit	Verify the backs of all supply air diffusers insulated with blanket flexible mineral fiber insulation	A	QA	QA	
		VFDs	Submittal Process/ Field Visit	Verify are factory-assembled VFD drive control systems for variable speed control	A	RA/ QA	QA
			Submittal Process/ Field Visit	Verify all AHU and pump VFD's are from same manufacturer	A	RA/ QA	QA
			Submittal Process/ Field Visit	Verify each VFD provided includes motor starter, motor disconnects, and controls as required for a complete system	A	RA/ QA	QA
			Submittal Process/ Field Visit	Verify VFD units provided are UL-Listed and comply with the National Electric Code	A	RA/ QA	—
			Submittal Process/ Field Visit	Verify the following accessories were provided: Disconnect switch, Control circuit transformer with primary and secondary fuses, Manual bypass, System hand-off-auto switch with provisions for remote start/stop of the system, System initialized light, Run	A	RA/ QA	QA
		Air Separators	Submittal Process/ Field Visit	For hot and chilled water - Verify provided are ASME rated air separators with tangential inlet and outlet connections and automatic air vent	A	RA/ QA	—
		Solids Separators	Submittal Process/ Field Visit	Verify provided are centrifugal solids separators with automatic drain in open systems.	A	RA/ QA	—
		Expansion Tanks	Submittal Process/ Field Visit	For hot and chilled water - Verify provided are ASME rated expansion tanks with polypropylene or butyl diaphragm or compression tanks as indicated in UFC 3-400-10N.	A	RA/ QA	—
		Make-Up Water Station	Field Visit	Verify station consists of a water pressure-reducing valve, filter, and relief valve in the make-up water line to the chilled and hot water systems to maintain the operating pressure	A	QA	—
			Field Visit	Verify a 20mm (3/4 inch) globe valve by-pass provided around the pressure reducing station	A	QA	—
			Field Visit	Verify a reduced pressure backflow preventer provided upstream of the by-pass	A	QA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Plant & Components (continued)	Glycol Make-Up Station	Submittal Process/ Field Visit	If required, verify a glycol make-up system provided to maintain system proper operating mixture	A	RA/ QA	—
	Chemical Treatment	Submittal Process/ Field Visit	If required, verify chilled and hot water systems provided with automatic chemical treatment system for the control of pH, scale formation, and corrosion inhibition	A	RA/ QA	—
		Field Visit	Verify shot-type feeders provided for manual chemical feed	A	QA	—
		Submittal Process	Verify feeders rated for use with pressures up to 900 kPa (130 PSI) (gage)	A	RA	—
		Submittal Process/ Field Visit	Verify condenser water systems provided with automatic chemical treatment systems that monitor conductivity, pH, etc, and provide for water metering and bleed-off	A	RA/ QA	—
		Submittal Process/ Field Visit	Verify chemicals provided are in accordance with EPA and equipment manufacturer's recommendations	A	RA/ QA	—
	System Flushing	Field Visit	Verify hydronic systems flushed thoroughly prior to system startup	A	QA	—
	Heat Tape	Submittal Process/ Field Visit	Verify heat tape provided is UL-Listed, and self-regulating	A	RA/ QA	—
		Submittal Process/ Field Visit	Verify heat tape provided on piping subject to freezing	A	RA/ QA	QA
	Terminal & package Units	Submittal Process/ Field Visit	Where required in ESR Section D30, verify anti-corrosion coating provided on the casing and both the condenser and evaporator coils to protect against salt air damage	A	RA/ QA	—
		Submittal Process/ Field Visit	Verify anti-corrosion coating is immersion applied, baked phenolic or other approved coating (Field applied coatings are not acceptable)	A	RA/ QA	—
	Seismic Design	Submittal Process	Verify provided in accordance with UFC 3-400-10N, Mechanical Engineering	A	RA	—
	Energy Recovery Wheel (Enthalpy Wheel)	Field Visit	Verify provided is a total energy (enthalpy) type energy recovery wheel (heat wheel)	A	QA	—
		Submittal Process/ Field Visit	Media - Verify media is aluminum or a lightweight polymer coated with a corrosion resistance finish (Etched or oxidized surfaces are not acceptable)	A	RA/ QA	—
