SECTION 16151 - SUPPLEMENTAL

LOW VOLTAGE VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SCOPE This section covers ac voltage source, pulse width modulated (PWM) type variable frequency drives with bypass contactor for the equipment listed in the schedule at the end of this section.

1.2 GENERAL

Equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the Contractor.

Unless otherwise indicated on the drawings, one variable frequency drive, complete with all required control components, shall be furnished for each motor.

Drives shall be manufactured and assembled in their entirety at the VFD manufacturer's factory.

Manufacturer of the AC drive shall be certified ISO 9001 facility.

1.2.01 Coordination The design of each variable frequency drive shall be coordinated with the driven equipment. All low voltage variable frequency drives shall be of the same manufacturer.

The equipment furnished under this section shall conform to the Equipment General Provisions, Section 16050.

1.2.02 Governing Standards Each variable frequency drive shall be designed, constructed in accordance with the applicable standards of NEMA, ANSI, UL, and IEEE, and shall be designed for installation in accordance with the NEC. The drive components shall be UL listed where applicable.

Governing standards:
ANSI/NFPA 70 (NEC)
IEC61000: Electromagnetic compatibility.
NEMA 250: Enclosures for electrical equipment
NEMA ICS 7: Industrial control and systems VFD

NEMA ICS 7.1: Safety standards for construction and guide for selection installation and operation of VFD.
UL 50: Enclosure for electrical equipment.
UL 98: Disconnect switches.
UL 507: Electric fan.
UL 508: Industrial control equipment.
IUL 508C: Power conversion equipment.
UL 991: Safety tests for safety related controls employing solid state devices.
OSHA 1910.95: VFD acoustic noise.

1.2.03 Nameplates All devices mounted on the face of each drive shall be provided with suitable nameplates. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate. All other devices shall have an engraved, laminated plate, with at least 3/16 inch high, black lettering on a white background.

1.3 DESCRIPTION

Each drive shall produce an adjustable ac voltage/frequency output and shall be equipped with an output voltage regulator to maintain correct output V/Hz despite incoming voltage variations. Each drive shall be furnished with integral 3% line input reactors.

Each drive will be provided with bypass contactor in an appropriate configuration such that the pump/motor can be operated in either VFD or bypass mode without restricting the capability to perform maintenance on the VFD System.

The general arrangement of VFD/Bypass Contactor shall be in accordance with the sketch shown on drawing D-08-06-730.

1.3.01 Eighteen-Pulse Drives

Each drive, for motors rated 100 horsepower and above, shall be of the pulse-width modulated type and shall consist of an 18-pulse, full-wave diode or gated-open SCR bridge. The rectifier shall convert incoming fixed voltage and fixed frequency to a fixed dc voltage. The pulse-width modulation technology shall be of the space vector type, implemented in a microprocessor which generates a sine-coded output voltage. Harmonics shall meet IEEE 519 guidelines.

The phase shifting transformer required to produce the phase shifted input to the 18-pulse rectifier shall be provided with drive and may be mounted within the drive enclosure as an integral part of the drive assembly or as a separate enclosure.

The drive inverter output shall be generated by insulated gate bipolar transistors (IGBT) which shall be controlled by six identical base driver circuits. The drive shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation. The drive shall be factory pre-set to operate most common applications

1.4 SUBMITTALS

Complete drawings, details, and specifications shall be furnished in accordance with the submittals section.

1.4.01 Shop Drawing Submittals: The shop drawing submittals shall include the following information for each size and type of drive being furnished.

1. Name of manufacturer.
2. Types and model numbers.
3. Rated drive input kVA and output kVA.
4. Percent efficiency at 100 percent speed and 60 percent speed.
5. Maximum Btu heat release data and verification of the drive cooling requirements.
6. Total weight and lifting instructions, height, mounting, and floor space required. With the maximum dimensions of 25” D, 56” W, 94” H.
7. Panel interior and front and side exterior view details showing maximum overall dimensions of transformer, and drive assembly.
8. Schematics, including all interlocks.
9. Wiring diagrams, including all internal and external devices and terminal blocks.
10. Locations and sizes of electrical connections, ground terminations, and shielded wires.
11. List of diagnostic indicators.

