



Pump Specifications

I. GENERAL

The work under this section shall consist of providing all pumping equipment including the hydraulically driven axial flow or mixed flow pumps, drive units, all piping, appurtenances and mechanical system as shown on the drawings and as specified herein. Pumps shall be manufactured by MWI Corporation, 201 N Federal Hwy., Deerfield Beach, FL 33441-3624, or ENGINEER approved equal.

The substitution form enclosed must be returned two (2) weeks prior to bid opening for consideration of approval.

The pump and drive equipment to be furnished under this contract shall be made by a manufacturer regularly engaged in such work, and who has furnished like equipment and specialties for at least five (5) similar installations which have been continuously operating successfully for not less than five (5) years.

Evidence of this experience and data on the equipment and its operation in those installations shall be made available to the ENGINEER at their request to determine whether the equipment and specialties offered meet the requirements of these specifications.

Pump bowls, propellers, and hydraulic power units shall be the product of a single manufacturer.

II. DESIGN DATA

The Contractor shall furnish with the bid, guaranteed pump performance curves based on shop tests of pumps in accordance with procedures as specified by Standards of Hydraulic Institute. Curves shall be certified by a professional engineer, registered in the state where the tests are conducted and employed full time by the pump manufacturer. Any bid not including such curves shall be considered non-responsive and shall not be accepted.

1.	Quantity of Pumps	_____	_____
2.	Design Capacity Ea.	_____ GPM	_____ CMS
3.	Datum Elevation	_____ FT	_____ M
4.	Discharge Pipe Invert	_____ FT	_____ M
5.	Suction Bell Inlet	_____ FT	_____ M
6.	Downstream Water Elevation	_____ FT	_____ M
7.	Pump Propeller Elevation	_____ FT	_____ M
8.	Operation Head: Design TDH	_____ FT	_____ M

III. WARRANTY

The hydraulic propeller pump system and controls shall be warranted for 1 year by the manufacturer against defects in material and workmanship, under normal use and service from the date of shipment from the factory as described in the warranty certificate.

IV. PUMP MATERIAL AND DESIGN

The pumps to be furnished under this specification shall be hydraulically driven, axial flow propeller, completely submersible with propeller bowl assembly, hydraulic motor assembly, suction bell assembly and discharge tube.

A. SUCTION BELL - The suction bell assembly shall be manufactured from alloy steel, _____ thick and conforming to ASTM A242 or equal, and shall have an inlet diameter of 1.5 times the propeller diameter. The inlet bell shall be constructed to minimize vortex formation by maintaining equal pressures and velocities across the entrance. Bars shall be placed across the bell mouth to prevent entrance of large sticks, logs or debris. Inlet bell face shall be parallel to the water surface regardless of the angle of installation.

B. PUMP BOWL - The propeller bowl assembly section shall be a single stage, shop assembled unit consisting of a venturi housing, stainless steel liner, propeller shaft, bearings and stainless steel propeller blades. The venturi housing shall be manufactured from _____ thick alloy steel conforming to ASTM A242 or equal and shall be fitted with a machined, removable housing liner of 300 series stainless steel of not less than 3/16" thickness and a liner length of not less than the pitch length of the propeller.

C. PROPELLER and SHAFT - The pump propeller blades shall be manufactured using ASTM A304 stainless steel. The propeller shall be balanced and secured firmly to the taper shaft with alignment key and locknut. The propeller shaft shall be machined from solid stainless steel bar stock and shall conform to ASME Code for transmission shafting to transmit full load torque and shall have additional safety factor for shock loads.

D. BEARINGS - The propeller shaft shall be supported and contained in place multiple angular contact bearings. The shaft bearings shall be designed for an L_{10} life of 50,000 hours and lubricated by low pressure hydraulic oil. The propeller shaft and bearing assembly shall be contained in a machined bearing housing centrally supported by flow straightening vanes in the propeller bowl assembly and shall be protected against sand particle intrusion. The bearings shall be designed to accept thrust in either direction. Include a non-reverse rotation mechanism (except in two way pumping applications).

