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Constant Pressure Booster system – level 2 **Sulzer Pumps Houston Inc.**

General

Furnish a skid packaged domestic water pressure booster system as described in these specifications and shown in the plans. The system shall be complete requiring only suction and discharge piping connection, one electrical power connection and installation and wiring interconnection of remote sensors.

The entire unit shall be factory assembled, wired and tested with complete electrical, hydrostatic and performance test. It shall be cleaned and painted with a high-grade machinery enamel prior to shipment.

The system shall be rated for total system capacity with individual pumps in the system sized and sequenced to deliver a portion of the total flow as demand varies. The system shall be so designed to provide the most attainable wire to water efficiency as determined by the individual pump curves and system demand.

Field startup by the manufacturer is required for final acceptance.

Acceptable Manufacturers

A. Sulzer Pumps

Motors

Motors shall be high efficiency type. The motors shall be selected to operate within the horsepower rating of the pump at all points on the pump curve without overload. The motors shall conform to specification section _____.

Pumps

Pumps shall be end suction, horizontal split case, vertical turbine or vertical multistage design. The pump manufacturer shall select type to meet system requirements and shall submit individual pump curves as well as system loss calculations for approval. The pumps shall conform to specification section _____.

Piping

Piping and all pertinent components shall be cold water rated for working pressure of 125 psig and shall be hydro statically tested in accordance with Hydraulic Institute Standards for centrifugal pumps. All materials in contact with the system water shall be corrosion resistant. Unit manifolds shall utilize 300 series stainless steel. Suction and discharge connections shall be flanged.

Valves

Each pump's suction and discharge connection shall be furnished with an isolated valve facilitating individual pump service with system operating.

Each pump will also be supplied with a pilot controlled, hydraulically operated, diaphragm type pressure-regulating valve. The valve will provide a constant reduced down stream pressure as set by the pressure reducing control. The main valve body will be fused epoxy coated – FDA approved for potable water. An integral check feature will guard against reverse flow.

Where required, a silent check valve shall be installed on the discharge of the pump. Valves shall be bronze or epoxy coated with bronze trim and stainless steel spring.

Accessories

Each pump shall be equipped with thermal sensing and thermal purge system to protect the pump from overheating.

Air bleed fittings / petcocks shall be provided at all system "high" points.

Pressure gauges shall be furnished for indication of the common suction and discharge pressures. Each sensing line shall be equipped with an isolation block and bleed valve arrangement.

System shall include a _____gallon, ____PSI rated pre-charged steel hydro-pneumatic tank with replaceable heavy-duty butyl rubber bladder. The tank will include an NPT system connection and a 0.302" – 32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure vessel code.

Power Wiring

All electrical wiring shall be installed in accordance with NEC requirements. Contractor shall adhere to all local and other applicable codes.

Pre packaged pumping systems shall be supplied with lockable service disconnecting means for each pump. Appropriate disconnect and branch circuit protection shall be provided for the control logic.

Controls

All control components other than the remote sensors shall be mounted in a single enclosure. The enclosure will be of metal construction for rejection of EMI and RFI signals. The control panel shall be UL listed as an assembly. The controls shall include all components and wiring to perform the necessary operations. The panel shall include terminal block connections for the external sensors and remote telemetry contacts.

The system logic shall be by a microprocessor-based controller and shall include an operator interface unit for display of system variables and adjustment of designated set points. Field programming shall be password accessible.

The operator interface unit (HMI) shall offer the following features:

A. 6" touch screen display
B. Flash memory-based
C. 999 screen capability
D. Built in clock and calendar
E. Password protection capability for every touch screen
F. Passwords for up to 8 user groups
G. Built in keypad for numeric and alphanumeric entry
H. Alarm log including the number of incidents for each alarm, date/time of alarm trip and date/time when alarm was reset
I. Two communication ports
J. NEMA type 4/4X indoor use enclosure
K. UL, cUL and CE listed

All system messages will be displayed in plain English with standard engineering units.

The control panel will include one self-protected starter per motor. A self-protected starter combines a short circuit and overload protection module with a contactor to make a single unit. Motor nameplate amps, FLA, shall be within the module's current range. Starter shall have independent adjustments for thermal and magnetic trip settings.

Each starter will include a thru the door disconnect operator. Disconnect operator will include "locked in off" position feature.

The pump system manufacture shall supply as a minimum, two pressure transmitters for monitoring the system suction and system discharge pressures. The transmitters shall incorporate diffused silicon sensor and provide a 4-20 mA output. The transmitters shall also include:

A. Proof pressure rating of 2 x rated pressure
B. Reverse polarity protection
C. ¼" NPT, 316 stainless steel male process connection
D. High pressure snubber
E. NEMA 4 enclosure

The pump system manufacturer shall furnish and install a flow sensor to monitor system flow. The sensor and associated transmitter shall produce a 4-20 mA linear signal proportional to system flow. The unit shall be calibrated for maximum system flow.

The microprocessor controller shall include the following minimum parameters:

A. 20 discrete inputs
B. 16 discrete outputs
C. 4 analog inputs
D. 2 analog outputs
E. 2 communication ports
F. 3 spare I/O expansion slots
G. Non volatile memory
H. PID programming capability and floating point math
I. Real time clock

The control panel shall include individual pump hand-off-auto selectors.

The control panel shall include an audible alarm horn to annunciate a fault condition. Specific cause of fault will be displayed on the HMI.

The system will include a 120 Vac step down transformer for systems were the primary line voltage exceeds 120 Vac. Transformer primary and secondary will be fuse protected.

Control logic
Flow Sequencing

The system is designed with 20/40/40 split capacities include a lesser capacity pump termed “lead pump” to handle normal system demand. System is equipped with two larger capacity pumps termed “main pumps” to satisfy demands above normal requirements. The system utilizes the most efficient pump arrangement needed to satisfy flow requirements by providing five-stage sequencing. Each stage has separate start and stop set points as well as independent adjustable “Minimum Run” timers.