12. List of fault and failure conditions which the drive can recognize and indicate for simultaneous occurrence.

13. List of standard features and options.

14. List of spare parts to be furnished.

15. Harmonic calculations by the drive manufacturer at the points of common coupling. Detailed drawings and information showing how protection is applied to comply with harmonic limits.

16. Input line protection model numbers and manufacturer's data sheets.

17. Output filter model number and manufacturer's data sheets.

18. Submit a detailed harmonic testing plan. The test plan should include instruments to be used, verification of testing locations for voltage and current harmonic metering, verification of maximum allowable voltage and current distortion, and drive load and speed test parameters. VFD manufacturer shall furnish field test, adjust and certify all installed AC drives for satisfactory operation.

19. VFD software shall have an energy saving function that will reduce the voltage to motor when selected for variable torque loads. A constant V/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.

20. VFD should provide 3% line voltage imbalance without degrading power converter performance.

1.4.02 Operation and Maintenance Manuals The operation and maintenance manuals shall include the following information for each size and type of drive being furnished.

1. Manufacturer's operation and maintenance manual for each size of adjustable frequency drive. Programming instructions will be provided as applicable.

2. Manufacturer's standard manuals for each size and type of transformer. O&M manuals submittals must meet the standards for Manuals, SEMPs, PMAs, etc., in content, structure and native format so that they'll easily "upload" to our on line O&M application. This is true for all O&M documentation provided.

3. Schematics, wiring diagrams, and panel drawings in conformance with construction record.

4. Model numbers and up-to-date cost data for spare parts.

5. Troubleshooting procedures, with a cross-reference between symptoms and corrective recommendations.

6. Connection data to permit removal and installation of recommended smallest field-replaceable parts.

7. Information on testing of power supplies and printed circuit boards and an explanation of the drive diagnostics.

1.5 SPARE PARTS

The drive manufacturer shall provide spare parts with a combined cost equal to at least 10 percent of the cost of a single drive for each type and size of drive supplied. The spare parts shall include at least one complete set of all plug-in components for each drive, and shall include but not limited to the following:

- Two (2) drives
- Power fuses
- Control fuses
- Indicating lights
- Rectifier power semiconductors
- Internal Fan
- Power Module
- Capacitor Assembly
- LCD Graphic Keypad

Spare parts shall be suitably packaged in accordance with the Equipment General Provisions, with labels indicating the contents of each package, and shall be delivered to the Contractor.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

2.1.01 Performance Each variable frequency drive controller shall be of sufficient capacity and shall produce a quality output waveform for stepless motor control from 1 to 100 percent of base speed. Each variable frequency drive shall be suitable for operating variable torque load consisting of RAS Pumps. Each variable frequency drive shall meet the following ratings and parameters:

1.	Input voltage and frequency	480 volts (±10 percent); 3 phase, 60 Hz (± 3 Hz); imbalance, 2 percent maximum. Continued operation with additional momentary 25 percent voltage dip of 0.5 second duration from nominal input voltage level.
2.	Minimum drive efficiency	96 percent at 100 percent speed, *85* percent at 50 percent speed including the phase shifting transformer losses.
3.	Ambient temperature	0 to 40°C.
4.	Relative humidity	0 to 95 percent *(*non-condensing*)*.
5.	Displacement power factor	95 percent or higher throughout the entire operating speed range, measured at drive input terminals.
6.	Drive service factor	1.15 over motor full load current.
7.	Overcurrent capability	110 percent for 1 minute for variable torque (VT);
8.	Volts/Hz ratio	Voltage varies as the square of frequency over the entire range of the unit for variable torque drives, constant over the entire range of the unit for constant torque drives; except under voltage boost condition.

9.	Acceleration/deceleration	Adjustable over a range that meets time the requirements of the driven equipment.
10.	Output speed regulation	0.5 percent.
11.	Output frequency stability	0.1 percent of nominal.
12.	Power Loss Ride-Through	200 milli seconds

The following drive adjustments shall be provided:

1. Maximum speed.
2. Minimum speed.
3. Linear acceleration time.
4. Linear deceleration time.
5. Volts/Hz ratio; linear, squared, and automatic settings.
6. Voltage boost.
7. Process follower gain, offset, and bias.
8. Torque limit.
9. Critical frequency avoidance with adjustable bandwidth.