		Submittal Process/ Field Visit	Verify heat transfer surfaces are coated with a non-migrating (permanently bonded) absorbent specifically developed for the selective transfer of water vapor	A	RA/ QA	—
		Submittal Process	Verify equal sensible and latent recovery efficiencies are documented through a certification program conducted per ASHRAE 84 and ARI 1060	A	RA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
Equipment		Submittal Process/ Field Visit	Verify energy recovery wheel provided with insulating housing of double wall construction, rotor seals specifically designed to limit cross-contamination, and a rotation detector	A	RA/ QA	—
		Field Visit	Verify the rotation detector alarms the HVAC control system if rotation stops	A	QA	—
		Field Visit	Filter Access - Verify filter sections are readily accessible for maintenance	A	QA	QA
	Heat Pipes	Submittal Process	Verify provided are factory fabricated, assembled and tested heat pipes with counter-flow arrangement	A	RA	—
		Submittal Process	Verify are provided with hermitically sealed, seamless aluminum tube cores with extended surfaces	A	RA	—
		Submittal Process	Verify heat exchanger frame constructed of not less than 16-gage galvanized steel and fitted with intermediate tube supports and flange connections	A	RA	—
		Submittal Process	Verify tube end covers and a partition of galvanized steel provided to separate exhaust and supply air streams without cross-contamination	A	RA	—
		Submittal Process	Refrigerant - Verify refrigerant used as the working fluid (Type I refrigerants are not allowed)	A	RA	—
	Exterior Piping Manholes	Submittal Process/ Field Visit	Manholes - Verify system manholes are constructed of reinforced, 206.8 bar (3000 psi) concrete. Verify manhole floor and sides are watertight and were made in one monolithic pour. Verify manhole top extends a minimum of 300 mm (6 inches) above grade. V	A	RA/ QA	—
		Submittal Process	Verify a sump pit and a vertical sump pump designed for an operating temperature design of 93 degrees C (195 degrees F) minimum are provided in each system manhole.	A	RA	—
		Submittal Process	Sump Pump - Float Control - Verify a 2-pole float control is provided for each manhole sump pump.	A	RA	—
	Exterior Piping Cathodic Protection	Field Visit	If underground steel piping is installed, verify a cathodic protection system is provided.	A	QA	—
		Submittal Process	If a cathodic protection system is provided, verify the system was designed by a National Association of Corrosion Engineers (NACE) certified Cathodic Protection Engineer and they supervised, inspected and tested the installation and performance of the ca	A	QA	QA
		Field Visit	Verify the test stations were post mounted and placed at the manhole or nearby building and test stations were provided at each end of each cathodically protected section.	A	QA	—
	DDC		Verify one of the following provided as directed in ESR Section D30			
		Submittal Process	A) Verify Direct Digital Controls (DDC) provided to comply with UFGS Section 23 09 54.00 20, Direct Digital Control Systems	A	RA	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
Equipment & Components (continued)		Submittal Process	A) Verify DOR utilized UFGS Spec Section 23 09 54.00 20, Direct Digital Control Systems, for the project spec, and submitted the edited spec section as part of the design submittal for the project	A	RA	—	
		Submittal Process/ Field Visit	B) Verify a partial DDC system provided that communicates with the existing DDC system	A	RA/ QA	—	
		Submittal Process	B) Notwithstanding any other provisions of this contract, no other product will be acceptable other than that indicated in ESR Section D30	A	RA	—	
		Submittal Process/ Field Visit	B) Verify the system has stand alone digital controllers, a communication network, and a workstation computer with control software (Pneumatic controllers and components are not acceptable)	A	RA/ QA	—	
		Submittal Process	B) Verify all 120-volt wiring complies with NFPA 70	A	RA	—	