E. The discharge tube and head assembly shall be manufactured as shown on the drawings and the material shall be abrasive resistance steel conforming to ASTM A242 or equal with a minimum wall thickness of _____. The complete pump assembly shall be painted inside and outside with bitumastic enamel equal to Zophar Triple A.

F. HYDRAULIC MOTOR - The hydraulic motor assembly section shall consist of the assembly housing, hydraulic motor, propeller shaft coupling and inlet, and outlet port pipe connections. The assembly housing shall be manufactured from _____ thick alloy steel conforming to ASTM A242. The housing assembly shall contain a hydraulic motor coupled to the propeller shaft. The hydraulic motor, bearings, shaft and coupling shall be enclosed and sealed to permit totally submerged operation in any position. The hydraulic motor shall be provided with inlet and outlet pipes that extend from the hydraulic motor through the assembly housing and terminate with quick coupling connections. The hydraulic motor shall be mounted on the discharge side of the propeller to minimize NPSH requirements, avoid clogging of the intake and induce more efficient oil cooling. Suction side installations shall not be permitted.

V. DIESEL SKID DRIVE UNIT

Each Hydraflo pump shall be supplied with an individual diesel engine drive unit as shown on the drawings and as specified herein. The drive unit shall be manufactured and tested at the same factory as the pumping unit to provide a single source of responsibility and for the proper coordination of all components of the system. The drive unit shall consist of an oil reservoir, a fixed displacement hydraulic pump, a diesel engine, inter-connecting piping, valves and accessories mounted on a steel base with lifting eyes.

- A. The hydraulic pump shall be a fixed displacement vane type unit capable of continuous operation at 3000 psi and shall produce a minimum output of _____ hp at 1,800 rpm.
- B. The prime mover shall be a _____ or equal diesel engine with a continuous duty rating of _____ BHP at 1,800 rpm. The engine shall be fully equipped and shall include but not be limited to: a radiator, batteries and cable, safety shutdown switches, and exhaust system with a muffler or sound attenuating system.
- C. The diesel drive unit shall be factory assembled and skid-mounted. Hydraulic equipment shall include but not be limited to: a full flow oil filter, adjustable pressure relief valve, pressure and temperature gauges, quick connect couplings and safety shut down controls for low hydraulic oil level, high suction vacuum, high hydraulic oil temperature, low engine oil pressure, and high engine water temperature.
- D. A hydraulic system monitoring device to allow diagnosing hydraulic system behavior even while pump is still submerged shall also be included.
- E. The drive system shall include a "clutch" starting system which allows the prime mover to start unloaded and then gradually (3 to 5 seconds) engage the load. The "clutch" system shall be used to gradually disengage the load prior to shut-off of the prime mover.
- F. Sufficient hydraulic oil cooling capacity shall be provided to sustain direct sunlight radiation as well as ambient temperatures up to 122°F (50°C).

VI. HYDRAULIC PIPE AND HOSE

Hydraulic lines connecting the power unit to the pumping unit shall be a combination of black steel pipe and reinforced hose and shall be installed in accordance with the drawings and as specified herein.

Supply pipe shall be ASTM-A106, Schedule 80 seamless black steel pipe, and return pipes shall be ASTM-A106, Schedule 40 seamless black steel pipe. All hydraulic pipe shall be pickled, oiled and plugged (P.O.P.). All reinforced supply hose shall be double wire braid reinforcement and shall have minimum safe working pressure of 2500 psi. All pipe fittings shall be socket weld type (with socket weld to thread fittings at conversion point of pipe to reinforced hose). Quick connect couplings shall be provided at connection points of drive unit and water pump. Both supply and return piping shall be of the size indicated on the drawings and internal velocities shall not exceed 15 fps. Hose lengths shall be determined in the field after erection of pumps.

VII. PUMP TESTING

- A. Each pump and hydraulic power transmission system shall be full size tested at the manufacturer's factory. The test shall be conducted in an open tank with sufficient capacity for accurate pump testing. All tests shall be in accordance with the Hydraulic Institute Standards and certified by a Professional Engineer employed full time by the manufacturer. Testing shall include but not be limited to:
1. Design head vs. design capacity
 2. Mechanical integrity for a minimum of 90 minutes at design operating temperatures and pressures
 3. Proper operation of all gauges and safety shutdown systems
 4. Hydraulic oil leak test. In the event a leak is detected, it shall be repaired and the test repeated until all leaks are eliminated.