2.1.02 Fault Protection The design of the power circuit shall include provisions for protection against fault conditions as follows.

1. Input Protection
    a. Circuit breaker for isolating the VFD from input power source.
    b. 3% INPUT line reactors
    c. Solid state instantaneous overcurrent trip set at 180%.
    d. Adjustable overvoltage and undervoltage protection with automatic restart.

e. Phase loss and reverse phase trip with manual restart.

2. Internal Protection

a. AC line, phase-to-phase transient voltage surge suppression utilizing silicone avalanche suppressor diodes (SASD) minimum class 4. Drive shall meet the requirements of IEEE C62.41.

b. Power device snubbers.

c.. Power devices rated 2.5 times line voltage.

d. Instantaneous overcurrent.

e. Static overspeed (overfrequency) protection.

f. DC bus overvoltage trip.

g. DC bus discharge circuit with an indicator lamp, for protection of personnel.

h. Individual transistor overtemperature and overcurrent protection.

i. Control logic circuit malfunction indication.

j. Cabinet

3. Output Protection

a. Inverse-time motor overload protection adjustable from 10 percent to 100 percent.

b. Overvoltage protection.

c. Overfrequency protection.

d. Short circuit protection (three phase, phase to phase, and ground fault protection).

e. Protection against opening or shorting of motor leads.

f. Static overspeed protection.

g. Stall protection on overload with inverse time overcurrent trip, adjustable current limit from 10 percent to 120 percent.

2.1.03 Harmonic Distortion Protection

1. Each variable frequency drive shall be provided with the necessary equipment to protect the drive and the power system ahead of the drive from harmonic distortion, as recommended in IEEE 519, 1992.

2. The drive shall operate satisfactorily when connected to a bus supplying other solid-state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt-microseconds.

3. Current Distortion Limits: Maximum allowable total and individual harmonic current distortion limits for each odd harmonic shall not exceed limits set forth in IEEE 519, 1992. The utility connection shall be the primary point of common coupling for current distortion.

4. Voltage Distortion Limits: Individual or simultaneous operation of the drives shall not add more than 5 percent total harmonic voltage distortion to the normal bus, as recommended in IEEE 519, 1992.

2.1.04 Safety Interlocks

1. The input circuit breakers shall be furnished with suitable key interlock system to prevent simultaneous energization of VFD and bypass contactor/starter.

2. The output contactors of VFD shall be electrically interlocked with the bypass contactor to prevent simultaneous closure of both devices.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

2.2.01 Performance. All drives shall be pulse-width modulated type, as manufactured by Allen-Bradley, ABB, Cutler Hammer, Siemens, or Square D.

2.2.02 Adjustments. All low voltage variable frequency drives shall be a product of the same manufacturer. The General Contractor shall be responsible for selecting the single drive manufacturer of all drives listed in the schedule at the end of this Section.

2.3 CONSTRUCTION

2.3.01 Fabrication and Assembly

1. Each variable frequency drive system shall be shop assembled in a single enclosure using interchangeable plug-in printed circuit boards and power conversion components wherever possible. Shop assembly shall be performed by the drive manufacturer; systems fabricated or assembled in whole or in part by parties other than the drive manufacturer will not be acceptable. Changes to the drive manufacturer's product by a distributor or system integrator are not allowed.

2. Input line reactors, phase shifting transformers, fuses, circuit breakers, input filters, and output filters, where required, shall be mounted within the drive enclosure, without exception. Isolation/voltage matching transformers, where required, may be enclosed separately from the remaining drive equipment. Bypass Contactor shall be enclosed in a separate section.

2.3.02 Wiring

1. Internal cabinet wiring shall be neatly installed in wireways or with wire ties where wireways are not practical. If wire ties are used, the wire bundles shall be held at the back panel with a screw-mounted mounting base. Bases with a self-sticking back are not acceptable.

