

EXHIBIT 1

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER BOOSTER
PUMP STATIONS**



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TABLE OF CONTENTS

Section One – Report Requirements

1.1 Report Page 8

Section Two – Site Design

2.1 Site Design Page 13

Section Three – Structure and Architectural

3.1 Structure and Architectural Page 18

Section Four – Mechanical Equipment and Piping

4.1 Mechanical Equipment and Piping Page 22

Section Five – HVAC and Plumbing

5.1 HVAC and Plumbing Page 31

Section Six – Electrical

6.1 Electrical Page 35

Section Seven – Controls / SCADA

7.1 Controls / SCADA Page 39

Section Eight – Miscellaneous Design Criteria

8.1 Miscellaneous Design Criteria Page 47

GLOSSARY

DEFINITIONS

Wherever used in this document, the following terms shall have the meanings indicated. These terms shall be used in conjunction with the defined terms in the City of Rapid City Infrastructure Design Criteria Manual, 2012 Edition, as well as the City of Rapid City Standard Specifications for Public Works Construction 2007 Edition.

“Engineer”: Already defined. Reference Infrastructure Design Criteria, 2012 Edition, 7.1.S.

Add to Definitions under section 7.1

“Consultant”: Shall mean the Design Engineer and Engineer of Record providing design and/or construction management services. Engineer responsible for the content of design drawing and specifications. Engineer whose stamp is on the design drawings and specifications.

ABBREVIATIONS

Whenever the following abbreviations are used in these Criteria they are to be construed the same as the respective expressions represented. These terms shall be used in conjunction with the abbreviations defined in the City of Rapid City Infrastructure Design Criteria Manual, 2012 Edition, as well as the City of Rapid City Standard Specifications for Public Works Construction 2007 Edition.

ABS	Acrylonitrile butadiene styrene
ACC	Asphalt Cement Concrete
ADA	Americans with Disabilities Act
AWWA	American Water Works Association
BPS	Booster Pump Station
CCP	Cost Change Proposals
CMU	Concrete Masonry Units
CSI	Construction Specifications Institute
EMI/RFI	Electromagnetic Interference / Radio Frequency Interference
EMT	Electrical Metallic Tubing
FEMA	Federal Emergency Management Agency
FO	Field Orders
FRP	Fiberglass Reinforced Plastic
GPM	Gallons Per Minute
HI	Hydraulic Institute
HVAC	Heating, Ventillation, and Air Conditioning
I.E.E.E.	Institute of Electrical and Electronics Engineers
IFC	International Fire Code

I/O	Input/Output
LED	Light Emitting Diode
MCC	Motor Control Center
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NEMA	National Electrical Manufacturers Association
NPSH	Net Positive Suction Head
NSF/ANSI	National Science Foundation /American National Standards Institute
OIT	Operator Interface Terminal
PCC	Portland Cement Concrete
P&ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
PSDC	Pump Station Design Criteria
PVC	Polyvinyl Chloride
RFI	Request for Information
RFP	Request for Proposal
SOP	Standard Operating Procedure
SCADA	Supervisory Control and Data Acquisition System
SDDANR	South Dakota Department of Agriculture and Natural Resources
SI	Supplemental Instruction
SST	Stainless Steel
TDH	Total Dynamic Head
VFD	Variable Frequency Drive

Related Documents

The following documents or references may be utilized as additional or supplemental sources of design criteria or standards:

AWWA Standards;

Hydraulic Institute (HI);

State of South Dakota Standards (SDDANR);

Ten States Standards as adopted and supplemented by SDDANR;

American Concrete Institute (ACI)

American Institute of Steel Construction (AISC)

American Society of Civil Engineers (ASCE)

International Building Code (IBC)

International Mechanical Code (IMC)

Uniform Plumbing Code (UPC)

International Plumbing Code (IPC)

International Fuel Gas Code

International Energy Conservation Code

National Electric Code (NEC)

ASHRAE 90.1 & ASHRAE 62.1

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION ONE

REPORT REQUIREMENTS

Section One – Report Requirements

1.1 Report

1.1.1 General

The Consultant shall provide a detailed design report detailing the project design and demonstrating compliance criteria. Following review by the Engineer, the detailed design report shall be submitted to Council for approval. The detailed design report for any facility shall include the following, for both present and future design conditions:

The report shall specifically consider the following in addition to other design aspects identified in the following sections of this document. An example table of contents for the design report is located at the end of this section.

- 1) Design Life: Design life of non-mechanical components shall be designed to achieve a design life goal of seventy-five (75) years. Mechanical components shall be designed to achieve a design life goal of twenty-five (25) years.
- 2) The design shall incorporate provisions for ease of replacement of mechanical equipment that reaches the end of its life. The design shall also incorporate design aspects to allow for ease of expansion and equipment replacement without having to take the entire booster station out of service.
- 3) Operation and maintenance considerations to include provisions for:
 - a. Building and site operation and maintenance considerations;
 - b. Provisions for equipment replacement and maintenance and upgrades;
 - c. Availability of replacement parts;
 - d. Power costs and overall facility efficiency;
 - e. Need for visible or audible screening of facilities; including items not necessarily contained within buildings; shall be identified and discussed in the report.
- 4) Design Criteria Summary: each design discipline shall develop a design criteria table and include it in the project drawings.
- 5) Engineering Economic Analysis.
- 6) Funding options.

1.1.2 Design Report Table of Contents

The Design Report shall address the elements of the water booster pump station design criteria, as applicable to the specific project. Subjects can be added or deleted as required for the specific project.

- 1) Table of Contents
- 2) List of Figures
- 3) List of Tables
- 4) Executive Summary
- 5) Introduction
 - a. Background
 - b. Purpose and objectives
 - c. Design Life
 - d. Standards and References
 - e. Abbreviations
- 6) Hydraulic Demands
 - a. Design Period
 - b. Population Densities per Acres and Total Population
 - c. Area Served in Acres
 - d. Per Capita Contributions-Average and Maximum
 - e. Land Use
 - f. Current Demands
 - g. Future Demands
 - h. Commercial and Industrial Contributions
 - i. Design Flow Rates - Average and Peak
 - j. Fire Flow Requirements
- 7) Hydraulics
 - a. Design Criteria
 - b. Hydraulic Analyses and Results
 - c. System and Pump Curves
 - d. Surge Analyses and Mitigation
- 8) Process Equipment
 - a. Design Criteria, and Applicable Codes
 - b. Equipment
 - c. Pipe Support
 - d. Clearance
 - e. Coatings and Linings
 - f. Thrust Restraint
 - g. Operation and Maintenance Cost comparisons
 - h. 25 Year life cycle cost analyses
 - i. Cathodic Protection
 - j. Chemical Feed
 - k. Flushing, Pressure Testing, and Disinfection
 - l. Identification and Tags
- 9) Layout Options

10) Site Plan

- a. Design Criteria, and Applicable Codes
- b. Physical Address;
- c. Floodplain
- d. Site, Grading, Drainage, Setbacks
- e. Access and Parking
- f. Fencing
- g. Landscaping
- h. Irrigation
- i. Site Piping
- j. ADA Requirements

11) Structural

- a. Structural Design Criteria, and Applicable Codes
- b. Geotechnical
- c. Foundation and Floor
- d. Building Walls and Roof
- e. Equipment (Crane, etc.)

12) Architectural

- a. Design Criteria, and Applicable Codes
- b. Americans with Disabilities Act (ADA)
- c. Interior and Exterior
- d. Minimum Workspace
- e. Aesthetics
- f. Doors and Windows
- g. Storage Area
- h. Noise
- i. Security
- j. Fire Protection

13) Mechanical and Plumbing

- a. Design Criteria, and Applicable Codes
- b. Heating
- c. Ventilation
- d. Dehumidification
- e. Plumbing
- f. Identification and Tags

14) Electrical

- a. Design Criteria, and Applicable Codes
- b. Power
- c. Electrical Panels and VFDs
- d. Standby Power Generation
- e. Interior and Exterior lighting
- f. Security
- g. Phase Monitoring
- h. Identification and Tags
- i. Harmonics and Arc Flash

- 15) Instrumentation and Controls
 - a. Radio Path Study
 - b. System Design
 - c. Piping and Instrumentation Diagrams
 - d. Field Devices
 - e. Conduit and Wire
 - f. Programmable Logic Controller
 - g. Schedules and Lists
 - h. Identification and Tags

- 16) Operation Narrative
 - a. Applicable codes and compliance

 - b. Modes of Operation (Tank Level Control, Discharge Pressure Operation)
 - c. Pump Operation (Pressure Setpoints, Flow Setpoints, Flowrate, Pump Ramp)
 - d. Alarms, Monitoring and Control
 - e. Scada Display

- 17) Safety Through Design

- 18) Permitting
 - a. Building Permits Required for Facilities
 - b. SDDANR Permit

- 19) Construction Sequencing

- 20) Engineers Opinion of Probably Construction Cost

- 21) Project Schedule

- 22) Bibliography

- 23) Appendices
 - a. Geotechnical Report
 - b. Hydraulics Output
 - c. Surge Analysis Output
 - d. Calculations
 - e. Exception Requests

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION TWO

SITE DESIGN

Section Two – Site Design

2.1 Site Design

2.1.1 Property/Lot

The facility shall be located on a platted lot. Title to the lot shall be transferred to the City prior to the project being advertised for bid;

2.1.2 Lot size requirements:

- 1) Shall be per City Ordinance, Title 17, but not less than eight thousand (8,000) square feet.

2.1.3 Setbacks and yards:

- 1) Shall be provided per City Ordinance, Title 17, but not less than twenty-five (25) feet for all lot lines. Must meet all setback requirements for the zoning.

2.1.4 Driveway and approach:

- 1) Shall be per City Ordinance, Title 17 and the City of Rapid City Infrastructure Design Criteria Manual current edition, but not less than twenty (20) feet wide plus five (5) feet tapers.
- 2) Shall be a reinforced PCC pavement for commercial approaches and driveways. Weight of service vehicles shall be considered in design.
- 3) If located within an allowed zoning area, minimum approach width shall be twenty-four (24) feet plus five (5) feet tapers.

2.1.5 Landscaping:

- 1) Shall be per City Ordinance, Title 17.
- 2) Provide low maintenance landscaping and vegetation to screen External Accessory Equipment. Contact local City resources as applicable and utilize local and preferred species of vegetation.
- 3) Provide landscape irrigation for vegetation.
- 4) Irrigation systems shall be designed to avoid runoff onto hardscape from low head drainage, overspray and other similar conditions where water flows onto adjacent property, non-irrigated areas, walks, roadways or structures.
- 5) Spacing of sprinkler heads shall not exceed manufacturer's maximum recommendations for proper coverage.
- 6) The use of drip or micro irrigation is encouraged for all shrubs.
- 7) Sod shall be provided in grassed areas.
- 8) Extent of visual or audible screening of External Accessory Equipment shall be identified in the design report.

2.1.6 Parking requirements:

- 1) Shall be per City Ordinance, Title 17.
- 2) Parking lot shall be paved. Pavement shall be designed to accommodate maintenance equipment. Pavement material shall be either Asphalt Cement Concrete (ACC) or Portland Cement Concrete (PCC). Preference for parking lot material is Portland Cement Concrete (PCC) Pavement.
- 3) Provide adequate turn around space in parking area for required delivery and maintenance vehicles.
- 4) Parking area shall meet ADA requirements as necessary.
- 5) Remainder of parking areas not required for ADA access shall not exceed a slope of 5%. Steeper grades are not allowed without separate written approval by the Public Works Director.
- 6) All driving areas within the parking lot shall not exceed a slope of 8%. Steeper grades are not allowed without separate written approval by the Public Works Director.

2.1.7 ADA requirements:

Meet Americans with Disabilities Act (ADA) requirements for site access.

2.1.8 Site grading and drainage:

- 1) The maximum site grade shall not exceed 20% (5:1). Steeper grades or use of retaining walls is not allowed without separate written approval by the Public Works Director.
- 2) Drainage is to be directed towards streets or drainage easements. Detention facilities may be required and should be identified in the design report.
- 3) Include construction phase sediment and erosion control plans.
- 4) Control and release of site drainage shall be per City Ordinance and the City of Rapid City Infrastructure Design Criteria Manual current edition.
- 5) Site and building drainage shall be directed away from building entrances and all walkways minimizing possibility of icing or slipping hazards.

2.1.9 Exterior lighting:

- 1) Shall be vandal proof.
- 2) Supplemental external lighting shall be provided outside of the building and shall be wired so that they can be switched on or off from within the building.
- 3) Lighting shall be provided for all external accessory equipment to allow maintenance work at night.
- 4) Lighting shall be wired so that it can be switched on or off from within the building.
- 5) The lighting design shall be consistent with neighborhood aesthetics.

