SECTION 15131

PUMPS AND EQUIPMENT

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SECTION 15131

PUMPS AND EQUIPMENT

PART 1 GENERAL

1.1 SCOPE: This section covers the supply and delivery of vertical pumps for the Wahpeton Flood Control project.

1.2 APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this section to the extent indicated by the references thereto:

1.2.1 American Society for Testing and Materials (ASTM):

A 27-95.	Steel Castings, Carbon, for General Application.
A 36-97.	Structural Steel.
A 48-94.	Gray Iron Castings.
A 53-97.	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
A 108-99.	Steel Bars, Carbon, Cold Finished, Standard Quality.
A 123-2001.	Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
A 193-99.	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
A 194-98B.	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
A 276-98.	Stainless and Heat-Resisting Steel Bars and Shapes.
A 285-90.	Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength.
A 516-90.	Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service.
A 564-99.	Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes.
A 576-90B.	Steel Bars, Carbon, Hot Rolled, Special Quality.
A 668-96E1.	Steel Forgings, Carbon and Alloy, for General Industrial Use.
A 743-98A.	Castings Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for general Use.
B 148-92A.	Aluminum-Bronze Sand Castings.

B 584-91A. Copper Alloy Sand Castings for General Applications.

1.2.2 American Society of Mechanical Engineers (ASME)

ASME-17-92 Boiler and Pressure Vessel Code; Section IX, Welding And Brazing Qualifications

B4.1-94. Preferred Limits and Fits for Cylindrical Parts.

B16.5-96. Pipe Flanges and Flanged Fittings.

B17.1-98. Keys and Keyseats.

B46.1-95. Surface Texture (Surface Roughness, Waviness, and Lay).

1.2.4 American Welding Sociey (AWS)

AWS D1.1-2000 Structural Welding Code - Steel

1.2.5 American Water Works Association (AWWA)

AWWA C207-1999 Steel Pipe Flanges for Water Works Service

1.2.6 Hydraulic Institute (HI):

Standards for Centrifugal, Rotary and Reciprocating Pumps, 15th Edition, 1994.

HI 2.1-2.5 (1994) Vertical Pumps

HI 2.6 (1994) Vertical Pump Test

1.2.7 National Fire Protection Association (NFPA):

No. 70-99. National Electrical Code (NEC).

1.3 SUBMITTALS: Government approval is required for submittals with a "GA" designation. Submittals having an "FIO" designation are for information only. The following shop drawings shall be submitted.

1.3.1 Shop Drawings, GA: Shop drawings, including catalog cuts and manufacturer's data, shall be submitted for approval. Shop drawings shall be neat, legible, and of sufficient size so as to be easily read and/or reproduced. The following items shall be submitted:

a) Outline drawings of all proposed pumps showing all pertinent dimensions and weight of the various components of the pumps.

b) Dimensioned cross sectional drawings of the pumps and components including motors. Pumps and motors shall be shown as a complete assembly. Include shop drawings of pump/motor coupling.

c) The proposed coating (painting) systems and procedures for the pumps and components.

d) Pump capacity-head curves with the brake horsepower (BHP) and the net positive suction head required (NPSHR) requirements presented; operating points shall be indicated on the pump curves. Efficiency data shall be plotted.

e) Material listing and material certification of the proposed pumps. Include listing of all pump components. Include the associated industry standard for all materials and components.

f) Welding qualification and certification.

g) Warranty. A copy of the pump warranty for each pump provided shall be submitted.

h) Factory Testing. Factory test data shall be submitted as specified in Paragraph: FACTORY TEST.

i) Listing of current pump installations for the vertical pumps.

j) Spare parts listing.

k) Lubrication system for the vertical pumps.

l) Qualifications of the pump installation technician or pump erecting engineer.

m) Service capability of the pump supplier.

1.3.2 Installation And Erection Instructions: Installation of the pumps will be done under a future contract. The pump supplier shall furnish installation manuals and instructions to assist a future contractor in installing the pumps. Five copies of a printed and bound manual shall be submitted describing the procedures, to be followed by a pump installation contractor with supervision of an erecting engineer, for erecting, assembling, and installing the pumps, lubrication system, and motors. The proposed manuals shall be submitted with the pump shop drawing submittals.

1.3.2.1 The installation description shall be a complete, orderly, step-by-step explanation of the various operations required to install each types of pump. It shall describe all special procedures and outline special precautions. It shall also include such things as bolt torque values, permissible wear ring clearances, recommended instrument set-ups, recommended gages and instruments, bearing clearances, and similar details.

1.3.2.2 The description shall be complemented and supplemented by drawings, sketches, photographs, and similar materials as necessary. The overall result shall be a description which may be comprehended by an engineer or mechanic without extensive experience in erecting or installing pumps of the types required.

1.3.2.3 After review, the Government will furnish to the Contractor recommended revisions as necessary or desirable for the installation manual and return four copies of the previously submitted manual back to the Contractor. Differences of opinion between the Contractor, manufacturers, and the Contracting Officer shall be reconciled in a manner mutually agreeable to all parties, and five copies of the revised manual shall resubmitted. The approved installation manual and instructions will be utilized by the future pump installation contractor.

1.3.3 Operation And Maintenance Manual: The Contractor shall submit, prior to delivery of any pumps and motors, five copies of a manual containing complete information in connection with the operation, lubrication, adjustment, routine and special maintenance, disassembly, repair, and reassembly of the pumps and accessories. The manual shall include detailed requirements for maintaining the pumps during potential long-term storage. The manual shall also have a listing of special tools required for working on the pumps. Comprehensive as-built drawings, photographs, factory test results, and sketches of the pumps shall be included. A copy of the warranty shall be included in the operation and maintenance manual. The manual shall include complete diagnostic information on the pumps and all approved shop drawing submittals on the pump and motors. The manual shall be complete enough and provide enough details so the pumps can be operated by the City of Wahpeton using the manual.

