Route 9 Sewer Project
Technical Specifications
December 10, 2019
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SECTION 01151
MEASUREMENT AND PAYMENT

PART 1 - SCHEDULE OF VALUES

1.1. LUMP SUM ITEMS

When a lump sum Bid item exists, CONTRACTOR shall submit a schedule of values for the lump sum Work, including quantities and unit prices aggregating the lump sum price, for approval in accordance with the General Conditions. The schedule of values shall show component Work and associated prices in sufficient detail to allow evaluation of partial payment applications and must be approved by ENGINEER.

If any unit price in the approved schedule of values requires that the said unit price cover and be considered compensation for certain Work or material essential to the item, this same Work or material will not also be measured or paid for under any other pay item.

1.2. UNIT PRICE ITEMS

For Unit Price Work, a schedule of values shall not be required since the scope of work and materials to be provided are adequately set forth in this Section under respective bid item to allow evaluation of partial payment applications.

PART 2 - MEASUREMENT OF QUANTITIES

2.1. GENERAL

A. Payment for the Work will be made at the lump sum and unit prices shown in the Bid, which prices shall include the furnishing of all labor, tools, equipment, materials, overhead, profit, insurance, and the performance of all work required to complete the Project as indicated and specified in accordance with all requirements of the Contract Documents and to the entire satisfaction of ENGINEER.

B. All incidental minor and miscellaneous items, Work, and materials for which no specific lump sum or unit price bid item is shown and which are necessary to complete the Work and to maintain and/or repair the Work, shall be done and furnished by CONTRACTOR without extra charge.

C. It is intended that all Work shown and stipulated in the Contract Documents will be measured and paid for under the items listed in the Bid form. The absence of specifically described or shown items from the Bid shall be interpreted as meaning that the quantity and cost of any such Work contemplated by the Contract Documents shall be included in related items which appear in the Bid form. CONTRACTOR shall not be entitled to receive additional compensation for anything furnished or done except as provided for in the General Conditions and Supplementary Conditions.
D. Lump-sum items will not be measured.

2.2. MEASUREMENT

A. Square Yard: In figuring quantities for payment under the applicable items, the payment widths will be taken as not more than a width equal to the specified pavement removal limits where additional pavement cut back is specified.

B. Cubic Yard: In figuring quantities for payment under the applicable items, the payment widths will be taken as not more than a width equal to the specified maximum trench width as specified on the Drawings. The depth will be the thickness installed and a length measured horizontally along the centerline of the trench.

C. Linear Foot: In figuring quantities for payment under the applicable items, measurement shall be along the centerline of the item as installed by CONTRACTOR and measured in place by ENGINEER.

2.3. PAYMENT

A. No separate or additional payment will be made for removing existing pavement, whether asphalt or concrete. CONTRACTOR shall, prior to bidding, perform tests and inspections as necessary to determine depth and type of existing pavement to be removed and include cost of same in unit prices shown in the Bid.

B. No separate or additional payment will be made for removing and maintaining temporary paving required on paved roadways and pavement shoulders of roads and streets or for performing any additional excavation or any other work required to prepare the subgrade to receive the specified permanent pavement.

C. No separate or additional payment will be made for dust control.

D. The prices shown in the Bid for performance of the Work shall be inclusive; that is, the said prices shall include not only the doing the Work, but also all costs in connection with the Work and payment therefore including:

1. providing all materials, equipment, supplies and appurtenances;
2. providing all construction, plant, tools, and other equipment and services;
3. performing all necessary labor, superintendence and administration required to fully complete the Work.

No item of Work that is required for the proper and successful completion of the Work, whether shown or not, shall be paid for outside of or in addition to the prices submitted in the Bid except as specifically provided for in the Contract Documents.
2.4. BID ITEM DESCRIPTIONS

A. ITEM 1 – MOBILIZATION

1. Measurement

Measurement for this lump-sum item will be on the basis of Work percentages completed monthly in accordance with the schedule of values identified in Part 1 of this Section.

2. Payment

Total payment for this item will be made using the lump-sum price shown in the Bid. Partial payments for this item will be made for Work completed in accordance with schedule of values. Lump-sum price shall include all labor, tools, materials and equipment for mobilizing to and demobilizing from the Site. Lump-sum price shall also account for incidental work including but not limited to:

a. establishing staging areas;
b. establishing and maintaining CONTRACTOR field office;
c. providing Project sign;
d. performing audio-video recording of preconstruction conditions;
e. soft costs relating to requirements of the General Conditions (EXCEPTION: WVDOH bond fee and railroad inspection/monitoring fees - separate Bid items are provided for these fees).

No deduction will be made, nor will any increase be made, in the lump sum mobilization item amount regardless of decreases or increases in the Contract Price or for any other cause.

B. ITEM 2 - TRAFFIC CONTROL

1. Measurement

Measurement for this lump-sum item will be on the basis of Work percentages completed monthly in accordance with the schedule of values identified in Part 1 of this Section.

2. Payment

Total payment for this item will be made using the lump-sum
price shown in the Bid. Partial payments for this item will be made for Work completed in accordance with schedule of values. Lump-sum price shall include all labor, tools, materials and equipment for controlling and protecting pedestrian and vehicular traffic through and adjacent to the Site. Lump-sum price shall also account for incidental work including but not limited to:

a. coordinating with WVDOH;
b. notifying driveway owners of access interruptions;
c. covering or relocating existing traffic signs;
d. maintaining portable traffic signs and other devices.

C. ITEM 3 – EROSION AND SEDIMENT CONTROL

1. Measurement

Measurement for this lump-sum item will be on the basis of Work percentages completed monthly in accordance with the schedule of values identified in Part 1 of this Section.

2. Payment

Total payment for this item will be made using the lump-sum price shown in the Bid. Partial payments for this item will be made for Work completed in accordance with schedule of values. Lump-sum price shall include all labor, tools, materials and equipment for erosion and sediment control through and adjacent to the Project alignment, except at the pump station sites. Lump-sum price shall also account for incidental work including but not limited to:

a. coordinating with WVDEP, WVDOH and Jefferson County NRCS;
b. providing public-notice signage;
c. providing e/sc measures at off-Site staging areas;
d. correcting deficient e/sc measures;
e. removing material deposited on roads.

Erosion and sediment control at the pump station sites will be paid for under the pump station Bid items.
D. ITEMS 4-7 – GRAVITY SEWER, OPEN-CUT

1. Measurement

Measurement for these items will be on a linear-foot basis along the top of the pipe as installed from inside wall of manhole. Depth measurement for these items will be the vertical distance from pipe invert to grade.

2. Payment

Payment for these items will be made using the corresponding unit price per linear foot shown in the Bid. Unit price shall include all labor, tools, equipment and material to install gravity sewer line complete by open-cut. Unit price shall also account for incidental work including but not limited to:

   a. clearing and grubbing;
   b. excavating all materials encountered in trenches including rock;
   c. protecting adjacent structures and utilities;
   d. sheeting or bracing;
   e. dewatering;
   f. handling surplus material;
   g. temporary repair of roads and driveways;
   h. environmental controls (dust, runoff);
   i. backfilling to subgrade;
   j. air and deflection testing;
   k. maintaining record copy of Drawings annotated to show changes.

E. ITEMS 8 and 13 – FORCE-MAIN, OPEN-CUT

1. Measurement

Measurement for these items will be on a linear-foot basis along the horizontal centerline of the middle force-main pipe as installed. The outer force-main pipes will not be measured.
2. Payment

Payment for these items will be made using the corresponding unit price per linear foot of force-main trench shown in the Bid. Unit price shall include all labor, tools, equipment and material to install triple force-mains complete by open-cut. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;
b. excavating all materials encountered in trenches including rock;
c. protecting adjacent structures and utilities;
d. sheeting or bracing;
e. dewatering;
f. environmental controls (dust, runoff);
g. DIP fittings shown or called for on the Drawings;
h. joint restraint;
i. handling surplus material;
j. temporary repair of roads and driveways;
k. backfilling to subgrade, including furnishing imported fill if needed to maintain cover;
l. acceptance testing;
m. maintaining record copy of Drawings annotated to show changes.

F. ITEM 9 – FORCE-MAIN IN EXISTING ROUTE 9 CASING

1. Measurement

Measurement for this item will be on a linear-foot basis along the length of the existing casing.

2. Payment

Payment for this item will be made using the unit price per linear foot shown
in the Bid. Unit price shall include all labor, tools, materials, equipment to install three bundled force-mains (6”-4”-6”) in the existing 30” casing as shown on Dwg. C043 and detailed on Dwg. C053. Unit price shall also account for incidental work including but not limited to:

a. coordinating with WVDOH;
b. clearing and grubbing;
c. excavating access pits at casing ends;
d. protecting adjacent structures and utilities;
e. sheeting or bracing;
f. dewatering;
g. environmental controls (dust, runoff);
h. removing existing bulkheads;
i. verifying suitability of casing for use;
j. providing spacers and joint restraints;
k. providing grout for bulkheads and associated drainage provisions;
l. backfilling access pits to subgrade, including furnishing imported fill if needed;
m. handling surplus material;
n. acceptance testing of carrier pipes;
o. resetting existing wood markers for adjacent 24” casing and/or existing fencing;
p. maintaining record copy of Drawings annotated to show changes.

G. ITEMS 10 and 14 – FORCE-MAIN AIR VAULT AND INTERNALS

1. Measurement

Measurement for these items will be for each complete air vault installation.
2. Payment

Payment for these items will be made using the corresponding unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install force-main air vaults complete with internal and external components. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;
b. excavating all materials encountered including rock;
c. protecting adjacent structures and utilities;
d. sheeting and shoring;
e. dewatering;
f. environmental controls (dust, runoff);
g. fittings and joint restraint outside the vault for transitioning pipe spacing;
h. backfilling to subgrade;
i. handling surplus material;
j. acceptance testing.

H. ITEMS 11 and 15 – FORCE-MAIN FLUSHING VAULT AND INTERNALS

1. Measurement

Measurement for these items will be for each complete flushing vault installation.

2. Payment

Payment for these items will be made using the corresponding unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install force-main flushing vaults complete with internal and external components. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;
b. excavating all materials encountered including rock;

c. protecting adjacent structures and utilities;

d. sheeting and shoring;

e. dewatering;

f. environmental controls (dust, runoff);

g. fittings and joint restraint outside the vault for transitioning pipe spacing;

h. backfilling to subgrade;

i. handling surplus material;

j. acceptance testing.

I. ITEMS 12 and 16 – FORCE-MAIN COMBINED AIR/FLUSHING VAULT AND INTERNALS

1. Measurement

Measurement for these items will be for each complete combined air/flushing vault installation.

2. Payment

Payment for these items will be made using the corresponding unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install force-main combined air/flushing vaults complete with internal and external components. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;

b. excavating all materials encountered including rock;

c. protecting adjacent structures and utilities;

d. sheeting and shoring;

e. dewatering;

f. environmental controls (dust, runoff);
g. fittings and joint restraint outside the vault for transitioning pipe spacing;

h. backfilling to subgrade;

i. handling surplus material;

j. acceptance testing.

J. ITEM 17 – FORCE-MAIN MISCELLANEOUS DIP FITTINGS, IF DIRECTED

1. Measurement

Measurement for this item will be on a per-pound basis for miscellaneous DIP fittings (bends) directed by ENGINEER in excess of those shown or called for on the Drawings (as in the case of horizontal or vertical alignment changes). Measurement will be based on a detailed list (CONTRACTOR-furnished and ENGINEER-approved) by location of types and weights of fittings added or deleted. Weights shall be nominal weights supplied in manufacturer literature. Fittings shown on the Drawings but eliminated by changes will be deducted from measurements for this item. Retainer gland weights will not be measured.

2. Payment

Payment for this item will be made using the unit price per pound shown in the Bid. Unit price shall include all labor, equipment and material required to furnish and install additional DIP fittings as directed by ENGINEER. Unit price shall also account for incidental work including but not limited to:

a. providing retainer glands;

b. maintaining record copy of Drawings annotated to show changes.

K. ITEM 18 – CONCRETE CLASS B, IF DIRECTED

1. Measurement

Measurement for this item will be on a cubic-yard (in place) basis for miscellaneous Class B concrete installed where directed by ENGINEER (as in the case of pipe encasement or buttress).