2.1.10 Site Fencing:

- 1) Entire platted lot shall be fenced.
- 2) A physical barrier analysis shall be completed and identified in the design report. The physical barrier analysis shall discuss the type of fencing recommended for the specific site (i.e., chain-link, anti-climb, wrought iron, coated chain-link, etc.).
- 3) Fencing at a minimum shall consist of the following:
 - a. 10 feet minimum height with an anti-climb outrigger consisting of three strands of barbed wire, 12 inches high at a 45-degree angle outward.
 - b. Bottom tension cable.
 - c. Provide a 10-foot clear zone on each side of the fence. Clear zone must be free from trees. Limit vegetation height in clear zone to 4-inches or less.
- 4) Incorporate Concrete Mow Strips with site fencing, shall be 2.25-foot wide minimum with 4-inch minimum thickness centered on the building site fence line adjacent to landscaped areas. Reference City Standard Detail PSDC-1.
- 5) Gates shall be double swing gate type for vehicle access points and swing type for pedestrian access. Vehicle access gates shall have a minimum actual opening width of twenty (20) feet total. Pedestrian access gates shall have a minimum opening width of four (4) feet. At vehicle access points provide adequate space for vehicle parking prior to opening gate to not disrupt adjacent vehicular or pedestrian traffic.

2.1.11 Elevation Datum:

Use City Elevation Datum for site elevations; Utilize Rapid City Benchmarks, South Dakota State Plane Coordinate System NAD83 (2011), Vertical Datum NAVD 88.

2.1.12 Site Pipe Buried five (5) feet Outside of Foundation:

- 1) Including but not limited to; Transmission Water lines, Domestic Water Service, Sanitary Sewer Service, and Storm Sewer.
- 2) Shall be in accordance with the City of Rapid City Infrastructure Design Criteria Manual current edition, and the City of Rapid City Standard Specifications for Public Works Construction current edition.
- 3) Provide isolation valves from site discharge and suction transmission water lines at connection to main distribution system.
- 4) Provide a fire hydrant on discharge transmission line prior to connection to main distribution system.
- 5) Provide a fire hydrant on suction transmission line prior to the booster pump station.

2.1.13 Sites located within a FEMA Special Flood Hazard Area:

- 1) Provide flood plain analysis and permitting as required. Requirements per City Ordinance Title 15. A floodplain development permit shall be required and approved by the City Floodplain Administrator.
- 2) Establish Base Flood elevations and provide an elevation certificate.

- 3) Provide a finished floor elevation of a minimum three (3) feet above the 100-year flood level. All exterior equipment necessary to the booster pump station operation shall also meet this criteria. (Reference Ten States Standards 6.1.1.a)

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION THREE

STRUCTURE AND ARCHITECTURAL

Section Three – Structure and Architectural

3.1 Structure and Architectural

3.1.1 Geotechnical:

A geotechnical investigation shall be completed that as a minimum collects data and provides recommendations for site improvements, building subgrade and foundation design, and data for buried pipe cathodic protection design.

3.1.2 Building:

Preference for above ground buildings and site built.

3.1.3 Minimum workspace and floor plan requirements:

Provide a minimum of 36-inch corridors and walk area widths within the building. Consultant shall coordinate with all disciplines on required clearances for specific equipment. Also reference Section 3 of “Guide to the ADA Accessibility Standards”.

3.1.4 Aesthetics:

Both the exterior and interior of the building shall have appearance and aesthetics that are appropriate for the location and application. The structure will be architecturally pleasing, functional, and will be designed with the local environment in mind. The design philosophy for the facility will be toward functionality, energy efficiency, economy, and minimal maintenance requirements while maintaining pleasing aesthetics.

3.1.5 Architectural items:

- 1) Provide a code plan and code study drawing.
- 2) Concrete Masonry Unit (CMU) walls with exterior brick facing and/or siding, pitched shingled roof, roof overhang. CMU walls shall not be coated or painted on the interior of the building.
- 3) Flat roofs are not desired. Any roof with a pitch flatter than 3:12 requires written permission from the Engineer.
- 4) Hollow metal doors factory finished; Single doors shall be 36-inch minimum width. Double doors shall have a width as needed for the application and have a removable center astragal.
- 5) Provide a door large enough to back a pickup truck into the building for loading purposes.
- 6) Preference is doors located on south or east sides of building, and at locations for ease of access to building.
- 7) Preference is painted plywood ceiling. However, gypsum board, or other ceiling/roof assemblies can be used if need for fire code reasons.
- 8) Low maintenance building materials shall be utilized;

- 9) Aluminum windows. Place higher in walls to allow light entrance, while helping mitigate break-ins. Include an interior mounted bar or expanded metal system to mitigate break-ins. The design can include faux windows for architectural purposes on walls containing equipment on the building interior.
- 10) Restroom: Walls shall be FRP sheeting over plywood backing, and ceiling shall be painted plywood. However, gypsum board, or other ceiling assemblies can be used if need for fire code reasons.
- 11) Minimum ceiling height shall be 12 feet, 14 feet if a crane is included, but shall be determined during design to provide height needed for crane operation, and to allow equipment to be removed and installed.
- 12) Provide address numbers on primary street side of building in accordance with City code.
- 13) Thermal and moisture protection: Provide below grade and below foundation/floor insulation board.
- 14) Consideration shall be given to provisions for vandalism reduction and ease of cleanup for exterior walls such as coating with an anti-graffiti coating. Present options for consideration.
- 15) Noise mitigation shall be incorporated into the design. Increase in noise level at the property line shall meet applicable City ordinances, or not have an increase of more than 15 dB.

3.1.6 Structural Items:

- 1) Address geotechnical engineering site evaluation and considerations.
- 2) Preference is a floating floor with a broomed concrete finish with adequate control jointing.
- 3) A drawing shall be included that shows layout of concrete control joints. The jointing plan should be thoroughly considered to minimize concrete cracking, including but not limited to placement of concrete equipment pads, drains, trench drains.
- 4) Preference is pump pedestals are placed on top of the main floor.
- 5) Floor shall slope towards drains and cover the entire booster station.
- 6) Door thresholds shall be constructed by placing the top of the building footing at doorways at the same elevation as the interior floor, and exterior stoop. Threshold devices that rise above the floor shall not be incorporated. Reference City standard detail PSDC-2 for configuration.
- 7) A wet cure shall be utilized for concrete Floor, slabs, and foundation. Curing compound can be utilized for housekeeping pads, and pump pedestals.
- 8) At the conclusion of construction, a clear liquid floor sealer shall be applied. The product shall penetrate, harden, and densify the concrete.
- 9) Air entrainment in foundation and slabs shall be between 4 and 7 percent.

3.1.7 Amenities:

Provide a stainless-steel sample sink, and workstation area.

3.1.8 Restroom requirements:

Provide an ADA compliant restroom.

3.1.9 Building Storage:

Provide space for storage within the building

- 1) At a minimum storage within the building shall be supplied for the following: O&M Manuals, Plan Drawings, Shop Drawings, spare parts, supplies, possible tools needed that are specific to the booster station facility, general tools such as mops and brooms.
- 2) Consideration shall be given to available wall space for any future storage cabinets or storage systems.

3.1.10 Fire protection requirements:

Fire protection meeting City fire code requirements (IFC).

3.1.11 Equipment Crane requirements:

A manual monorail and bridge crane shall be incorporated that has a minimum lift capacity for the heaviest item that may need to be moved within the booster station. Monorail and bridge crane shall be capable of moving equipment to the building doors without having to move to another lifting system. Crane shall be painted safety yellow.

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION FOUR

MECHANICAL EQUIPMENT AND PIPING

Section Four – Mechanical Equipment and Piping

4.1 Mechanical Equipment and Piping

4.1.1 NSF Certification:

- 1) All materials that contact potable water shall be NSF/ANSI 61 certified.
- 2) Lead Free components shall comply with NSF/ANSI 372

4.1.2 Chemical feed and storage requirement:

- 1) Coordinate what chemicals and form of chemical to be fed, shall be coordinated with the Engineer prior to beginning preliminary design.
- 2) Chemical feed systems and chemical storage tanks should be located in their own room(s) within the booster station.
- 3) Liquid chemical feed pump systems shall be designed as a system. Pre-manufactured skids will be considered as acceptable if the following conditions are met:
 - a. Possibility of single component replacement for repairs.
 - b. A proprietary system or specific manufacturer is not required for replacement parts.
- 4) Chemicals tanks shall be of a material compatible with the chemicals being stored, typically fiberglass or polyethylene.
- 5) Provide spill containment for bulk and day tanks.
- 6) Piping, tubing, gaskets, and O-rings shall be compatible with the chemical being feed. The Consultant shall include chemical compatibility summary in the design report.
- 7) Provide means to measure weight or volume in tanks.
- 8) Calculations:
 - a. Chemical feed calculations shall be completed. A chemical feed design criteria table shall be included in the design report, and also on the drawings.
 - b. Calculations shall be cover minimum to maximum pumping rate of the booster station.
 - c. Calculations shall cover minimum to maximum anticipated dosages.
 - d. Criteria shall show minimum and maximum range that must be covered by the feed equipment.
 - e. Day tanks, and bulk tanks sizes shall comply with Ten State Standards guidelines.

4.1.3 Clearance:

- 1) Provide a minimum of 36 inches of clearance around pumps, valves, and piping within booster station and as require to provide unimpeded access to equipment without having to step over/under piping. Minimum clearance shall also meet any code requirements that apply. In rehab situations lesser clearances can be presented and incorporated with approval of the Engineer.

4.1.4 Pump requirements:

- 1) Pump stations shall be designed in accordance with Hydraulic Institute (HI), Ten States Standards, and AWWA standards as appropriate for specific project.
- 2) Number, type, capacity, motor horsepower, bowl efficiency and net positive suction head (NPSH) requirements of proposed pumping units. Number and capacity of pumps shall take into account both current conditions and ultimate future conditions. Number and capacity of pumps shall consider operational needs, provide for flexibility and efficiency at min, average and peak day conditions.
- 3) Firm Capacity: Station shall provide the design flow rate with the largest pump out of service.
- 4) Closed Loop Systems (No Discharge Tank)
 - a. Jockey Pump: For stations that pump to a closed system, without a storage reservoir, an appropriately sized jockey pump shall be included that will operate to maintain system pressure under low flow conditions. The jockey pump discharge pipe shall include a pressure relief valve discharge back into the suction header that will relieve excess pressure once the jockey pump has reached its minimum operating speed. The relief line shall include a flow meter.
 - b. Hydropneumatic Tank: In lieu of a jockey pump an appropriately sized hydropneumatic tank can be included. Tank size shall result in pump cycling not exceed the manufactures allowed number of starts per hour.
- 5) Pump Curve Design Points
 - a. Primary design point (GPM, TDH, Bowl Efficiency)
 - b. Pump curve shall be continuously rising and shall be free of dips and valleys within the normal pump operating range.
 - c. The shutoff head shall be at least 120 percent of the head that occurs at the design point.
- 6) System head curves and overlay of pump curves (including head computations) for the pumping system. Applicable system head curves (lowest head conditions, normal system conditions, highest head conditions) will be used to develop the window of pump operation. Include a window of pump operation (min to max speed) if variable frequency drives are utilized. Show one pump operation, and multiple pump operation scenarios to satisfy all pumping conditions.
- 7) Establish maximum and minimum operating conditions for 1, 2, 3, etc. pump operation.
- 8) System head calculations and assumed C (friction) factor.
- 9) Pump bowl efficiency should be greater than 75 percent.
- 10) Pumps shall be vertical turbine, end suction centrifugal, or horizontal split case centrifugal as appropriate for the pumping conditions.
- 11) Impellers shall be stainless steel.
- 12) Preference is use of mechanical seals.
- 13) Pump motors:
 - a. Shall include winding temperature sensors.
 - b. At no point on pump curve shall motor operate at over name plate horsepower.
 - c. Motors shall be rated for use with a VFD.

- d. Motors shall be High Efficiency.
- 14) At a minimum, pumps 250 gpm or more in capacity shall be factory flow tested before shipping to project site.
- 15) Pumps shall undergo a 3rd party vibration test following field installation and shall meet appropriate Hydraulic Institute standards.
- 16) To extent possible, pumps shall be fully factory coated, interior and exterior, using either a three-part epoxy coating system, or fusion bonded epoxy.
- 17) Inlet and outlet piping straight runs and orientation shall meet design criteria set forth in AWWA design manuals and Hydraulic Institute design criteria.
- 18) Field Pump Test: Following installation each pump, and combination of pumps shall be field flow tested. Field testing shall be conducted to confirm the installed pumps are producing a flow anticipated for the suction and discharge pressures, and pump speed.

4.1.5 Gate and Butterfly Valves:

- 1) Provide both inlet and outlet isolation valves to each pump.
- 2) Provide a valve on suction and discharge headers inside the booster station to fully isolate the station.
- 3) Utilize non-rising stem resilient wedge gate valves (AWWA 509, C515) for interior isolation. If space does not allow utilize butterfly valves (AWWA 504) on a rehabilitation project with approval of the Engineer.
- 4) Valves shall be flanged and meet AWWA standards. Wafer type butterfly valves can be used in rehab projects if a lesser lay length is necessary.
- 5) Valves shall have a factory applied fusion bonded epoxy coating and lining, if not available in which case a three-coat epoxy coating system shall be applied with prime coat applied at the factory.
- 6) Valve handles shall be "Red" in color.
- 7) Gate valve hand wheels shall be minimum of diameter as set forth in AWWA 509.
- 8) Butterfly valves, handwheels and actuators shall be sized per AWWA C504.
 - a. Actuators shall be properly sized for valve and conditions.
 - b. Contractor to calibrate actuators prior to bury or final acceptance and turnover to the City.
 - c. Consultant shall verify proper calibration at Final Acceptance.
- 9) Butterfly valve disc shall be stainless steel.