1.3.3.1 Parts list: The operation and maintenance manual shall have a complete parts list for the pumps and motors including spare parts. The list shall clearly show all details and parts, and all parts shall be adequately described and have identification markings and include sources for all parts.

1.3.3.2 Manuals shall be made up with hard cover post type binders and printed on 8-1/2 inch by 11 inch high quality paper with indexed, tabbed section dividers. Large sheets shall be neatly folded and installed with post hole reinforcements such that sheets can unfold without need to open binder posts. Drawings, sketches, and parts lists incorporated in the manual may be reduced to page size provided such reductions are clear and easily legible: otherwise they may be folded into the manual.

1.4 WELDING QUALIFICATIONS: Welding operators, welders, and tack welders shall be qualified and, as necessary, re-qualified for the particular type of work. Qualification shall be in accordance with one of the following codes: Part III, Section 5 of AWS D1.1; or Section IX of ASME-17. Contractor shall certify by name to Contracting Officer the welders and welding operators so qualified, including date of qualification, code, and procedures under which each qualified. Prior qualification may be accepted provided the welder has performed satisfactory work under the code for which he qualified within the preceding three months. Contractor shall require welder or welding operator to repeat qualifying tests when, in the opinion of Contracting Officer, work indicates reasonable doubt as to welder's proficiency. In such cases, welder shall be re-certified as required above. The welder shall be considered disqualified until successful completion of retest. All expenses in connection with qualification and re-qualification shall be borne by Contractor.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS: Pumps shall be furnished for the Wahpeton Flood Control project and will be installed at a future date by others. The term "pump" shall mean the assembled pump-motor unit complete with base plate, discharge elbow, bowl assembly, etc. Pumps shall be designed for above the base plate discharge. A total of 6 pumps are required. Four of the pumps will be installed in new pumping stations and will be identical. Two pumps will be installed in existing stations. A shop drawing of the existing pumps in these stations are provided as reference only. A reference drawing is also provided for the new pumping stations to determine pump column and shaft length. Motor specifications for the vertical pumps are covered in SECTION: ELECTRIC MOTORS, 3-PHASE VERTICAL INDUCTION TYPE. Vertical pumps shall be designed per HI Standards 2.1 to 2.5.

2.1.1 Standard Products: All pumps supplied shall be the standard product of a reputable pump manufacturer. A pump installation list of similar size pumps that are required in this contract (or larger) shall be provided. A service facility

for the pumps and motors shall be available within the continental United States. On an emergency basis, parts and service shall be available within 72 hours to Wahpeton, North Dakota. The pump supplier shall maintain in stock wear parts of the pump including bearings and wear rings.

2.1.2 Coordination: The pump supplier shall furnish the motor required for the contract work. All pump shop drawings and motor shop drawings will be rejected unless this work is properly coordinated. All pumps shall be furnished complete with motors.

2.1.3 Nameplates: Each major item of equipment shall have the manufacturer's name, address, type/style, model, serial number, and catalog number on a plate secured to the item of equipment. Nameplates shall be made of corrosion resisting metal with raised or depressed lettering on a contrasting colored background. Pump nameplates shall also include horsepower, voltage, current, speed, and phase data.

2.1.4 Instruction Plates: As necessary, each item of equipment shall be equipped with suitably installed instruction plates including warnings and cautions describing special and important procedures to be followed during starting, operating, and servicing the equipment. The plates shall be made of corrosion resisting metal with raised or depressed lettering on a contrasting colored background.

2.1.5 Guards and Covers: Safety guards and/or covers shall be provided wherever necessary to protect the operators from accidental contact with moving parts. Guards and covers shall be of sheet steel, expanded metal, or another acceptable material and removable for disassembly of the pump.

2.1.6 Factory Test Location. Factory testing facility shall be in the continental United States. Proposed testing facility shall be submitted as a shop drawing.

2.2 MATERIALS:

2.2.1 Materials not specifically described shall, as far as practicable, conform to the latest approved industry standard(s) covering the appropriate class or types of materials.

2.2.2 Designated items shall conform to the following:

Item	Requirements
Cast Iron	ASTM A 48, Class No. 30A, 30B and 30C
Cast Steel	ASTM A 27, Grade 65-35, annealed
Copper Alloy Castings	ASTM B 584, Alloy No. C93700 or C86300
Corrosion Resistant Castings	ASTM A 743
Aluminum Bronze Castings	ASTM B 148
Structural Steel	ASTM A 36
Cold Rolled Steel Bars	ASTM A108, Minimum Working Strength 65,000 pounds per square inch
Hot Rolled Steel Bars	ASTM A 576, Grades: G10200, G10450, G11410
Hot Rolled Stainless	ASTM A 564, Grade 517400
Bars and Shapes:	
Steel Plates, Structural	ASTM A 285, Grade B
Steel Plates, Pressure Vessel	ASTM A 516, Grade 55
Steel Forgings	ASTM A 668, Class F

Keys and Keyseats ASME B17.1

2.3 VERTICAL PUMPS:

2.3.1 General: A total of six pumps (and motors) shall be provided. Four of these pumps shall be identical to each other and are for installation in the new pump stations in Wahpeton, North Dakota. The remaining two pumps shall be similar in design except they are for installation in the existing pump stations Number 4 and Number 5 as shown. These pumps will have a different column and shaft length. The pumps shall be the electric, axial flow, vertical, type. Pump column and discharge elbow shall be 20″. Each pump shall be capable of pumping solids up to 2" in diameter. Pumps are for the purpose of pumping storm water. Water pumped will not exceed 85 degrees F, will be relatively turbid, and may contain sand, silt, and vegetative trash capable of passing trash rack. Trash racks will have 2-inch clear openings. Pumps shall be designed to operate in the dry.