A representative of the Owner shall be selected to witness these performance tests. The pump manufacturer shall be required to provide to the Owner's satisfaction that all materials used in the manufacture of equipment and its performance meet and are being furnished as specified.

- B. A field test shall be witnessed by the ENGINEER. All plumbing fittings and hydraulic equipment shall be inspected for leakage. Should a leak be detected, repairs shall be made and the test performed again until all leaks are eliminated.

VIII. INSTALLATION AND SUPERVISION

- A. The contractor shall coordinate construction of station and installation of the pumps with the pump manufacturer. All construction and installation shall be in conformance with the drawings and specifications and the pump manufacturer's recommendations.
- B. The contractor and pump manufacturer shall provide for final inspection and testing of the system and shall make necessary adjustments to the control system prior to actual start-up tests. Start-up tests and demonstration shall be performed by the pump manufacturer's representative and the contractor, and witnessed by the engineer. Three (3) sets of operating and maintenance manuals and start-up procedures shall be provided to the engineer. Contractor shall have pump manufacturer train and instruct owner's operator on all equipment.

IX. SUBSTITUTION OF MATERIALS OR EQUIPMENT

The procedure for review by ENGINEER will be as set forth in following paragraphs:

Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified. The application will state whether or not acceptance of the substitute for use in the Work will require a change in the Drawings or Specifications to adapt the design to the substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish at CONTRACTOR'S expense additional data about the proposed substitute. ENGINEER will be the sole judge of acceptability, and no substitute will be ordered or installed without ENGINEER'S prior written acceptance. OWNER may require CONTRACTOR to furnish at CONTRACTOR'S expense a special performance guarantee or other surety with respect to any substitute.

ENGINEER will record time requirements by ENGINEER and ENGINEER'S consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Drawings or Specifications occasioned thereby. Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER'S consultants for evaluating any proposed substitute.

X. MANUFACTURER'S QUALIFICATIONS

Not later than _____, 20____(two weeks prior to bid date) all bidders must submit for evaluation purposes by certified mail the following data: (NOTE: If this information is not received, the bidder's proposal will not be acceptable and will be considered non-responsive.)

Name, address, phone number of pump manufacturer:_____

Number of years in business:_____

Banking reference of manufacturer:_____

Trading references (3) Name, Address and Phone:

A. _____

B. _____

C. _____

Length of time manufacturing permanently installed pumps of this type:_____

Number of units of this type manufactured:_____

Location:_____

Size:_____

Discharge:_____

Owner & Phone Number:_____

Directly employed key personnel, experience and qualifications:

A. Chief Engineer (Name, Address, Professional Registration Number):

Length of Time Employed:_____

Academic Qualifications:_____

B. Other professional personnel employed (Name, Address, Title):

Name and registration number of responsible testing engineer who will perform factory certified witness testing of the pumping system:_____

XI. PROSPECTIVE BIDDERS SHALL SUBMIT THE FOLLOWING FOR EVALUATION:

Completed Manufacturer's qualification sheet (previous page)

Guaranteed pump performance curves based on shop tests of pumps in accordance with procedures as specified by Standards of Hydraulic Institute. Curves shall be certified by a professional engineer, registered in the state where the tests are conducted and employed full time by the pump manufacturer. Any bid not including such curves shall be considered non-responsive and shall not be accepted.

Certification by Chief Engineer that manufacturer's pump testing facilities meet all requirements of the Hydraulic Institute Standards.

Specific acknowledgment that all testing shall be conducted in accordance with procedures described in the "Hydraulic Institute Standards" USA

A representative list of manufacturer's experience in the furnishing of hydraulically driven axial flow pumps of similar sizes or larger to those specified for this project, permanently installed and presently operating shall be furnished and include the names, addresses and telephone numbers of the consulting engineers, owners and operators of the system. The dates of installations shall also be included.

