SECTION 15550
STORM WATER LIFT STATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes specifications for packaged storm water pump lift stations.

1.02 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM International):

1. C443 Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

2. C478 Specification for Precast Reinforced Concrete Manhole Sections

B. State of California Department of Transportation Bridge Design Specifications (Caltrans)

C. Standard Specifications for Public Works Construction (SSWPC):

1. Section 208-6 Pipe to Manhole Flexible Couplings

1.03 DEFINITIONS

A. H-20 loading: As defined in Caltrans Bridge Design Specifications.

B. NEMA: National Electrical Manufacturers Association.

1.04 PERFORMANCE REQUIREMENTS

A. Operating Conditions: Each pump shall be capable of delivering scheduled flow at scheduled dynamic head. All openings and passages shall be large enough to permit the passage of a sphere three (3) inches in diameter.

1.05 SUBMITTALS

A. Refer to Section 15000, Basic Mechanical Requirements, for additional submittals.

B. Product Data:

1. Dimensional drawings of lift station drawn to scale indicating components and connections to other equipment and piping.

2. Indicate pump type, capacity, and power requirements.

3. Certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include net positive suction head (NPSH) curve and total dynamic head (TDH) calculations.

4. Include a performance chart for motor showing curves for torque, current, power, factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

5. Mass moment of inertia calculations for the impellers upon the Engineer's request.

6. Indicate materials of construction.

7. Electrical characteristics and connection requirements.

C. Shop Drawings: The shop drawings shall include the following:

1. Dimensions of sump manhole, equipment, anchors, steps or ladders, pipe supports, attachments, lifting points, tappings, drains, piping, valve, fittings, float switches and access cover and locking hardware.

2. Structural calculations and shop drawings for precast reinforced concrete valve vault manhole and other precast drainage structure components.

3. Any fabricated items not detailed on Contract Drawings.

1.06 DELIVERABLES

A. Submit certificates of factory and manufacturer's representative's on-site inspection, testing, and approval to the Engineer.

B. Operation and Maintenance Data: Submit as specified in Sections 01700, Contract Closeout, and 15000, Basic Mechanical Requirements. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.07 QUALITY ASSURANCE

A. Notify the Engineer prior to and perform all testing during progress of the work in the presence of the Engineer.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum ten years experience.

C. Structural calculations and shop drawings for precast reinforced concrete valve vault manhole and other precast drainage structure components shall be sealed and signed by a registered structural engineer licensed in the State of California.

1.08 WARRANTY

A. Warranty: Submit five year manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Equipment and appurtenances for each packaged storm water lift station shall include two pumps; valves; internal piping; central control panel with circuit breakers; motor starters; level controls; electrical controls and wiring; electrical service connection; precast concrete valve pit vault; concrete work; and miscellaneous appurtenances.

B. Provide pumps with manufacturer's name, model number, and rating/capacity clearly identified.

C. Provide pumps complete with the following features and appurtenances:

1. Submersible, centrifugal, duplex arrangement, non-clog pumps.

2. Precast reinforced concrete valve vault manhole structure, galvanized steel steps, pipe supports, and similar items.

3. Pump guide rails shall be custom stainless steel construction and shall allow pump lift-out assembly and pump to move from bottom of guide to top of guide without binding. The lift-out assembly shall be easily removable from the top of rail.

4. Liquid level sensors, control panel complete with starters, alternator, controls, and alarm lights.

5. Plumbing: Provide each pump discharge with a check valve and a gate valve.

6. The motor and pump shall be designed and assembled by the same manufacturer.

7. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity.

2.02 SUBMERSIBLE CENTRIFUGAL NON-CLOG PUMPS

A. Pumps: Submersible centrifugal non-clog type for wet pit installation, capable of continuous submergence to the maximum depth indicated in the Contract Documents.

B. When lowered on its guide rail, each pumping unit shall be automatically and firmly connected to a discharge fitting permanently mounted on the discharge pipe. Sealing of the discharge connection by means other than metal to metal contact of the pump discharge flange and the discharge fitting will not be acceptable. The guide rail system shall be furnished, complete by the lift station manufacturer or in accordance with manufacturer’s recommendations. Each pump shall be equipped with a lifting chain and power cable of sufficient strength and length to permit easy removal for inspection or repair.

2.03 MOTOR

A. Pump Motor: Induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 311 degrees F. The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The motor shall be designed for continuous duty handling pumped media of 104 degrees F and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 260 degrees F shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.

B. The combined service factor shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10 percent. The motor shall be designed for operation up to 104 degrees F ambient and with a temperature rise not to exceed 144 degrees F.

C. Motors shall be sufficiently cooled by the surrounding environment or pumped media. A water cooling jacket shall not be required.

D. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

E. Motors shall be capable of continuous submergence to a depth of 65 feet without loss of watertight integrity.

2.04 ELECTRICAL CABLE AND PROTECTION

A. Size power cable in accordance with the National Electric Code (NEC) and Insulated Cable Engineers Association (ICEA) standards with sufficient length to reach the junction box above sump pit without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber.

B. The cable entry seal design shall include specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

C. All starters shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 260 degrees F, the thermal switches shall open and stop the motor.