2.3.2 Design pump so that no major modifications, alterations, or additions will be required to the pumping station or suction bays to accommodate it. However, requests for changes in setting of pump, supports, and accessories, which would involve only minor modifications, will be considered. Design pump so that pump parts will fit within the limiting horizontal and vertical dimensions shown. Pump shall discharge into discharge system shown.

2.3.3 Capacities:

(1) Condition Point #1: Discharge not less than 10,000 gallons per minute against a Total Dynamic Head (TDH) of 18 feet of water. Pump bowl efficiency shall be a minimum of 80% at this condition point.

(2) Condition Point #2: Capable of pumping against 21 feet of T.D.H without any instability.

(3) Condition Point #3: Capable of pumping down to 10 feet of T.D.H without any instability.

2.3.4 Speed: The speed of the pumps shall not exceed 1200 revolutions per minute. The pump speed and motor speed shall match each other.

2.3.5 Reverse Rotation: Pump shall withstand, with no damage, full rotative speed caused by subjecting pump to reverse flow. Head used to determine this reverse speed is calculated from the highest pipe discharge elevation and lowest pump intake water elevation. Both the pump and its connected electric motor shall be capable of full reverse speed when acting as a turbine by reverse water flow.

2.3.6 Suction Bell. Suction bell shall be cast iron with a minimum tensile strength of 30,000 psi, or cast steel, or welded steel plate. Steel plate shall be a minimum of ¼″ thick. Provide flanged connection for mating with impeller bowl. Suction bell shall be made in one piece. Suction bell shall be supported entirely by pump bowl casing. Supports from sump floor will not be acceptable. Umbrellas, if used, should be supported by suction bowl. Construct umbrella in two pieces, if a single piece umbrella could not be removed using pump opening in operating floor. Provide bolted flanges on each half of umbrella and provide for easily removable bolted connection to suction bowl. Provide sufficient lifting lugs on umbrella to aid in handling.

2.3.7 Propeller Bowl and Diffuser Bowl. The propeller bowl and diffuser bowl shall be cast iron with a minimum tensile strength of 30,000 psi or cast steel or welded steel plate. Steel shall be a minimum of ¼″ thick after machining. All welds shall be heat treated stress-relieved prior to machining. Provide flanges

for mating with suction bell and pump column. The bowls may be combined into a single unit or furnished as separate units and mated with a flanged joint. Diffuser shall contain support for upper impeller shaft bearing and have vanes to guide the pumped flow. Equip diffuser bowl with a bypass drain to outside of pump from the diffuser cavity located between the enclosing tube connection and propeller. Furnish throttle bushing located in the cavity immediately above propeller. Bypass drain and throttle bushing should be designed to reduce water pressure on lower seal.

2.3.8 Pump Column and Discharge Elbow: Discharge elbow shall be above the pump base plate. The pump column and discharge elbow shall be steel with a minimum thickness of 0.375". Elbow shall be of mitered type or long radius type. Turning vanes shall not be used. Column and discharge elbow shall be designed to withstand internal pressures and external loadings associated with various conditions of pump operation. Provide flanges for mating individual segments together and for mating pump column to diffuser bowl. Flanges shall have rabbeted fits or four equally spaced dowels installed in flanges for initial alignment purposes and to maintain concentric alignment. The elbow shall terminate in a plain-end circular section. Diameter of discharge end of elbow shall be as shown and shall allow standard diameter flexible couplings to be used.

2.3.8.1 Column Support: Pump column shall be designed for suspension from a baseplate assembly specified in paragraph: BASE PLATE AND SUPPORTS and located at operating floor level.

2.3.9 Flanges: Machine flanges and drill bolt holes concentric with pump shaft vertical centerline, having tolerance of plus or minus one fourth of clearance between bolt and bolt hole. When fabricated from steel plate, flanges shall not be less than 1-1/2 inches thick after machining. Flange thickness after machining shall not vary more than 10 percent of greatest flange thickness. Provide external stiffeners, if needed. Construct fabricated flanges, as a minimum, to the dimensions of AWWA C207, Class B and ASME B16.5. Flanges on major components of pump casing (suction bell, impeller bowl, diffuser bowl, and column and elbow piping) shall be designed such that blind-holes necessitating use of cap screws or stud bolts will not be used. Design flanges for connection to column pipe by at least two continuous fillet welds. One weld shall connect inside diameter of flange to pump column and the other shall connect outside diameter of pump column to flange. Final design of welds rests with manufacturer, and specified welds are the minimum requirement. They shall be parallel machined, when provided on each end of the same component, and mounted parallel to a plane that is normal to pump shaft centerline. Flanges on each end of the same component shall have parallel tolerance of 0.002 inch. Finish machine mating surface on flange to 125-microinch finish or better. Provide flanges with minimum of three jacking bolts to aid in disassembly of pump.

2.3.9.1 Flanged Joints: Design flanged joints to be air-and water-tight, without the use of preformed gaskets, against positive and negative operating pressures that will be experienced, except that "PERMATEX" or equal gasketing compound will be permitted. Provide mating flanges, unless of the male-female rabbet type, with not less than four tapered dowels equally spaced around flange. If rabbeted fit is not used, then Contractor shall provide the method used to determine concentricity of connected pieces.

2.3.10 Nuts and bolts: Bolts used in assembling pump and its supporting members, including anchor bolts and dowels, shall be of 300 series stainless steel. Use only bronze nuts and hexagonal bolts and nuts. Washers used shall be 300 series of stainless steel. Bolts and nuts shall conform to ASTM A193 and ASTM A194.