2. Payment

Payment for this item will be made using the unit price per cubic yard shown on the Bid. Unit price shall include all labor, tools, materials and equipment.
for installing Class B concrete complete. Unit price shall also account for incidental work including but not limited to:

a. excavating all materials encountered including rock;
b. sheeting or bracing;
c. dewatering;
d. reinforcing bars or mats;
e. forming;
f. providing polyethylene wrap.

L. ITEMS 19-23 – CASING BORED

1. Measurement

Measurement for these items will be on a linear-foot basis along the length of the installed casing.

2. Payment

Payment for these items will be made using the corresponding unit price per linear foot shown in the Bid. Unit price shall include all labor, tools, materials and equipment for installing steel casing pipe by boring and jacking and for installing carrier pipe(s) within complete. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;
b. excavating all materials encountered in bore pits including rock;
c. protecting adjacent structures and utilities;
d. environmental controls (dust, runoff);
e. dewatering;
f. sheeting and shoring;
g. welding casing segments;
h. providing spacers and joint restraints;
i. providing grout for bulkheads and associated drainage provisions;

j. fittings and joint restraint in the bore pits for transitioning pipe arrangement;

k. backfilling bore pits to subgrade;

l. handling surplus material;

m. acceptance testing;

n. maintaining record copy of Drawings annotated to show changes.

M. ITEMS 24-25 – CASING OPEN-CUT

1. Measurement

Measurement for these items will be on a linear-foot basis along the length of the installed casing.

2. Payment

Payment for these items will be made using the unit price per linear foot shown in the Bid. Unit price shall include all labor, tools, materials and equipment for installing steel casing pipe by open-cut and for installing carrier pipe(s) within complete.

The Northport Avenue casing (#11) was installed by Others, but the 6” sewer pipe was not installed. Therefore, the unit price for Northport casing shall include all labor, tools, materials and equipment for installing and testing the complete 6” gravity sewer service line within the existing casing between manhole SMH JO-04 and cleanout SMH JO-04A (encased and un-encased portions), and the clean-out on the west side of the casing.

Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;

b. excavation of paved surface and all materials encountered in trench including rock;

c. protecting adjacent structures and utilities;

d. environmental controls (dust, runoff);

e. dewatering;

f. sheeting and shoring;
g. welding casing segments;
h. providing spacers and joint restraints;
i. providing grout for bulkheads and associated drainage provisions;
j. fittings and joint restraint for transitioning pipe arrangement;
k. backfilling to subgrade;
l. handling surplus material;
m. acceptance testing of carrier piping;
n. maintaining record copy of Drawings annotated to show changes.

N. ITEMS 26-28 – MANHOLE, 4’-DIA. (UP TO 6’ DEEP)

1. Measurement

Measurement for these items will be for each complete manhole installation up to 6’ deep. Depth as measured from flow line at center of manhole to bottom of frame and cover shall be 6’ or less. Manhole depths in excess will be paid separately per vertical foot.

2. Payment

Payment for these items will be made using the corresponding unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install 4’-diameter manholes complete up to 6’ deep with internal and external components including eccentric cone and frame and cover. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;

b. excavating all materials encountered including rock;

c. protecting adjacent structures and utilities;

d. sheeting and shoring;

e. dewatering;

f. environmental controls (dust, runoff);
g. backfilling to subgrade;

h. handling surplus material;

i. installing anchoring bolts for frame/cover assembly;

j. vacuum testing;

k. manhole inspection report documenting test results, manhole depth, etc.

O. ITEM 29 – MANHOLE EXTENSION, 4’-DIA.

1. Measurement

Measurement for this item will be on a vertical-foot basis along the wall of the installed extension section(s). This item shall apply whenever the total depth of the manhole as measured from the invert at the center of the manhole to the top of the concrete at the bottom of the frame and cover exceeds 6.0’. Measurement of the depth that exceeds the 6.0’ will be to the nearest 0.1’.

2. Payment

Payment for this item will be made using the unit price per vertical foot shown in the Bid. Unit price shall include all labor, tools, materials and equipment for installing 4’-diameter manhole extensions complete. Unit price shall also account for all incidental work as identified in Item “MANHOLE, 4’-DIA. (UP TO 6’ DEEP)” above.

P. ITEMS 30-31 – MANHOLE DROP CONNECTION

1. Measurement

Measurement for these items will be for each complete outside drop connection assembly. All other manhole costs will be paid separately.

2. Payment

Payment for these items will be made using the corresponding unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install each outside drop connection assembly complete. Unit price shall also account for incidental work including but not limited to:

a. additional excavating including rock;

b. spool pieces;
c. sealing wall penetrations;

d. aggregate bedding/backfill;

e. handling surplus material.

Q. ITEMS 32-33 – TRANSITION MANHOLES

1. Measurement

Measurement for these items will be for each complete transition (force-main termination) manhole installation.

2. Payment

Payment for these items will be made using the corresponding unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install transition manholes complete with internal and external components including frame and cover. Unit price shall also account for incidental work including but not limited to:

a. clearing and grubbing;

b. excavating all materials encountered including rock;

c. protecting adjacent structures and utilities;

d. sheeting and shoring;

e. dewatering;

f. environmental controls (dust, runoff);

g. backfilling to subgrade;

h. handling surplus material;

i. vacuum testing;

j. manhole inspection report documenting test results, etc.

All other manholes will be paid separately.

R. ITEM 34 – SEWER MARKER

1. Measurement

Measurement for this item will be on the basis of each complete sewer marker installation.
2. Payment

Payment for this item will be made using the unit price per each shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install sewer markers complete including decals.

S. ITEMS 35-37 – CONNECTION TO EXISTING FACILITIES

1. Measurement

These items will not be measured for payment since they are lump-sum items.

2. Payment

Payment for these items will be made using the lump-sum prices shown in the Bid. Lump-sum price shall include all labor, tools, materials and equipment for connecting proposed facilities with existing facilities complete. Lump-sum price shall also account for incidental work including but not limited to:

a. excavating materials encountered including rock (Manhole 11V);

b. connecting to or removing existing stub if applicable (Manhole 11V);

c. metering existing flow (Manholes BV-03 and DC-02);

d. preparing bypass-pumping plans and performing bypass pumping (Manholes BV-03 and DC-02);

e. protecting existing facilities from damage, back-up or service disruption;

f. taking precautions for work within “live” manholes;

g. sealing wall penetrations.

T. ITEMS 38 – PUMP STATION, WAR ADMIRAL

1. Measurement

Measurement for this lump-sum item will be on the basis of work percentages completed monthly in accordance with the schedule of values identified in Part 1 of this Section.

2. Payment

Total payment for this item will be made will be made using the lump-sum
price shown in the Bid. Partial payments for these items will be made for work completed in accordance with schedule of values. The lump-sum price shall include all labor, tools, materials and equipment for installing pump station complete including but not limited to all civil, structural, mechanical and electrical components (i.e., wet well, pumps, valve and meter vaults, air-injection facilities, generator, electrical cabinets and controls, SCADA system, lighting, fencing, drainage, landscaping, access, etc.). The lump-sum price shall also account for incidental work including but not limited to:

- providing stabilized construction entrance;
- clearing and grubbing;
- excavating all materials encountered including rock;
- protecting adjacent structures and utilities;
- sheeting and shoring;
- dewatering;
- environmental controls (dust, runoff);
- backfilling to subgrade;
- handling surplus material;
- constructing off-site electrical facilities (i.e., conduits/duct banks from provider’s service drop to pump station service rack), including surface restoration;
- constructing off-site driveway (i.e., driveway portion between pump station easement/parcel and WVDOH roadway) and associated improvements such as culvert, filter fabric, rip-rap and asphalt apron;
- O&M manuals, operational testing, start-up and training;
- documenting proper pump performance;
- maintaining record copy of Drawings annotated to show changes.

U. ITEMS 39-43 – SURFACE RESTORATION

1. Measurement

Measurement for these items will be on a square-yard basis for asphalt, gravel or unimproved (grass) surfaces as installed.
2. Payment

Payment for these items will be made using the corresponding unit price per square yard shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install asphalt, gravel or unimproved surface restoration complete. Unit price shall also account for incidental work including but not limited to:

a. preparing subgrade surface;
b. sawcutting;
c. furnishing and installing aggregate base for asphalt surfaces;
d. applying tack coat;
e. compacting;
f. replacing bike path and road pavement markings;
g. permanent seeding, mulching and watering.

V. ITEM 44 – CULVERT REPLACEMENT

1. Measurement

Measurement for this item will be on a linear-foot basis along the top of the pipe as installed for each complete culvert installation.

2. Payment

Payment for this item will be made using the corresponding unit price per linear foot shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install each culvert complete. Unit price shall also account for incidental work including but not limited to:

a. documenting invert elevations of existing pipe;
b. excavating and disposing of existing pipe;
c. aggregate bedding and backfill;
d. controlling erosion at pipe inlet/outlet.
W. ITEM 45 – ABANDONMENT OF WATER WELL

1. Measurement

This item will not be measured for payment since it is a lump-sum item.

2. Payment

Payment for this item will be made using the lump-sum price shown in the Bid. Lump-sum price shall include all labor, tools, materials and equipment to abandon the existing water well complete. Lump-sum price shall also account for incidental work including but not limited to:

   a. obtaining permit from local health department;
   b. following procedures prescribed in the permit;
   c. procuring supervisory services of a WV-certified water-well driller;
   d. removing pump, piping and wiring.

X. ITEM 46 – EXCAVATION AND BACKFILLING BELOW SUBGRADE

1. Measurement

Additional excavation below subgrade will be measured on a cubic-yard basis for extra excavation required due to unsuitable subgrade as determined by the Engineer. Measurement will be limited to trench widths shown on the drawings or one foot beyond the pipe wall on each side; length measured along the centerline of the pipe and the depth of material directed to be removed.

2. Payment

The unit price per cubic yard of earth excavation and compacted backfill below subgrade will include all labor, equipment and materials required to excavate below pipe subgrade and backfill with graded aggregate, compact materials in layers, and dispose of all unsuitable material. Aggregate used shall be included in the unit price.

Y. ITEM 47 – ALLOWANCE - WVDOH COSTS

1. Measurement

This item is an allowance that will not be measured for payment since it is a lump-sum item.
2. Payment

Payment for this item will correspond to the actual cost incurred to obtain the WVDOH bond. Payment may be less than the lump-sum allowance shown in the Bid.

Z. ITEM 48 – ALLOWANCE – RAIL PROTECTIVE SERVICES

1. Measurement

This item is an allowance that will not be measured for payment since it is a lump-sum item.

2. Payment

Payment for this item will correspond to actual costs incurred for CSX and Norfolk-Southern inspection/monitoring in the course of the Work. Payment may be less than the lump-sum allowance shown in the Bid.

AA. ITEMS 49-54 - ALLOWANCE - SINKHOLE REPAIR

1. Measurement

Measurement for soil and aggregate items associated with sinkhole repair will be on a cubic-yard basis for each complete sinkhole repair. Measurement for the impervious core item associated with sinkhole repair will be on a square-foot basis (3-foot depth) for each complete sinkhole repair.

2. Payment

Payment for soil and aggregate items will be made using the corresponding unit price per cubic yard shown in the Bid. Payment for the impervious core item will be made using the corresponding unit price per square foot (3-foot depth) shown in the Bid. Unit price shall include all labor, tools, materials and equipment to furnish and install each sinkhole repair component complete. Unit price shall also account for incidental work including but not limited to:

a. contacting WVDOH environmental coordinator if applicable;

b. excavating into bedrock;

c. providing erosion/sediment control at repair location.

Seeding and mulching will be paid separately under “RESTRUCTION, UNIMPROVED (GRASS) SURFACE.”
BB. BID ALTERNATE NO.1 – PUMP STATION, NORTHPORT

1. Measurement

Measurement for these lump-sum items will be on the basis of work percentages completed monthly in accordance with the schedule of values identified in Part 1 of this Section.