		Submittal Process/ Field Visit	B) Verify all 24-volt wiring complies with the IMC and terminal device manufacturer's recommendations	A	RA/ QA	—	
		DDC - Equipment Controllers	Submittal Process/ Field Visit	Verify DDC hardware are UL-916 rated	A	RA/ QA	—
			Submittal Process/ Field Visit	Verify controllers used in a distributed control manner	A	RA/ QA	QA
			Submittal Process/ Field Visit	Verify controllers are stand alone with an internal clock and modem	A	RA/ QA	QA
			Submittal Process	Verify the total number of I/O hardware points do not exceed 48 in any controller	A	RA	QA
			Submittal Process	Verify sufficient memory provided for each controller to support required control, communication, trends, alarms, and messages	A	RA	QA
			Submittal Process/ Field Visit	Verify communications ports provided for controller to controller, on-site interface, remote workstation interface, and telecommunications interface	A	RA/ QA	QA
		DDC - Electronic Controls	Submittal Process/ Field Visit	If required, verify programmable thermostats provided with built in keypads for scheduling of day and night temps with two setback periods per day	A	RA/ QA	QA
			Submittal Process/ Field Visit	Verify independent summer and winter programs provided	A	RA/ QA	QA
			Submittal Process/ Field Visit	Verify thermostats have temporary and manual override of schedule and battery backup	A	RA/ QA	QA
		All Submittals	Submittal Process	All equipment and controls hardware reviewed by A/E	A	RA	RA
		DALTS - Submittals	Submittal Process	TAB contractor qualifications & certification	RA	RA	A
			Submittal Process	DALT test equip with certification	RA	RA	A

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
		Submittal Process	DALT test plan	RA	RA	A	
		Submittal Process	DALT tests report including plan drawing of duct to be tested and square foot calc for each section	RA	RA	A	
	DALTS - Testing	Submittal Process	Ductwork to be DALT'd	RA	RA	A	
		Field Visit	Testing	V	W	W	
		Submittal Process	Pre-final DALT report	RA	C	A	
		Submittal Process	Certified final DALT report	RA	C	A	
	DALTS - Acceptance Testing	Field Visit	Quality assurance - Contracting officer DALT field checks	V	W	W	
		Field Visit	Additional field checks	V	W	W	
	TABS - Submittals	Submittal Process	TAB contractors qualifications & certification	RA	RA	A	
		Submittal Process	Pre-TAB engineering report	RA	RA	A	
		Submittal Process	*Discussion on TAB procedure	RA	RA	A	
		Submittal Process	*Pre-requisite checklist	RA	RA	A	
		Submittal Process	*Design review report	RA	RA	A	
		Submittal Process	*Preliminary TAB test report	RA	RA	A	
		Submittal Process	Certified TAB test report (Season 1)	RA	RA	A	
		Submittal Process	Certified TAB test report (Season 2 (coil data))	RA	RA	A	
	TABS - Pre-Test Checklist		1) Variable Air Volume Series Boxes				
			a) General				
		Field Visit	Louvers installed	V	W	—	
		Field Visit	Manual dampers open and locked	V	W	—	
		Field Visit	Automatic dampers set properly	V	W	—	
		Field Visit	Housing construction leakage	V	W	—	
		Field Visit	Access doors per plans & specs.	V	W	—	
		Field Visit	Condensate drain piping & pan	V	W	—	
		Field Visit	Free from dirt & debris	V	W	—	
		Field Visit	Nameplate data clearly visible	V	W	—	
			b) Filters				
		Field Visit	Type / size / number correct	V	W	—	
Field Visit		Clean	V	W	—		
Field Visit		Blank-off plates installed	V	W	—		
Field Visit		Frame leakage at a minimum	V	W	—		
		c) Coils (Hydronic – Water / Steam)					
Field Visit		Size & rows	V	W	—		
Field Visit		Fin spacing & condition	V	W	—		
Field Visit	Obstructions and/or debris	V	W	—			
Field Visit	Correct air flow direction	V	W	—			
Field Visit	Correct piping connections / flow	V	W	—			

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
		Field Visit	Valves open & set	V	W	—
		Field Visit	Vents / traps installed correctly	V	W	—
		Field Visit	Provisions for TAB measurements	V	W	—
			d) Coils (Electric)			
		Field Visit	Size & construction	V	W	—
		Field Visit	Airflow direction	V	W	—
		Field Visit	Duct connections	V	W	—