Three (3) certified copies of the pump performance curve of the unit. The curve shall be stamped as certified (correct) by a Professional Engineer registered in the state in which the pumps are tested and manufactured. The curve shall show the pump capacity, discharge head, speed, and horsepower requirements.

Three original copies of manufacturer's complete engineering catalogues for pumps.

Three certified copies of installation and operation manuals for permanent pump systems.

Three descriptive brochures showing photographs and/or describing the pump unit.

Three copies of all pump "Bill of Materials" of the unit's construction, cut-a-way drawings, and dimensions as offered to confirm compliance with the specifications.

V. PORTABLE DIESEL DRIVE UNIT

Each Hydrflo pump shall be supplied with an individual portable diesel engine drive unit as shown on the drawings and as specified herein. The portable drive unit shall be manufactured and tested at the same factory as the pumping unit to provide a single source of responsibility and for the proper coordination of all components of the system. The drive unit shall consist of an oil reservoir, a fixed displacement hydraulic pump, a diesel engine, inter-connecting piping, valves and accessories mounted on a self contained trailer.

- A. The hydraulic pump shall be a fixed displacement vane type unit capable of continuous operation at 3000 psi and shall produce a minimum output of _____ hp at 1,800 rpm.
- B. The prime mover shall be a _____ or equal diesel engine with a continuous duty rating of _____ BHP at 1,800 rpm. The engine shall be fully equipped and shall include but not be limited to: a radiator, batteries and cable, safety shutdown switches, and exhaust system with a muffler or sound attenuating system.
- C. The diesel drive unit shall be factory assembled and skid-mounted. Hydraulic equipment shall include but not be limited to: a full flow oil filter, adjustable pressure relief valve, pressure and temperature gauges, quick connect couplings and safety shut down controls for low hydraulic oil level, high suction vacuum, high hydraulic oil temperature, low engine oil pressure, and high engine water temperature.
- D. A hydraulic system monitoring device to allow diagnosing hydraulic system behavior even while pump is still submerged shall also be included.
- E. The drive system shall include a "clutch" starting system which allows the prime mover to start unloaded and then gradually (3 to 5 seconds) engage the load. The "clutch" system shall be used to gradually disengage the load prior to shut-off of the prime mover.
- F. Sufficient hydraulic oil cooling capacity shall be provided to sustain direct sunlight radiation as well as ambient temperatures up to 122°F (50°C).
- G. The trailer must be steerable with safety tongue hitch, wheel guards and proper lighting. The system shall be designed and certified for roadability in accordance with lateral instability and longitudinal stability engineering analysis per ASAE standards for highway vehicular operation practices.

V. ELECTRIC SKID DRIVE UNIT

Each Hydraflo pump shall be supplied with an individual electric motor drive unit as shown on the drawings and as specified herein. The drive unit shall be manufactured and tested at the same factory as the pumping unit so as to provide a single source of responsibility and for the proper coordination of all components of the system. The drive unit shall consist of an oil reservoir, a fixed displacement hydraulic pump, an electric motor, interconnecting piping, valves and accessories mounted on a steel base with lifting eyes.

- A. The hydraulic pump shall be a fixed displacement vane type unit capable of continuous operation at 3000 psi and shall produce a minimum output of _____ hp at 1,800 rpm.
- B. The prime mover shall be US Electric Motors or equal rated at _____ Hp at 1780 rpm. The electric motor shall be a horizontal, foot-mounted, open drip proof, induction squirrel cage type, with self-lubricating ball bearings. The motor shall operate on 460 volt, 3-phase, 60 Hertz electric power and shall be wound for across-the-line starting. Windings shall be completely encapsulated and have a 1.15 service factor.
- C. Power unit shall be factory assembled and skid-mounted. Hydraulic equipment shall include but not be limited to: a full flow oil filter, adjustable pressure relief valves at each pump outlet, pressure and temperature gauges, quick connect couplings and safety shutdown controls for low oil pressure and high oil temperature. All systems shall be assembled, piped and tested prior to delivery to the site.
- D. A hydraulic system monitoring device to allow diagnosing hydraulic system behavior even while pump is still submerged shall also be included.
- E. The drive system shall include a "clutch" starting system which allows the prime mover to start unloaded and then gradually (3 to 5 seconds) engage the load. The "clutch" system shall be used to gradually disengage the load prior to shut-off of the prime mover.
- F. Sufficient hydraulic oil cooling capacity shall be provided to sustain direct sunlight radiation as well as ambient temperatures up to 122°F (50°C).