False start signals are minimized by requiring pressure start and flow up-staging signals remain constant for 2 seconds before the controller acts. Including a permissive sequence such that each later stage cannot be called to operate until previous stage start signal is latched will prevent simultaneous pump starts. Likewise, on de-staging, each later stage must complete the minimum run time before the earlier stage minimum run circuit can be activated.

To lessen the possibility of line surge, controls shall incorporate “soft alternation “ logic. Soft alternation allows for continuous operation of the previous stage pump for a fixed time after controller registers run confirmation of the next stage pump. If the controller does not confirm pump run, previous stage pump will continue to operate. A typical sequence is described:

The controller is designed to monitor the system pressure and flow transmitter signals. The controller compares the pressure deviation to the system set point. A system pressure drop below the predetermined set point will initiate the start of the lead pump.

The controller will signal the start of a main pump when demand exceeds the “2nd Stage Start” set point. The lead pump will stop 5 seconds after second stage pump is confirmed running.

Water demand exceeding “3rd Stage Start” set point will signal restart of the lead pump allowing parallel operation of lead and one main pump.

The fourth stage is signaled to operate when flow is greater than “4th Stage Start” set point. The controller signals the second main to start; lead pump will stop 5 seconds after second main is confirmed running.

If flow demand exceeds “5th Stage Start” set point, controller will signal lead pump to restart providing maximum system flow with both mains and lead pump operating in parallel.

As demand is satisfied, controller will reduce pumping system output allowing the minimum pump arrangement required for present flow. De-staging logic for fifth stage is triggered when flow is less than “5th Stage Stop” set point. Controller initiates a “Minimum Run” circuit. If flow remains less than “5th Stage Stop” set point for the

duration of the minimum run time, controller will signal lead pump stop. If flow exceeds "5th Stage Stop" set point while minimum run timer is active, controller will reset minimum run time. As demand decreases below said set point, minimum run circuit is again triggered.

Stages two, three and four follow same logic. First stage requires system pressure to be above "Pressure Start" set point and flow to be less than "No Flow Stop" set point.

Main Pump Alternation

Control system has two methods of automatically alternating the main pumps. Primary alternation of the main pumps occurs at the completion of every first stage cycle. Cycle completion is determined by a first stage start and subsequent stop after the minimum run time. If additional stages are signaled to run and stop during the same cycle, the called main pump sequence will remain.

Control system also includes a timed method of main pump automatic alternation. Operator programs the maximum number of hours, range 1- 9999, which a given main pump sequence is allowed. Alternation time is initiated by a first stage start signal. If the alternation time is completed before the end of the run cycle, main pumps alternate positions. If the run cycle is completed before the alternation time elapses, then the alternation time is reset and the main pumps alternate based on cycle completion. Alternation will occur only if main pump H-O-A selectors are in the auto mode and no main pump failure has been sensed.

An additional feature is that of over riding automatic pump alternation and designating a pump sequence. Operator, using the HMI, may place either pump 2 or 3 in the main pump lead position, second stage start. Designating pump 2 as lead will place pump 2 as second stage pump with pump 3 in lag position. Likewise, pump 3 lead designates pump 3 as second stage pump with pump 2 as lag.

H-O-A

Controller monitors the selector position of each pump. As flow is required, the controller selects a pump start sequence based on available pumps. When the selector is placed in the auto mode the respective pump is placed into the pumping sequence.

Pumps placed in the off mode will not operate.

Pump will immediately operate when selector is placed in hand position. With the exception of motor overload, monitored safeties are bypassed. Pump will continue to run until selector is placed in off position.

Monitored Alarms

The controller monitors the system for the following fault conditions:

1. Pump failure. Motor auxiliary contacts for each pump are wired to the PLC. When a start signal for a given pump is sent, the respective motor auxiliary contact must signal a motor start within five seconds of the start signal. If time elapses before the run confirmation is sensed by the PLC, controller signals given pump failure and locks out pump from pumping sequence. Manual reset is required before pump is reinstated into the sequence rotation.

2. Low Discharge pressure. HMI includes set point for low discharge pressure. Discharge pressure must remain below programmed value for 30 seconds before controller signals fault. Low discharge pressure will shut down all pump operation. Manual reset required before controller can resume normal pump operation.

3. High Discharge pressure. HMI includes set point for high discharge pressure. Discharge pressure must remain above programmed value for 2 seconds before controller signals fault. High discharge pressure will shut down all pump operation; auto reset of alarm condition when pressure drops below alarm set point and remains below set point for a minimum of 10 seconds.

4. Low Suction pressure. HMI includes set point for low suction pressure. Suction pressure must remain below programmed value for 10 seconds before controller signals fault. Low suction pressure will shut down all pump operation. Automatic reset when suction pressure is restored for a minimum of 10 seconds. Alarm available only with pressurized suction supply.

5. Low Suction level. Controller includes terminal points for interface with external low-level float switch. Level switch must remain closed for 10 seconds before controller signals fault. Low suction level will shut down all pump operation. Automatic reset when suction level switch opens and remains open for a minimum of 10 seconds. Alarm available only with flooded suction supply.

6. High Suction pressure. HMI includes set point for high suction pressure. Suction pressure must remain above programmed value for 30 seconds before controller signals fault. High suction pressure will alarm only, pumps will continue to operate. Automatic reset when suction pressure drops below set point.

7. High System flow. HMI includes set point for high system flow. System flow must remain above programmed value for 10 seconds before controller signals fault. High system flow will alarm only, pumps will continue to operate. Automatic reset when system flow falls below alarm set point.