		Field Visit	Safety switches	V	W	—
		Field Visit	Obstructions	V	W	—
		Field Visit	Free from debris	V	W	—
		Field Visit	Contractors & disconnect switches	V	W	—
		Field Visit	Electrical service & connections	V	W	—
		Field Visit	Nameplate data clearly visible	V	W	—
			e) Fans			
		Field Visit	Rotation	V	W	—
		Field Visit	Wheel clearance & balance	V	W	—
		Field Visit	Bearing & motor lubrication	V	W	—
		Field Visit	Drive alignment	V	W	—
		Field Visit	Belt tension	V	W	—
		Field Visit	Drive set screws tight	V	W	—
		Field Visit	Belt guards in place	V	W	—
		Field Visit	Flex duct connector alignment	V	W	—
		Field Visit	Proper unit / duct alignment	V	W	—
		Field Visit	Starters & disconnect switches	V	W	—
		Field Visit	Electrical service & connections	V	W	—
		Field Visit	Nameplate data clearly visible	V	W	—
			f) Vibration isolation			
		Field Visit	Springs & compression	V	W	—
		Field Visit	Base level & free	V	W	—
			2) DUCT SYSTEMS			
			a) General			
		Field Visit	Manual damper positioned & locked	V	W	—
		Field Visit	Damper adjustments accessible	V	W	—
		Field Visit	Access doors closed & tight	V	W	—
		Field Visit	Fire dampers open & accessible	V	W	—
		Field Visit	Terminal units open & set	V	W	—
		Field Visit	Registers/diffusers wide open & set	V	W	—
		Field Visit	Turning vanes in square elbows	V	W	—
		Field Visit	Provisions made for TAB tests	V	W	—
		Field Visit	System installed per plans & specs.	V	W	—
		Field Visit	All ductwork sealed as required	V	W	—
			b) Architectural			
		Field Visit	Windows installed & closed	V	W	—
		Field Visit	Doors closed as required	V	W	—
		Field Visit	Ceiling plenums installed/sealed	V	W	—
		Field Visit	Access doors closed & tight	V	W	—
		Field Visit	Air shafts/openings as required	V	W	—
			3) PUMPS			
			a) Motors			
		Field Visit	Rotation	V	W	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
System Acceptance (continued)		Field Visit	Lubrication	V	W	—	
		Field Visit	Alignment	V	W	—	
		Field Visit	Set screws tight	V	W	—	
		Field Visit	Guards in place	V	W	—	
		Field Visit	Tank level and controls	V	W	—	
		Field Visit	Starters & disconnects	V	W	—	
		Field Visit	Electrical service & connections	V	W	—	
				b) Piping			
		Field Visit	Correct flow	V	W	—	
		Field Visit	Correct connections	V	W	—	
		Field Visit	Leakage	V	W	—	
		Field Visit	Valves positioned & set	V	W	—	
		Field Visit	Strainers clean	V	W	—	
		Field Visit	Air Vented	V	W	—	
		Field Visit	Flexible connectors installed	V	W	—	
		Field Visit	Provisions made for TAB tests	V	W	—	
		Field Visit	System water clean	V	W	—	
				c) Bases			
		Field Visit	Vibration isolation	V	W	—	
		Field Visit	Grouting (if required)	V	W	—	
		Field Visit	Leveling	V	W	—	
				4) HYDRONIC EQUIPMENT			
				a) Boilers			
		Field Visit	Operating controls & devices	V	W	—	
		Field Visit	Safety controls & devices	V	W	—	
		Field Visit	Lubrication of fans & pumps	V	W	—	
		Field Visit	Draft controls & devices	V	W	—	
		Field Visit	Piping controls & devices	V	W	—	
		Field Visit	Valves set & open	V	W	—	
		Field Visit	Water make-up provisions	V	W	—	
		Field Visit	Blowdown provisions	V	W	—	
		Field Visit	Electrical connections	V	W	—	
		Field Visit	Nameplate data clearly visible	V	W	—	
				b) Heat Exchangers			
		Field Visit	Correct flow & connections	V	W	—	
		Field Visit	Valves open or set	V	W	—	
		Field Visit	Air vents or steam traps	V	W	—	
		Field Visit	Leakage	V	W	—	
		Field Visit	Provisions made for TAB tests	V	W	—	
		Field Visit	Nameplate data clearly visible	V	W	—	
				c) Cooling Towers/Evaporative Condensers			
		Field Visit	Correct flow & connections	V	W	—	
		Field Visit	Valves open or set	V	W	—	
		Field Visit	Leakage	V	W	—	
		Field Visit	Provisions made for TAB tests	V	W	—	
	Field Visit	Sump water level	V	W	—		
	Field Visit	Spray nozzles	V	W	—		
	Field Visit	Fan/Pump rotation	V	W	—		
	Field Visit	Motor/Fan lubrication	V	W	—		
	Field Visit	Drives & alignment	V	W	—		

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
System Acceptance (continued)		Field Visit	Guards in place	V	W	—	
		Field Visit	Starters & disconnects	V	W	—	
