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Revise this Section by deleting and inserting text to meet Project-specific requirements.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Close-coupled, vertical, in-line centrifugal pumps.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been revised for a project.

* + - * 1. ECM: Electronically commutated motor.
				2. EPDM: Ethylene propylene diene monomer.
				3. EPR: Ethylene propylene rubber.
				4. EPT: Ethylene propylene terpolymer.
				5. FKM: Fluoroelastomer polymer.
				6. HI: Hydraulic Institute.
				7. NBR: Nitrile rubber or Buna-N.
				8. ODP: Open, drip proof.
				9. TEFC: Totally enclosed, fan-cooled.
				10. TENV: Totally enclosed, non-ventilated.
				11. VFD: Variable-frequency controller.
			1. ACTION SUBMITTALS
				1. Product Data: For each type of pump.

Include published performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.

Indicate pump's operating point on curves.

* + - * 1. Shop Drawings: For each pump.

Show pump layout and connections.

Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

Include diagrams for power, signal, and control wiring.

* + - * 1. Delegated Design Submittal: For each pump.

Retain subparagraph below if pumps are required to withstand specific design loads and Architect either has delegated design responsibility to Contractor or wants to review structural data as another way to verify equipment's compliance with performance requirements. Professional engineer qualifications are specified in Section 014000 "Quality Requirements."

Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.

Design Calculations: Calculate requirements for selecting vibration isolators[**and seismic restraints**] and for designing vibration isolation bases.

Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

* + - 1. INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below for situations when Contractor prepares drawings where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates for pumps, accessories, and components.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For pumps to include in operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Revise "Seal Kit" Subparagraph below to suit Project.

Seal Kit: [**One**] <**Insert number**> mechanical seal kit(s) for each pump.

Bearings.

Gaskets.

<**Insert spare parts**>.

1. PRODUCTS

Manufacturers and products listed in this Section are neither recommended nor endorsed by the AIA or Deltek. Before selecting manufacturers and products, verify availability, suitability for intended applications, and compliance with minimum performance requirements. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

Product options commonly available from manufacturers are included in square brackets throughout the Section Text. Not every manufacturer listed can provide every option offered; verify availability with manufacturers. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. PERFORMANCE REQUIREMENTS
				1. Provide pumps and associated equipment that are in compliance with energy conservation guidelines published in 2020 by the U.S. Department of Energy Rulemaking Committee for commercial and industrial pumps.
				2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation[**and seismic restraints**].

Retain "Seismic Performance" Paragraph below with "Seismic Qualification Data" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Pumps to withstand the effects of earthquake motions determined in accordance with [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

* + - 1. CLOSE-COUPLED, VERTICAL, IN-LINE CENTRIFUGAL PUMPS

Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to require a specific product or a comparable product from manufacturers listed.

* + - * 1. Basis-of-Design Product: Subject to compliance with requirements, provide Taco Comfort Solutions, Inc.; KV Series <**Insert product name or designation**> or comparable product by one of the following:

Bell & Gossett.

Thrush Co. Inc.

<**Insert manufacturer's name**>.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump [, **NSF 61-compliant,**] as defined in HI 14.1, HI 14.2 and HI 14.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
				3. Pump Construction:

Casing: Radially split, [**cast iron**] [**ductile iron**], [**with threaded gauge tappings at inlet and outlet,**] [**replaceable bronze wear rings,**] and threaded[**companion-flange**] connections.

In "Impeller" Subparagraph below, retain first option for basis-of-design product.

Impeller: [**Type 304 stainless steel**] [**ASTM B584, cast bronze**]; statically and dynamically balanced, keyed to shaft, and secured with a stainless steel locking cap screw. For pumps that are not variable-frequency-drive controlled, trim impeller to match specified performance.

Retain "Pump Shaft Sleeve" or "Pump Stub Shaft" Subparagraph below. Some larger in-line close-coupled pumps have a stub shaft rigidly attached to the motor shaft without a bearing or flexible connector to make disassembly easier. Consult manufacturers.

Retain "cupro nickel" option for basis-of-design product.

Pump Shaft Sleeve: [**Cupro nickel**] [**Bronze**] [**Type 304 stainless steel**].

Pump Stub Shaft: [**Type 304**] [**Type 316**] stainless steel.

