



SPECIFICATION TWO-PUMP STATION WITH VARIABLE FREQUENCY CONTROLS

OPERATING CONDITIONS

The two variable speed pumps shall each be capable of delivering a maximum capacity of ___ GPM of raw, unscreened sewage against a maximum total dynamic head of ___' at ___ RPM of the pump motor and a minimum capacity of ___ GPM against a total dynamic head of ___' at not less than ___ RPM of the pump motor. The rated horsepower of each pump motor shall be ___.

The anticipated operating head range at maximum speed is from ___' minimum to ___' maximum.

All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter.

PUMP OPERATION

Starting from a low wet well and neither pump operating, the pump operation sequence shall be as follows:

- When the wet well rises to a preset lead pump "ON" level, an electrical signal provides power to the controller causing the lead pump connected to the Variable Frequency Drive (VFD) be accelerated gradually from zero to maximum speed. If the inflow to the wet well does not exceed the maximum pumping rate of the lead pump, the lead motor speed shall be varied between maximum and minimum in response to a wet well level transducer and shall establish a discharge flow rate to match the inflow rate to the wet well.
- If the capacity of the lead pump is greater than the flow into the wet well, as the wet well level continues to drop, the speed of the lead motor shall decrease to a minimum. If the inflow to the wet well is less than the capacity of the lead pump at minimum speed, the wet well will reach the low level shut-off position and the lead pump shall shutdown.
- If the flow into the wet well increases beyond the capacity of the lead pump operating alone at maximum speed, a high-level electrical signal shall start the lag pump which shall pump up to full speed.
- Both pumps operating at varying speed, then pump the wet well down to the pumps "OFF" level, stopping both pumps and completing the pumping cycle. This process will repeat itself as the wet well liquid level rises.
- The variable speed operated pump-motors shall be alternated by the station controller between "Lead" and "Lag" to distribute the wear.

ADJUSTABLE FREQUENCY PUMP CONTROL SYSTEM

The control system shall consist of adjustable frequency drives and associated components necessary to automatically operate two identical pump motors to control the level in the wet well. The converters shall each be dedicated to a separate pump-motor.

The VFD shall be designed to accept a speed signal from a level transducer in an automatic speed control mode or from a programmable preset speed when the manual mode is selected. The selected speed signal shall control the motor speed between the adjustable minimum and maximum speed settings. The total speed signal shall follow a linear time ramp which is adjustable from 0 to 1800 seconds to provide acceleration and deceleration control. A circuit breaker shall be provided to disconnect the VFD from all power, and the VFD shall be segregated within the enclosure to reduce the danger of power-off servicing while the remainder of the control system is in operation. The VFD shall be capable of operating the motor continuously at 100% of rated speed.



The variable speed power unit shall be a completely solid-state converter. The unit shall transform (208) (230) (460) volt, 3-phase, 60 cycle input power into variable voltage, adjustable frequency, 3-phase output of suitable capacity and wave-form to control the speed of a NEMA B design AC motor. Control shall be throughout a step-less speed range, under variable torque load on a continuous basis. The converter shall be of the PWM (pulse width modulation) type and shall include the following features:

ADJUSTABLE SPEED DRIVES FOR 3-PHASE PUMP MOTORS

Construction

The drive shall be designed to provide for ease of maintenance.

The inverter section power semiconductors shall be of an approved-type, and shall not require commutation capacitors.

The drive shall consist of the following major components:

- A. Input rectifier section to supply fixed DC bus voltage
- B. Phase-to-phase and phase-to-ground MOV protection, a capacitor clamp and 5% impedance reactors
- C. Smoother reactors for the DC bus (dual positive and negative)
- D. DC bus capacitors
- E. Sine weighted PWM generating inverter section
- F. Separate terminal blocks for control and power wiring

The drive shall supply a constant volts output when operating above 60 Hz.

The volts-per-hertz output of the drive shall not be affected or require readjustment when other drive adjustments (such as maximum speed) are changed.

The drive output waveform shall be the PWM type waveform producing smooth torque at low frequencies and low harmonics.

The drive shall be capable of operating output opened circuited with no fault or damage.

CONTROL FEATURES

When specified, the speed potentiometer may be remotely located up to 100 feet (30 meters) from the drive.

The drive shall produce an output frequency proportional to the speed reference without external feedback.

For digital speed commands, the drive shall maintain set frequency to within 0.01 Hz during power line fluctuations or changes in ambient temperatures.

Two adjustable "skip bands" shall be available to prevent pump operation at resonant frequencies, if necessary, to avoid potentially damaging pump vibration.

Within the drive rating, the drive shall maintain set frequency, and not require readjustment due to changes in load.

ENGINEERING DATA



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Variable Flow
2-Pump Station with
Variable Frequency
Controls Specification
June, 2012
Page 3

Motor Overload Protection

The drive shall provide motor overload protection when a single motor is connected to the drive. Class 10, 20 or 30 (programmable) electronic motor overload protection shall be included.

The overload protection shall be adjustable from 50% to 115% of the drive full load current rating.

Motor overload protection shall provide the protection required by the NEC.

Under-Voltage Sensing

Should the input line fall below 10% of rated input voltage, the drive shall sense an under-voltage condition and annunciate it on the digital display panel.

Over-Voltage Sensing

Should either the input line rise above 10% of rated input voltage, or the internal DC bus rise above allowable levels due to load regeneration, the drive shall sense an over-voltage condition and annunciate it on the digital display panel.

Phase Protection

The drive shall have protection against (and indicate) a phase-to-phase short in the output load, or a short circuit in a phase of the output module.

Each output phase shall be monitored. If a short circuit condition occurs, a circuit shall guard against further damage by turning off the entire output section experiencing the shorted condition.

The drive shall shut down and annunciate the fault and display the appropriate fault on the digital display panel.

Drive Protection

The drive protection functions shall monitor and annunciate the following conditions as a minimum:

- Over-Current
- Short-Circuit/Ground Fault
- Under-Voltage
- Over-Voltage
- Over-Temperature
- Phase Loss