2. Payment

Total payment for this item will be made using the lump-sum price shown in the Bid. Partial payments for this item will be made for work completed in accordance with schedule of values. The lump-sum price shall include all labor, tools, materials and equipment for installing pump station complete including but not limited to all civil, structural, mechanical and electrical components (i.e., wet well, pumps, valve and meter vaults, generator, electrical cabinets and controls, SCADA system, lighting, fencing, drainage, landscaping, access, etc.). The lump-sum price shall also account for incidental work including but not limited to:

a. providing stabilized construction entrance;
b. clearing and grubbing;
c. excavating all materials encountered including rock;
d. protecting adjacent structures and utilities;
e. sheeting and shoring;
f. dewatering;
g. environmental controls (dust, runoff);
h. backfilling to subgrade;
i. handling surplus material;
j. constructing off-site electrical facilities (i.e., conduits/duct banks from provider’s service drop to pump station service rack), including surface restoration;
k. constructing off-site driveway (i.e., driveway portion between pump station easement/parcel and WVDOH roadway) and associated improvements such as asphalt pavement;
l. providing off-site buffer plantings at Northport Pump Station (i.e., plantings in WVDOH right-of-way);

m. O&M manuals, operational testing, start-up and training;

n. documenting proper pump performance;

o. maintaining record copy of Drawings annotated to show changes.

END OF SECTION
SECTION 02315

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this Section includes, but is not limited to

1. Clearing and grubbing
2. Trench and structure excavation
3. Support of excavation
4. Pipe bedding and laying requirements
5. Backfilling and compaction

1.2 QUALITY ASSURANCE

A. Testing Agency: Density testing shall be performed by an independent soils testing laboratory engaged and paid for by CONTRACTOR and approved by ENGINEER.

B. Referenced Standards

1. American Society for Testing and Materials (ASTM)
   a. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
   b. D2922 Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods

C. Density Testing

1. Conduct one test per lift for each 500 linear feet of pipeline. Conduct density tests at locations as directed by ENGINEER during backfilling operations.

2. Determine density by ASTM D1556 or ASTM D2922 in areas other than WVDOH roads and shoulders.
1.3 SUBMITTALS

A. Certificates
   1. Submit, prior to delivery of the material to the job site, a Statement of Compliance from the materials supplier, together with supporting data, attesting that the composition analysis of pipe bedding and select material stone backfill materials meets specification requirements. Should a change in source of materials be made during construction, submit a new Statement of Compliance from the new source for approval before the material is delivered to the job site.

   2. Submit certified density testing results from the soils testing laboratory.

B. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer’s lift thickness limitations.

C. Agreements with Property Owners: Prior to storing or disposing of excavated materials on private property, submit a copy of the written agreement with the property owner.

D. CONTRACTOR shall appoint qualified and competent licensed shot firers for the planning and design of a Master Blasting Plan, geotechnical matters, and use of explosives. The staff shall be appointed to specified positions to be responsible for the duties necessary to carry out excavation by the method of blasting. Blasting Contractor documentation shall be submitted to ENGINEER for approval documenting that the Blasting Contractor has at least 5-years of experience and evidence of the satisfactory completion of at least five blasting programs or operations comparable in scope to this work. The Blasting Contractor shall submit documentation of licensing required by Laws and Regulations. The Blasting Contractor shall apply for and obtain all required blasting permits, and shall submit documentation to ENGINEER.

   The staff shall be full time on site and each appointed personnel shall work exclusively on duties relating to their position.

   The appointed staff shall be responsible for taking possession of explosives on site, having pre-blast surveys performed as required, compiling of the Master Blasting Plan, preparation of the design for the blast holes drilling pattern, supervision of the drilling, establishing the explosive design, preparation of the wiring and firing sequence plan and supervision of the loading, wiring, and firing of all blasts.

   The appointed staff shall also undertake accurate recording of all information regarding the drilling and blasting on a “Drilling and Blasting Record Sheet” and the explosive type, weight, and delay on a “Load Record Report.” The format of said record sheets and reporting shall be to the approval of ENGINEER.
The appointed staff shall attend each month or at more frequent intervals as required by the Engineer, a meeting on safety and other relevant aspects of the excavation works by blasting which will also be attended by ENGINEER. The first meeting shall be held prior to and within 1-week of the first blasting, minutes of each meeting shall be maintained and submitted to ENGINEER within 24-hours.

CONTRACTOR shall submit in writing his blasting proposals to ENGINEER for approval at least 1-week before an initial blast and at least 48 hours before any subsequent blasts.

Before using explosives obtain written permission from ENGINEER and submit a rock removal plan including working drawings and data ten working days in advance of proposed blasting, for information only, showing blasting design and monitoring thereof, prepared and certified by a Professional Engineer registered in the State of West Virginia experienced in blasting operations.

1.4 JOB CONDITIONS

A. Classification of Excavation: All excavation work performed under this Contract is unclassified, and includes excavation and removal of all soil, shale, rock boulders, fill, and all other materials encountered of whatever nature.

B. Protection of Existing Utilities and Structures:

1. Take all precautions and utilize all facilities required to protect existing utilities and structures. Advise each utility at least 3 working days in advance of intent to excavate, and give the location of the job site. Request cooperation of utility and suggestions for procedures to avoid damage to its lines.

2. Advise each person in physical control of powered equipment used in excavation work of the type and location of utility lines at the job site, and procedures to follow to prevent damage.

3. Immediately report to the utility and ENGINEER any break, leak or other damage to the lines or protective coatings made or discovered during the Work and immediately alert the occupants of premises of any emergency created or discovered.

4. Allow free access to utility personnel at all times for purposes of maintenance, repair and inspection.
C. Storage and Transport of Explosives:

1. Proper building or magazines, with separate compartments for detonators in suitable positions for the storage of explosives in the manner and quantities to be approved, shall be provided by CONTRACTOR. Separate vehicles or vessels for detonators shall also be used for the transportation of explosives. Deliver explosives to the site in vehicles that are in compliance with Laws and Regulations. Prevention of any unauthorized use or improper use of any explosives brought onto the Site shall be the responsibility of CONTRACTOR and only experienced licensed shot firers shall be employed to handle the explosives for the purposes of the Work.

2. CONTRACTOR’s security measures dealing with the storage, handling, and transport of explosives shall comply with applicable Laws and Regulations.

3. The quantity of explosives on the Site shall at all times be limited to that required to complete one day’s work. Explosives on the Site shall be stored in locked, heavy, shockproof containers. Detonators and explosives shall be inventoried at the end of each work day. Missing items shall be immediately reported to the proper authorities and to ENGINEER.

PART 2 - PRODUCTS

2.1 PIPE BEDDING MATERIAL

Bedding Material: Clean granular material meeting the requirements of AASHTO M 43 size No. 8 or as approved by ENGINEER.

2.2 BACKFILL MATERIAL

A. Granular material conforming to the Uniform Soil Classification Groups GW, GP, SW or SP that will completely pass a (1 1/2") sieve and that will compact readily when the usual methods of tamping are used. It shall conform to the requirements of AASHTO M 43, size number 57 and have a maximum Los Angeles Abrasion (LA) test (AASHTO T-96) of 50%.

B. Suitable Backfill Material

1. From top of pipe bedding material to 24" over top of pipe

   a. Material excavated from the trench if free of stones larger than 2" in size and free of wet, frozen or organic materials.
2. From 24" above pipe bedding to subgrade elevation
   
   a. Material excavated from the trench if free of stones larger than 6" in size and free of wet, frozen or organic materials.
   
   C. Unsuitable Backfill Material: Where ENGINEER deems backfill material to be unsuitable and rejects all or part thereof due to conditions prevailing at the time of construction, remove the unsuitable material and replace with select material stone backfill as specified in paragraph 2.02A or suitable foreign backfill material.

PART 3 - EXECUTION

3.1 MAINTENANCE AND PROTECTION OF TRAFFIC

A. Coordinate the work to ensure the least inconvenience to traffic and maintain traffic in one or more unobstructed lanes unless closing the street is authorized.

B. Maintain access to all streets and private drives.

C. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform to construction operations and to keep traffic flowing with minimum restrictions.

D. Comply with Laws and Regulations.

3.2 CLEARING AND GRUBBING

A. Clearing and grubbing shall be in accordance with WVDOH Section 201.

3.3 CUTTING PAVED SURFACES

A. Where excavation includes breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the centerline of the trench. Cut offsets at right angles to the centerline of the trench. For structure excavations cut pavement to a rectangular shape as opposed to circular shape of a manhole, if applicable. Saw cut concrete surfaces; saw cut other hard surfaces or make straight cuts with jackhammer. No paving shall be broken except that which has been previously cut.

B. Protect edges of cut pavement during excavation to prevent raveling or breaking; square edges prior to pavement replacement.
3.4 BLASTING

No blasting will be permitted without prior written approval of ENGINEER.

A. Use of Explosives

1. The use of explosives will be permitted for rock excavation only under conditions herein.

2. Notify ENGINEER 72-hours prior to starting blasting operations. Notify any public or private companies sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from damage.

3. When the use of explosives is necessary for the prosecution of the Work, use extraordinary care so as not to endanger life or property.

B. Rock Excavation Requirements

1. Rock excavation employing methods other than the use of explosives shall be submitted to ENGINEER for approval. A detailed description of the means, methods, equipment, and materials used, and methods for limiting ground motion and airblast shall be submitted to ENGINEER. Regardless of the methods for rock excavation, conform to the requirements for the use of explosives or blasting, as described herein.

2. Prior to drilling and blasting, CONTRACTOR shall meet the requirements of all submittals. Submittals of the Blasting Schedule, of the Blasting Plans, of all blasting operations, and of blasting products, and compliance by CONTRACTOR with provisions for protection of life and property shall not relieve CONTRACTOR of the responsibility or liability for the safety of persons and property.

CONTRACTOR is responsible for blasting in a safe manner, for producing smooth and sound rock surfaces at the lines of excavation; and for controlling damage and vibration. CONTRACTOR’s submittals to ENGINEER shall not constitute nor shall they be construed to be a guarantee by ENGINEER that the desired results will be achieved. Submittals to ENGINEER shall not relieve CONTRACTOR from the responsibility complying with the requirements of these specifications.

3. Where rock removal is necessary, engage the services of a Vibration Consultant, who shall be approved by ENGINEER, to advise on explosive charge weights per delay and to analyze results from seismographic recordings. Vibration Consultant representative shall be a licensed professional engineer or geologist with a minimum of 5 years of experience.
and have managed similar types of blasting activities for a minimum of 5 projects. Submit the credentials of the Vibration Consultant 30-days prior to any blasting activities for approval. Employ only personnel qualified by training and experience to perform vertical wall trenching by blasting in high-damage-potential areas, such as those close to above- and below-ground structures including pipelines and utilities. Individual blasts shall be kept to a practical minimum as determined by seismograph recordings analyzed by the Vibration Consultant. Maintain close supervision of blasting personnel. Ensure that blasting Laws and Regulations, explosive manufacturer’s instructions and Vibration Consultant’s requirements are complied with.

C. Blasting Plan

In each distinct individual blasting area where pertinent factors affecting blasting vibrations and their effects in the area remain the same, submit a blasting plan of the initial blasts to ENGINEER for approval. The plan shall consist of hole size, depth, spacing, burden, type of explosive, type of delays, delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden if any. Maximum hole diameter on any blast shall not exceed 2 ½-inches; no more than one hole can be fired on the same delay period; explosives with minimum propagating characteristics shall be used; and all blasts shall be initiated at the hole having the most relief.

Monitor existing vibrations in the area of blasting during normal business hours when blasting will be used for a minimum of 2-hours per day for 1-week prior to blasting to determine the existing noise within the area to be monitored.

The blasting plan shall contain complete details on the drilling blasting patterns and controls to be used, including the following information as a minimum:

1. Station limits at planned location of proposed shot
2. Plan and section views of proposed drill pattern, including blasthole spacing, blasthole diameters, blasthole angles, lift height, and subdrill depth
3. Loading diagram showing type and amount of explosives, primers, initiators, and location depth of stemming
4. Initiation sequence of blastholes, including delay times and delay system
5. Manufacturer’s data sheets for all explosives, primers, and initiators to be employed
6. Location of all blasting zones signs
7. Type of monitoring used to ensure no one enters the blasting area
8. Public alert and warning system
9. Proposed location of seismic instruments and sound level meters
10. Anticipated blasting schedule, indicating days of week and time of day
11. Planned use of blasting mats and other protective measures
12. Additional information, as needed and appropriate

D. Blasting Schedule

The Blasting Contractor shall develop a Blasting Schedule detailing the date, time and location or proposed blasts. The Blasting Schedule shall be published in a local newspaper and submitted to the Engineer for information and record purposes at least 10-days, but not more than 20-days, before the start of the blasting program.