In "Seal" Subparagraph below, verify suitable bellows and gasket materials if pumped fluids operate above 200 deg F (93 deg C) or contain glycol. If fluid pH is maintained above 9.0 or if fluid contains more than 400 ppm of dissolved solids or 20 ppm of undissolved solids, consider using silicon carbide stationary and rotating rings.

Retain silicon carbide or tungsten carbide seal for basis-of-design product operating at temperatures from 250 to 300 deg F (121 to 149 deg C).

Seal: Mechanical seal consisting of [**ceramic/EPT**] [**silicon carbide/EPT**] [**tungsten carbide/EPT**], and [**NBR**] [**EPDM**] [**FKM**] <**Insert material**> rubber bellows and gasket. Include water slinger on shaft between motor and seal.

Seal Flushing: Flush, cool, and lubricate pump seal by directing pump discharge water to flow over the seal.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" Subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: [**Totally enclosed, fan cooled**] [**Open, drip proof**] <**Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single**] [**Variable**]-frequency motor.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of close-coupled, in-line centrifugal pump, delete "Capacities and Characteristics" Paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm (L/s)**>.

Total Dynamic Head: <**Insert feet (kPa)**>.

Maximum Operating Pressure: [**175 psig (1204 kPa)**] [**250 psig (1720 kPa)**] <**Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F (107 deg C)**] [**250 deg F (120 deg C)**] <**Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS (DN)**>.

Impeller Size: <**Insert inches (mm)**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Turndown Ratio: [**4:1**] <**Insert ratio**>.

Electrical Characteristics:

Volts: [**120**] [**240**] [**208**] [**460**] <**Insert value**> V.

Phase: [**Single**] [**Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert amperage**> A.

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Retain first two paragraphs below if required.

* + - * 1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. PUMP INSTALLATION

In first paragraph below, retain "HI 14.4" option for centrifugal pumps and "HI 2.4" option for vertically mounted, turbine centrifugal pumps.

* + - * 1. Comply with [**HI 14.4**] [**and**] [**HI 2.4**].
				2. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
				3. Where required, independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
				4. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Retain one of two subparagraphs below if vibration isolation is required. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

Retain "Equipment Mounting" Paragraph below for in-line pumps suspended from structure.

* + - * 1. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and [**elastomeric hangers**] [**spring hangers**] [**spring hangers with vertical-limit stop**] of size required to support weight of in-line pumps.

Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

* + - 1. ALIGNMENT

Retain this article only for separately coupled, end- and double-suction centrifugal pumps.

Retain one of first two paragraphs below.

* + - * 1. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.
				2. Comply with requirements in HI standards for alignment of pump and motor shaft.
				3. Comply with pump and coupling manufacturers' written instructions.
				4. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.
			1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to pump, allow space for service and maintenance.
				3. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
				4. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
				5. Install [**check, shutoff, and throttling valves**] [**check valve and throttling valve with memory stop**] [**triple-duty valve**] on discharge side of pumps.
				6. Install [**Y-type strainer**] [**suction diffuser**] and shutoff valve on suction side of pumps.

Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.

* + - * 1. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

Retain paragraph below for automatic condensate pump units.

Provide detail of condensate pump piping inlet and drain on Drawings. Coordinate with plumbing design.

* + - * 1. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.
			1. ELECTRICAL CONNECTIONS
				1. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems.der
				3. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
				4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of two subparagraphs below. First subparagraph cross-references Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of product specified in Section 260553 "Identification for Electrical Systems."

Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

* + - 1. CONTROL CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
			2. STARTUP SERVICE
				1. [**Perform**] startup service.

Complete installation and startup checks in accordance with manufacturer's written instructions.

Check piping connections for tightness.

Clean strainers on suction piping. Use startup strainer for initial startup.

Perform the following startup checks for each pump before starting:

Verify bearing lubrication.

Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

Verify that pump is rotating in correct direction.

Prime pump by opening suction valves and closing drains, and prepare pump for operation.

Start motor.

Open discharge valve slowly.

* + - 1. FIELD QUALITY CONTROL

Retain "Testing Agency," "Manufacturer's Field Service," or "Perform tests and inspections" Paragraph below. Retain first option in first paragraph if Owner will hire an independent testing agency.

* + - * 1. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" Paragraph below to require Contractor to perform tests and inspections and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

* + - * 1. Perform tests and inspections [**with the assistance of a factory-authorized service representative**].

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Hydronic pumps will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. DEMONSTRATION
				1. [**Train**] Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123