V. COMBINATION DIESEL-ELECTRIC DRIVE UNIT

Each Hydrflo pump shall be supplied with an individual diesel-electric drive unit as shown on the drawings and as specified herein. The dual prime movers shall provide an "either/or" power operation with the electric motor as the primary source and the diesel engine as the emergency source. In the event of electrical power failure, the control system shall select to start the diesel engine either automatically from a level-sensing signal or manually from the control panel switch. The drive unit shall be manufactured and tested at the same factory as the pumping unit to provide a single source of responsibility and for the proper coordination of all components of the system. The diesel-electric drive unit shall consist of an oil reservoir, fixed displacement hydraulic pumps, diesel engine, electric motor, inter-connecting piping, valves, and accessories, mounted on a fabricated steel base with lifting eyes.

- A. The hydraulic pumps shall be fixed displacement vane type units capable of continuous operation at 3000 psi and shall produce a minimum output of _____ hp at 1,800 rpm. Each hydraulic pump shall be directly mounted to separate prime movers.
- B. The electric prime mover shall be US Electric Motors or equal rated at _____ Hp at 1780 rpm. The electric motor shall be horizontal, foot-mounted, open drip proof, induction squirrel cage type, with self-lubricating ball bearings. The motor shall operate on 460 volt, 3-phase, 60 Hertz electric power and shall be wound for across-the-line starting. Windings shall be completely encapsulated and have a 1.15 service factor.
- C. The emergency prime mover shall be a _____ or equal diesel engine with a continuous duty rating of _____ BHP at 1,800 rpm. The engine shall be fully equipped and shall include but not be limited to: a radiator, batteries and cable, safety shutdown switches, and exhaust system with a muffler or sound attenuating system.
- D. The power unit shall be factory assembled and skid-mounted. Hydraulic accessories shall include but not be limited to: a full flow oil filter, adjustable pressure relief valves at each pump outlet, pressure and temperature gauges, quick connect couplings and safety shutdown controls for low hydraulic oil level, high suction vacuum, high hydraulic oil temperature, and high engine water temperature. All systems shall be assembled, piped and tested prior to delivery to the site.
- E. A hydraulic system monitoring device to allow diagnosing hydraulic system behavior even while pump is still submerged shall also be included.
- F. The drive system shall include a "clutch" starting system which allows the prime mover to start unloaded and then gradually (3 to 5 seconds) engage the load. The "clutch" system shall be used to gradually disengage the load prior to shut-off of the prime mover.
- G. Sufficient hydraulic oil cooling capacity shall be provided to sustain direct sunlight radiation as well as ambient temperatures up to 122°F (50°C).

V. DUAL ELECTRIC SKID UNIT

The Hydraflo pumps shall be supplied with a dual electric motor drive unit as shown on the drawings and as specified herein. The drive unit shall be manufactured and tested at the same factory as the pumping unit so as to provide a single source of responsibility and for the proper coordination of all components of the system. The drive unit shall consist of an oil reservoir, a fixed displacement hydraulic pump, an electric motor, interconnecting piping, valves and accessories mounted on a steel base with lifting eyes.

- A. The hydraulic pumps shall be fixed displacement vane type units capable of continuous operation at 3000 psi and shall produce a minimum output of _____ hp at 1,800 rpm. Each hydraulic pump shall be directly mounted to separate prime movers.
- B. The electric prime movers shall be US Electric Motors or equal rated at _____ Hp at 1780 rpm. The electric motors shall be horizontal, foot-mounted, open drip proof, induction squirrel cage type, with self-lubricating ball bearings. The motor shall operate on 460 volt, 3-phase, 60 Hertz electric power and shall be wound for across-the-line starting. Windings shall be completely encapsulated and have a 1.15 service factor.
- C. Power unit shall be factory assembled and skid-mounted. Hydraulic equipment shall include but not be limited to: a full flow oil filter, adjustable pressure relief valves at each pump outlet, pressure and temperature gauges, quick connect couplings and safety shutdown controls for low oil pressure and high oil temperature. All systems shall be assembled, piped and tested prior to delivery to the site.
- D. A hydraulic system monitoring device to allow diagnosing hydraulic system behavior even while pump is still submerged shall also be included.
- E. The drive system shall include a "clutch" starting system which allows the prime mover to start unloaded and then gradually (3 to 5 seconds) engage the load. The "clutch" system shall be used to gradually disengage the load prior to shut-off of the prime mover.
- F. Sufficient hydraulic oil cooling capacity shall be provided to sustain direct sunlight radiation as well as ambient temperatures up to 122°F (50°C).