2.05 BEARINGS

A. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove

ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces.

2.06 MECHANICAL SEAL

A. Provide each pump with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary ceramic seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. Each pump shall be provided with an oil chamber for the shaft sealing system.

2.07 PUMP SHAFT

A. Pump motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Coupling shall not be acceptable. The pump shaft shall be stainless steel.

2.08 IMPELLER

A. Impellers: Gray cast iron, Class 35B, dynamically balanced, double shrouded non-clogging design having a long through outlet without acute turns. The impellers shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in storm water. Impellers shall be retained with an allen head bolt and shall be capable of passing a minimum 3 inch diameter solid. All impellers shall be coated with alkyd resin primer.

2.09 WEAR RINGS

A. A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impellers. The wear ring shall be stationary and made of brass, which is drive fitted to the volute inlet.

2.10 VOLUTE

A. Pump Volutes: Single-piece gray cast iron, Class 30, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller.

2.11 PIPING

A. Piping associated with the plumbing system of the storm water lift station and its discharge pipe shall be ductile iron with mechanical joints for buried service and galvanized steel for exposed service in the sump and the valve vault. Piping shall be in accordance with the requirements specified under Section 15150, Plumbing, and the manufacturer's recommendations.

B. The pump discharge piping embedded in concrete shall be welded steel with flanged ends, hot dip galvanized after fabrication.

C. Size and type of inlet and outlet pipe varies. Refer to Contract Drawings and Section 02630, Storm Drainage System, for the requirements of inlet and outlet piping at sump manhole.

2.12 ELECTRICAL CONTROLS

A. Design standard duplex control panel to operate two submersible pumps based on wet well level monitored by level sensors. There shall be three (3) level sensors required for automatic operation of duplex pump station and (1) level sensor for high level alarm. The controls shall be float operated, duplex, with corrosion resistant floats to alternate operation of pumps and cut-in the second pump on rising level or lead pump failure. Provide additional set of wired terminals for future wiring of a remote alarm circuit.

B. The NEMA 1 control pump panel shall include the following:

1. Integral fused main switch
2. Pump short circuit protection
3. Pump overload protection
4. Pump direct on-line contactors
5. Twp (2) sets start capacitors and two (2) sets run capacitors
6. Control transformer
7. Control transformer primary and secondary protection
8. Electromechanical and solid state logic components for interface with wet well level sensors, built-in pump sensors and selected standard options.
9. Pump and control terminal blocks
10. Panel mounted pilot lights and operators
11. NEMA 1 padlock enclosure and mounting components
12. Intrinsically safe relays for float circuits
13. High water alarm: Flashing light (red), pump No. 1 operating light (green), and pump No. 2 operating light (green) to be mounted on controller enclosure door.
14. H-O-A switches and status transformer type pilot lights
15. Utility 120 volts duplex receptacle fed from separate internal 1 Kva transformer

16. Elapsed time meter

17. Lightning suppresser

18. Remote light contacts

19. Individual pump starters with "soft start" modules and breakers

20. Alternator relay and override relay

21. Front of panel reset push-button

C. All of the items shall be UL approved and provided with requirements as specified hereinafter.

D. Sequence of operation of duplex controls shall be as follows:

1. When water level in pump pit reaches level sensors No. 2 (lead pump start sensor), the alternator provided for charging pump No. 1 and pump No. 2 duty (lead-lag alternating) will change its state and lead pump contactors will be energized. If water level continues to rise and reaches level sensor No. 3 (lag pump start sensor), the lag pump contactors will be energized until water level drops to level sensor No. 1 (pump's stop sensor).

2. Auxiliary contacts of pump circuit breakers shall be introduced into the circuitry in such a way that pump's contactors will be de-energized if circuit breaker trip condition occurs.

3. Auxiliary contacts of thermal overload relays shall be introduced into the circuitry so that pump's contactors are de-energized should a motor overload condition occur.

4. Pump motor windings thermal switch shall be introduced into the circuitry via a control relay so that a pump's contactor is de-energized should high temperature of motor windings occur. It shall not be possible for pump to restart automatically but front of panel reset push-button shall be provided for manual clearing of the fault.

5. If the inflow to the station is greater than the combined capacity of both pumps, the liquid levels will rise to the High Level Sensor No. 4 and send a signal to red alarm light.

6. Flashing red light alarm trouble light indicates any trouble or failure of pumps to drain wet well.

2.13 PRECAST REINFORCED CONCRETE VALVE VAULT MANHOLE

A. Reinforced concrete sump manhole shall conform to ASTM C478 and the applicable material and installation requirements of Sections 02630, Storm Drainage System, and 03300, Cast-in-Place Concrete.

B. Ground Surface Elevation: As indicated in the Contract Documents.

C. Ground Water Table Elevation: As indicated in the Contract Documents.

D. Static Loads & Dynamic (Seismic) Loads: Refer to Geotechnical Investigation Report.

E. Uplift: Refer to the Buoyancy Safety Factor specified in the Contract Documents and to contract-specific Geotechnical Investigation Report.