2. Power entry and exit shall be through the bottom of each drive.

3. Terminal blocks shall be nonbrittle, interlocking, track-mounted type, complete with a marking strip, covers, and pressure connectors. Screw terminals will not be acceptable. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. In freestanding panels, 8 inches of clearance shall be provided between terminals and the panel base for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Terminals shall be labeled to agree with the identification on the submittal drawings. Each control loop or system shall be individually fused, clearly labeled, and located for ease of maintenance.

4. All grounding wires shall be attached to the sheet metal enclosure with a ring tongue terminal. The surface of the sheet metal shall be prepared to ensure good conductivity and corrosion protection.

5. Wires shall not be kinked or spliced and shall be color coded or marked on both ends. The markings or color coding shall agree with the submittal drawings.

6. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for at least 600 volts, with a moisture-resistant and flame-retardant covering rated for at least 90°C.

2.3.03 Enclosures

1. The drive shall consist of factory mounted and wired components within a dead front, grounded, NEMA Type 12 enclosures with fans and filters. The complete drive package, including accessories, shall fit into the space indicated on the drawings. Dimensions of the drive including the bypass section shall not exceed 56"W x 24"D x 96"H.

2. Freestanding panels shall be suitable for mounting on a concrete housekeeping pad and shall include provisions for anchoring to the supporting structure. Suitable lifting facilities shall be provided for handling and shipment.

3. Relays, terminals, and special devices inside the control enclosure shall have permanent markings to match the identification on the manufacturer's wiring diagrams.

4. All plug-in type boards shall be mechanically held at the circuit board connector. Compression fit only at the connector will not be acceptable.

5. All panels shall include a space heater to maintain the temperature of 70 deg F.

6. VFD front panel should be equipped with display windows for flow meter (RAS flow) and sludge density/sludge depth meter.

7. All enclosures shall have a lock with a R-36 core so that only electricians have access. Any exception or deviation to these specifications shall be indicated in writing.

2.3.04 Shop Painting

1. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop cleaned in accordance with the coating manufacturer's

recommendations, and finished with the drive manufacturer's standard coating. Finish color shall be medium gray or the manufacturer's standard color. Dry film thickness of the finish coat shall be at least 4 mils. Field painting, other than touchup, will not be required. A sufficient quantity of additional coating material and thinner shall be furnished for field touchup of damaged coatings.

2.4 ACCESSORIES

A. A warning nameplate shall be mounted on each drive to warn the operator to trip the circuit breaker before performing any maintenance.

B. Each eighteen-pulse drive shall be supplied with an input AC line reactor. Provide proper transient protection of the drive input power devices. AC Line reactors shall be factory mounted and wired within the drive enclosure.

C. All VFD panels will be provided with a documentation pocket containing set of schematics and an O & M manual.

D. The VFD and bypass contactor shall be furnished with suitably rated input circuit breakers for isolation of device from the incoming power source.

E. Bypass Contactor/Starter

1. Bypass starter shall be provided for each VFD. The starters shall be FVNR-type and rated suitably for the connected motors.

F. Overload protection will be provided for `bypass starters in accordance with NEC requirements

2.5 CONTROLS

A. Each variable frequency drive shall include the following features in addition to those indicated on the drawings:

1. A door mounted membrane keypad with integral 3-line, 24 character minimum LCD display that is capable of controlling the drive and setting drive parameters. The keypad module shall be programmed with factory set drive parameters in nonvolatile EEPROM or FLASH memory and shall be resettable in the field through the keypad. The keypad module shall contain a self-test

software program which can be activated to verify proper keypad operations.

2. Microprocessor-based regulator. Nonvolatile memory modules shall have a useful life of at least 20 years without requiring battery or module replacement.

3. Input thermal-magnetic or motor circuit protector type molded-case circuit breaker disconnect rated 22,000 amperes RMS symmetrical interrupting capacity. Circuit breakers shall be labeled in accordance with UL standard 489. The circuit breakers shall be mounted inside the controller enclosure and shall have door interlocks and a handle with provisions for padlocking in the "Off" position.

4. Input line high-speed, current limiting fuses rated 200,000 amperes interrupting and specifically designed for solid-state applications.