4.1.6 Check Valves:

- 1) Pump discharge shall utilize silent check valves, unless the Consultant can show justification for another type of check valve. The use of another type of check valve shall be approved by the Engineer.
- 2) Valves shall be flanged and meet AWWA standards. Wafer type silent check valves can be used in rehab projects if a lesser lay length is necessary.

4.1.7 Hydraulic Control Valves:

- 1) Valves shall be designed and specified by the Consultant for the needed application.
- 2) Valves shall utilize stainless steel internal materials.
- 3) Valves shall utilize stainless steel control tube or stainless-steel braided tube.
- 4) Valves shall be fully factory coated and lined with fusion bonded epoxy.
- 5) Consultant shall evaluate the impact of control valve failure modes, and develop mitigation measures.

4.1.8 Surge Control Devices:

- 1) Water hammer and surge analysis; A detailed surge analysis shall be completed by an experienced person on the Consultant's team. If surge mitigation is required, preference is use of surge tanks, pressure relief valves discharging back to the suction header on up-surge, check valves that let water flow from the suction header to discharge header on down-surge, inclusion of air/vacuum relief valves at critical points inside the station or within the distribution system. Use of surge anticipator valves is not desired.
- 2) The surge analysis output shall include a table or graph that shows the maximum and minimum pressures at critical points along the transmission main.
- 3) Control valves shall be hydraulically actuated and designed to serve the purpose needed. Valves shall be fully factory coated.
- 4) Control and surge related relief valves shall have "not closed" limit switches.
- 5) The Consultant shall indicate on the drawings the design opening and closing pressure settings for control valves.
- 6) Preferred use of a bladder type surge tank, if incorporated. If a surge tank is incorporated, a control panel shall be included that monitors as a minimum pre-charge pressure reading, and pre-charge low pressure alarm.

4.1.9 Flow Meters:

- 1) Provide an inlet or outlet magnetic flow meter above the floor within the booster station to record the flow for the entire station.
- 2) Provide manufactures required minimum up and down stream straight pipe run or utilize a magnetic flow meter that can provide a minimum of 1.5% accuracy if less than recommended pipe runs cannot be provided within the booster station.
- 3) Provide flow meters so only one-directional flow measurement is needed. Use of bi-directional flow measure shall be approved by the Engineer.
- 4) Magnetic meters shall have a manufactures standard exterior paint coating.
- 5) Meter shall have a submersion service rating.
- 6) Provide a flanged spool that can be inserted into the pipe header in the event the flow meter needs to be removed for repair.

- 7) For Signal Requirements see Controls Section 7.1.14 - Flow Meters

4.1.10 Pressure Gauges, Switches, Transducers:

- 1) The suction and discharge headers shall contain a 2 1/2-inch pressure gauge, and pressure transducer. Reference City standard detail PSDC-3 for configuration.
- 2) Each pump shall contain a low-pressure suction and high discharge pressure switch and 2 1/2-inch pressure gauge. Reference City standard detail PSDC-3 for configuration.
- 3) Include a pressure snubber on gauge connections. Do not include a snubber on pressure switch or pressure transducer connections.
- 4) Gauges shall be liquid filled, ABS or Nylon case with bronze bourdon tube.
- 5) Place pressure transducers on suction and discharge headers away from pump suction and discharge to minimize start/stop impacts.

4.1.11 Finishes and coatings, including provisions for corrosion resistance:

- 1) Exterior of exposed pipe within the booster building shall be coated with a three-part epoxy paint system.
- 2) Paint specification shall include the following statements:
 - a. Submit certifications from the manufacturer of field coatings that shop prime coat materials to be applied by others is compatible with field coats.
 - b. In the event, the field coats are not by the same manufacture as the shop prime coat, the Contractor shall provide a certification from the field coat manufacture that the field coats are compatible with the shop prime coat. It is solely the Contractors responsibility to review the prime coat manufacture material and confirm compatibility. If not compatible, or written certification cannot be obtained, provide field coating products that are compatible.
- 3) Valves, and pumps shall be fully factory coated to extent possible. Any field coatings shall be three-part epoxy paint system.
- 4) Pipe finished color shall be Sherwin Williams Safety Blue (SW4086), or other paint manufacture color matched equivalent.
- 5) Below floor and buried metallic pipe, valves, and fittings shall be cathodically protected using a passive cathodic system with jumper bonds and anodes. The cathodic protection needs to be designed by a licensed engineer in South Dakota, with past experiences in cathodic protection design.
- 6) Cathodic protection test stations for metallic pipe, valves, and fittings within five (5) feet of the building, shall be located within the building. Test station box shall be mounted on the wall.
- 7) Tracer wire termination box for pipe shall be located within the building. Tracer wire access box shall be mounted on the wall.
- 8) Below floor and buried metallic pipe, valves, and fittings shall be wrapped in polyethylene pipe wrap per AWWA C105.
- 9) Flange insulation kits shall be provided on the first flange above the floor to cathodically isolated buried from above floor pipe.

4.1.12 Thrust restraint and pipe support design:

- 1) All buried pipe shall be restrained with use of thrust blocks, and restrained joints. All process pipe buried beneath the building shall be encased in concrete. Reference City standard detail PSDC-5.
- 2) All above floor pipe shall be fully restrained with use of flanges, restrained flange adapters, or restrained couplings. Provide tie-rods as a secondary restraint on restrained flange adapters, and restrained couplings.
Restraint rods located above the floor within the booster station building:
 - a. That have humidity control and not chemicals that off-gas shall utilize galvanized, 304 SST, or 316 SST.
 - a. That do not have humidity control or include chemicals that off-gas shall utilize 316 SST.
- 3) Pipe supports shall be detailed by the Consultant for the application.
 - a. Pipe supports in booster stations that have humidity control and no chemicals that off-gas shall utilize galvanized, 304 SST, or 316 SST supports and hangers
 - b. Pipe supports in booster stations that do not have humidity control or include chemicals that off-gas shall utilize 316 SST supports and hangers.
 - c. Strut type of supports shall be galvanized, FRP, 304 SST, or 316 SST. In no humidity control or with chemical that off-gas utilize FRP or 316 SST.

4.1.13 Pipe:

- 1) The Consultant shall include calculations and/or documentation showing how process or transmission pipe pressure class was selected. Calculations shall take into account minimum and maximum modeled pressure in suction and discharge pipe, and surge pressure.
- 2) Pipe design shall minimize the use of field cut pieces and use of flange coupling adapters. However, pipe design shall allow for relative ease to remove pipe spools to allow flow meters, and pumps to be removed. Pipe fabrication drawings shall be required from the contractor as a submittal during construction.
- 3) Pipe located below the pump station floor to a point five feet outside the foundation shall be restrained cement lined ductile iron pipe. Pipe shall be asphaltic coated per AWWA C151. Fittings shall be fusion bonded epoxy lined and coated per AWWA C550.
- 4) Pipe located through and above the pump station floor shall be cement lined ductile iron pipe. Pipe and fittings shall be factory coated with the primer coat for a three-part epoxy coating system.
- 5) Below grade, transition for ductile iron to PVC with use of a restrained coupling to allow for minor deflection.
- 6) If the Consultant determines alternate pipe materials may be applicable approval is required by the Engineer for inclusion.
- 7) Buried site piping beyond 5 feet from the building shall be as set forth in Rapid City Standard Specifications Section 8A.
- 8) Process Pipe Velocity: Preference is to maintain pipe velocity in the range of 3.5 to 5 feet per second range. Velocity between 6 and 8 feet

per second, shall be clearly pointed out in the design report. Velocity over 8 feet per second will require approval from the Engineer.

- 9) Bolts and nuts located above the floor within the booster station building:
 - b. That have humidity control and not chemicals that off-gas shall utilize galvanized, 304 SST, or 316 SST. Apply anti-seize to SST bolts.
 - c. That do not have humidity control or include chemicals that off-gas shall utilize 316 SST. Apply anti-seize to SST bolts.
- 10) Provide a cathodic isolation flange kit on the flange nearest the above floor suction and discharge flanges.
- 11) Include a basket strainer (also known as, rock basket) on the inlet piping. Device shall be located above the floor within the station. Provide inlet isolation valve ahead of the device. One common device can be provided, or individual devices on the suction to each pump can be provided.

4.1.14 Domestic Water Supply:

Provide a tap off the discharge header for domestic water supply within the booster station.

4.1.15 Disinfection, Flushing and Test Pressure Plans:

- 1) Separate disinfection and flushing plans shall be developed by Consultant during the final design phase.
- 2) Test pressure will be determined by Consultant for the specific project, and a pressure test plan developed by the Consultant.
- 3) Needs to account for source of water if not readily available.
- 4) Surface discharge needs to be de-chlorinated. Other discharge locations, if applicable, can be identified in the plan.
- 5) Need to account for sufficient water quantity to obtain a minimum of 3 ft/sec flushing velocity in the piping, unless other cleaning and flushing alternatives are identified per AWWC C651.
- 6) Contractor is responsible for collecting and paying for bacteriological analysis. Two tests are required a minimum of 16 hours apart.
- 7) Use of chlorine tablets is not acceptable for in-building or the immediate booster station piping within 5 feet of the building foundation .
- 8) Follow AWWA C651, including connecting to existing pipe.

4.1.16 Pump Bases and Anchor Bolts:

- 1) Pump pedestal shall be concrete, integral and placed on top of the pump station floor. The pedestal shall be tied to the station floor with rebar. Pedestal shall be large enough to provide a minimum of three inches of clearance between anchor bolts and edge of pedestal.
- 2) Pump base shall be provided with the pump and motor. Base shall be leveled, and non-shrink grout placed between the base and pedestal. As directed by the pump manufacturer grout shall be placed within the pump base to control vibration.

- 3) Number and size of anchor bolts shall match the pump base holes. Anchor bolts to be galvanized, 304 SST, or 316 SST following the same material type as defined for pipe bolts in 4.1.13.9
- 4) Design of the anchor bolts shall be the responsibility of the Consultant. Anchor bolts can either be placed during pedestal construction, or post pour type of anchor used, as designed by the Consultant.

4.1.17 Identification and Tags:

- 1) The Consultant shall show on the drawings or specifications a list of pipe identification labels to be utilized.
- 2) Equipment such as flow meters, valves, control valves, transducers, etc. shall be tagged on the drawings. Tags shall be consistent between various design disciplines within the drawings.
- 3) Pipe identification labels shall be painted on in contrasting color. For pipe four inch and smaller laminated pipe markers can be utilized.
- 4) Include flow direction arrows on pipe.
- 5) Equipment / Instrument tags shall be 316 SST rectangular engraved tags. Attach by rivet, stainless steel cable, or use chain.
- 6) Labels and signs shall comply with ANSI A13.1, and ANSI Z535.1

4.1.18 Air and Vacuum Relief Valves:

- 1) Valves shall interior and exterior epoxy coatings.
- 2) Utilize galvanized steel dielectric nipple with plastic liner to isolate dissimilar metals.
- 3) Provide additional support if needed pending specific layout.
- 4) Reference City standard detail PSDC-7 for configuration.

4.1.19 Spare Parts:

- 1) The Consultant shall include in the project specifications spare parts that are to be supplied. Spare parts shall be provided for pieces of critical equipment that wear or are consumed and need periodic replacement.
- 2) A comprehensive list of the Spare Parts identified throughout the project specifications/Contract documents shall be developed by the Consultant and provided to the contractor at the beginning of construction.
- 3) As spare parts are delivered to the City, they shall be neatly organized and shall include the vendor name, address, and phone number.
- 4) Upon delivery a transfer statement shall be signed by both the contractor and city acknowledging the transfer of the spare parts.
- 5) If any specialized equipment or tools specific to the booster station facility is needed, e.g., a ladder to access storage areas and provide routine inspection and maintenance, the specialized equipment or tools shall be provided. Provide a wall hanger or storage area for this type of equipment.

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION FIVE

HVAC AND PLUMBING

Section Five – HVAC and Plumbing

5.1 HVAC and Plumbing

5.1.1 Codes:

Design to current applicable codes for plumbing and HVAC and building.

5.1.2 Heating:

Preference is heating is provided by a natural gas fired forced air heating system, or electric unit heaters. Consideration shall be given to provision of a back-up source of heat when primary source is disabled.

5.1.3 Air Conditioning:

Preference is air conditioning and dehumidification provided by a forced air system, or ductless split system.

5.1.4 Ventilation:

Do not use wall louvers or wall exhaust fans, except for a small intake and fan to provide minimum outside air ventilation, if not handled by heating/cooling equipment. Heating/cooling equipment selection will be based on process equipment needs. In all cases of outside air intake, there shall be consideration given to occupancy controls so outside air ventilation is only used when building is occupied.

5.1.5 Floor Drains:

Preference is 6-inch floor trench drains with circular floor drains only where necessary.

5.1.6 Building Drainage Inlets and Pipe:

Building drainage sumps, outlets, and pipes shall be sized for highest potential flow rate that could occur within the booster station.