2.3.11 Propeller: The propeller hub and propeller blade shall be cast aluminum bronze or stainless steel. They may be cast separately or together as a single unit. If cast separately, attach blades to hub in a manner that ensures them against loosening in service but that does not necessitate any damage during disassembly. Welding of blades to hub is acceptable. If this method of attachment is used, Contractor shall submit welding procedure to be used.

2.3.11.1 Minor surface imperfections shall be filled and/or ground down as necessary to preserve the correct contour and outline of the propeller and restore the surface imperfections to the same degree of finish as the surrounding surfaces. Surface pits, depressions, projections, or overlaps showing greater than 1/16 of an inch variation from the general contour for that section shall be corrected. The method and procedure for accomplishing the repairs shall be as set forth in the bolted connections requirements in PARAGRAPH: FABRICATION AND MACHINING. Castings which exhibit surface imperfections as defined above covering an area of more than 10 percent of any surface of any blade will be rejected.

2.3.11.2 Statically Balance: As part of the final manufacturing and machining process, the finished propeller shall be statically balanced and then dynamically balanced at speeds up to 110% of operating speed.

2.3.12 Shafts

2.3.12.1 Propeller Shaft: Propeller shaft shall be ASTM A-276, Type 416, stainless steel. Design shafting so that any necessary vertical adjustment of impeller can be made from the operating room floor without interfering with shaft alignment. Also provide for removal of propeller from below without disassembly of pump above propeller bowl.

2.3.12.2 Line Shaft. Line shaft shall be steel, grade 1045, conforming to ASTM A-108. Line shaft shall have an enclosing tube. Shaft sections shall be joined together with sleeve-type couplings capable of taking rotation in either direction. Threads, except on fasteners, shall not be employed in construction of sleeve-type couplings. Couplings, including keys and fasteners, shall be constructed of stainless steel materials.

2.3.12.3 Pump and Motor Shafts: Pump and motor shafts shall be coupled together using sleeve type couplings or rigid flange couplings. Couplings shall be capable of transmitting the forces and torques involved. Coupling halves shall be bolted together and shall be maintained concentric with each other, by means of a rabbet fit, to within 0.002 inch. Shaft coupling nut, if used, shall be retained by fitted bolts, and all tolerances specified for the coupling shall apply. Finish machine the flange and bore in one setup to insure that flange of coupling shall be true to the bore. Flange shall be perpendicular to the bore, and parallel to the opposite end and mating flanges to within 0.002 inch. Flange shall be concentric to centerline of shaft to within 0.002 inch. The finished shaft assembly shall be concentric about shaft centerline to within 0.004 inch. Shop assemble couplings and pump shaft and inspect for compliance with contract requirements. After inspection, match mark parts, including fitted bolts, to their mating pieces. Sleeve-type couplings shall be capable of taking rotation in either direction. Threads, except on fasteners, shall not be employed in construction of sleeve type couplings. Couplings, including keys, split rings, and fasteners shall be constructed of stainless steel.

2.3.13 Removable and Renewable One-piece Journals: Provide stainless steel removable and renewable one-piece journals at each bearing and the packing gland. Securely fasten journals to shaft to prevent shifting. Keys and fasteners, if used, shall be made from corrosion-resisting steel. Fastening of journal sleeves to shaft by welding or by adhesives will not be permitted. Shaft finishes and

construction at lower seal locations shall be as specified in subparagraph: GUIDE BEARINGS.

2.3.14 Lineshaft Enclosure: Lineshaft enclosing tube shall be ASTM A53, Schedule 80 steel pipe. Provide shaft enclosure to cover intermediate shaft and couplings. It shall be placed in tension. External supports or bracing located in pump water passage shall not be used for support of the enclosing tube. Enclosing tube shall be furnished in interchangeable 5 foot long sections (or other lengths as approved). The lineshaft bearings shall be threaded externally to act as a coupling for the enclosing tube. Design enclosure to be watertight and for easy assembly and disassembly in the field. Provide shaft enclosure for grease-lubricated pumps with a drain to pump exterior. Locate drain at bottom of shaft enclosure.

2.3.15 Guide Bearings: Provide pump with sleeve-type bearings designed for grease lubrication. Bearing shall have a bronze lining in contact with shaft journal and shall be removable and renewable type. Arrange bearing liner for maximum distribution of grease for lubrication of journal surface. Bearings shall have a surface finish of 32 rms or better. Bearing parts, especially seal rings, shall preclude entrance of foreign material between bearing and journal or journal sleeve and shaft due to differential water pressure. Bearings shall be keyed to the bearing housing.

2.3.16 Grease Lubrication Shaft Seals: Pumps designed for grease lubrication shall have a shaft seal consisting of lip seals. Seal system shall consist of a lip-type seal located on each end of bearing. Each seal shall contain a lip element having a stainless steel garter spring back-up and be constructed of TFE (Teflon). Lip element shall face bearing. Lowest bearing shall have an additional grease seat with lip facing away from bearing. Grind shaft journal to finish of 16 rms at seal location. Shaft surface under seal area shall have a hardness as recommended by seal manufacturer or shall be fitted with a replaceable stainless steel sleeve of manufacturer's recommended hardness. Use bullet-shaped assembly tool or other special tools over the end of shaft and shaft grooves to preclude damage to lip element during assembly.

2.3.17 Thrust Bearing: Provide thrust bearing to carry total thrust load with motor as specified in SECTION: ELECTRIC MOTORS, 3-PHASE VERTICAL INDUCTION TYPE.

2.3.18 Packing Gland: Provide grease-lubricated packing gland split longitudinally to facilitate removal or renewal. Arrange it to permit inspection, repair, removal, or replacement of packing without entering pump from below operating room floor. Provide eye bolts and tapped holes in each half of the split gland if halves weigh over 30 pounds each.