Should a change occur to the schedule, it shall be re-published and re-distributed. The Blasting Contractor shall also provide a Blasting Schedule to any public utilities, private residence, or others possibly affected. Blasting operations shall be restricted to between the hours of 8:00 AM. and 5:00 PM., Monday through Friday. ENGINEER must approve any variation to this restriction in writing.

E. Pre-Construction Meeting

ENGINEER will review the required submittals for conformance with the Drawings and Specifications. Procedural approvals given by ENGINEER shall be subject to trial in the field and shall not relieve CONTRACTOR of responsibility to satisfactorily complete the Work in this Specification. Prior to construction, arrange a pre-construction meeting with ENGINEER to discuss rock excavation procedures for this Project.

F. Test Blasts

Design and conduct a test-blasting program with the objective of establishing the type and weight of charge, spacing and delays, etc., which will avoid overbreak of the excavation face and which are commensurate with the peak allowable particle velocity and sound level. Conduct a test-blasting program at the beginning of the operation, and when material of different characteristics is encountered. Become familiar with the stratigraphic sequence of rocks that will be exposed in each cut. Match the sonic velocity of rock with the velocity of detonation of the explosive used to create the desired rock fragmentation.

Upon completion of test blasting, expose the test area for ENGINEER to examine and evaluate the results and for the blasting Contractor to determine the spacing and
cartridge strength to be used for the full-scale blasting operation.

ENGINEER’s acceptance or approval of the test-blasting program and techniques and procedures associated with the test blasting program or production blasting will not relieve CONTRACTOR of his responsibilities to employ appropriate safety measures, and exercise proper supervision of the blasting operations. CONTRACTOR is solely responsible for damage or injury to persons, property, or utilities as a result of the use of explosives. Perform all necessary repairs in a satisfactory manner, to roadway, dwellings, utilities, or any property damage as a result of blasting at no cost to OWNER. For existing utilities, monitor particle velocities at the edge of the right-of-way nearest the blast.

After each test blast, review the particle velocities and sound levels documented and evaluate rock breakage. Make adjustments to the blasting procedures, and conduct subsequent test blasts until the desired rock breakage occurs within allowable values of peak particle velocity. Establish the relationship of the scale distance concept with respect to peak particle velocity to control ground vibration. If any test blast results in damage or injury to property, person or utility, immediately cease all blasting activity until written permission to resume is received from OWNER.

G. Prevention of ‘Flyrock’

All blasts shall be designed to prevent ‘flyrock’. Use adequate, good quality stemming materials. Wherever necessary, as determined by ENGINEER, the covering of blasts, with blasting mats or adequate dirt cover will be required. ENGINEER reserves the right at any time to reduce explosive amounts, change blasting patterns on any blasting, or eliminate blasting in certain areas should conditions warrant. Nothing presented herein in any way relieves CONTRACTOR of any responsibility of any damage to the existing pipelines or other structures or utilities in the area of blasting.

H. Seismograph, Blasting Records, and Pre-blast Surveys

Provide a minimum of one seismograph to measure and record ground motion caused by each subsequent blast detonated under the Contract. The seismograph shall be attached or located immediately adjacent to the nearest structure or dwelling, or on top of the nearest pipeline, as approved by ENGINEER. The seismograph equipment shall be an Instantel Blastmate DS 677, or equivalent, capable of producing a permanent record of the three components of the ground motion in terms of particle velocity and the air blast in decibels. The instrument shall be capable of internal dynamic calibration. The record of each blast shall consist of the seismograph records identified by instrument number, location of the instrument positively identified, date, time and location of the blast, amount of explosive used, maximum explosive charge weight per delay period and all other data necessary to control the blasting operations. These records, as a formal report, shall be made available to ENGINEER as required. Preliminary records of blasting and vibrations shall be submitted within 24-hours of blasting. Provide pre-blasting surveys as
required by Laws and Regulations at no additional cost to OWNER.

I. Rock Excavation Vibration Limits

All blasting operations shall be monitored in accordance with the Office of Surface Mining (OSM) Method 3. Modification of the blasting method and reduction of the explosive weight per delay shall be used to ensure that vibration limits are met. Though there might be buildings, pipelines or other structures closer to the blast than the monitoring location (for example, a dwelling foundation), CONTRACTOR will not be relieved of responsibility for any damage sustained to the buildings, pipelines or structures.

J. Crossing under Existing Pipelines

If rock removal is required when crossing under existing pipelines, a rigid steel or wood beam shall be provided to support the pipeline and the bearing points of this beam should be outside the 45-degree influence line from the nearest point of the blast. A wood buffer shall be placed below the existing pipeline (in addition to conventional blasting mats) in order to prevent damage to the pipeline by flyrock.

K. Blasting Adjacent to Utilities

Blasting shall not be performed closer than 10-feet to existing water, gas, sewer or conduit utilities unless such facilities have been completely exposed, definitely located, and then backfilled prior to the blast. In any case, blasting shall be no closer than 2-feet from accurately located existing utilities, 10-inch or smaller diameter and no closer than 5-feet from utilities larger than 10-inch diameter.

L. Pre- and Post-Construction Surveys

1. Prior to starting and subsequent to completing any work, retain the services of a qualified Professional Engineer licensed in the state of West Virginia to make a detailed inspection of all buildings, structures, roadways, landscaping and related surface improvements within 150-feet of all blasting.

2. The inspection shall include notes, measurements, photographs, and a DVD (with audio sound track) of all facilities prior to the start of construction. The audio description of the inspection shall include the date, time, weather conditions, address/stationing/location, brief description of the facility and description of physical conditions encountered. The inspection shall also include documentation of existing damage and other factors (both inside and outside) which could be affected by blasting.

3. With the owner’s permission, install crack monitors such as Avongard or approved equal in areas of existing cracks in structures as directed by the ENGINEER. Upon installation of crack monitors, obtain three baseline
readings. Monitor crack monitors installed for a minimum of 1 week prior to all blasting operations and daily during blasting operations.

4. CONTRACTOR shall notify and obtain written permission from the property owner(s) to enter upon said properties for the purpose of making these survey inspections. In the event that access for the purpose of determining the condition of the property is refused by the owner, CONTRACTOR shall notify ENGINEER in writing and may be relieved of the responsibility for making said survey inspections with respect to the property to which access is denied. A copy of all notes, measurements, photographs, DVD, reports and data relative to existing conditions of each respective property as found by the pre-construction survey, shall be forwarded to each property owner. Two identical copies shall be submitted to ENGINEER.

5. The maximum allowable noise level at any inhabited building shall not exceed 110-decibels peak when measured by an approved instrument having a flat frequency response over the range of 6 to 200-Hertz. The maximum allowable noise limit at any uninhabited building shall not exceed 120-decibels. When blasting is of a continuous nature, 124 to 130-decibels shall be within the caution range. When the noise levels are consistently within the caution range, rock removal procedures shall be changed to reduce the decibel level on the next rock removal procedure.

M. Safety

CONTRACTOR shall provide an approved system of warning and preparing the general public and all site personnel of an impending blast by both audible and visual means and shall ensure that the blasting area is cleared of all personnel immediately prior to blasting. This system shall comply with Laws and Regulations. Devise adequate system for warning and clearing the public from specified areas during blasting operations and for preventing persons entering the blasting area.

Automotive and pedestrian traffic within at least 150-feet shall be stopped just prior to firing. This operation shall be carried out in close cooperation with the Police Department and in such a way as to cause minimum traffic delay. Traffic warning and signage shall be in accordance with MUTCD requirements. Operations involving explosives shall be suspended on the approach of a thunderstorm and shall not be resumed until the storm has clearly passed.

Erect blasting screens to conform with the permit conditions. Public roads, private roads and property adjacent to the site and services within the site area shall be protected by rock-fall fences. In all such cases particular attention should be paid to the requirements stated above, and the effects on these structures and installations shall be closely monitored and the quantities of explosives limited accordingly.

Drilling rigs for shot holes shall be of the hydraulic type fitted with efficient silencers
and with means of dust suppression.

N. Slurry Explosives

The pump truck from which any explosives are dispensed into the drilled holes shall be equipped with an accurate flow meter or similar measuring/recording device in order to accuracy monitor and control the volume of explosives dispensed at each position.

Milli-second delay detonators shall be used in all blasting locations. The use of long second delay detonators shall be limited. Sequential timers may be used only on the direction of the Blasting Engineer and with the approval of ENGINEER and then only by persons suitably qualified and under the control of the Contractor’s Engineer.

After a charge has been wired and tested, gunny sacks shall be placed over the charged holes. Blasting mats shall then be placed on top of the charge and sand bags placed on the blasting mats.

O. Scaling and Stabilization

Rock on the cut face that is loose, hanging, or creates a potentially dangerous situation during or upon completion of the excavation in each lift shall be removed or stabilized. No drilling for the next lift shall be carried out until this work is completed.

Slopes throughout the span of the contract shall be scaled at such frequency as required to remove all hazardous loose rock or overhangs. Stabilization shall be performed at CONTRACTOR’s expense if caused by CONTRACTOR’s blasting operations.

3.5 TRENCH EXCAVATION

A. Trench excavation for force-mains shall be in accordance with CTUB Standard Detail No. S-2, and WVDOH 670.3 and 670.4.1.

B. Trench excavation for gravity sewers shall be in accordance with CTUB Standard Detail No. S-1, and WVDOH 675.3 and 675.4.

3.6 STRUCTURE EXCAVATION

Structure excavation shall be in accordance with CTUB Sewer System Specification 8.2 and to a nearly vertical plane beginning at the bottom of excavation one-foot beyond structure base outside diameter (six inches each side) to two-feet beyond structure base outside diameter dimension for top of excavation limit (one-foot each side).
3.7 SUPPORT OF EXCAVATION

A. Support excavations with sheeting, shoring and bracing or a “trench box” as required to comply with Laws and Regulations. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through negligence or fault of CONTRACTOR in any other manner shall be repaired at CONTRACTOR’s expense.

B. Withdraw shoring, bracing, and sheeting as backfilling proceeds unless otherwise directed by ENGINEER.

3.8 INSTALLING CASING PIPES

A. Where open-cut installation of casing pipes is indicated on the Drawings, construction methods shall be in accordance with WVDOH 670.4.

B. Where boring and jacking of casing pipes is indicated on the Drawings, construction methods shall be in general accordance with WVDOH 604.11, except (1) conduit to be jacked shall be steel casing pipe per Section 02535 and (2) variation from grade shown on the Drawings shall not exceed 0.5 feet vertically regardless of casing length placed. Variation from horizontal alignment shown on the Drawings shall not exceed 0.2 feet for each 20 feet of casing placed, per WVDOH 604.11.

3.9 PIPE BEDDING REQUIREMENTS

Pipe bedding shall be in accordance with CTUB Standard Detail Nos. S-1 and S-2, and WVDOH 675.5. Where these requirements conflict, Detail Nos. S-1 and S-2 shall govern.

3.10 PIPE LAYING

A. Give ample notice to ENGINEER in advance of pipe laying operations.

B. Pipe laying for force-mains shall be in accordance with WVDOH 670.4.2, and for gravity sewer shall be in accordance with WVDOH 675.6. Additionally, pipe laying shall be in accordance with CTUB Sewer System Specification 8.1.A and 8.1.B.

3.11 THRUST RESTRAINT

Provide pressure pipeline and restrained joints or concrete thrust blocking at all bends, tees, and changes in direction; construction concrete thrust blocking in accordance with Standard Details. If restrained joints are utilized, submit design calculations showing determination of restrained lengths and submit joint restraint details. Method of joint restraint shall utilize devices specifically designed for the application for which manufacturer’s data is available for the application. Submit manufacturer’s literature for approval.
3.12 CRADLES AND ENCASEMENT

Provide concrete cradle and encasement for pipeline in accordance with CTUB Sewer System Specification 8.2.E or when directed by ENGINEER.

3.13 BACKFILLING TRENCHES

A. Backfill pipeline trenches only after examination of pipe laying by ENGINEER.

B. Backfilling and compacting for force-mains and gravity sewers shall be in accordance with CTUB Standard Detail Nos. S-1 through S-3, WVDOH 670.4.5, Project Details S-3A and S-3B, and CTUB Sewer System Specification 8.1.A.