		Field Visit	Electrical connections	V	W	—	
		Field Visit	Nameplate data clearly visible	V	W	—	
			5) REFRIGERANT EQUIPMENT				
		Field Visit	Crankcase heaters energized	V	W	—	
		Field Visit	Operating controls & devices	V	W	—	
		Field Visit	Safety controls & devices	V	W	—	
		Field Visit	Valves open	V	W	—	
		Field Visit	Piping connections & flow	V	W	—	
		Field Visit	Flexible connectors	V	W	—	
		Field Visit	Oil level & lubrication	V	W	—	
		Field Visit	Alignment & drives	V	W	—	
		Field Visit	Guards in place	V	W	—	
		Field Visit	Vibration isolation	V	W	—	
		Field Visit	Starters/Contactors/Disconnects	V	W	—	
		Field Visit	Electrical connections	V	W	—	
		Field Visit	Nameplate data clearly visible	V	W	—	
			6) HYDRONIC PIPING SYSTEM				
		Field Visit	Leak tested	V	W	—	
		Field Visit	Fluid levels & make-up	V	W	—	
		Field Visit	Relief or safety valves	V	W	—	
		Field Visit	Expansion tanks & air vents	V	W	—	
		Field Visit	Steam traps & connections	V	W	—	
		Field Visit	Strainers clean	V	W	—	
		Field Visit	Valves open & set	V	W	—	
		Field Visit	Provisions made for TAB tests	V	W	—	
		Field Visit	Systems installed per plans & specs.	V	W	—	
			7) CONTROLS & CONTROL SYSTEMS				
		Field Visit	Data centers	V	W	—	
		Field Visit	Outdoor/return Air/reset	V	W	—	
		Field Visit	Economizer set & tested	V	W	—	
		Field Visit	AHU Static pressure set	V	W	—	
		Field Visit	Room controls calibrated	V	W	—	
		Field Visit	VAV box regulators set to design	V	W	—	
		Field Visit	VAV box P.E. switches set	V	W	—	
		Field Visit	Proper end-of-line static pressure	V	W	—	
		Field Visit	VAV box reheats tested	V	W	—	
			8) OTHER CHECKS				
		Submittal Process	Appropriate contractors notified of TABS		A	RA	S
		Submittal Process	Preliminary data complete		A	RA	S
		Submittal Process	Test report forms prepared		S	RA	A

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)
	TABS - Testing	Field Visit	TAB field work	V	W	
		Submittal Process	Preliminary procedures	RA	C	A
		Field Visit	TAB air distribution systems	V	W	—
		Field Visit	TAB water distribution systems	V	W	—
		Field Visit	Sound measurement work	V	W	—
		Field Visit	TAB work on performance tests without seasonal limitations	V	W	—
		Field Visit	TAB work on performance tests with seasonal limitations	V	W	—
		Field Visit	Marking settings	V	W	—
		Field Visit	Marking of test ports	V	W	—
	TABS - Acceptance Testing	Field Visit	Quality assurance - Contracting officer TAB field checks	V	W	W
		Field Visit	Additional field checks	V	W	W
	ACATS - Submittals	Submittal Process	Controls contractor qualifications	RA	RA	A
		Submittal Process	Manufacturers field report	RA	RA	A
		Submittal Process	Performance verification test plan (PVT)	RA	RA	A
		Submittal Process	Pre-PVT checklist	RA	RA	A
		Submittal Process	Final certified PVT report (with all mods incorporated in as-builts)	RA	RA	A
	ACATS - Pre-PVT Checklist	Field Visit	Prior to conducting the PVT, thoroughly inspect the installed work with the Contractor's QC representative and the mechanical contractor using the following checklist. Submit the checklist with items checked off once verified. Provide a detailed explana	V	W	—
		Field Visit	a. Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).	V	W	—
		Field Visit	b. Verify HVAC motors operate below full-load amperage ratings.	V	W	—
		Field Visit	c. Verify all required control system components, wiring, and accessories are installed.	V	W	—
		Field Visit	d. Verify the installed control system architecture matches approved drawings.	V	W	—
		Field Visit	e. Verify all control circuits operate at the proper voltage and are free from grounds or faults.	V	W	—
		Field Visit	f. Verify all required surge protection is installed and functions correctly.	V	W	—
		Field Visit	g. Verify the A/C Power Table specified in "CONTROLS SYSTEM OPERATORS MANUALS" is accurate.	V	W	—

MECHANICAL ENGINEERING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	ME QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)	
System Acceptance (continued)		Field Visit	h. Verify all DDC network communications function properly, including uploading and downloading programming changes.	V	W	—	