2.3.19 Lifting Lugs: Furnish major pump components with lifting lugs or eye bolts to facilitate handling. Design and arrange lugs or bolts to allow safe handling of pump components singly or collectively as required during shipping, installation, and maintenance.

2.3.20 Torsional Vibration And Critical Speeds: The assembled pumping unit, consisting of the motor and pump shall be free of critical speeds or harmful torsional vibrations at all speeds encountered within the operating range. When tested in the dry, in accordance with PARAGRAPH: FIELD TESTING, the vibration amplitude shall conform to those presented in the "General Machinery Vibration Severity Chart" and referred to the lower limit of "Fair". The "General Machinery Vibration Severity Chart" may be obtained from IRD Mechanalysis Inc., 6150 Huntley Road, Columbus Ohio 43229. Pump shall be capable of operation without instability over the entire range of heads required. Instability is defined, for this specification, as when one or more of the following conditions occur: (1) pump has two or more flow rates at the same total head; (2)

head-capacity curve has a dip (region on curve where change in flow rate produces an abnormally low head); (3)when any point in usable range of head-capacity curve cannot be repeated within 10%; and (4) when a test point deviates from normal curve by 20%.

2.3.21 Painting: Pump interiors and exteriors shall be painted with the manufacturers paint system, as approved. As a minimum, the pump shall be painted with 2 coats (minimum of 6 mils) of a high solids epoxy paint system similar to Ameron Amerlock 400 and Amercoat 450 or approved equal. Alternate paint systems are acceptable provided that the pump manufacturer can demonstrate corrosion resistance equal to the high solids epoxy system.

2.3.22 Baseplate and Supports: Baseplate shall be furnished by the pump supplier integral with the pump. Base plate shall be cast steel. The baseplate shall be proportioned to support the entire pump assembly, the motor and the loads to which it may be subjected during operation. It shall be supported and anchored as shown on the drawings. Lifting lugs or eye bolts, special slings, strongbacks, or other devices necessary to handle the pump during loading, unloading, erection, installation, and subsequent disassembly and assembly shall be furnished. A sole plate shall be provided under the baseplate. Jacking bolts shall be provided for leveling the baseplate assembly. An anchor bolt layout shall be provided to aid in placement of anchor bolts. All leveling jacking bolts shall be backed off after grouting so that they do not support any of the load. The pedestal supporting the motor shall contain a 1-inch lip to contain water leakage from the shaft packing. A threaded drain to the sump shall be provided.

2.3.23 Freeze Protection: All parts of the pump shall have drain holes to eliminate trapped water that could freeze. These drain provisions shall be self-draining without any requirement to enter the sump.

2.3.24 Factory Assembly: The pump and motor shall be assembled at the manufacturer's plant to assure proper fitting and alignment of all parts. The motor shall also be assembled at this time. The suction bell, impeller housing, diffuser, and the discharge elbow shall be properly match marked and have their centerlines clearly marked on the outside of all flanges to facilitate erection and alignment in the field. The Contractor shall notify the Contracting Officer sufficiently in advance to permit a representative of the Contracting Officer to inspect and witness the pump assembly. All parts disassembled for shipment shall be match marked.

2.3.25 Electric Motors: A total of 6 pump motors are required. All pump motors shall be rated at 75 horsepower, minimum. Pump motors (2 total) to be installed outside at the existing stations shall be squirrel-cage, induction type design, totally enclosed fan cooled (TEFC). Pump motors for new stations 1A and 7 (4 total) that will be installed inside the new buildings shall be weather protected WP1 type. Specific motor requirements are given in SECTION 16221: ELECTRIC MOTORS, 3-PHASE VERTICAL INDUCTION TYPE. The pump unit and motor unit shall be coupled to form a single integral unit. Each motor shall be wound for 3-phase, 60 Hz, alternating current, and 480 volt operation. Motors shall include winding heaters. Motor service factor shall be 1.10.

2.3.26 Alarms: The following alarm features shall be provided:

a) Over temperature alarm: The motor over temperature alarm circuit shall be actuated by three thermal sensors embedded in the stator windings of the pump motor (one switch in each stator phase). The pump motor shall stop on over temperature and not restart until the over temperature alarm is manually reset and the motor temperature has cooled to the appropriate temperature.

b) Overload alarm: The motor overload circuit on the pump motor shall stop the motor upon overload and not restart until the overload condition is corrected and manually reset.

2.4 LUBRICATION SYSTEM FOR VERTICAL PUMPS

2.4.1 General. Provide each pump with its own individual, manually operated, centralized pressure lubrication system, designed to deliver the proper predetermined or metered quantity of lubricant to each individual bearing and stuffing box. Mount individual metering devices, and any required auxiliary operating accessories suitably on the pump base plate. System shall be furnished complete and ready for operation, including sufficient lubricant to fill each pressure pump lubricant reservoir. Submit complete centralized pressure lubrication system to Contracting Officer for review and approval. Furnish lubricant recommended by pump manufacturer, subject to approval of Contracting Officer.

2.4.2 Pumping Unit: Provide manual central pumping unit as a complete assembly, consisting of flow-directing valve (if required), lubricant reservoir, to give a complete and workable unit conforming to requirements specified. Lubricant reservoir shall be of suitable metallic construction, shall have a nominal, minimum, capacity of 24 pounds of lubricant (within 10%). Central pumping unit shall be provided with suitable means that will ensure positive priming of pump at all times (such as an atmospheric or spring-loaded follower plate), an indicator to show quantity of lubricant in reservoir, and a screened fill connection to permit filling reservoir by transfer pump without exposing lubricant to atmosphere.