C. Install detectable utility marking tape above all plastic pipeline, 12” to 18” below final grade.

3.13 BACKFILLING STRUCTURES

A. Backfill structures after testing and examination by ENGINEER.

B. Backfilling and compacting shall be in accordance with CTUB Sewer System Specification 8.2.

END OF SECTION
SECTION 02535

PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this section includes, but is not limited to

1. Force Main Piping
2. Gravity Sewer Piping
3. Casing Pipe
4. Culvert Pipe
5. Pipe Accessories
6. Manholes

1.2 QUALITY ASSURANCE

A. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels, aromatic compounds, paint solvent, paint thinner, or acid solder will be rejected.

1.3 SUBMITTALS

A. Shop Drawings and Product Data: Submit Shop Drawings and manufacturer's catalog information for pipe materials, including but not limited to:

1. Piping layout
2. Pipe hangers, supports, guides and anchors
3. Pipe wall sleeves and seals
4. Pipe coupling adapters
5. Pipe spacers and retainers for casing installation
6. Manholes (in accordance with CTUB Sewer System Specification 8.2.A)
B. Restrained Joints

1. Where restrained joints are utilized in lieu of thrust blocking, submit restrained joint calculations in conformance with DIPRA Standards establishing lengths of restrained joint piping required.

2. Submit restrained joint details and materials being utilized.

C. Manufacturer’s Instructions: Submit manufacturer’s instructions for installation of adapters and assembly of mechanical and push-on joints, including the manufacturer’s maximum recommended deflection per joint.

D. Certificates: Submit certification from each product manufacturer attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting, unloading, and storage on site, exercise care to prevent damage to piping materials.

B. Do not drop pipe or fittings.

C. Store materials on site in enclosures or under protective coverings.

D. Assure that materials are kept clean and dry; do not store materials directly on the ground.

E. Deliver, store and handle manholes in accordance with CTUB Sewer System Specification 8.2.B.

PART 2 – PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) FORCE-MAIN PIPE

A. PVC force-main pipe shall conform to AWWA C900, rated 165 psi (DR 25); with C.I. outside diameter.

B. Pipe Compound: ASTM D1784, Cell Class 12454

C. Elastomeric Seals (Gaskets): ASTM F477

D. Push-on Joints Using Flexible Elastomeric Seals: ASTM D3139
2.2 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

A. PVC gravity sewer pipe shall be in accordance with CTUB Sewer System Specification 7.2.B.

2.3 DUCTILE IRON PIPE

A. Ductile iron force-main pipe and mechanical-joint fittings for buried service shall be in accordance with CTUB Sewer System Specification 7.1.B and 7.1.C. Cement lining for mechanical-joint fittings shall be in accordance with AWWA C104.

B. Ductile iron force-main pipe and fittings in vaults and wet wells shall be flanged in accordance with CTUB Water System Specification 7.1.B and 7.2.F.

2.4 STEEL CASING PIPE

A. Pipe

1. Steel casing pipes under railroads shall be in accordance with ASTM A252 Grade 2, with 35,000-psi minimum yield strength.

2. Steel casing pipes under WVDOT/DOH roads, private roads and driveways shall be in accordance with WVDOT/DOH 718.12.

2.5 BLACK AND GALVANIZED STEEL PIPE (GENERAL USE)


B. Fittings

1. Threaded: Malleable Iron, ANSI B16.3, 150# Class

2. Flanged: Cast Iron, ANSI B16.1, 125# Class


C. Flanges: AWWA C207.

D. Unions: Threaded, Forged Carbon Steel, MSS SP-83.
2.6 METAL CULVERT PIPE

A. Metal culvert pipe shall be bituminous coated corrugated steel pipe conforming to the requirements of AASHTO M 190 as identified in WVDOT/DOH 713.3. Coupling bands shall also conform to the requirements of AASHTO M 190.

2.7 PIPE ACCESSORIES

A. Wall Sleeves and Wall Pipes
   1. Cast Iron: ASTM A48, Class 30B
   2. Ductile Iron: ASTM A536, Grade 60-40-18
   3. Mechanical Joint, ANSI/AWWA C111/A21.11
   4. Integral cast intermediate wall collar

B. Wall Seals
   1. All structure pipe openings shall conform to CTUB Sewer System Specification 7.2.D.7.a.6) and 8.2.F (caulk sealing).
   2. Alternatively, wall seals located in penetrations through new walls that are below grade can be installed in a cast iron wall sleeve that conforms to the requirements of this specification section or installed in a steel wall sleeve. This steel wall sleeve shall consist of a piece of standard weight steel pipe with an integral steel anchoring collar. This anchoring collar shall be 1/4" thick, shall project 3" beyond the pipe outer wall and shall be welded to the pipe around its entire periphery. No sleeves are required if hole is core drilled through a new or existing concrete wall. The annular space shall be sealed using one of the options in CTUB Sewer System Specifications 7.2.D.7.a.6) and 8.2.F (caulk sealing).

C. Flange Adapters
   1. For connecting plain-end pipe to flanged valves, fittings and pumps, constructed of ductile iron with 125 lb. flange drilling; anchor to plain-end pipe by means of setscrews conforming to ANSI B16.1. Provide with Buna-N gasket. Temperature range -20oF to 150oF; working pressure as follows:
      a. 2" to 12"  175 psi
      b. 14" to 24"  150 psi
   2. Setscrews shall prevent pullout up to working pressure specified plus 100 psi surge pressure.
D. Flange Coupling Adapters

1. For joining plain-end pipe to flanged valves, fittings and pumps.


E. Coupling Adapters

1. Factory pre-assembled couplings for plain-end pipe.

2. Double-ring, steel followers, rubber compounded wedge-gasketed, steel flared middle ring type mechanical joint, ANSI/AWWA C111/A21.11.

F. Transition Couplings

1. To connect pipes of different outside diameters.

2. High-grade steel middle ring with ductile iron follower flanges with rubber compounded wedge section gaskets. Mechanical Joint, ANSI/AWWA C111/A21.11.

2.8 UNDERGROUND UTILITY WARNING TAPE

A. Underground warning tape for force-mains and gravity sewers shall be detectable type in accordance with CTUB Sewer System Specification 7.2.C.

2.9 MANHOLES

A. Unless otherwise detailed on the Drawings, manholes and accessories for gravity sewer shall be in accordance with CTUB Sewer System Specification 7.2.D.

PART 3 - EXECUTION

3.1 TRENCHING, BACKFILLING AND COMPACTING

A. Trenching, backfilling and compacting shall be as specified in Section 02315.

3.2 BORING AND JACKING

A. Boring and jacking shall be as specified in Section 02315.
3.3 PIPING INSTALLATION IN WET WELLS AND VAULTS

A. Pipe Layout
   1. Coordinate work to prevent interference between structural, electrical and mechanical features; the Drawings are generally diagrammatic due to their small scale.
   2. Provide such offsets, fittings and other items as may be required to suit conditions.
   3. The completed installation shall present a neat, orderly appearance; do not block openings or passageways; run piping parallel to the walls of structures.
   4. Provide clearance between piping, walls, floors, and equipment to prevent the transmission of noise and vibration.
   5. Orient handwheels, levers, valve operators and other valve actuators for convenience of operation.
   6. Cut pipe to measurements established at the site and install without springing or forcing; make changes in direction with fittings.
   7. Connect ferrous piping to non-ferrous piping with dielectric couplings.

B. Equipment Connections
   1. Make connections to pumps and other equipment in a manner to eliminate strains on piping and equipment.
   2. Install unions or flanges adjacent to equipment and wherever their use will facilitate removal of equipment.

C. Wall Sleeves and Wall Pipes
   1. Provide pipes passing through concrete construction with wall sleeves or wall pipes having an integral cast or welded intermediate wall collar, as indicated on the Drawings.
   2. Set wall sleeves and wall pipes of the required size during construction of the wall, foundation or slab.

D. Wall Seals
   Provide watertight wall seals between pipe and wall sleeve where pipes penetrate walls, foundations or slabs.
E. Flanged Joints
   1. Tighten flange bolts so that the gasket is uniformly compressed and sealed; do not distort flanges; do not exceed manufacturer’s recommended maximum torque.
   2. Leave flange bolts with ends projected 1/8" to 1/4" beyond the face of the nut after tightening.

F. Flange Adapters and Flange Coupling Adapters
   1. Flange Adapters: Tighten flange adapter setscrew with torque wrench to manufacturer’s recommended tightening torque.
   2. Flange Coupling Adapters: Drill hole in plain-end of process pipe at each anchor stud location. Tighten anchor stud fully so that anchor stud protrudes into drilled hole, thereby preventing lateral movement of the pipe.

G. Threaded Joints: ANSI B2.1, NPT
   Cut threads full and clean with sharp dies; ream ends of pipe after threading and before assembly to remove burrs; leave not more than three pipe threads exposed at each connection; use joint compound or thread tape on the male thread only.

H. Solder Joints
   1. Ream or file pipe to remove burrs; clean and polish contact surfaces of joints.
   2. Apply flux to both male and female end; insert end of tube into fittings full depth of socket.
   3. Bring joint to soldering temperature, in as short a time as possible, forming continuous solder bead around entire circumference of joint.

3.4 PIPE SUPPORTS

A. Support piping from structural construction using pipe hangers, pipe riser clamps and pipe clamp hangers in conjunction with beam clamps, brackets or other equipment as dictated by structure construction.

B. Trapeze hangers approved by ENGINEER may be used where several horizontal pipes run closely parallel; secure pipes on trapeze hangers to prevent sideway motion.

C. Install supports for piping 2-1/2" and greater in diameter in accordance with details indicated on the Drawings; support piping under 2-1/2" diameter as specified herein.
D. Vertical Piping

1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and its contents.

2. Support vertical iron and steel pipe on maximum 5’-0” centers with steel pipe riser clamps.

E. Horizontal Piping

1. Support at sufficiently close intervals to prevent sagging, thrust restraint, and vibration.

2. Install hangers or supports at ends of runs or branches and at each change of direction or alignment.

3. Install steel clevis-type pipe hangers for horizontal iron and steel pipe on maximum 10’-0” centers.

F. Pipe Bracing: CONTRACTOR is responsible for properly bracing piping against lateral movement or sway. ENGINEER shall review with CONTRACTOR and approve method of bracing of piping at each location prior to CONTRACTOR proceeding with the installation of the bracing. Bracing shall be installed at all locations where sway is anticipated and as directed by ENGINEER.

3.5 MANHOLE INSTALLATION

A. Manhole installation shall be in accordance with CTUB Sewer System Specifications 8.2.C through 8.2.F.

3.6 TESTING

A. Force-main, header and discharge piping shall be pressure/leak-tested in accordance with CTUB Water System Specification 8.17. Disinfection shall not be required. Working and test pressures are as follows:

1. Northport Pump Station = 45 psi, Test Pressure = 100 psi
2. War Admiral Pump Station = 95 psi, Test Pressure = 143 psi

B. Force-main vaults shall be vacuum-tested in accordance with CTUB Sewer System Specification 8.2.G.

C. Gravity sewer piping shall be deflection-tested and leak-tested in accordance with CTUB Sewer System Specification 8.1.C. CONTRACTOR shall rectify defects found by OWNER during the warranty period, per CTUB Sewer System Specification 8.1.A.5.
D. Gravity sewer manholes shall be vacuum-tested in accordance with CTUB Sewer System Specification 8.2.G.

END OF SECTION
SECTION 11101

GENERAL PROCESS MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The provisions of this entire section are intended to govern the quality of design, fabrication, workmanship, operation, etc., of all materials, equipment and appurtenances to be furnished and installed under the various sections of the process mechanical specifications and all other sections that include process mechanical equipment as part of the specified items.

1.2 SUBMITTALS

A. Shop Drawings and Product Data

1. Submit shop drawings, including dimensioned drawings, descriptive literature, performance data, electrical characteristics, and in general all information necessary to provide compliance with the specifications.

B. Maintenance Data and Operating Instructions

1. Submit an Operation and Maintenance Manual for the equipment furnished including a detailed description of the function of each principal component, procedures for operation, instructions for overhaul and maintenance. Include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

1.3 GUARANTEE

All materials, equipment, workmanship and performance shall be guaranteed for the minimum period of one year from final acceptance.

1.4 STANDARDS

Where standards, codes or specifications are referred to, the reference is to particular standards, codes or specifications together with all the latest amendments and errata applicable at the time the bids are taken. These are listed below:

I.E.E.E. Institute of Electrical & Electronics Engineers
A.S.T.M. American Society for Testing Materials
A.S.M.E. American Society of Mechanical Engineers
1.5 GENERAL DESIGN OF EQUIPMENT AND MACHINERY

A. Equipment and machinery furnished shall be of the latest and most improved design suitable for the service of which it is to be used. Equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of labor, power, maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum noise, wear and vibration (maximum amplitude of 3.0 mils unless otherwise specified) when properly installed.