5.1.7 Domestic Water Supply:

Domestic water supply for the booster station building, shall be a tap on the discharge header. Provide isolation valves, pressure gauges, pressure reducing valve, and a reduced pressure principal backflow preventer on the domestic water supply line. Include space and install Owner furnished flow meter.

5.1.8 Water Heater:

Provide hot water heater for supply to restroom sink, and sample sink. Water heater sized for max flow out of sink.

5.1.9 Safety Shower:

Provide safety shower, emergency eye wash, and tempered water supply system, if chemicals are fed at the booster station. Reference SDG-3.

5.1.10 Sample Line/Sink:

- 1) Provide a separate dedicated faucet to sample sink from domestic water supply line for sample collection.
- 2) Provide a common dual hot/cold faucet at the sample sink, also.

5.1.11 HVAC Condensing and Condensate Lines:

Route HVAC condensing and condensate lines in aluminum concealment chase.

5.1.12 Clearance:

Provide a minimum of 36 inches of clearance around HVAC equipment, and other key equipment.

5.1.13 Coatings:

HVAC and plumbing equipment shall be fully factory coated to extent possible. Any field coatings shall be three-part epoxy paint system.

5.1.14 Insulation for Domestic Water:

Domestic water piping shall be wrapped in jacketed insulation sleeves.

5.1.15 Identification and Tags:

- 1) The Consultant shall show on the drawings or specifications a list of pipe identification labels to be utilized.
- 2) Equipment such as HVAC equipment, flow meters, valves, control valves, transducers, etc. shall be tagged on the drawings. Tags shall be consistent between various design disciplines within the drawings.
- 3) Pipe identification labels shall be painted on in contrasting color. For pipe four inch and smaller laminated pipe markers can be utilized.
- 4) Include flow direction arrows on pipe and air ducts.
- 5) Equipment/Instrument tags shall be 316 SST rectangular engraved tags. Attached by rivet, stainless steel cable, or use chain.
- 6) Labels and signs shall comply with ANSI A13.1, and ANSI Z535.1

5.1.16 Plumbing Riser Diagrams:

Provide plumbing riser diagrams for restrooms, sinks, trench drains and floor drains.

5.1.17 Hose Bibs:

Provide minimum of (2) interior and (3) exterior hose bibs.

5.1.18 Design Criteria Table:

Include on the drawings a HVAC and Plumbing design criteria table.

5.1.19 Spare Parts:

- 1) The Consultant shall include in the project specifications spare parts that are to be supplied. Spare parts shall be provided for pieces of critical equipment that wear or are consumed and need periodic replacement.
- 2) A comprehensive list of the Spare Parts identified throughout the project specifications/Contract documents shall be developed by the Consultant and provided to the contractor at the beginning of construction.
- 3) As spare parts are delivered to the Owner, they shall be neatly organized and shall include the vendor's name, address, and phone number.
- 4) Upon delivery a transfer statement shall be signed by both the contractor and Owner acknowledging the transfer of the spare parts.

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION SIX

ELECTRICAL

Section Six – Electrical

6.1 Electrical

6.1.1 General Electrical:

- 1) Include floor plans, sections, schematics, equipment schedules, conduit and wire runs, materials, panel boards, MCCs, VFDs, and labeling of equipment and switches, etc.
- 2) Conduit runs shall be shown on drawings for major equipment such as the pumps. Provide spare conduits to accommodate planned future changes and modifications to the electrical system. Home runs can be used for smaller electrical items such as lights, outlets, and small electrical load devices.
- 3) Design to current City adopted Electrical code.
- 4) Electrical service size shall consider current and potential future electrical loads.
- 5) Design shall include provisions to monitor incoming voltage on all three phases. Monitoring shall include current status, and ability to trend back in time for up to at least 30 days.
- 6) Provide VFDs for all pumps. Six (6) pulse or eighteen (18) pulse drives shall be used on pump motors less than 100 horsepower. Eighteen (18) pulse drives shall be used on pump motors 100 horsepower and higher.
- 7) VFDs shall be capable of a minimum of two (2) stage ramp within the VFD as follows: Zero to a set point quickly to get water moving, and then from that point to the final run set point over an adjustable time period up to two minutes. Settings to be determined by Consultant. This sequence shall reverse on pump shut down.
- 8) VFD's shall include dv/dt filtering for wire lead lengths of 60 feet or longer. Sine Wave filters shall be installed for lead lengths longer than 500 feet.
- 9) VFD's shall include EMI/RFI filtering to minimize electrical interference.
- 10) VFDs to include time delays for low suction and high discharge pressure switch trip input and shall be in effect in both Hand and Auto operation.
- 11) VFDs shall have capability to allow up to three (3) restarts upon a trip out, then lock out and require local reset. This capability shall not be engaged without Owner approval.
- 12) VFDs shall have capability to allow remote start/restart. This capability shall not be engaged without Owner approval.
- 13) VFDs shall have capability to allow restart without fail after power is restored after power outage.
- 14) Project specifications shall include a requirement that VFD manufactures provide follow up site visits at 6 months and 11 months following startup. Design should include the electrical panel layout and show electrical clearances.
- 15) Preference is electrical distribution, VFDs, and control as separate cabinets. Design can include Motor Control Center with approval of Engineer.
- 16) Design shall include lightning protection.
- 17) Electrical design shall include electrical power surge protection.

- 18) Electrical service to include lightning arresters.
- 19) Provide separate grounding system to meet National Electrical Code and provide in field testing to verify the level of grounding and that grounding meets code.
- 20) Preference is to not ground to process water piping. May not be allowed by electrical code. Needs to be investigate with local code official during design, and result outlined to Owner engineering staff.
- 21) Provide 4-inch concrete housekeeping pads under floor mounted electrical equipment. Confirm that disconnect handles are within code compliance above floor height.
- 22) Provide spare conduits and over-sized conduits to accommodate planned future changes and modifications to electrical system. Provide space for future additional electrical panels to allow changes to be made without having to take the booster station out of service.
- 23) Interior spaces that are conditioned and clean, NEMA 1 panels can be utilized. Otherwise, interior panels shall be NEMA 12. Exterior panels shall be NEMA 3R or 4X.
- 24) Conduit Materials: Buried conduit may be PVC, interior exposed or subject to damage rigid steel, interior protected location EMT, Chemical rooms PVC coated rigid steel.

6.1.2 Standby Power Requirements:

- 1) Coordinate with City on need to standby power at booster pump station.
- 2) Size generator to operate booster station at its firm pumping capacity.
- 3) Preference is use of natural gas fuel source if readily available. The natural gas supply contract needs to be a non-interruptible service.
- 4) If diesel is the fuel source, size tank for minimum of 24 hours minimum or as directed by City hours of run time.
- 5) If diesel fired, provide dual wall fuel tank for secondary fuel containment.
- 6) Generator shall have a weather enclosure for outdoor location. Verify sound encloser requirements with city due to location.
- 7) If a generator is not provided during initial design, plan for future installation by providing space for generator, transfer switch. Include conduit stub outs from building interior to exterior.

6.1.3 Lighting:

- 1) Preference is interior lights to be LED.
- 2) Preference is exterior lights to be LED.
- 3) Exterior lights should be on a photocell starter with marked manual override.

6.1.4 Security:

- 1) The entry door shall be equipped with an entry alarm. The system shall require entry of a code upon entry to disarm and exit to arm.
- 2) A RED emergency stop button shall be mounted adjacent to the door. When engaged all electrical supply into the building shall be cut-off immediately.

- 3) Engineer shall provide guidance based on the most current Risk and Resiliency report document.

6.1.5 Tagging and Labeling:

- 1) The Consultant shall show on the drawings or specifications a list of identification labels to be utilized.
- 2) Equipment such as MCC, VFDs, panel boards, etc., shall be tagged on the drawings. Tags shall be consistent between various design disciplines within the drawings.
- 3) Conduit shall be labeled with laminated markers at regular intervals with panel of origin, voltage, circuit number and equipment served.
- 4) All wiring shall be labeled. Labels to be at panel, at each pull box/junction box and at equipment connection. Wire label shall incorporate the equipment or instrument tag where applicable.
- 5) Equipment / Instrument tags shall be 316 SST rectangular engraved tags. Attach by rivet, stainless steel cable, or use chain.

6.1.6 Spare Parts:

- 1) The Consultant shall include in the project specifications spare parts that are to be supplied. Spare parts shall be provided for pieces of critical equipment that wear or are consumed and need periodic replacement.
- 2) A comprehensive list of the Spare Parts identified throughout the project specifications/Contract documents shall be developed by the Consultant and provided to the contractor at the beginning of construction.
- 3) As spare parts are delivered to the City, they shall be neatly organized and shall include the vendor name, address, and phone number.
- 4) Upon delivery a transfer statement shall be signed by both the contractor and city acknowledging the transfer of the spare parts.

6.1.7 Harmonics Study:

A harmonics study shall be specified and completed by the VFD supplier as a part of VFD submittal. VFD harmonics must meet current I.E.E.E. 519 for harmonics.

6.1.8 Arc Flash:

An arc flash study shall be completed as part of the project, either at the end of the project or after shop drawings are completed. The Owner's Arc Flash report shall be amended or supplemented with the new booster station Arc Flash study.

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION SEVEN
CONTROLS / SCADA

Section Seven – Controls / SCADA

7.1 Controls / SCADA

7.1.1 P&ID Drawings

The Consultant shall develop complete P&ID drawings for the booster station. The P&ID drawings shall include the following levels and map all connections. Levels are to be shown from the top down on the sheet, starting with SCADA functions. Process flow shall be shown as left to right across the sheet. P&ID Tagging and Device Symbology shall follow ANSI/ISA 5.1 2009. P&ID's shall be in black & white. P&ID's shall display equipment design data, with specific manufacture and model filled in with record.

Levels:

- 1) SCADA
- 2) CONTROL PANAL / PLC
- 3) POWER / MOTOR CONTROLS
- 4) FIELD PROCESS FLOW

7.1.2 Field Devices

Location of field devices and control panels shall be shown on plan drawings. Devices shall be tagged on the drawings and the tag shall match the P&ID tag.

7.1.3 Control Conduit

Control conduit runs shall be shown on drawings. Provide spare conduits to accommodate planned future changes and modifications to control system. No "home runs" will be allowed on the controls drawings.

7.1.4 Spare Inputs/Outputs, and Wires

Provide for a minimum of 20 percent spare inputs/outputs to the PLC. Provide a minimum of 20 percent spare wires between key equipment, such as VFDs and PLC.

7.1.5 Line of demarcation

The line of demarcation between the Contractor and Owner's System Integrator shall be an electrical gutter box adjacent to the PLC panel. Contractor to be responsible for everything beyond the gutter. System Integrator shall be responsible for everything from gutter to PLC.

7.1.6 PLC

PLC to be provided by System Integrator. The PLC shall be set up to receive/transmit 24VDC digital signals, 4-20ma and Pulse analog signals, and have Ethernet capabilities. The PLC must be provided with panel drawings showing the connections of auxiliary devices/instruments. Instrument tags shall match the P&ID

7.1.7 Owner's System Integrator

The Consultant shall work with the Owner's System Integrator throughout the design phase to develop the booster station control system. In addition to other aspects of this criteria, this team shall:

- 1) Have a radio path study completed.
- 2) Determine type and mounting height of antenna.
- 3) Develop antenna mounting details.

7.1.8 Control Wiring

Control wiring shall be run in separate conduits from power wiring. Analog and Digital wiring shall be run in separate conduits. Use Shielded Cable for Instrument signals. Minimum size is 14awg for signal field wiring.

Preference is hardwired 24 VDC control circuits. Use of 120VAC circuits is deterred and must be approved by the Engineer

Ethernet type circuits can be used upon specific discussion with the Owner and approval of the Engineer. Example PLC to VFD communication. External Ethernet connected devices shall require a registry map as a deliverable to be provided with the design documentation.

7.1.9 Operations Narrative

The Consultant shall develop an Operations Narrative specification section during the design phase. The section shall provide a general narrative of the intended operation, hard wired control, interlocks, interlock control, PLC control, software interlocks, status, and failure modes. The section shall include as a minimum the following:

- 1) Mode of Operation descriptions:
 - a. Tank Level – Pumps operate in stages based on discharge tank level set points.
 - b. Discharge Pressure – Pumps operate to maintain at discharge pressure set point.
- 2) Pump Operation:
 - a. Lead, Lag, Lag Lag
 - b. Automatic alternation
 - c. Speed set points
 - d. Current speed

7.1.10 Pump Motor

- 1) Temperature,
- 2) Voltage
- 3) Amperage draw

7.1.11 VFD

- 1) Input speed
- 2) Current operating speed
- 3) Alarms

7.1.12 Suction and Discharge Pressure Cut-Off Switches

- 1) Each pump suction shall be equipped with a low suction pressure cut-off switch
- 2) Each pump discharge shall be equipped with a high discharge pressure cut-off switch
- 3) Switches shall be hardwired to the VFDs such that they engage whether the pump is in Hand or Auto operation.
- 4) An adjustable delay timer, 0 to 120 seconds, shall be incorporated into the circuit to avoid nuisance tripping. Pressure switch timers shall be incorporated into the VFD panel.