2.4.3 Piping: System piping shall be stainless steel tubing, Type 410, using flared or compression-type connectors. Provide flexible grease lines between pump column and the underside of the pump base plate. Flexible grease lines shall be stainless steel, reinforced hose a minimum of 12 inches long. Adequately protect and rigidly support piping located below operating room floor in a manner approved by Contracting Officer. Provide each individual grease line with a "Tee" fitting, located immediately below the respective metering valve and accessible from operating room. Also provide with a standard 1/4-inch grease fitting so that each individual line may be fully charged without using pump of lubricating system. Size and strength of pipe and type and strength of fittings shall be as recommended and guaranteed by lubrication system manufacturer, but in no case shall bursting pressure of pipe or tubing used be less than three times the maximum working pressure. Provide check valve located between discharge outlet of the measuring valve and "Tee" fitting specified above in each lubricating line of bearings that is exposed to water pressure to prevent entrance of water into the respective measuring valves.

2.4.4 Lubrication System Accessories: A hand operated, heavy-duty lever type, greasing system shall be provided for charging lubrication lines similar to that manufactured by Farval or equal. Provide grease as recommended by the vertical pump manufacturer.

2.4.5 Service Facilities: A service facility consisting of a portable hand operated transfer pump, a hand-towed dolly, and a 120 pound drum of lubricant, all assembled and ready for operation shall be provided. The pump shall be self-contained and designed for mounting on the grease drum to protect the contents from the entrance of foreign matter. The pump shall deliver not less than one pound in not more than eight strokes of the pump handle under normal temperature conditions. Furnish necessary hose and quick disconnect coupling for a complete system. The hand-towed dolly shall have a rigid platform with four

anti-friction bearing mounted wheels, a towing handle and a provision for securing the lubricant barrel. The type of lubricant shall be as recommended by the vertical pump manufacturer.

2.5 SPARE PARTS AND SPECIAL TOOLS:

2.5.1 The Contractor shall furnish all specials tools that are unique to the pump or control system for proper installation, testing, operation, and/or maintenance. Special tools shall be delivered with the pumps and controls.

2.5.2 Spare Parts: All spare parts shall be duplicates of the original parts furnished and shall be interchangeable with those parts. The Contractor shall furnish at a minimum the following spare parts:

a. One complete replacement set of bearings, bearing shells, journal sleeves, shaft coupling, if applicable, and seals for one vertical pump.

b. One complete replacement set of wearing parts for the packing gland for one vertical pump, and sufficient packing for all vertical pumps.

PART 3 EXECUTION

3.1 FABRICATION AND MACHINING:

3.1.1 Machine Work: All tolerances, allowances, and gauges for metal fits between plain, non-threaded cylindrical parts shall conform to ASME B4.1 for the class of fit required.

3.1.2 Castings: Each casting shall have a mark number cast or stamped upon it. In addition, each casting weighing more than 500 pounds shall have the heat number cast or stamped upon it. Warped or otherwise distorted castings that are oversize to an extent that could interfere with proper fit with other parts of the machinery or structure will be rejected. Cracked castings of non-weldable materials (i.e., cast iron, etc.) will be rejected. Repairs to castings shall not be made without prior approval.

3.1.2.1 Casting repair: Castings shall have all unsound material or defects removed by chipping, machining, air-arc gouging, or grinding; and shall be repaired by welding. Welding repairs shall conform to the welding procedures which shall have been submitted and approved for the type material involved. Stress relief annealing, where required, shall be accomplished prior to final machining.

3.1.2.2 Visually Examine: Visually examine each casting for defects. Examine visually defective impeller and other castings using Magnetic Particle Tests. Magnetic particle tests and inspection shall conform to Appendix 6 of ASME-16 and ASTM E 709. Do not use castings with defects in steel disclosed by magnetic particle test which exceed the degree permitted by Appendix 7 of ASME-16.

3.1.2.3 Acceptance Criteria: Criteria for acceptance of castings and casting repairs, including the approved welding procedure for each material used, shall be developed by the Contractor. Standards that are not definitive or that delegate discretionary authority for acceptability of castings or casting repairs to manufacturer's representatives or other individuals are not acceptable. Castings not meeting approved criteria shall be either rejected or repaired as dictated by approved standards.

3.1.3 Bolted Connections: Bolts, nuts, and washers shall conform to the applicable requirements of PARAGRAPH: MATERIALS AND MATERIAL STANDARDS for the types required.

3.1.4 Holes for regular bolts shall be drilled or sub-drilled and reamed in the shop. Holes shall be accurately located, smooth, perpendicular to the member, and cylindrical.

3.1.5 Holes for fitted bolts shall be match-reamed or drilled in the shop. Holes shall be smooth, perpendicular to the member, and cylindrical. Burrs resulting from reaming shall be removed. The threads shall be entirely outside of the holes. The body diameter of the bolt shall have tolerances as recommended by ANSI B4.1 for the class of fit required. Fitted bolts shall be fitted in reamed holes by selective assembly to provide an LN-2 fit.

3.1.6 Holes for high-strength bolts shall be accurately spaced, perpendicular to the member, and cylindrical. If the thickness of the material is greater than the diameter of the bolt, the holes shall be either drilled full size or shall be sub-drilled and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting done during assembly shall not distort the metal or enlarge the holes. For slight mismatching, reaming to a larger diameter for the next standard size bolt will be allowed.

3.1.7 Metallic Coating: Zinc coatings shall be applied in a manner, thickness, and quality conforming to ASTM A 123. Where the zinc coating is destroyed by cutting, welding, or other causes, the affected areas shall be re-galvanized to the thickness and quality required for the original zinc coating.