B. Ample room for erecting, repairs, inspecting and adjusting equipment and machinery shall be provided. The design, construction and installation of equipment and machinery shall conform to and comply with the latest Laws and Regulations.

C. The design and construction of the several units shall be such that they shall present a uniform appearance and the arrangement shall be such that their operation shall be in harmony in every respect. Whenever possible, fittings and fixtures of the same make and model shall be used for the several units and their connections. Equipment of identical type and service shall be the product of the same manufacturer.

D. Equipment selected shall be of such size and general arrangement to suit the space in which it is to be installed.
E. The various parts of the equipment and machinery shall be of plain shape and good lines, especially designed and constructed for strength and durability. Casting shall be designed and constructed to cool uniformly without shrinking strains and shall have good-sized fillets at re-entrant corners. Sudden change of section shall be avoided.

F. Whenever possible, parts of each unit shall be made to gauge and be a duplicate of and interchangeable with the same parts of other machines of the same size and kind.

G. The workmanship shall be of the highest class throughout.

H. All assemblies shall be completely shop fabricated and structural steel parts shall be shop erected. Assemblies and structural steel parts shall be match-marked before being disassembled for shipment. Parts shall be shipped assembled in as large unit as possible to minimize field reassembly. All parts shall be amply proportioned for all stresses which may occur during operation, and for any additional stresses which may occur during fabrication and erection.

I. Unless otherwise specified, welding shall be in accordance with the latest standard specifications for “Gas Tight Welding” of the American Welding Society.

J. Unless otherwise specified, galvanizing shall be hot-dipped in accordance with the latest standard specifications for “Zinc Coating” of the ASTM, Serial Designation A-123.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified, materials shall be in accordance with the following latest Standard Specifications of the ASTM:

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Steel</td>
<td>A-36</td>
</tr>
<tr>
<td>Welding Steel Pipe</td>
<td>A-53</td>
</tr>
<tr>
<td>Iron Castings</td>
<td>A-48</td>
</tr>
<tr>
<td>Babbitt</td>
<td>B-23</td>
</tr>
<tr>
<td>Bronze Castings</td>
<td>B-30</td>
</tr>
<tr>
<td>Bronze (Manganese)</td>
<td>B-138</td>
</tr>
<tr>
<td>Bronze (Silicone)</td>
<td>B-98</td>
</tr>
<tr>
<td>Steel Bolts</td>
<td>A-307</td>
</tr>
<tr>
<td>Hot Dip Zinc Coating</td>
<td>A-123</td>
</tr>
<tr>
<td>Stainless Steel Bolts</td>
<td>A-193, Grade B, Type 2</td>
</tr>
</tbody>
</table>
B. Materials shall, if required, be tested and shall fulfill all requirements specified. Physical tests may be made by OWNER or OWNER’s representative. CONTRACTOR at his own expense shall furnish test pieces and samples in the number, shape, size and finish required by the ENGINEER. Broken material shall become the property of OWNER. The failure of test specimens to fully conform to the requirements of the specifications shall be sufficient cause for rejection of the whole melt or stock from which samples were obtained.

C. Iron castings shall be smooth, clean and free from scale, lumps, blisters and other defects. No plugging, welding or filling will be allowed.

D. The alloy grade number of all Babbitt shall be that bearing alloy of a composition recommended by the manufacturer of the equipment or machinery for the service required, subject to the approval of ENGINEER.

E. Bronze shall be made of new material and shall be free from objectionable imperfections. If the materials show signs of improper mixing when being machined, the castings will be rejected.

2.2 JOURNALS, BEARINGS AND KEYS

A. Journals and bearing surfaces shall be of sufficient size and properly proportioned for the least wear and to avoid heating under all conditions, and where necessary, provisions shall be made for each removal and for proper adjustments. Journals shall be suitable boxes which, where necessary, shall be lined with Babbitt metal hammered into grooves and bored in place. If bearings are of the ball bearing type, both inner and outer races as well as the balls shall be heat treated steel to resist wear. The balls shall be of ample size to carry the maximum loads with a large factor of safety to prevent flaking, spalling, or crushing. The balls shall be properly spaced and held in position by rugged continuous spacing or retainer rings.

B. Pins and keys shall be properly proportioned. Keys, nuts and all other parts which might otherwise work loose shall be secured with approved locking devices.

2.3 LUBRICATION

A. Bearings, except those specifically requiring oil or water lubrication, shall be pressure grease lubricated. Lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the “Alemite” type as made by the Stewart Warner Corporation, or equal. The pattern of the fitting shall be selected for accessibility in lubricating and shall meet the approval of ENGINEER. Housings of grease lubricated bearings shall be automatically exhausted to atmosphere to prevent excessive greasing. CONTRACTOR shall furnish three Alemite Hydraulic guns, or equal.

B. CONTRACTOR shall furnish lubrication charts or schedules for each piece of
equipment or machinery. The charts or schedules shall designate each point of lubrication, the type of lubricant to be applied and the frequency of lubrication. Charts and schedules shall be submitted to ENGINEER in quadruplicate, bound in folios, with each chart or schedule protected by a transparent plastic envelope.

C. CONTRACTOR shall furnish one (1) year supply of each type of lubricant. A typewritten list shall be furnished with the lubricants, designating the specific lubricant to be used for each piece of equipment. This is in addition to the required operating and maintenance manuals which will also contain lubrication requirements.

2.4 MOTORS AND CONTROLS - GENERAL

A. Motors and controls shall conform to the latest requirements of IEEE and NEMA, and where applicable, shall be UL-listed. Minimum sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. CONTRACTOR is advised to consult all Specification sections to determine responsibility for motors and controls.

B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.

C. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplate.

2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of CONTRACTOR to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overload, without exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR2 of the driven equipment to operating speed.

3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.

4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than 1/2 horsepower shall be single phase, and motors 1/2 horsepower and larger shall be 3-phase.
5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.

D. Single phase motors smaller than 1/20 horsepower shall be ball or sleeve bearing, drip-proof, totally enclosed or explosion proof, as specified, 115 volts, permanent split capacitor or shaded pole type. These motors shall not be used for general power purposes and shall only be provided as built-in components of such mechanical equipment as fans, unit heaters, humidifiers and damper controllers.

E. Single phase motors 1/20 horsepower and larger shall be ball bearing, drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115, 115/230, 200 or 230 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type.

F. Except as otherwise specified in the various Specification sections, 3-phase motors shall meet the requirements of this paragraph. Motors shall be NEMA design B squirrel cage induction type. Insulation shall be Class F and motor shall be rated at no greater than 50 degrees C rise for open motors and 65 degrees C rise for closed motors both above an ambient temperature of 45 degrees C. At 40 degrees C ambient temperature explosion proof and totally enclosed motors shall have a 1.00 service factor and drip-proof motors shall have a service factor of 1.15 or higher. Motors specified for operation at 480 volts shall be name-plated 460 volts.

G. Minimum three phase motor efficiencies at full load for motors having nominal rated speeds of 1200 RPM and higher shall be as follows:

<table>
<thead>
<tr>
<th>Horsepower</th>
<th>Minimum Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80.0</td>
</tr>
<tr>
<td>1-1/2</td>
<td>81.5</td>
</tr>
<tr>
<td>2</td>
<td>82.5</td>
</tr>
<tr>
<td>3</td>
<td>84.0</td>
</tr>
<tr>
<td>4</td>
<td>85.5</td>
</tr>
<tr>
<td>5</td>
<td>87.5</td>
</tr>
<tr>
<td>7-1/2</td>
<td>87.5</td>
</tr>
<tr>
<td>10</td>
<td>87.5</td>
</tr>
<tr>
<td>15</td>
<td>88.5</td>
</tr>
<tr>
<td>20</td>
<td>90.2</td>
</tr>
<tr>
<td>25</td>
<td>91.0</td>
</tr>
<tr>
<td>30</td>
<td>91.0</td>
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<tr>
<td>40</td>
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<td>50</td>
<td>92.4</td>
</tr>
<tr>
<td>60</td>
<td>93.0</td>
</tr>
<tr>
<td>75</td>
<td>93.0</td>
</tr>
<tr>
<td>100</td>
<td>93.6</td>
</tr>
<tr>
<td>125</td>
<td>93.6</td>
</tr>
</tbody>
</table>
Three phase motors shall be E-plus Energy Efficient Standard Duty Motor of the Electric Motor Division of Goulds, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corporation, the equivalent product of Baldor Company, or equal.

I. Motors seventy-five (75) horsepower and larger shall be as specified with the driven equipment in these Specifications.

2.5 FLANGES AND BOLTS

A. Flanges, except as otherwise specified, shall be cast solid, and bolt holes shall be drilled and spot-faced on the back. Stud holes shall not be drilled through. Flanges shall be uniform in thickness and shall come fair and, if required, shall be turned or chipped in a neat and workmanlike manner.

B. Jacking screws shall be provided for covers, etc. where required, and also suitable eye bolts for lifting. Bolts and nuts shall be of the best quality of open hearth, free machining steel. Bolts shall have good, sound, well-fitting threads; nuts shall be cold pressed. Heads, nuts and threads shall be of the American Standard regular sizes. Ferrous bolts and nuts shall be galvanized by the hot dipped process.

C. Bolts and nuts connecting pumps, valves and meters (as in flange connections) shall be Stainless Steel - Grade 416.

PART 3 - EXECUTION

3.1 MANNER OF INSTALLATION

A. The general arrangement of pipe and equipment shall be as shown on the Drawings. Detailed drawings of proposed departures due to actual field conditions or other causes shall be submitted to ENGINEER for approval. CONTRACTOR shall carefully examine the Drawings and shall be responsible for the proper fitting of materials and equipment as indicated, without substantial alteration. Because of the small scale of the Drawings, it is not possible to indicate the exact location of piping, all offsets, fittings and accessories which may be required. CONTRACTOR shall carefully investigate the space requirements for proper clearances and the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such offsets, fittings, valves and accessories as may be required to meet such conditions.

B. Each trade shall determine the location, size, etc. of all chases and openings required for the proper installation of its work, and shall see that such are provided. Where it is necessary to run pipes or ductwork through walls or fittings, the trade performing the
work shall notify CONTRACTOR so that proper provisions can be made for same. Each trade shall furnish and set all inserts, sleeves, hanger supports, etc. required for its work and shall be responsible for their proper and permanent location.

C. Piping and ductwork exposed to view shall be run generally parallel with the lines of the building and as close to walls and columns as may be practical and consistent with proper grade and the maintenance of proper clearances for access to all parts requiring servicing.

D. CONTRACTOR shall do no cutting of woodwork, masonry, concrete or other materials after same have been installed, without the written permission of ENGINEER. No waterproofing shall be cut for any purpose except on written approval of ENGINEER.

3.2 TESTING

A. After erection, CONTRACTOR shall adjust and balance all equipment and systems, and shall demonstrate that all equipment is operating in a satisfactory manner. All rotating equipment shall be lubricated according to recommendations of the manufacturer and all adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly, without vibration, overheating, or sign of distress at full specified capacity. Adjustments shall be made as necessary. Defective parts shall be replaced.

B. ENGINEER shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction.

3.3 MISCELLANEOUS

A. Finished parts shall be well protected in the shop, during transportation and before and after erection to prevent injury of any kind. Injured parts which in the opinion of ENGINEER are damaged or which cannot be refitted, shall be promptly replaced by CONTRACTOR without expense to OWNER. Exposed finished parts of machinery shall be greased or oiled before shipment.

B. CONTRACTOR shall furnish tools of special nature which are required for making adjustments (by OWNER after the Work has been turned over to him) to equipment, but will not be required to furnish standard tools.

C. Exposed belts, gears, and drives shall be protected with guards. Guards may be of the equipment manufacturer’s standard design, but must meet OSHA Standards.

3.4 PAINTING AND LABELING

A. Fabricated or assembled surfaces normally painted shall be thoroughly dry and free from all rust, grease, dirt or scale. CONTRACTOR shall correlate the selection of shop prime coats to be compatible with subsequent field applied coats of paint. CONTRACTOR shall touch-up paint any item damaged during shipping or installation.
B. Each piece of equipment (including mechanical operators, and electrical switches for the equipment) shall be identified by hand painted or stenciled two-inch letters and numbers, to indicate the service or function. Unless specified otherwise in the mechanical and electrical sections of the Specifications, each motor and motor controller shall be similarly numbered (or lettered) to correspond to the number (or letter) of the driven unit.