		Field Visit	i. Using the BACnet protocol analyzer (if provided or required in this specification), verify communications are error free.	V	W	—	
		Field Visit	j. Verify each digital controller's programming is backed up.	V	W	—	
		Field Visit	k. Verify all wiring, components, and panels are properly labeled.	V	W	—	
		Field Visit	l. Verify all required points are programmed into devices.	V	W	—	
		Field Visit	m. Verify all TAB work affecting controls is complete.	V	W	—	
		Field Visit	n. Verify all valve and actuator zero and span adjustments are set properly.	V	W	—	
		Field Visit	o. Verify all sensor readings are accurate and calibrated.	V	W	—	
		Field Visit	p. Verify each control valve and actuator goes to normal position upon loss of power.	V	W	—	
		Field Visit	q. Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.	V	W	—	
		Field Visit	r. Verify each controller works properly in stand-alone mode.	V	W	—	
		Field Visit	s. Verify all safety controls and devices function properly, including interfaces with building fire alarm systems.	V	W	—	
		Field Visit	t. Verify all electrical interlocks work properly.	V	W	—	
		Field Visit	u. Verify all workstations, notebooks and maintenance personnel interface tools are delivered, all system and database software is installed, and graphic pages are created for each workstation and notebook. Notify the Government when phone lines or netw	V	W	—	
		Field Visit	v. Verify the as-built (shop) control drawings are completed.	V	W	—	
		ACATS - Testing	Field Visit	Field testing of components	V	W	—
			Field Visit	Field testing of programming	V	W	—
			Field Visit	Pre-performance verification testing	V	W	—
		ACATS - Acceptance Testing	Field Visit	Performance verification testing	V	W	W
			Field Visit	Performance verification re-resting	V	W	W

ROOFING ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	Roof QC / DOR (Ktr)	FEAD (SIOH)	FEC (PCAS)		
Roofing	Low Sloped Roofs	Design Guidance	Post Award Kick Off Meeting		S	A		
		Design Guidance	Verify Roof Design Assurance	A	R	S		
		Submittal Process	Review Shop Drawings	A	S	S		
		Submittal Process	Review Manufacturer's Product Data Sheets	A	S	S		
		Submittal Process	Review Design Data (to include wind and fire resistance)	A	S	S		
		Submittal Process	Review Test Reports	A	S	S		
		Submittal Process	Review Certificates	A	S	S		
		Submittal Process	Review Sample Roof Warranty	A	S	C		
		Field Visit	Conduct Pre Roofing Conference	V	S	S		
		Field Visit	Review Delivery, Storage, and Handling	A	S	S		
		Field Visit	Verify Conditions for roof application	A	S	S		
		Field Visit	Verify Preparation	A	S	S		
		Field Visit	Verify Application	A	S	S		
		Field Visit	Verify Protection of Applied Roofing	A	S	S		
		Field Visit	Verify Field Quality Control	A	S	S		
		Field Visit	Verify Operation Maintenance and Support Information (Roof Warranty and Information Card)	A	S	S		
		Steep Sloped Roofs	Design Guidance	Post Award Kick Off Meeting			S	A
			Design Guidance	Verify Roof Design Assurance	A	R	S	
	Submittal Process		Review Shop Drawings	A	S	S		
	Submittal Process		Review Manufacturer's Product Data Sheets	A	S	S		
	Submittal Process		Review Design Data (to include wind and fire resistance)	A	S	S		
	Submittal Process		Review Test Reports	A	S	S		
	Submittal Process		Review Certificates	A	S	S		
	Submittal Process		Review Sample Roof Warranty	A	S	C		
	Field Visit		Conduct Pre Roofing Conference	V	S	S		
	Field Visit		Review Delivery, Storage, and Handling	A	S	S		
	Field Visit		Verify Conditions for roof application	A	S	S		
	Field Visit		Verify Preparation	A	S	S		
	Field Visit		Verify Application	A	S	S		
	Field Visit		Verify Protection of Applied Roofing	A	S	S		
	Field Visit		Verify Field Quality Control	A	S	S		
	Field Visit	Verify Operation Maintenance and Support Information (Roof Warranty and Information Card)	A	S	S			

UNDERWATER STRUCTURES ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	UW QC / DOR (Ktr)	FEAD (SIOH)	FEC/NF ESC (PCAS)