3.1.8 Metalwork

3.1.8.1 Flame Cutting of Material: Flame cutting of material other than steel shall be subject to approval of Contracting Officer. Shearing shall be accurately done, and all portions of work neatly finished. Steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a smooth surface free from cracks and notches is secured. Surfaces and edges to be welded shall be prepared in accordance with Section 3 of AWS D1.1. Chipping and/or grinding will not be required except where specified and as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Visible or exposed hand-guided cuts shall be chipped, ground, or machined to metal free of voids, discontinuities, and foreign materials.

3.1.8.2 Stress-Relieving Procedure: After all fabrication welding is completed, and prior to any machining, stress-relieve suction bell by heat treatment. Contractor shall submit proposed stress-relieving procedure for approval by Contracting Officer.

3.1.9 Surface Finishes: Where surface finishes are indicated, or on Contractor's drawings, or are specified herein, symbols used or finishes specified shall be in accordance with ASME B46.1. Values of roughness height specified are the arithmetical average deviation expressed in microinches. Roughness specified is the maximum value and any lesser degree will be satisfactory unless otherwise called for on drawings. Compliance with specified surface shall be determined by sense of feel and by visual inspection of work compared to Roughness Comparison Specimens, in accordance with provisions of ASME B46.1. Values of roughness width and waviness height are not specified, but shall be consistent with general type of finish specified by roughness height. Flaws such as scratches, ridges, holes, peaks, cracks, or checks, which will make part unsuitable for intended use, will be cause for rejection.

3.1.10 Welding: Unless otherwise authorized or specified, welding of steel shall be by electric arc-welding process, using a method that excludes atmosphere from molten metal. Welding of steel, unless specified otherwise, shall conform to applicable provisions of AWS D1.1. Temporary welds required for fabrication and erection shall be made under controlled conditions prescribed herein for permanent work. Each temporary weld shall be removed after serving its purpose and ground flush with adjacent surfaces.

3.1.11 Shop Assembly: Unless otherwise specified, each piece of machinery furnished, shall be assembled in the shop to determine correctness of fabrication and matching of component parts. Tolerances shall not exceed those specified or shown on Contractor's manufacturing drawings and each assembled unit shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in shop shall be in the same position as final installation in the field unless otherwise specified. Perform assembly and disassembly work in the presence of a Government representative, unless waived in writing by Contracting Officer, and immediately remedy errors or defects disclosed without cost to Government. Before disassembly for shipment, match mark each piece of a machine or structure to facilitate erection in the field. Indicate location of match marks by circling with a ring of white paint after the shop coat of paint has been applied, or as otherwise directed.

3.2 FACTORY TEST:

3.2.1 General: The factory test shall be conducted using the furnished vertical pumps. All the proposed vertical pumps shall be factory tested. However, witness testing is only required on one of the pumps. No pumps shall be delivered to the project work site until the factory testing has been completed and the Contracting Officer has accepted the factory test results. Testing shall be in accordance with HI "Standards for Centrifugal, Rotary and Reciprocating Pumps" and HI 2.6.

3.2.2 Test Setup: Pump shall be test setup to simulate its actual field installed position. The proposed motor shall be installed on the pump for the witness test. The Contractor shall submit for approval, within 45 calendar days after the contract notice to proceed, a description of the proposed test setup and proposed test procedures: this information must be submitted prior to the construction of the proposed test setup. The submittal shall include dimensioned drawings and cross-sectional views of the setup and pump, with the location of all instrumentation and the point of their connection indicated. Each instrument shall be described in detail giving all data applicable such as manufacturer's name, type, model number, the certified accuracy, coefficient ratios, specific gravity of manometer fluid to be used, and smaller scale divisions. When necessary for clarity, a sketch of the instruments or instrument arrangements shall be presented. Also include a fully detailed narrative description of each proposed method of instrumentation and the proposed test procedures.

3.2.3 Instrumentation: Head measurements shall be made using either a direct reading water column, mercury-air, mercury-water, or a meriam fluid manometer. Vacuums shall be measured with either a mercury-air or a mercury-water manometer. Fluctuations shall be dampened sufficiently to permit the column gauges to be read to either the closest one-hundredth of one foot of water or Meriam fluid, or the closest one tenth of one inch of mercury.

3.2.4 Capacity shall be determined using a calibrated venturi flowmeter or a long radius ASME flow nozzle: orifice plates shall not be used. The venturi or nozzle tube shall be connected to column gages equipped with dampening devices which shall permit the differential head to be determined to either the closest one-hundredth of one foot of water or Meriam fluid, or the closest one tenth of

one inch of mercury. A magnetic flowmeter will be acceptable provided a calibrated accuracy within 2.5 percent or 50 gallons per minute can be demonstrated.

3.2.5 The power input to the pump shall be measured using calibrated electric meters and transformers. The method used shall permit the pump brake horsepower to be determined to the closest $\pm$ 0.75 of one horsepower. Calibrations shall include true input-output values of actual motor efficiency.

3.2.6 Performance Test: The test shall be sufficiently extensive and complete to demonstrate that the proposed pump operates without instability and complies with the required performance. Compliance with the contract requirements will be determined from the curves required below. The temperature of the water used for testing shall be approximately the same for all test runs.

3.2.7 Pump performance: The performance of the furnished pumps shall be determined by a series of test points sufficient in number to develop a constant speed curve over the range of total heads, from 5.0 feet to 30.0 feet inclusive, for the speeds involved. Tests shall be made using specified heads and a suction water elevation at minimum submergence conditions. A second curve shall be developed with suction water elevation at least five feet higher then the minimum submergence condition. Head differentials between adjacent test points shall not exceed 2.0 feet. If the plot of the data indicates a possibility of instability in the head versus capacity curve, a sufficient number of additional points shall be made to clearly define the head-capacity characteristics.