3.5 ADJUSTMENTS TO RELATED WORK

The final Work shall include any adjustment that may be required by the approved equipment furnished, with modifications made to concrete shapes and to dimensions shown on the Drawings as may be required to suit the details of the approved equipment furnished, all at no additional cost to OWNER.

END OF SECTION
SECTION 11320
SUBMERSIBLE PUMPS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Furnish all labor, equipment and materials necessary to install, test and place in operation submersible pumping units as shown in the Drawings and as specified herein.

B. Intended Purpose: The purpose of the pumps is to convey raw, unscreened, untreated wastewater under the conditions and installation described in the Specifications and shown in the Drawings.

1.2 SUBMITTALS

A. Submit complete characteristic curves of pumps prior to fabrication with completely assembled pump weight for each pump model to be provided.

B. Submit the following pump electric motor data:

1. Horsepower Rating
2. Voltage
3. Number of Phases
4. Service Factor
5. RPM @ Full Load
6. Locked-Rotor kVA Code (letter)
7. LRA (Locked Rotor Amps)
8. Design Letter (A, B, C, or D)
9. FLA (Full Load Amps) Efficiency (%)
10. Power Factor

C. Prior to pump delivery submit for approval certified copies of factory-run pump performance tests. Characteristics of pumps may have a tolerance of plus 10 percent of rated capacity at rated head or plus 5 percent of rated head at rated capacity. No minus tolerance will be acceptable. Give ENGINEER seven days advance notice of
D. Submit the following pump information:

1. Dimension drawings suitable for installation purposes, showing in particular distance from centerline of the pump to the face of the suction and discharge flanges, location and size of pump base anchor bolts, motor dimensions and the location and number of motor lifting lugs.

2. Complete material specifications for the pump.

3. Complete material specifications and drawings for the pump rail system.

4. Complete “Manufacturer’s Equipment Warranty & Certification” form included at the back of this section.

1.3 QUALITY ASSURANCE

A. Design and construct the pumps in accordance with standards of the Hydraulic Institute. The efficiency of the pumps, when operating under conditions of the specified capacities and heads, shall be as near peak efficiency as practicable.

B. Obtain pumping equipment, motors, pump controls and appurtenances from the pump supplier whose responsibility is to ensure that the pumping equipment is properly coordinated and operated in accordance with the Specifications.

PART 2 – PRODUCTS

2.1 NON-CLOG WASTEWATER PUMPS

A. GENERAL – Furnish and install a complete non-clog sewage pumping system at each pump station listed in Table 1 below, consisting of: three (3) submersible non-clog sewage pumps and lift-out rail systems, valves, controls, access covers, and all other appurtenances to make a complete system.

B. PUMP MODEL - Each pumping unit, including motor and guide rails, shall be under the unified responsibility of the furnished-by pump manufacturer. The pumps shall be Yeomans or approved equal. Approved equal pump manufacturer shall be Flygt. Pump shall be solid-state start. Openings in pump shall be large enough to pass a 3”
diameter sphere.

C. OPERATING CONDITIONS – Refer to Table 1.

D. PUMP UNITS - The submersible pumping units shall be self-contained, integral pump/motor units designed to operate at continuous full load in a partially or completely submerged condition without the need for any external cooling devices such as water jackets. The air-filled motor shall be cooled by an adequately sized motor frame which shall conform to the latest applicable requirements of NEMA, IEEE, ANSI and NEC standards and shall meet the latest design standards of a Totally Enclosed Non-Ventilated NEMA frame motor. Heat transfer shall be accomplished by convection through the stator-housing wall to the surrounding media. Designs which incorporate cooling jackets and in particular, designs which rely on circulation of the pumped sewage or externally sourced water for cooling, are not considered equal to the equipment described in this specification and shall not be acceptable.

The nameplate ratings of the motor shall be based on 40º C ambient environment. The pump motors and all associated sealing devices shall be designed to operate submerged at a depth of 150 feet of water. Motors shall be furnished and certified per IEEE 117 with Class H rated insulation materials (Class F on 140 frame). Motors not having IEEE 117 certified insulation systems shall be considered not acceptable. Insulation materials rated lower than Class F (i.e. Class B or A) are specifically prohibited.

E. BEARINGS AND LUBRICATION - Bearings shall be specifically selected to carry all radial and axial loads imposed by the pump and motor. Bearings shall be rated to provide a minimum L10 Bearing Life of 25,000 hours at any design operating point within the allowable operating region. Bearing selection shall limit the bearing temperature rise to a maximum of 60º C under full load operation.

All bearings shall be permanently lubricated with a premium moisture resistant grease containing rust inhibitors and shall be suitable for operation over a temperature range of -25º C to +120º C. The bearings shall not require any additional or periodic lubrication. All bearings shall be commercially available from third party sources other than the pump/motor manufacturer.

F. SHAFT SEALS – Two independent, tandem mounted, mechanical seals shall be provided in the oil filled housing to isolate and protect the air-filled motor from the pumped media. The oil level shall not require constant monitoring and shall be suitable for a minimum of two (2) years’ service under specified operating conditions before requiring replacement for normal maintenance. The oil reservoir shall act as a barrier to trap moisture and provide sufficient time for a planned shutdown in the event of an outer seal failure. The inner mechanical seal shall be constructed with a solid block carbon rotating seal face and a solid block silicon carbide stationary seal face. The outer mechanical seal shall be constructed with a solid block silicon carbide rotating seal face and a solid block silicon carbide stationary face. All metal
components of the inner and outer seals shall be AISI 316 stainless steel. All elastomers of both inner and outer seals shall be of Viton® material. The outer mechanical seal shall be located in a recessed housing outside the main flow path of the pump to avoid damage. Mechanical seals that employ sprayed or laminated seal faces shall neither be considered equal, nor shall they be acceptable. Mechanical seals shall be readily and commercially available from third party sources other than the pump and motor manufacturer, their agents, dealers and/or distributors. Mechanical seals shall be Type 21 or approved equivalent.

G. MOISTURE DETECTION SYSTEM – A dual (2) probe moisture sensing system shall detect the entrance of moisture and provide an alarm. The moisture detection system shall be designed to detect the entrance of moisture in the stator and lower oil seal housing. The use of single probe or float switch type sensor systems shall not be acceptable. The moisture sensing probe leads shall terminate at a conductance relay located in the control panel, which shall provide an alarm in the event of moisture intrusion. The sensing relay (if not specifically ordered from the pump manufacturer) shall be approved by the pump/motor manufacturer.

H. CABLE ENTRY SYSTEM – The power and control cable entry system shall be designed to provide a positive, leak-free seal to prevent liquid from entering the air-filled motor housing. The design shall incorporate provisions that prevent moisture from wicking through the cable assembly even in the event the cable jacket has been punctured. Cable shall be type SEOW-A or better and U.L. listed for the intended submersible service.

Units above 1-1/2 HP shall be designed with separate power and control cables to prevent false sensor warnings. The power and control cable entry into the lead connection chamber shall be epoxy encapsulated for positive moisture sealing. For frame size 180 and above, the power and control cables shall be unitized modular assemblies permitting individual repair or replacement. Each modular cable unit shall include a cast iron connector body with flared inlet to protect against cable damage due to bending or flexing at the entry point. Each cable unit shall include both epoxy seal and a Neoprene sealing grommet. A sleeve/spacer shall be provided to isolate the epoxy from the connector body and facilitate easy removal and replacement of the sealing compound. Assembly of cable components and grommet tensioning shall be accomplished by a precision snap-ring connection to prevent cable damage or leakage due to under or over compression. The system shall permit the use of factory supplied epoxy or other commercial sealants for field repair. Cable strain relief shall be independent of the epoxy seal. Individual cable units shall be designed to permit repair or rebuilding independent of the motor.

Each cap/cable assembly shall include a modular design rail-mounted terminal block system with individual terminal units for connection of each power and control lead. The terminal block system shall utilize standard non-proprietary commercial components.
I. MOTOR MATERIALS OF CONSTRUCTION – The submersible motor enclosure including frame, end brackets, flanges and cap assembly shall be constructed of close-grained cast iron, ASTM A-48, Class 30 or better.

The top end bracket shall be fitted with a lifting bail and shall be capable of supporting four (4) times the combined weight of the pump and motor. Mating fittings on the motor frame shall have rabbet joints with large overlap as well as o-ring seals to provide for a watertight seal. O-rings shall be Buna-N.

The one-piece motor/pump shaft shall be constructed of stainless steel and shall be precision machined to ensure proper tolerances at all contact points. The entire rotating assembly shall be designed with sufficient rigidity for minimal shaft deflection at extreme pump operating conditions. The motor rotor shall be of squirrel-cage design and constructed of die cast aluminum, fabricated copper or their respective alloys. The rotor shall have an interference fit to the shaft and the rotating assembly shall be dynamically balanced to ISO 1940, G.6.3. Balance weights, if required, shall be secured to the rotor resistance ring or rotor fins. Machine screws or nuts and bolts used to attach balance weights are specifically prohibited.

J. MOTOR ELECTRICAL – The submersible motors shall successfully operate under power supply variations per NEMA MG1-14.30. Motors shall be NEMA Design B with torque and starting current in accordance with NEMA MG1-12.

The submersible motors shall be of an air-filled, high efficiency design and shall be rated for continuous full load operation. The motor construction shall be of explosion proof, TENV-TEXP design and capable of being certified for use in Class 1, Division 1, Groups C & D hazardous locations by Factory Mutual Research Corp. (F.M.). Motors shall be capable of withstanding up to 15 starts per hour and shall have a minimum 1.15 Service Factor at 40° C ambient.

Stators shall be solid copper wound and shall be press fitted into the stator housing for true positive alignment and efficient heat transfer. The motor insulation system shall be Class H minimum (Class F for 140 frame), utilizing materials and insulation systems evaluated and certified with IEEE 117 classification tests. The entire wound stator assembly shall receive a minimum of two (2) coats of insulating varnish utilizing a dip and bake process.

Three (3) normally closed, automatic reset thermostats connected in series shall be embedded in adjoining phases of the stator windings. The thermostats shall be connected to safely shut down the motor upon opening.

K. PUMP MATERIALS OF CONSTRUCTION – The pump casing, impeller, motor housing and stationary base elbow shall be manufactured of close-grained cast iron, ASTM A48, Class 30.

The pump casing shall be of the volute design, of one-piece construction, having
centerline discharge to minimize clogging or flow interference, and to provide the proper weight distribution for use with the Easy-Lift disconnect system.

The impeller shall be of a multi or single-vaned, fully shrouded enclosed design and shall have large passages to provide smooth flow transition and unimpeded passage of large spherical solids. The impeller shall be statically and dynamically balanced to ISO 1940, G.6.3. Solids-passing capability of the impeller offered shall be clearly indicated on the manufacturer’s performance curve.

Impeller Wearing Rings – A replaceable 400 Series stainless steel wear ring shall be provided on the impeller inlet to reduce the effects of abrasive wear and provide the ability to renew the running clearance.

Volute – The volute suction shall contain a replaceable 400 Series stainless steel wear ring to match the impeller wear ring.

All external casting surfaces of the pump/motor coming into contact with the pumped liquid shall have a surface cleanliness equal to that of a SSPC-SP3 process prior to being factory coated with epoxy paint with a dry film thickness (DFT) of 0.010” – 0.012”.

All external hardware including nameplates on the pump/motor shall be 300 Series stainless steel.

2.2 SLIDING GUIDE BRACKET & RAIL SYSTEM

A. The pump slide bracket shall be of heavy-duty cast iron construction.

B. The base discharge elbow shall meet the slide bracket by method of a three-point, wedged engagement that is uniquely designed to match the volute flange to the stationary elbow to eliminate head losses. The discharge elbow shall be designed to carry the full weight of the pump, motor and discharge piping.

Guide rail mounting brackets shall be furnished to stabilize the guide rails for installation in deep wet wells (deeper than 15 feet). Intermediate guide rail brackets shall be spaced no more than 10 feet apart. The brackets shall be designed to fit exactly into the pipes for which they were designed. Adjustable and/or flexible brackets designed to fit a variety of guide rail pipe sizes shall not be acceptable. Mounting brackets shall be of stainless steel construction.