5. Manual speed adjustment.

6. Indication of power "On", drive "Run", and drive "Fault".

7. Elapsed time meter.

8. Speed indication - calibrated in percent rpm*, digital readout*.

9. Control circuits of not more than 115 volts supplied by internal control power transformers. Control power transformers shall have additional capacity as required by external devices indicated on the drawings. Control power transformers shall be equipped with two primary leads fused, one secondary lead fused, and one secondary lead grounded.

10. Automatic controller shutdown on overcurrent, overvoltage, undervoltage, motor overtemperature, input phase-loss, input line surge, and other drive fault conditions. Controller shutdown shall be manually reset type. Incoming terminals shall accept wiring from temperature switches located in the motor.

11. Diagnostic indicators that pinpoint failure and fault conditions. Indicators shall be manually reset to restore operation after abnormal shutdown.

12. Isolated process follower with offset, gain, and span adjustment for accepting a remote 4-20 mA speed control signal rated 60 to 100 percent speed.

13. Process control output for remote 4-20 mA speed indication, rated 0 to 100 percent speed.

14. Spare interlock contacts rated 5 amperes at 120 volts ac, wired separately to the unit terminal board. One NO and one NC isolated spare interlock shall be furnished with each drive. Additional interlock contacts shall be provided as indicated on the drawings.

15. Drive fault and run status contacts for remote indication, rated 5 amperes at 120 volts ac.

16. Speed droop feature which reduces the speed of the drive on transient overloads. The drive shall return to set speed after the transient is removed. If the acceleration or deceleration rates are too rapid for the moment of inertia of the load, the drive shall automatically compensate to prevent drive trip.

17. Heavy duty, oil-tight pilot devices of the 30.5 mm type.

18. Individual adjustable speed profile settings for start, stop, entry, slope, and minimum and maximum speed points.

19. Coast, controlled ramp, or dc injection selectable modes of stopping.

20. Adjustable PWM carrier frequency. The inverter output section shall be provided with adjustable PWM carrier frequency from 500 Hz to 10 kHz.

21. Noise level of installed equipment shall not exceed 85 dB as measured by an appropriate calibrated instrument. The required sound level limit shall be met at a minimum of four locations, each not more than 3 feet above the floor and not more than 10 feet from the equipment. This requirement shall also apply to all filters, reactors, and transformers supplied with the drive.

22. All VFD panels will have a fluorescent utility light and a 120vac receptacle on a separate circuit. The overhead fluorescent light will be door switched.

23. A dirty filter indicating light shall be provided on the control panel with a contact for remote alarm.

B. Diagnostics: Diagnostic indicators on the face of the drive shall display the type of fault responsible for drive shutdown, warning, or failure. If two or more faults occur simultaneously, the diagnostic segment shall record or indicate each condition. The drive shall be capable of storing 15 events with a time and date stamp for each event.

C. Communications/Software:

1. Drive shall be capable of communications through standard protocols including EtherNet/IP, RS232 and RS485.

2. Drive shall be able to communicate with at least two networks at the same time. EtherNet/IP, ControlNet, or DeviceNet are the preferred networks.

3. Drive communications adapter shall have individually selectable fault actions in the case of a communications loss, or if the controller is idle (in program mode or faulted). Selections include faulting the drive, stopping the drive, zeroing data written to the drive, holding the drive in its last state, and using a selectable fault configuration.

4. The I/O packet shall consist of drive status and feedback, command and reference, and at least 8 data words of inputs and 8 data words of outputs that can be dynamically configured to access any parameter.

5. Startup wizards shall be provided to facilitate drive commissioning and startup.

2.6 Motor Protection Relay

Provide a Motor Protection Relay (MPR) with necessary potential transformers, current transformers, and ground current transformers – Mutilin SR469 to include the following alarms, trips and other protective features:

- Overload – Trip-Alarm-Block Start
- Overload Lockout – Block Start
- Undercurrent/Underpower – Trip-Alarm-Block Start