V. DIESEL MOBILE

Each Hydraflo pump shall be supplied with an individual mobile diesel engine drive unit as shown on the drawings and as specified herein. The mobile drive unit shall be manufactured and tested at the same factory as the pumping unit to provide a single source of responsibility and for the proper coordination of all components of the system. The drive unit shall consist of an oil reservoir, a fixed displacement hydraulic pump, a diesel engine, inter-connecting piping, valves and accessories mounted on a self contained trailer.

- A. The hydraulic pump shall be a fixed displacement vane type unit capable of continuous operation at 3000 psi and shall produce a minimum output of _____ hp at 1,800 rpm.
- B. The prime mover shall be a _____ or equal diesel engine with a continuous duty rating of _____ BHP at 1,800 rpm. The engine shall be fully equipped and shall include but not be limited to: a radiator, batteries and cable, safety shutdown switches, and exhaust system with a muffler or sound attenuating system.
- C. Equipment shall include but not be limited to: a full flow oil filter, adjustable pressure relief valves at each pump outlet, pressure and temperature gauges, quick connect couplings and safety shut down controls for low oil pressure and high oil temperature. All systems shall be assembled, piped and tested prior to delivery to the site.
- D. A hydraulic system monitoring device to allow diagnosing hydraulic system behavior even while pump is still submerged shall also be included.
- E. The drive system shall include a "clutch" starting system which allows the prime mover to start unloaded and then gradually (3 to 5 seconds) engage the load. The "clutch" system shall be used to gradually disengage the load prior to shut-off of the prime mover.
- F. Sufficient hydraulic oil cooling capacity shall be provided to sustain direct sunlight radiation as well as ambient temperatures up to 122°F (50°C).
- G. The trailer must be steerable with safety tongue hitch, wheel guards and proper lighting. The system shall be designed and certified for roadability in accordance with lateral instability and longitudinal stability engineering analysis per ASAE standards for highway vehicular operation practices.

XII. VARIABLE SPEED CONTROLLER

- A. A pump ramp controller shall be installed in the control center and shall control the pumps as shown on the Pumping Sequence Table. The control shall be a 100% solid-state, plug-in module. Each module shall receive a voltage or current signal as supplied from the control system. The ramp controller shall provide adjustable gain, offset, minimum and maximum speed limit adjustments, and differential set points as described below.
1. Adjustable Gain - The controller shall allow the 4-20 mA signal output to be continuously positioned over the full output range. The low output limit shall be adjustable from 10% to 100% of the output range. The high output limit shall be adjustable from 100% down to 10% of the output range. The gain, therefore, is used to adjust the slope of the output line.
 2. Offset - The control card shall have provision to allow adjustment of the 4-20 mA output over any portion of the input range.
 3. Minimum and Maximum Speed Limits - The control card shall have provisions to allow adjustment of the output signal so that a minimum and maximum speed can be selected and set by the Engineer. The minimum/maximum speed adjustments shall adjust the lowest and highest allowable current supplied by the 4-20 mA (max. range) output signal.
 4. Differential Set Points - Each ramp control shall be provided with a differential set point that senses the voltage or current input signal and provides an adjustable differential output. The differential control shall be used to turn the pump **ON** and **OFF**.
- B. Variable Speed Pumps Alternation - The pumps shall go through a fixed sequence timed alternation to decrease the amount of wear imposed on a single variable speed pump. The alternation shall be adjusted to transpose the pumps operation during the systems low demand hours.