7.1.13 Suction and Discharge Pressures

- 1) Pressure transducers on suction and discharge headers
- 2) Low suction and high discharge alarms at set points before the cut-off pressure switches engage.
- 3) An adjustable delay timer, 0 to 120 seconds, shall be incorporated into the circuit to avoid nuisance alarms. Pressure transducer timers shall be incorporated into the PLC panel.

7.1.14 Flowmeters

- 1) Totalize flow
- 2) Instantaneous flow rate
- 3) Incorporate high flow rate alarms for one, two, and three pump operation.
- 4) Incorporate low flow rate alarms for one, two, and three pump operation.
- 5) An adjustable delay timer, 0 to 120 seconds, shall be incorporated into the circuit to avoid nuisance alarms. Flow meter timers shall be incorporated into the PLC panel.

7.1.15 Control Valve Monitoring

- 1) Monitor position of control valves. Open, Closed, Not – Closed as appropriate for the application.
- 2) If modulating, monitor current position.
- 3) If valve is normally closed, alarm on Not-Closed position.

7.1.16 Building Conditions

- 1) Monitor interior temperature
- 2) Monitor humidity
- 3) Alarm on high or low interior temperature
- 4) Flood switch. Set one inch above finished floor

7.1.17 Emergency Stop Button

- 1) Reference Electrical section
- 2) Send alarm when engaged

7.1.18 Building Entry Alarms

- 1) Reference Electrical section
- 2) Send alarm if entry code is not entered within allotted time period. Coordinate with Owner on specifics for building alarm.

7.1.19 Electrical Power Monitor

- 1) Reference Electrical section
- 2) Alarm on event of overall loss of power.
- 3) Alarm on event of loss of power on an electrical leg.
- 4) Monitor and trend station amperage use.

7.1.20 Generator and Transfer Switch

- 1) Monitor transfer switch position.
- 2) Monitor generator status
- 3) Alarms, coordinate with generator manufacture on available alarms, and coordinate with Owner on specific alarms to pick up.

7.1.21 Set Point Table / Alarm List

- 1) Engineer to develop a Set Point table. Final settings to be determined during startup. Document final settings.
- 2) As many of the set points shall be operator inputs as possible. Very few (if any) set points shall be hard coded.
- 3) Incorporate a hierarchy to allow only higher-level operators to change set points.

7.1.22 Develop an Input/Output (I/O) signal list

The I/O List shall contain the Instrument or Signal Tag, the P&ID sheet number it is located on, a description of the signal, the field location, the signal type (AI, AO, DI, DO, Serial, Pulse, etc.), what PLC it is connected to, and power requirements.

7.1.23 Develop an Instrument List

The Instrument List shall contain a list of instruments for the project. The List shall display the Tag Number, P&ID location, Description of the Instrument, Location, Make, Model, and who is the provider. For early submittals, before instrument selection is made, make and model fields can be displayed with "TBD" (To Be Determined).

7.1.24 Develop a Signal Cable Schedule

The Cable Schedule shall contain the instrumentation/signal cabling specified for the project. Displayed on the lists shall be: From/To Cable Routing Between Devices, Cable Type (Spec), Cable Description, End/Field Device Location, P&ID location.

7.1.25 Develop Instrument / Panel Location Plan Drawings

- 1) Create Instrument location drawings. Show the location of instruments, control panels, and control junction boxes on a set of plan drawings.
- 2) The instruments shall be displayed on the plan drawing with an instrument symbol and tag as similar to the P&ID symbol.
- 3) Control panels / junction boxes shall be show as rectangular objects with the Tag clearly displayed.
- 4) Multiple instruments on a piece of equipment or skid may be show in a table format on the drawing. The Table must be labeled with the equipment tag and the equipment must be tagged and show on the drawing.

7.1.26 Develop a Controls System Network Schematic

The Network Schematic should show the connective between controllers (PLC / Sub-PLC / HMI Controller / RTU's), and SCADA workstations. The schematic is limited to serial connections (Ethernet, Modbus, Fiber, Radio). Routers, Modems, Ethernet Switches, Radio Transmitters/Receivers shall be shown, and locations identified.

7.1.27 Monitoring and control shall be provided:

- 1) At the local device (example VFD)
- 2) At the local PLC
- 3) At the operations center located elsewhere
- 4) From mobile devices

7.1.28 Data and Alarm Storage

The control system shall store data and alarms for a minimum of one year. The control system shall be capable to generating data tables and trend graphs. The frequency of recording each data record shall be addressed during design and discussed with the Owner.

7.1.29 Alarms – General List

- 1) Pump run fail
- 2) VFD fail
- 3) Motor high current
- 4) Motor low current
- 5) Motor high temperature
- 6) Discharge pressure high
- 7) Discharge pressure low
- 8) Suction pressure low
- 9) Suction low pressure switch trip (pump cut-out, manual reset)
- 10) Discharge high pressure switch trip (pump cut-out, manual reset)
- 11) High discharge flow rate (based on number of pumps operating)
- 12) Power fail
- 13) Power phase fail
- 14) Over amperage at VFD
- 15) Building intrusion
- 16) Building high temp
- 17) Building low temp
- 18) Yard gate intrusion
- 19) Flood
- 20) Emergency stop button pressed
- 21) Radio communication fail
- 22) Control valve limit switches not in normal positions, not-closed alarm
- 23) Transfer switch in generator power position
- 24) Generator running
- 25) Generator fail
- 26) Generator alarm(s)
- 27) Surge tank alarms, developed based on specific equipment provided.

7.1.30 Trending and Data Storage

- 1) Discharge flow rate
- 2) Yesterday flow total
- 3) Discharge pressure
- 4) Suction pressure
- 5) Pump running (each pump)
- 6) Pump run time yesterday (each pump)
- 7) Voltage incoming
- 8) Voltage each incoming leg
- 9) Amperage pump (each pump)
- 10) Overall incoming amperage
- 11) Surge tank pressures, developed based on specific equipment provided.

7.1.31 Tagging and Labeling:

- 1) The Consultant shall show on the drawings or specifications identification labels to be utilized.
- 2) Field devices shall be tagged on the drawings. Instruments shall be tagged in accordance with ANSI/ISA 5.1 – 2009 (See Tables 4.1 and

- A.2). Tags shall be consistent between various design disciplines within the drawings.
- 3) Signal Path Conduits shall be labeled with laminated markers. Conduit runs shall be individually labeled. A Cable Fill Schedule shall be created showing the conduit labels and is to include the labeled wires contained in the conduit. The Schedule shall also list which tag number or device and to which PLC the circuit is routed.
 - 4) All wiring shall be labeled on both ends. Wire label shall incorporate the equipment or instrument tag where applicable.
 - 5) Equipment / Instrument tags shall be 316 SST rectangular engraved tags. Attach by rivet, stainless steel cable, or chain.
 - 6) Control Panels and Control Junction Box Panels shall be tagged. The Primary or Main PLC Panel shall have a distinguishing tag. Control Panels or Junction Boxes that are supplied on equipment shall incorporate the Equipment Tag as a way to distinguish that the panel is related to the equipment.

7.1.32 Spare Parts

- 1) The Consultant shall include in the project specifications spare parts that are to be supplied. Spare parts shall be provided for pieces of critical equipment that wear or are consumed and need periodic replacement.
- 2) A comprehensive list of the Spare Parts identified throughout the project specifications/Contract documents shall be developed by the Consultant and provided to the contractor at the beginning of construction.
- 3) As spare parts are delivered to the Owner, they shall be neatly organized and shall include the vendor's name, address, and phone number.
- 4) Upon delivery a transfer statement shall be signed by both the contractor and Owner acknowledging the transfer of the spare parts.

7.1.33 Laminated P&ID Drawings

At the conclusion of start up a final Record Drawing of the P&ID drawing(s) shall be printed full size, 24 x 36 inch, and laminated. The laminated drawings shall be given to the Owner.

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

SECTION EIGHT

MISCELLANEOUS DESIGN CRITERIA

Section Eight – Miscellaneous Design Criteria

8.1 Miscellaneous Design Criteria

8.1.1 Startup / Final Acceptance:

- 1) Once startup is complete for a new booster station, if replacing an existing booster station, it shall be operated for a minimum of two (2) weeks, without need for support from the Consultant and/or the controls system integrator, before the old station is decommissioned.
- 2) If the new station is not replacing an old station, it shall be operated for a minimum of two (2) weeks without need for support from the Consultant and/or the controls system integrator before being considered ready for final acceptance.

8.1.2 Project Specifications and Details:

- 1) All work five (5) feet outside of the building foundation shall be designed and constructed in accordance with the City of Rapid City Standard Specifications for Public Works Construction, Current Edition, with all current updates, and supplemented with detailed specifications as necessary for the project design. If, in the Consultant's recommendation, the City's standard specification should not be used, these will be considered on a case-by-case basis with approval by the Engineer.
- 2) All work within the Water Booster Station and within five (5) feet of the building, The Consultant shall develop project specific detailed Specifications and Details. The Consultant supplied Specifications and Details shall be reviewed and approved by the Engineer.
- 3) Consultant provided technical specifications shall follow the CSI 48 Division numbering format.
- 4) Water Booster Station City standard details have been developed and are included in this criteria.

8.1.3 Construction Submittal requirements:

- 1) The Consultant shall develop a list of submittals required, and it shall be included in the project specifications.
- 2) Submittals can be submitted and reviewed electronically.
- 3) City will provide a list of submittals; they want to specifically review before being returned to the contractor.
- 4) Any submittals with an action of "Make Corrections Noted", will required a follow up submittal from the contractor showing the noted correction.
- 5) As a part of contract close out, the contractor shall provide three (3) printed hard copies and organized electronic copy of the final accepted submittals. These documents shall be organized and boxed for transmittal to the City. The Consultant shall review the organized documents before submittal to the Owner.

8.1.4 Record Drawings and Record Specification submittal requirements:

- 1) After project Construction Completion, Consultant of Record shall prepare “Record” Drawings and “Record” Specifications.
- 2) “Record” Drawings and Specifications shall contain any changes that occurred during Construction. These changes shall include but are not limited to:
 - a. Any infield changes that occurred during construction and recorded by the project Contractor or Construction Observer.
 - b. Request for Information (RFI) changes.
 - c. Request for Proposal (RFP) changes.
 - d. Supplemental Instruction (SI), may also be known as Field Orders (FO) changes.
- 3) “Record Specifications” can be completed adding a note in the PDF document noting to see a specific addendum, RFI, or supplemental instruction item.
- 4) “Record” Drawings and Specifications shall be submitted as a hard copy and digital copy compatible with AutoCAD Release 2018 or newer format. Must be submitted to Consulting Services within 30 days of project completion.

8.1.5 Construction Close Out Document Requirements:

- 1) Contractor shall submit written certification that the Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with the Project Contract Documents and ready for Consultant’s review. A partial list of such items appear below:
 - a. Written test results of project components, where required.
 - b. Performance affidavits for equipment, where required.
 - c. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 - d. Keys, padlocks and other items not considered spare parts or maintenance materials.
 - e. Clearances of all property owners for work requiring site restoration caused by Contractor’s operations.
 - f. Project total spare parts list for review after all submittals have been reviewed.
- 2) Contractor shall provide three (3) hard copies of final equipment and materials submittals to Consultant for review and transmission to the Owner.
- 3) Submittals from Contractor to Consultant for Project Closeout include:
 - a. Project record documents.
 - b. Project Photos, and a printed hard copy of thumb nail legend. Photos shall be organized by month and date.
 - c. Equipment manufactures operation and maintenance data.
 - d. Warranties signed and certified. Include all warranties in an organized booklet with a table of contents.
 - e. Bonds.
 - f. Lien Waivers for general contractor, and all suppliers and subcontractors. Lien Waiver requirements shall be as follows:

- i. Contractor Lien Waiver for the entire project.
 - ii. Lien Waivers from suppliers, subcontractors, and individuals (non-employees of the Contractor) providing work for the Contractor in excess of \$25,000 in value.
- 4) Consultant shall provide a digital copy as well as three (3) hard copies of Construction Closeout Document Submittals to the Owner. Submittals from the Consultant to the Owner for Project Closeout include:
 - a. Change Orders.
 - b. Correspondence
 - c. Testing Reports
 - d. Daily Observation Reports.
 - e. Request for Proposals (RFP).
 - f. Requests for Information (RFI).
 - g. Supplemental Instructions (SI).
 - h. Cost Change Proposals (CCP).
 - i. Construction Progress Meeting Minutes.
 - j. Pay Estimates.
 - k. Lien Waivers (Received from Contractor).
 - l. Shop Drawing Logs.
 - m. Spare Parts List.
 - n. Construction Photos.
- 5) Consultant shall collate Contractor and Consultant Closeout Documents (digital as well as three (3) hard copies) and submit to the Owner.