Waterfront Structure H10 (Uniformat II) - Substructure H1010	Pile Foundations (H101001) Sheet Piles (H101001) Caissons (H101001) Cofferdams (H101001) Wraps and Encasements (H101001) Sheet Pile Bulheads (H101003) Gravity Walls (H101003) Block Walls (H101003) Seawalls (H101006) Boat Ramps (H101007) Cut-Off Walls (H101008) Wave Attenuation Walls (H101009) Fender Piles (H104001) Dolphins (H104004)	Submittal Process	Shop Drawings	A	C	S
		Submittal Process	Manufacturer's Data Sheets	A	C	S
		Submittal Process	Pile driving records	A	C	S
		Submittal Process	Concrete testing: petrographic, chemical, service-life modeling	A	C	S
		Submittal Process	As-built drawings, 3D AUTOCAD format	A	C	S
		Field Visit	Validate in-water/underwater structure complies with RFP requirements, e.g., number, location, size, etc.	A	—	W
		Field Visit	Inspect in-water prestressed/precast concrete piles or sheetpiles for alignment, spalls, cracks, damages, defects, lifting hoops cut/area patched, exposed steel ties, penetrations, etc.	A	—	W
		Field Visit	Inspect in-water cast-in-place concrete drilled caissons for alignment, spalls, cracks, damages, defects, concrete quality (hardness), honeycombing, etc.	A	—	W
		Field Visit	Inspect in-water steel piles and/or p/c p/s concrete sheetpiles for alignment, damage/buckling, coating damage, penetrations, gaps, etc.	A	—	W
		Field Visit	Inspect underwater concrete placement for defects such as honeycombing, concrete quality (hardness)	A	—	W
		Field Visit	Inspect underwater slope protection for conformance with RFP requirements such as rock/boulder size, placement gap limits, angle, location (e.g., toe of slope protection), consistency, etc.	A	—	W
		Field Visit	Inspect underwater Cathodic Protection anodes and connections	A	—	W
		Field Visit	Inspect for underwater debris, existing or by construction.	A	—	W
		Field Visit	Validate in-water/underwater structure complies with RFP requirements, e.g., number, location, size, etc.	A	—	W
		Field Visit	Validate in-water/underwater structure complies with RFP requirements, e.g., number, location, size, etc.	A	—	W
		Field Visit	Validate in-water/underwater structure complies with RFP requirements, e.g., number, location, size, etc.	A	—	W

UNDERWATER STRUCTURES ROLES and RESPONSIBILITIES

System	Sub-Systems	Phase	Elements	UW QC / DOR (Ktr)	FEAD (SIOH)	FEC/NF ESC (PCAS)
Underwater Cables	All	Submittal Process	Shop Drawings	A	C	S
		Submittal Process	Manufacturer's Data Sheets	A	C	S
		Field Visit	Validate in-water/underwater cable complies with RFP requirements, e.g., number, location, size, etc.	A	—	W
		Field Visit	Inspect underwater cable for defects/damages, kinks, missing anchors, coating damage, etc.	A	—	W
		Field Visit	Inspect for underwater debris, existing or by construction.	A	—	W
Underwater Utility Pipes and Conduits	All	Submittal Process	Shop Drawings	A	C	S
		Submittal Process	Manufacturer's Data Sheets	A	C	S
		Field Visit	Validate in-water/underwater component complies with RFP requirements, e.g., number, location, size, etc.	A	—	W
		Field Visit	Inspect underwater component for defects/damages, cracks, missing anchors, coating damage, etc.	A	—	W
		Field Visit	Inspect for underwater debris, existing or by construction.	A	—	W

DEFINITIONS

A pprove	(A)	Professional or quality control endorsement of the submittal or installed system meets the contract requirements
R eview	(R)	To confirm accuracy of the submittal and that it meets contract requirements
W itness	(W)	Observe demonstration of system performance for acceptance
R eceipt A cknowledge	(RA)	Confirm receipt of submittal with no review necessary
S urveillance Review	(S)	A quality assurance review based on risk, complexity, and workload
Performance V erification and Acceptance Testing	(V)	A demonstration of satisfactory construction and system performance
Receive C opy of Correspondence	(C)	Receive a copy of the transmittal sheet and/or correspondence letter
Q uality A ssurance Inspection	(QA)	Witnessing satisfactory performance without testing all devices or visual inspection of various parts of the system