3.2.8 Test results: The results of the tests shall be plotted to show total head, brake horsepower, net positive suction head required, and efficiency as ordinates; all plotted against the pump discharge in gallons per minute as the abscissa. The above curves shall be plotted to a scale that shall permit reading head directly to five-tenths of one foot, capacity to 100 gallons per minute, efficiency to one percent, and power input to 2 horsepower. Net positive suction head required data may be based on original design data or previous test information.

3.2.9 Witness Test: A witness test shall be performed. When the Contractor has been satisfied that the pumps perform in accordance with the contract requirements, he shall notify the Contracting Officer that the witness test is ready to proceed. Two copies of the curves required above, along with a set of sample calculations including all constants and conversion factors, shall be furnished. A minimum of 14 calendar days will be required for reviewing the data before the Government will be available to visit the Contractor's test site for witnessing the test. Should the witness test reveal that the pump does not perform in accordance with the contract requirements and the guaranteed values, the Contractor shall make such changes as needed in order to make it acceptable before again notifying the Contracting Officer that a witness retest is ready to proceed. Immediately upon completion of the witness test, a copy of all data taken during the test shall be furnished to the Contracting Officer witnessing the test for review and approval.

3.2.10 Test Report: The Contractor, within 15 calendar days after receipt of approval of the witness test, shall submit three bound copies of a report completely covering the test setup and the performance tests. Each test report shall include as a minimum the following:

(1) A statement of purposes of test, the project name, the contract number, and the design conditions. Where guaranteed values differ from the specified values, guaranteed values should be given.

(2) A resume of preliminary studies if such studies were made.

(3) A description of the pump. The information required under (2) above may be included here.

(4) A description of test procedure used.

(5) Complete sample computations.

(6) A discussion of test results.

(7) Conclusions.

(8) Pictures: 6 color, 8 inch by 10 inch, with labels.

(9) Copies of all recorded test data.

(10) Curves showing performance of furnished pump.

(11) Drawings of the test setup showing all pertinent dimensions and elevations; and a detailed, dimensioned, cross-section of the pump.

3.3 SHIPMENT AND DELIVERY:

3.3.1 General. Deliver pumps to Wahpeton, North Dakota. The City of Wahpeton will utilize their shop and maintenance building for storage of the pumps. The Contractor shall coordinate with the Government for shipment and delivery. The Contractor shall be responsible for unloading of the pumps at the City of Wahpeton maintenance building.

3.3.2 Packaging, Marking, and Acceptance: The Contractor shall insure to have the pumps and motors delivered as completely assembled and wired as feasible in order to minimize site installation work. The manufacturer's standard packing method, as approved, for the pumps and motors shall be submitted at least 10 calendar days prior to the shipping date. Items to be shipped shall be protected against moisture or water damage and kept dry at all times. The pumps and motors shall be crated in order to protect them from damage during shipment and storage.

3.3.2.1 Spare Parts And Special Tools: Spare parts and special tools shall be packed separately using the manufacturer's standard packing method as approved.

3.3.3 Packing Lists: Packing lists shall accompany all items shipped and be placed in moisture-proof containers securely fastened to the side of each item. Two copies of each packing list shall be submitted to the Government at least ten calendar days prior to each shipment date.

3.3.4 All boxes and crates shall be tagged and/or labeled to clearly identify the contents. Spare parts and special tools shall be plainly marked. Packing lists shall include the following information:

(1) Project name

(2) Contract number

(3) Part description and quantity (including the manufacturer's name and the part number).

3.3.5 After delivery to the designated point of shipment, the items shall be inspected by the Government. The inspection shall include an accounting of the items delivered and a visual inspection to determine any possible damage during shipment. If this inspection reveals any defects or deviations from contract requirements, which could render the items unsuitable for the use intended, the

Contractor shall repair each such identified deficiency. In the event deficiencies cannot be acceptably corrected, the equipment will be subject to rejection.

3.4 PUMP INSTALLATION SERVICES

3.4.1 Services Of Pump Manufacturer During Installation: The pumps will be installed under a future contract. It is anticipated that this contract will take place in 2003. An erecting engineer or pump technician, regularly employed by the pump manufacturer or a pump manufacturer's representative shall inspect the vertical pump installation and determine the level of adherence to the approved installation instructions. Pump service technician shall be qualified in service, repair, and assembly of vertical type pumps and motors. A total of two trips are anticipated. Ten total calendar days on the site at Wahpeton, North Dakota and four calendar days of transit time shall be provided for installation services. The supervision of the setting of the discharge columns, alignment and assembly of the pumps, and the initial testing and operation of the pumps shall be included in these services. The proper installation and assembly of the lubrication system shall also be included. When so requested, erecting engineers or pump technicians shall provide and be responsible for providing complete and correct direction during initial starting and subsequent operation of equipment until field tests are completed. Erecting engineers or pump technicians shall initiate instructions for actions necessary for proper receipt, inspection, handling, uncrating, assembly, and testing of equipment. They shall also keep a record of measurements taken during pump installation, and shall furnish one copy to Contracting Officer on request or on completion of installation of assembly or part.

3.5 WARRANTY: Warranty shall include both the pump and motor. Parts and labor shall be covered for 2-1/2 years and parts only shall be warranted for an additional 2-1/2 years. Warranty shall go into effect from the date of acceptance by the Contracting Officer at the designated delivery point.

(1) Electric Vertical Pumps and Motors.

3.5.1 Defects or failures which develop within the warranty period shall be construed as due to faulty workmanship, materials, and/or design. Exceptions shall include instances where it can be conclusively proven that failure was a result of the improper operation of the equipment, either prior to or after acceptance by the Government. Affected parts shall be replaced promptly with new parts by the manufacturer at no additional cost to the Government.

--- END OF SECTION ---