8.1.6 Equipment Operation and Maintenance Manual Requirements:

- 1) The Consultant shall develop a list of equipment O&M manuals required, and it shall be included in the project specifications.
- 2) Consultant shall provide an intended table of contents of what needs to include in the required equipment O&M Manual for the Project. It is expected that the O&M Manual will include detailed O&M information including the following:
 - a. Name and contact information for local equipment representative, supplier and equipment manufacture.
 - b. Startup sequence (normal, emergency).
 - c. Shutdown sequence (normal, emergency).
 - d. Normal Operation.
 - e. Maintenance requirements, and servicing schedule
 - f. Troubleshooting.
- 3) O&M cover shall be supplied with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- 4) The O&M manual shall have a table of contents.
- 5) The O&M manual shall include schematics of all equipment, supplier, warranty information including start dates, and installer identification.
- 6) At the end of Construction, the O&M Manual submitted from the Contractor shall be reviewed by the Consultant to be complete and in compliance with the Drawings and Specifications.
- 7) Provide three (3) hard copies and a book-marked PDF version of the Final Operations and Maintenance Manual to Consulting Services at the end of Construction Completion.

- a. Hard copies shall be bound in 8-1/2 x 11-inch text pages, three ring binders with metal hinges. Internally subdivide the binder contents with permanent page dividers, logically organized, with tab titling clearly printed under reinforced laminated plastic tabs.
- b. PDF versions shall provide the capability of selecting and going to different sections of the manual.

8.1.7 Overall Booster Station O&M Manual:

- 1) The Consultant shall prepare an O&M manual for the overall booster station operation. An example table of contents for the design report is located at the end of this section.
- 2) The Contractor provided equipment O&M Manual will be considered as supplementary to the overall O&M manual. Detailed operation information shall be included in the O&M Manual including Startup sequence (normal, emergency), Shutdown sequence (normal, emergency), Normal Operation, Troubleshooting. Operations description shall include a general narrative in addition to specific control discussion (e.g., local, on, off, auto, and remote). The Consultant shall involve the control system integrator in the development/review of the overall O&M Manual for development of the control language and to verify continuity between disciplines.
- 3) Incorporate photos of field devices, PLC screen shots, P&ID drawings, final control set points, operations narrative, and other information to clearly outline operation and maintenance of the booster station.
- 4) The design criteria tables established for each design discipline shall be included in the O&M manual.
- 5) Consultant shall include within the O&M manual a a Standard Operating Procedure (SOP) overview to City Operations. SOP overview to include the following:
 - a. Discussion of facility need and intended use
 - b. Walk through from suction (water entrance) to discharge (water exit)
 - c. Description of each piece of equipment and its intended purpose and function.

8.1.8 Demonstration and Training Requirements:

- 1) The Consultant shall develop a training list, and it shall be included in the project specifications.
- 2) Consultant shall include, in the Specifications, requirements for training to be completed by Technical Representatives for required equipment.
- 3) Training shall be conducted separately and after startup has been completed.
- 4) Training sessions shall be video recorded and presented to City on digital medium.
- 5) A training agenda shall be developed by the trainer and submitted for review and approval prior to scheduling training.
- 6) Trainer shall have a minimum of three (3) years' experience with the equipment.

8.1.9 Training by Consultant prior to initial BPS start up:

Using the draft O&M manual and draft SOP developed by the Consultant, the Consultant will hold a training session with the Owner on purpose and operation of the BPS. This training will include a combination of classroom and in-field training sessions.

8.1.10 Overall Booster Station O&M Manual Table of Contents:

The O&M Manual shall address the following items, as applicable to the specific project. Subjects can be added or deleted as required for the specific project.

- 1) Introduction
 - a. Purpose of this Manual
 - b. Use of the Manual
 - c. Managerial and Operational Responsibility
 - i. Management
 - ii. Operating Personnel
 - d. Updating the Manual
- 2) Booster Pump Station
 - a. Pump Station Overview
 - b. Standard Operating Procedure
 - c. Pump Station Equipment
 - i. Pumps
 - ii. Valves
 - iii. Variable Frequency Drives (VFD)
 - iv. Flowmeter
 - v. Pressure Gauge & Transmitters
 - vi. Pump Pressure Switches
 - vii. Supervisory Control and Data Acquisition System (SCADA)
 - viii. Programmable Logic Controller (PLC)
 - d. Auxiliary Equipment
 - i. Heating, Ventilation, and Air Conditioning (HVAC)
 - ii. Intrusion Detection System
 - iii. Main Electrical Equipment
 - iv. Bridge Crane
- 3) Pump Station Control Overview
 - a. Normal Operation –Level Control
 - b. Alternative Operation – Discharge Pressure Control
 - c. Interlocks
- 4) Equipment Controls
 - a. Booster Pump Control
 - i. Pump Station Emergency Stop
 - ii. Variable Frequency Drives (VFD)
 - iii. PLC Operator Interface Terminal (OIT)
 - b. Process Operations
 - i. Remote/Auto
 - ii. Remote/Hand
 - iii. Local/Auto
 - iv. Local/Hand

- c. Pump Station Set Points
- 5) Operating Procedures (Standard Operating Procedures)
 - a. Prior to Pump Start-up
 - b. Remote/Auto Pump Operation
 - c. Remote/Hand Pump Operation
 - d. Local/Auto Pump Operation
 - e. VFD Local/Hand Pump Operation
- 6) Alarms And Troubleshooting
- 7) Auxiliary Equipment Controls
 - a. HVAC Controls
 - b. HVAC Set Points
 - c. Intrusion Detection System
 - d. Intrusion Detection System Set Points
- 8) Safety
 - a. Safety and Emergency Procedures
- 9) Miscellaneous Pump Station Information
 - a. Touchup Paint
 - b. Equipment Manufacturer O&M Manuals
 - c. City Water and Sewer Lines
 - d. Supplemental O&M Procedures
- 10) Reference Drawings

- 11) APPENDIX A: In-Field Hydraulics Memorandum
- 12) APPENDIX B: Screenshots
- 13) APPENDIX C: Suggested Safety and Emergency Procedures
- 14) APPENDIX D: City Water and Sewer Lines
- 15) APPENDIX E: Supplemental O&M Procedures

- 16) LIST OF FIGURES
- 17) Figure 2.1 – Distribution System Schematic.
- 18) Figure 2.2 – Interior of Pump Station with equipment tags.
- 19) Figure 6.1 – List of Alarms as shown on PLC OIT screen.

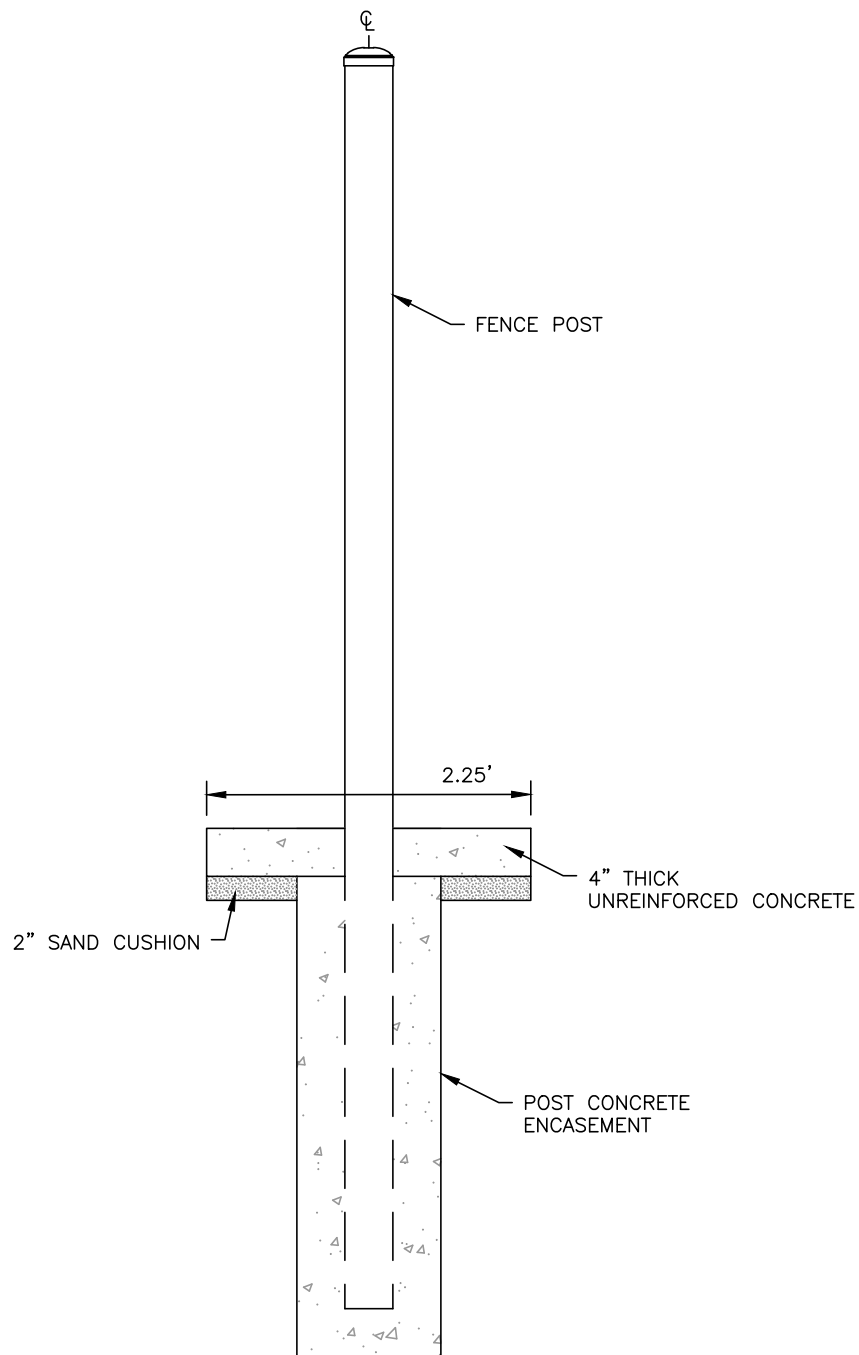
- 20) LIST OF TABLES
- 21) Table 1.1 – Manual Revisions
- 22) Table 4.1 –Booster Pump Station Setpoints as of (Date)
- 23) Table 6.1 – Alarm Troubleshooting
- 24) LIST OF ABBREVIATIONS

END OF SECTION

CITY OF RAPID CITY

**SUPPLEMENTAL DESIGN CRITERIA FOR WATER
BOOSTER PUMP STATIONS**

WATER BOOSTER PUMP STATION STANDARD DETAILS



N.T.S.