- Current Unbalance - Trip-Alarm-Block Start
- Ground Fault - Trip-Alarm-Block Start
- Phase Reversal – Trip-Block Start
- Restart Block (Anti-Backspin Timer) – Block Start
- Short Circuit and Short Circuit Backup – Trip-Block Start
- Mechanical Jam – Trip-Block Start
- Differential – Trip-Block Start
- Overvoltage/Undervoltage – Trip-Alarm
- Motor Stator RTD's – Trip-Alarm-Block Start
- Motor Bearing RTD's – Trip-Alarm-Block Start
- Pump Bearing RTD's – Trip-Alarm-Block Start
- Pump vibration alarm
- Motor vibration alarm

The relay shall be programmed as follows:

The 4-20 mA vibration signal inputs shall be programmed to represent a range of 0-1.0 inches per second (ips). Alarm point shall be set at 0.2 ips; shutdown point shall be set at 0.3 ips. The Alarm point shall be programmed to a normally closed (NC) MPR addressable output contact. The Shutdown point shall be programmed into the shutdown NC contact to the VFD start circuit.

The 4-20 mA stator signal inputs shall be programmed to represent a range of 0-160 Degrees C. Alarm point shall be set at 140 Degrees C; shutdown point shall be set at 150 Degrees C. The Alarm point shall be programmed to a normally closed (NC) MPR addressable output contact. The Shutdown point shall be programmed into the shutdown NC contact to the VFD start circuit.

The 4-20 mA bearing signal inputs shall be programmed to represent a range of 0-120 Degrees C. Alarm point shall be set at 80 Degrees C; shutdown point shall be set at 90 Degrees C. The Alarm point shall be programmed to a normally closed (NC) MPR addressable output contact. The Shutdown point shall be programmed into the shutdown NC contact to the VFD start circuit.

An addressable 4-20 mA MPR output shall be programmed for an average phase voltage range of 0 to 525 Volts.

An addressable 4-20 mA MPR output shall be programmed for an average phase current range of 0 to 150 Amperes.

Five (5) second time delays shall be programmed in prior to alarming or shutting down.

2.7 TESTING

A. All power switching components shall be prerun under anticipated operating temperature and load conditions.

B. Factory Testing

1. After the drive system has been assembled at the manufacturer's facility, it shall be tested for at least 24 hours before it is shipped.

2. The complete drive system, including all peripherals, shall be factory tested under simulated operating conditions, including normal operating sequences and fault conditions. Contact closure inputs and simulated driven-outputs shall be connected to the system input/output modules.

PART 3 - EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with the equipment manufacturer's recommendations.

3.2 FIELD TESTING

3.2.01 Field Acceptance Testing

1. After installation of the system at the site of the work and checkout by the drive manufacturer, a field acceptance test shall be conducted jointly by the drive manufacturer and the manufacturer of the driven equipment.

2. The field acceptance test shall consist of repeating the factory acceptance testing procedure and an additional 5 days of similar testing, during which the system shall run continuously without loss of basic functions. Functional tests shall demonstrate satisfactory operation of all interlocks, alarms, and normal operating sequences. The drive manufacturer shall use suitable test equipment to identify and correct malfunctions. Failure of redundant equipment will not be considered as downtime, provided that automatic failover occurs as specified herein and, that in the opinion of the Contracting Officer, the failure was not caused by deficiency in design or installation. Repeated failure of any component shall be cause for the acceptance test to be terminated and restarted.

3.2.02 Harmonic Distortion Test

1. The Contractor shall provide temporary four-channel power line monitoring equipment at the site to graph and record the harmonic line distortion for ac voltage and current, and to compute individual harmonic values up to the 50th harmonic as well as total harmonic distortion (THD) and total demand distortion (TDD).
2. Measurements shall include phase-to-phase, phase-to-neutral, and neutral-to-ground. The harmonic distortion shall be monitored at the primary and secondary points of common coupling. The test shall be run for the full range of drive operation to the extent practicable.

3. The test shall be conducted by qualified personnel acceptable to the Contracting Officer.

3.3 LOW VOLTAGE VARIABLE FREQUENCY DRIVE SCHEDULE

Driven Equipment Designation	Driven Equipment Section	Service	Number Required	VT/CT	Power Supply Volts	HP
RAS Pumps	11205	Sludge	25	**VT**	480	100 HP with service factor 1.15 and 900 RPM

End of Supplemental Section