F. Maximum Bearing Pressure: 4000 psf.

G. Excavate and perform backfill operations for valve vault manhole as specified in Section 02300, Earthwork. Unless otherwise noted, place 18 inch deep crushed gravel over the bearing soil to provide a firm-bearing surface for the manhole foundation.

H. Pipe to Precast Reinforced Concrete Sump Flexible Couplings: Shall conform to SSWPC Section 208-6. Couplings shall resist mild exposure to petroleum products.

I. Joints shall be bell and spigot, single rubber O-ring gasketed, conforming to ASTM C443.

J. Access cover shall be cast iron and designed for H20 loading with lockable hardware.

K. Exterior surfaces of the manhole structure shall receive two coats, 7 mils per coat of "Kop-Coat" Bitumastic (Coal Tar) Super Service Black Coating System as manufactured by the Carboline Company, or Engineer approved equal.

L. Provide knockouts in top slab of precast concrete structure to facilitate installation of electrical conduits, vent piping, and similar protrusions. Coordinate number and size of knockout requirements with storm water lift system equipment. Do not use access cover to facilitate the above.

2.14 PUMP CONTROL/ELECTRICAL ROOM

A. Light for Outside Wall of Electrical Room: Provide exterior red light with vapor proof enclosure. Refer to Electrical Controls Article herein. This light shall flash indicating any trouble or failure of pumps to drain wet well.

2.15 VALVE ACCESS HATCHES

A. The frame shall be of a single leaf design for H-20 loading and of sizes as shown on the Contract Drawings or the approved shop drawings. .

B. Hatch: Extruded aluminum with an integral anchor flange and seat. Equip with a flush aluminum drop handle which does not protrude above the cover and an automatic hold open arm with red vinyl grip on a release handle. Hinges shall be all stainless steel with tamper proof stainless steel blots and nuts, and be removable for maintenance after the access door is cast in place. Access door

shall be furnished with mill finish, cable holder, holes for cable holder and guide bracket. Aluminum surfaces which will be in contact with concrete shall be coated with "Bitumastic 300M" as manufactured by Kop-Coat or Engineer approved equal.

C, Equip access hatch with locking assembly consisting of self latching stainless slam lock and with a recessed hasp so that it can be locked with a padlock. The assembly shall not create obstruction or hazard for pedestrian traffic.

2.16 PUMP ACCESS HATCH

A. Access Hatch: Dual leaf design for H20 loading and of a size as shown on the Contract Drawings or the approved shop drawings.

B. Hatch: Extruded welded steel with an integral anchor flange and seat. Equipped with a flush steel drop handle, which does not protrude above the cover and an automatic hold open arm with red vinyl grip on a release handle. Hinges shall be all stainless steel with tamper proof stainless steel blots and nuts, and be removable for maintenance after the access door is cast in place. Access door shall be furnished with slip resistant galvanized diamond plate steel, Torsion spring assisted access door with hold open attachments. All parts shall be hot dipped galvanized. The walking surface shall be non-slip and rated for pedestrian service.

C. Equip access hatch with locking assembly consisting of self latching stainless slam lock and with a recessed hasp so that it can be locked with a padlock. The assembly shall not create obstruction or hazard for pedestrian traffic.

2.17 SOURCE QUALITY CONTROL

A. Perform tests to verify operation of electrical circuits and devices prior to shipment.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ensure pumps operate at specified system fluid temperature without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of mid-point of published efficiency curve.

B. Coordinate the size of the precast concrete manhole sump structure with the storm water lift station system equipment, including but not limited to pumps, plumbing and electrical components. Ensure that there is adequate space within the structure to remove both pumps and to access the structure to perform periodical maintenance.

C. Install plumbing and electrical components of the storm water pump system in accordance with Section 15150, Plumbing, and applicable Sections of Division 16, Electrical.

3.02 START-UP, TESTING AND INSPECTION

A. Provide services of manufacturer's representative on-site to assist with the start-up, testing, and inspection after the packaged storm water pump system has been installed.

B. The manufacturer's representative test shall include:

1. Megger starter and power cables.

2. Check seal lubrication.

3. Check for proper rotation.

4. Check power supply voltage.

5. Measure motor operated load and no load current.

6. Check level control operation and sequence.

7. Single pump and dual pump operation test on manual and automatically as directed by the level control system.

3.03 FIELD QUALITY CONTROL AND INSPECTION

A. Pressure test entire assembly (pump discharge piping) prior to embedding in concrete.

B. After completion of the work of this Section and with the agreement of the Engineer, place storm water pump system in operation. Acceptance will not be made until the system has operated satisfactorily for a period of not less than 30 days from the date designated by the Engineer. This test period shall be included with the specified contract time. Operation of the system shall not in any way be construed as an acceptance of the system, or any part of it, or as a waiver of any of the provisions of this Contract. The Contractor shall be responsible for the system during this period of operation. Make any adjustments or repairs which may be required and remedy defects or damages which may occur. The Owner will pay the electrical energy cost consumed by the system during this trial operation.

3.04 TRAINING

A. Provide training for Owner personnel as specified in Section 15000, Basic Mechanical Requirements.

END OF SECTION