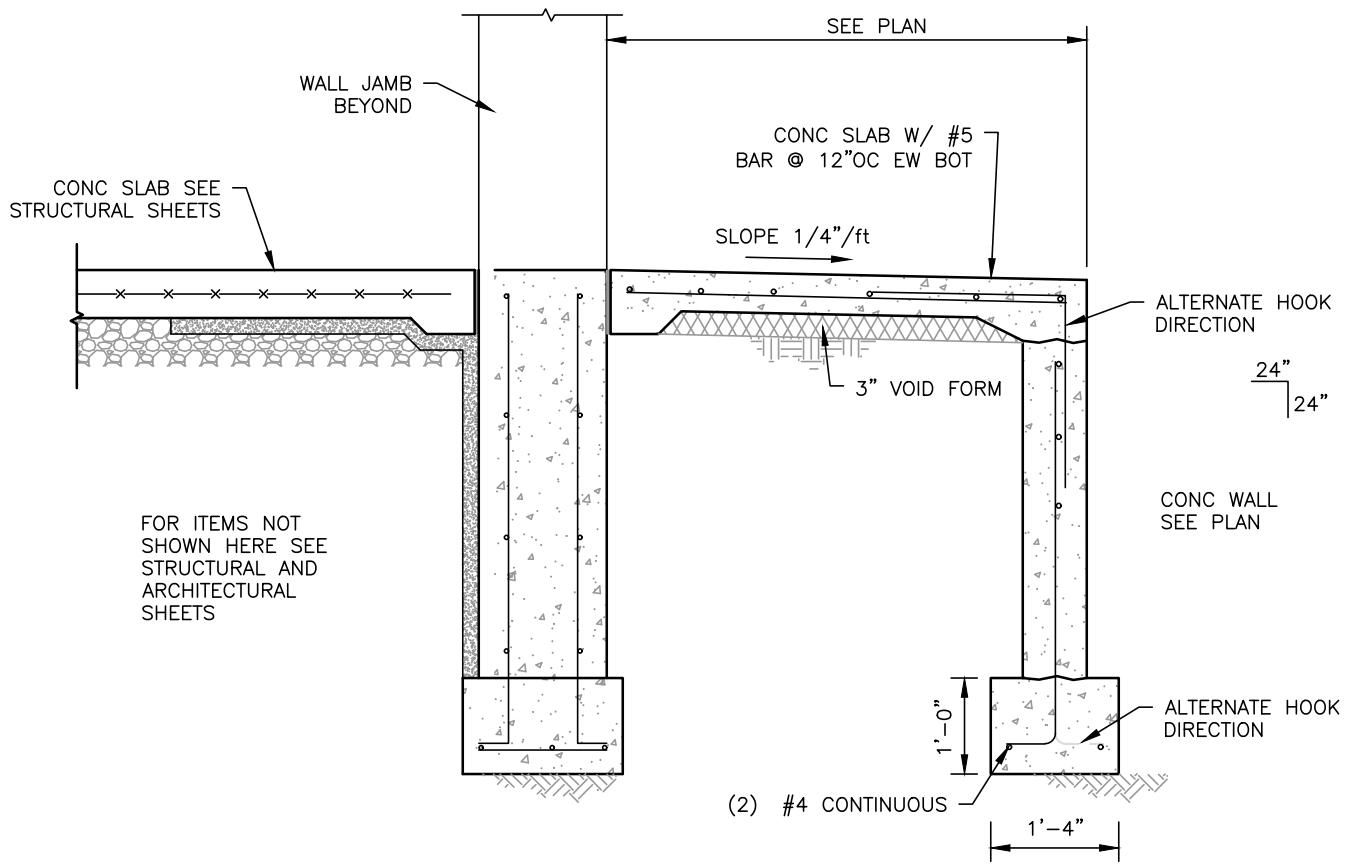
CITY OF RAPID CITY

PUBLIC WORKS DEPARTMENT

DATE: 02-25-22

MOW STRIP DETAIL

SEC. - SHT.
PSDC-1



FOR ITEMS NOT SHOWN HERE SEE STRUCTURAL AND ARCHITECTURAL SHEETS

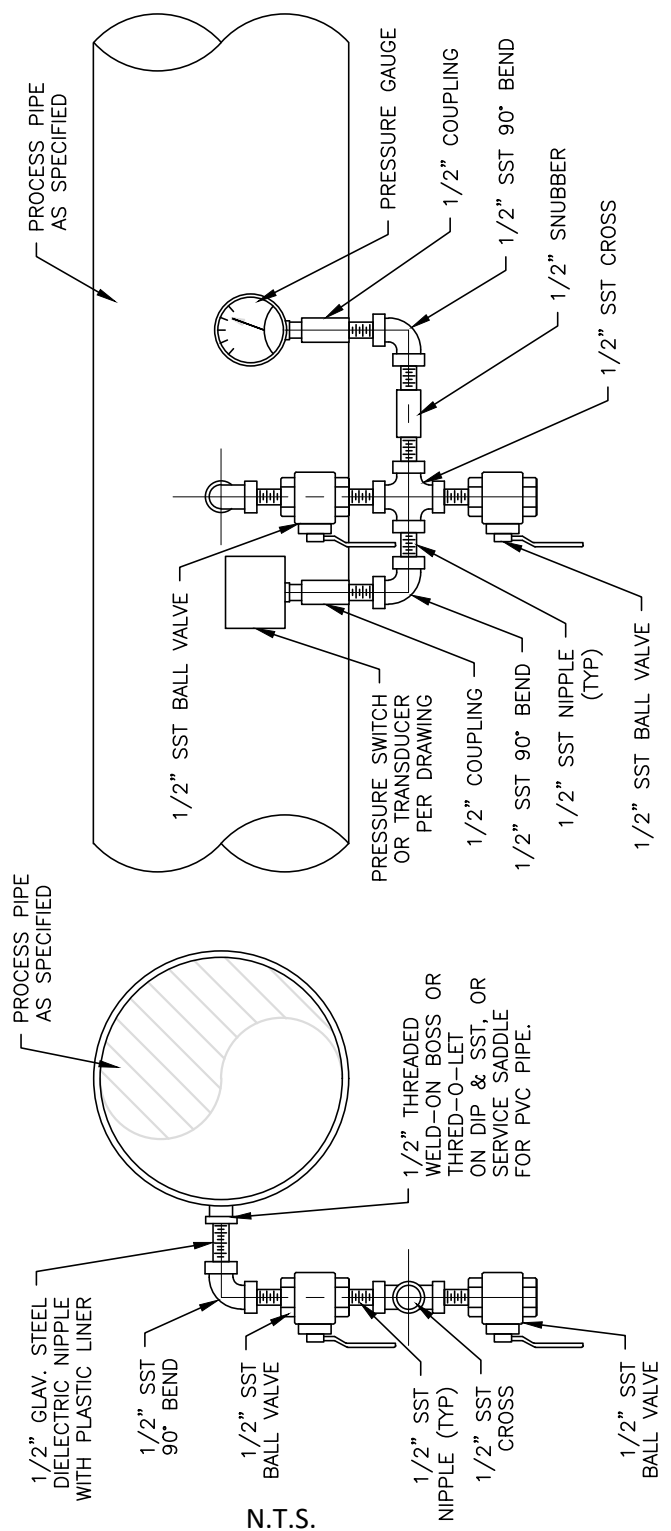
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CITY OF RAPID CITY PUBLIC WORKS DEPARTMENT

DOOR THRESHOLD DETAIL

DATE: 02-25-22

SEC. - SHT. PSDC-2



FRONT VIEW

SECTION VIEW

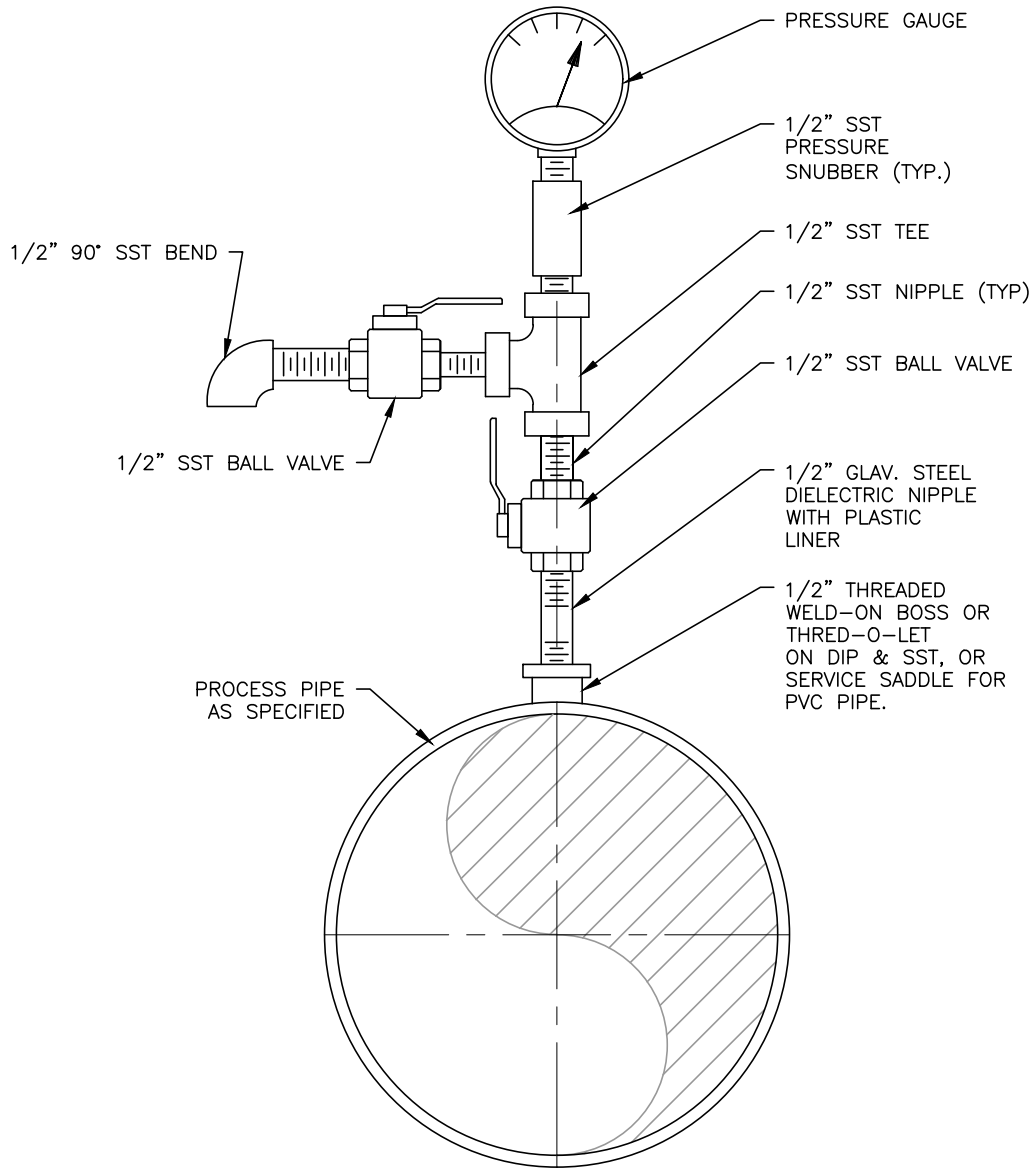
CITY OF RAPID CITY

PUBLIC WORKS DEPARTMENT

PRESSURE GAUGE & PRESSURE SWITCH/TRANSDUCER DETAIL

DATE: 02-25-22

SEC. - SHT. PSDC-3



NOTES:

1. PROVIDE DIAPHRAGM SEAL BETWEEN BALL VALVE AND PRESSURE SNUBBER ON CHEMICAL FEED LINE APPLICATIONS.

N.T.S.

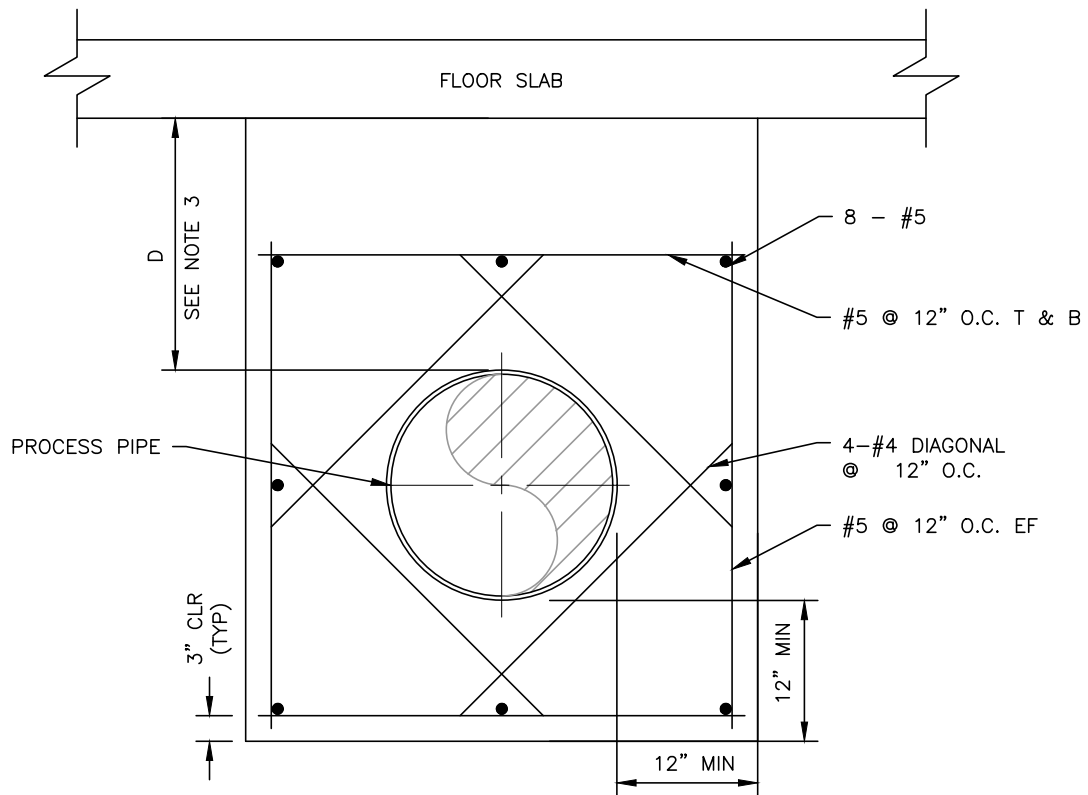
CITY OF RAPID CITY

PUBLIC WORKS DEPARTMENT

PRESSURE GAUGE MOUNTING
DETAIL

DATE: 02-25-22

SEC. - SHT.
PSDC-4



NOTES:

1. CONTRACTOR TO PROVIDE CONCRETE ENCASEMENT AROUND ALL PIPES UNDER STRUCTURAL FOUNDATION.
2. EXTEND CONCRETE ENCASEMENT 5' PAST EXTERIOR OF BUILDING FOUNDATION.
3. IF D IS LESS THAN 1'-6", PROVIDE ENCASEMENT CONTINUOUS TO SLAB. IF D IS GREATER THAN 1'-6", ENCASEMENT MAY BE SEPARATED FROM SLAB.
4. ENCASEMENT TO EXTEND UP VERTICAL PIPE TO 3 INCHES BELOW SLAB. PROVIDE 3 WRAPS OF TAPE AROUND REMAINING EXPOSED PIPE.
5. ALL PIPE JOINTS TO HAVE CATHODIC JUMPER WIRES INSTALLED AND TESTED BEFORE CONCRETE PLACEMENT.

N.T.S.

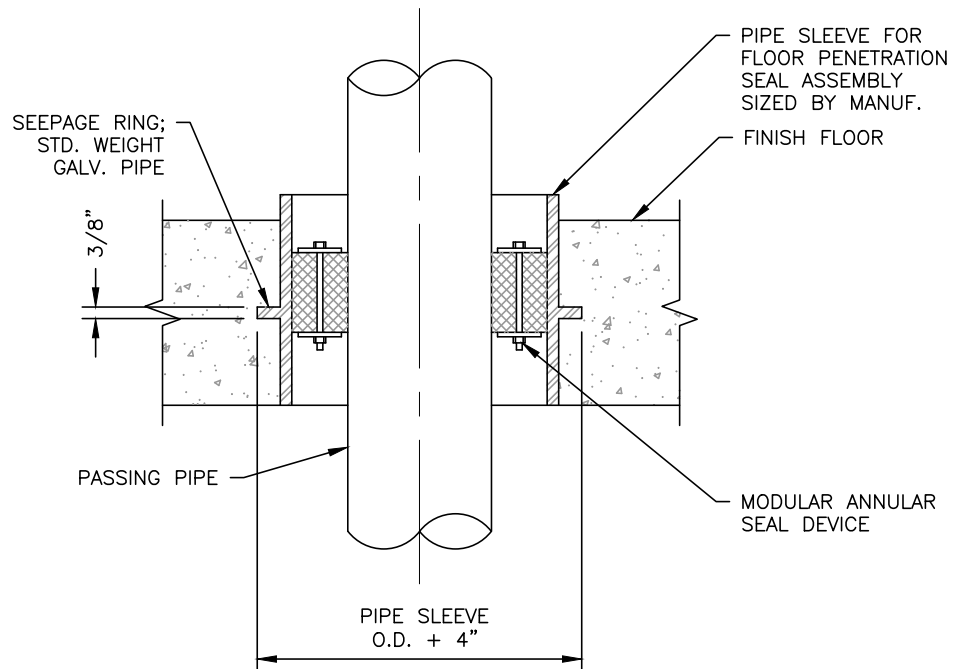
CITY OF RAPID CITY

PUBLIC WORKS DEPARTMENT

CONCRETE PIPE ENCASEMENT
DETAIL

DATE: 02-25-22

SEC. - SHT.
PSDC-5



NOTES:

1. PIPE SLEEVE SHALL BE CONSTRUCTED PER PROJECT SPECIFICATION.
2. EXTEND PIPE SLEEVE 6 INCHES ABOVE FINISHED FLOORS.
3. HOT DIP GALVANIZE AFTER FABRICATION.

N.T.S.

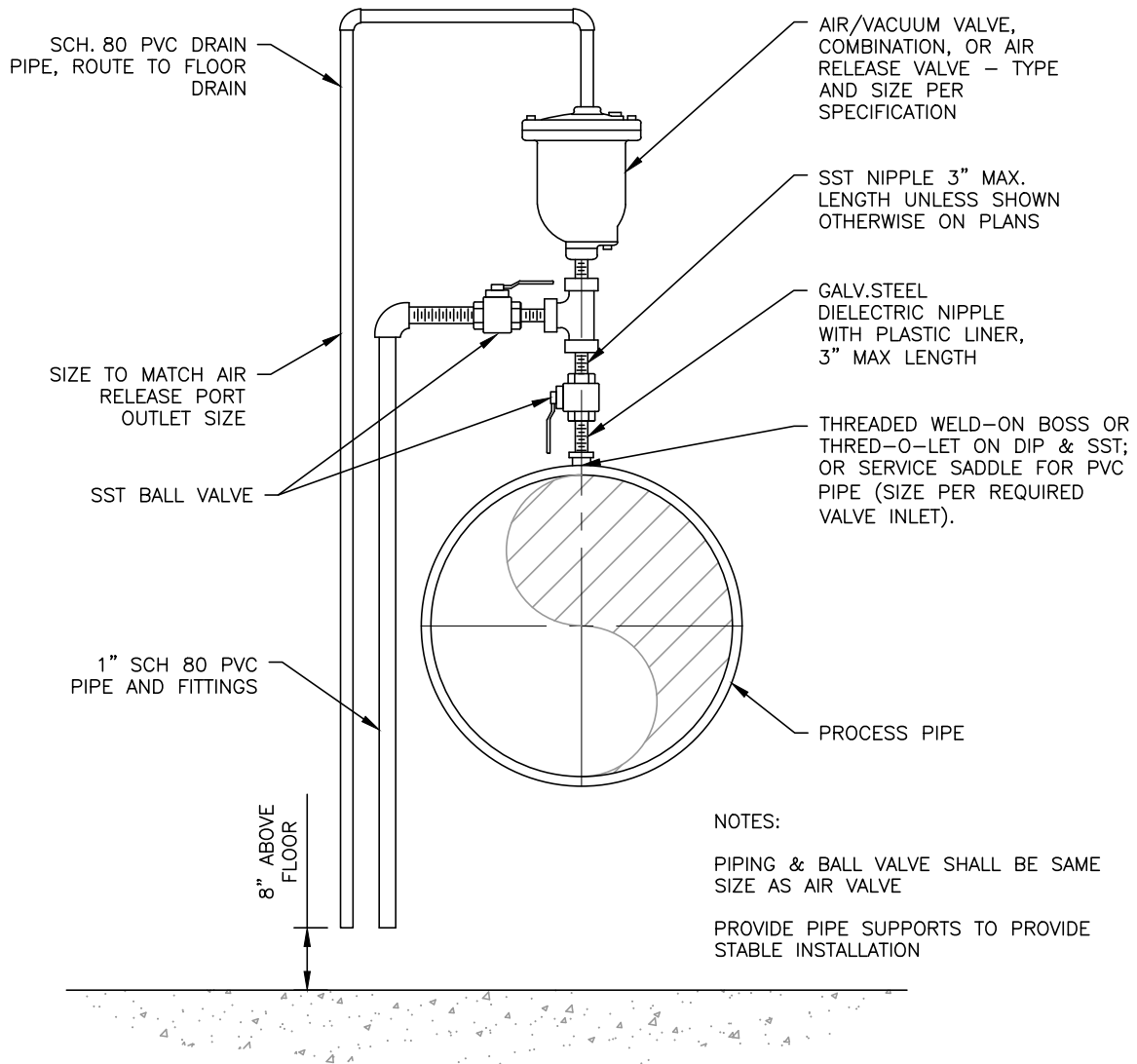
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DATE: 02-25-22

PIPE PENETRATION DETAIL

SEC. - SHT.
PSDC-6



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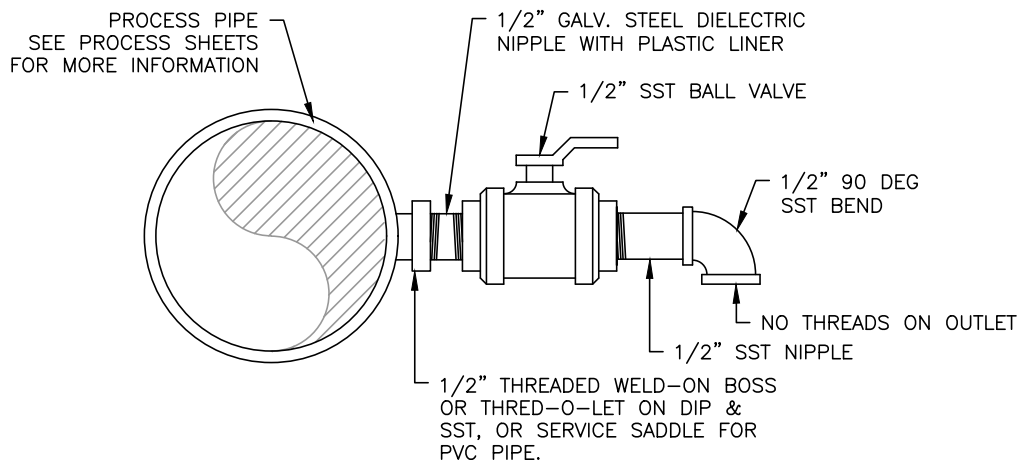
CITY OF RAPID CITY

PUBLIC WORKS DEPARTMENT

AIR / VACUUM VALVE DETAIL

DATE: 02-25-22

SEC. - SHT.
 PSDC-7



N.T.S.

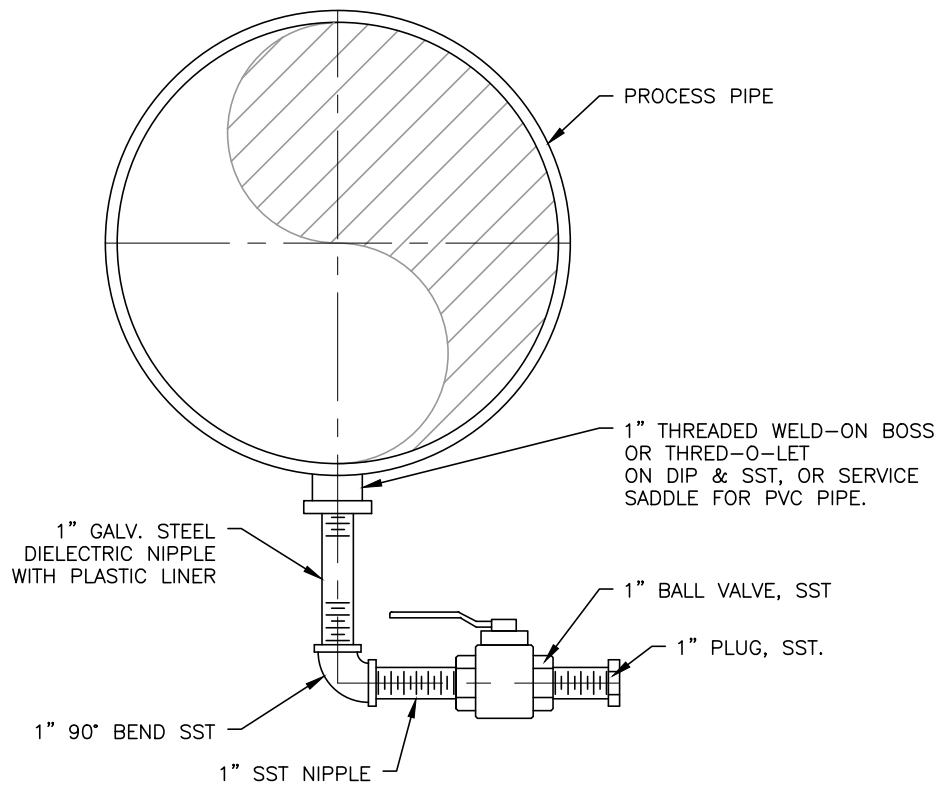
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PUBLIC WORKS DEPARTMENT

ABOVE GROUND SAMPLE TAP
DETAIL

DATE: 02-25-22

SEC. - SHT.
PSDC-8



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CITY OF RAPID CITY

PUBLIC WORKS DEPARTMENT

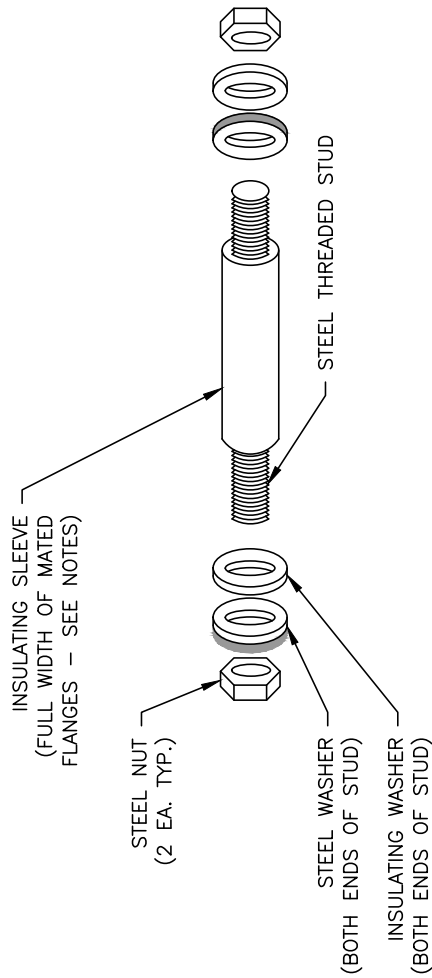
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DRAIN CONNECTION DETAIL

SEC. - SHT.
PSDC-9

NOTES:

1. USE HALF WIDTH SLEEVES AT THREADED FLANGE BOLTS. (I.E. AT BFV BONNET).
2. INSULATING MATERIALS:
 -GASKET - TYPE "E" FULLFACED G-10 EPOXY GLASS WITH RECTANGULAR NITRILE SEAL. (PSI LINEBACKER OR EQUAL).
 -SLEEVE - 1/32-INCH THICK, FULL LENGTH TUBE, LAMINATED G-10 EPOXY GLASS.
 -WASHER - 1/8-INCH THICK LAMINATED G-10 EPOXY GLASS SHEET.
3. ALIGN FLANGE PROPERLY AND FOLLOW GASKET MANUFACTURER BOLT TIGHTENING SEQUENCE INSTRUCTIONS.
 DO NOT PAINT OUTER SURFACE OF FLANGE WITH METALLIC PIGMENTED OR CONDUCTIVE PAINTS.
5. TEST MATED FLANGE WITH GAS ELECTRONICS MODEL 601 INSULATION CHECKER (OR EQUIVALENT) PRIOR TO ACCEPTANCE.



N.T.S.