C. Two rail pipes shall be used to guide the pump from the surface to the discharge base connection. The guide rails shall be stainless steel pipe and sized per the respective pump manufacturer’s specifications. The weight of the pump shall bear solely on the discharge base and not on the guide rails. Rail systems which require the pump to be supported by legs which might interfere with the flow of solids into the pump suction will not be considered equal.
D. An adequate length of stainless steel lifting chain shall be supplied for removing the pump. The chain shall be of sufficient length and shall include an adequate number of lifting rings for easy removal.

PART 3 - EXECUTION

3.1 TESTING

A. Each completed and assembled motor shall receive a routine factory test.

B. The pumps shall be performance tested at the manufacturer’s plant prior to shipment. The performance shall be within the limits set forth by the Hydraulic Institute. Certified curves shall be submitted to ENGINEER upon request.

C. As a minimum, each finished pump shall be performance tested for total dynamic head, capacity, efficiency and power requirements at six (6) operating points plus shut-off head for the selected impeller diameter, of which, the design capacity operating point shall be included. After installation, a Field Test shall be performed by CONTRACTOR on each completed Submersible Pump and easy lift assembly under the supervision of the manufacturer’s authorized representative and in the presence of the OWNER. The test shall demonstrate to OWNER’s satisfaction that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor or excessive motor heating.

D. The CONTRACTOR shall supply all clean water required for testing at no cost to the OWNER and shall be included in the Contract Bid Price. Further, the CONTRACTOR shall remove the water from the gravity sewers downstream of each pump station and safely dispose of it in accordance with State Health regulations. No discharge is allowed into public or private sewers without the written acceptance of the system’s owner.

3.2 WARRANTY

A. The Pump Manufacturer shall warrant to OWNER the Submersible Pump Units against defects in material and workmanship for a period of 1 year from date of Substantial Completion. This warranty shall cover the cost of labor and materials, excluding removal and reinstallation costs, required to correct any warrantable defect, FOB, Manufacturer’s authorized Warranty Service Center.

B. Additionally, the Pump Manufacturer shall provide and administer a 5-year, prorated materials warranty on the Submersible Pump against defects in materials and workmanship. The warranty shall provide for the replacement of any part of the pump found to be defective in accordance with the following schedule:
19 to 31 Months  Payment of 75% of the Current Replacement Parts Cost
32 to 45 Months  Payment of 50% of the Current Replacement Parts Cost
46 to 60 Months  Payment of 25% of the Current Replacement Parts Cost

3.3 FIELD SERVICE

A. One (1) day of Field Service shall be provided by an authorized, factory-trained representative of the Pump Manufacturer for each pump station. Services shall include, but not necessarily be limited to, inspection of the completed installation to ensure that it has been performed in accordance with the manufacturer’s instructions and recommendations, and supervision of all field-testing. Activation of the Manufacturer’s Prescribed Warranty shall occur on the date of Substantial Completion.

B. CONTRACTOR shall be responsible for coordinating the required field services with the Pump Manufacturer. The cost of additional days of the Pump Manufacturer’s Field Service required due to incomplete installation or performance-based issues associated with startup and/or performance testing shall be at the expense of the CONTRACTOR.

3.4 PUMP ACCESSORIES

A. Provide the following accessories with each pumping unit:

1. One (1) discharge gauge, glycerin filled, 3½ inch diameter.
2. One (1) thermal overload protection on pump.
3. One (1) mechanical seal (packaged and labeled for storage).
3.5 SPARE PARTS

A. Include the following spare parts for each pump station:

1. One (1) Shaft Mechanical Seal Set
2. One (1) Impeller
3. One (1) Set of Wear Rings
4. One (1) Bearing Set
5. O-rings
6. Gaskets
7. Seal leak wires and grommets

END OF SECTION
EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference:  City of Ranson, WV  
Route 9 Sewer Project  
NORTHPORT PUMP STATION

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE PROJECT DRAWINGS AND SPECIFICATIONS SECTION 11320 AND CERTIFIES THAT THE “WET PIT SUBMERSIBLE NON-CLOG PUMPS” THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION 1.1.B, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT:  “Wet Pit Submersible Non-Clog Pumps”

MANUFACTURER:  

Address:  


By:  

(Typed Name and Title)  

(SEAL)

(Signature)   (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must also sign this form.

SUPPLIER:  

Address:  

By:  

(Typed Name and Title)  

(SEAL)

(Signature)   (Date)
EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference:  
City of Ranson, WV  
Route 9 Sewer Project  
WAR ADMIRAL PUMP STATION

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE PROJECT DRAWINGS AND SPECIFICATIONS SECTION 11320 AND CERTIFIES THAT THE “WET PIT SUBMERSIBLE NON-CLOG PUMPS” THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION 1.1.B, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT:  
“Wet Pit Submersible Non-Clog Pumps”

MANUFACTURER:  
______________________________________________________________

Address:  
______________________________________________________________

______________________________________________________________

By:  
______________________________________________________________

(Typed Name and Title)  
(SEAL)

(Signature)  
(Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must also sign this form.

SUPPLIER:  
______________________________________________________________

Address:  
______________________________________________________________

By:  
______________________________________________________________

(Typed Name and Title)  
(SEAL)

(Signature)  
(Date)
SECTION 13100

PRECAST WET WELLS AND VAULTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast Wet Wells
B. Precast Valve Vaults
C. Precast Transition Manholes
D. Access Hatches

1.2 SUBMITTALS

A. Submit detailed Shop Drawings to ENGINEER for approval prior to fabrication.
B. Included details of reinforcing steel, joint design, concrete mix design, design calculations, and pipe opening sleeves, flexible connectors or compression seals.
C. Submit certification from the precast structures’ manufacturer attesting that the structures meet or exceed the Specifications.

1.3 QUALITY ASSURANCE

A. Design Criteria
   1. Watertight precast reinforced air-entrained concrete structures designed to ASTM C890, A-16 live loading and installation conditions, and manufactured to conform to ASTM C913.
   2. Minimum 28-day Compressive Strength: 4,500 psi.
   3. Honeycombed or re-tempered concrete will not be acceptable.

B. Reference Standards
   1. American Society for Testing and Materials (ASTM)
      a. ASTM C858 -Underground Precast Concrete Utility Structures.
      b. ASTM C890 -Standard Practice for Minimum Structural Design Loading
for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

c. ASTM C891 - Practice for Installation of Underground Precast Concrete Utility Structures.

d. ASTM C913 - Specifications for Precast Concrete Water and Wastewater Structures.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast concrete units with equipment designed to protect the units from damage.

B. Do not place units in position which will cause overstress, warp or twist.

C. Separate stacked members with battens across the full width of each bearing point.

D. Stack so that lifting devices are accessible and undamaged, and identification marks are discernible.

PART 2 - PRODUCTS

2.1 CONCRETE WET WELLS, VALVE AND METER VAULTS, TRANSITION MANHOLES

A. Structure shall be constructed from precast concrete base section and precast concrete riser sections, of sizes shown on the Drawings.

B. Manhole Components


2. Section joints shall be rubber gasket type and preformed plastic sealing compound.

   a. Rubber Compression Gasket: Composition conforming to ASTM C 361 or ASTM C 443.

   b. Preformed Plastic Sealing Compound: Preformed butyl rubber sealant type meeting the requirements of Fed. Spec. SS-5-210-A. Conesal as manufactured by Concrete Sealants, or equal.
3. Concrete compressive strength shall be a minimum of 5,000 psi.

4. Pipe penetrations through wall shall be made with prefabricated rubber gaskets, cast integrally in concrete wall and located as shown on the Drawings. Gaskets shall conform to ASTM C-923.

5. Concrete wet well shall be precast concrete manhole with D-Lok joints and A-Lok pipe seals. Manufacturer: Americast, Atlantic Concrete Products, Concrete Pipe & Precast, or equal.

C. Coatings: The components of the wet wells, transition manholes (CH-20 and BV-22), and manholes CH-18 and CH-19:

1. Exterior Surfaces, except the outside of the wet wells’ and transition manholes flat top section, shall be factory coated with a minimum of 20 mils of coal tar epoxy, Koppers 300-M, or equal, applied in two coats.

2. Interior surfaces, including the top sections shall be field-coated with a minimum of 20 mils of Raven 405 as manufactured by Raven Lining Systems or an approved equal. The work shall be performed by a licensed applicator in accordance with the manufacturers recommendations.

2.2 ACCESS HATCHES

A. Access hatch shall be manufactured by Halliday or approved equal and must meet the dimensional requirements and specifications as called out on the Drawings.

B. Hatch shall have a ¼” thick one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor with bituminous coating where in contact with concrete.

C. Door panels shall be ¼” aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf.

D. Uniform live load with maximum allowable deflection of 1/150 of the span.

E. Doors shall open to 90º and automatically lock with T-316 stainless steel hold open arms with aluminum release handles. Doors shall close flush with frame and have a 316-stainless steel slam lock with removable key and non-corrosive locking bar for use in conjunction with a Masterlock padlock.

1. Provide one padlock for each for each flushing, air-vacuum or air-vacuum/release/flushing valve vault as manufactured by Masterlock and keyed to Charles Town Utility Board (CTUB) master key. Coordinate with the CTUB representative for master key requirements.
F. Hinges and all fastening hardware shall be T-316 stainless steel.

G. Unit shall have a neoprene cushion/gasket.

H. Cover shall be equipped with stainless steel spring assist.

I. Unit shall carry a lifetime guarantee against defects in material and/or workmanship.

PART 3- EXECUTION

3.1 INSTALLATION

A. Unless otherwise specified herein below, the precast units shall be installed in accordance with ASTM C891.

B. Install precast concrete units to the elevation and location indicated on the Drawings.

C. Install required pipe connections, valves, baffles and other appurtenances as indicated on the Drawings.

3.2 BACKFILLING STRUCTURES

A. Do not backfill precast concrete structures until after examination and approval of ENGINEER.

B. Backfill structures on all sides equally in accordance with WVDOT/DOH 670.4.5.

END OF SECTION
SECTION 14201
PORTABLE DAVIT CRANE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Portable Hoist

1.2 DESCRIPTION

A. Furnish all labor, equipment and materials necessary to install, test, and place in operation a portable davit crane as shown in the Drawings and as specified herein.

B. Intended Purpose: The purpose of the portable davit crane is to hoist sewer pump station equipment during removal and installation from their respective vault and/or wet well under the conditions and installation described in the Specifications.

1.3 SUBMITTALS

A. Submit Shop Drawings and complete material specifications for the portable hoist.

PART 2 - PRODUCTS

2.1 PORTABLE DAVIT CRANE

A. Northport Pump Station: The portable davit crane shall be Thern Commander Series, Model 5PT20 (maximum load rating of 2,000 pounds), or ENGINEER-approved equal.

B. War Admiral Pump Station: The portable davit crane shall be Thern Admiral Series, Model 5PT30 (maximum load rating of 3,000 pounds), or ENGINEER-approved equal.

C. The crane shall be sized to facilitate equipment placement and removal.

D. The portable crane shall be all-steel construction.

E. Boom shall adjust to four positions with quick-release pin. Adjustment shall be made via a ratcheting screw-jack.

F. Crane and all other steel components shall have an epoxy finish to resist corrosion.

G. All hardware shall be stainless steel.
2.2 BASES

A. Provide davit crane bases in the quantity and locations shown on the Drawings.

B. Bases shall have an epoxy finish matching the crane to resist corrosion.

C. Each base shall include a cap with lanyard to keep water and debris out of base when crane is removed.

2.3 ELECTRIC WINCH

A. An electric winch shall be provided with each portable davit crane. Winch shall be Thern model 4WP2EGRA-K or ENGINEER-approved equal.

B. Winch shall operate on 115 Volt, AC, single-phase electric power.

C. Winch speed shall be 8 fpm – 13 fpm.

D. Winch shall have an epoxy paint finish matching the crane finish to resist corrosion.

E. Winch shall have a pendant control box with 6’ cable lead.

F. Winch shall mount on boom of crane via quick mount bracket.

G. Winch shall be equipped with 36 ft. of ¼” diameter 304 stainless steel wire rope. Wire rope shall include a swaged ball fitting and stainless steel swivel hook. Wire rope shall have a minimum load rating that exceeds the pump weight.

PART 3 - TESTING AND WARRANTY

3.1 Warranty – The portable davit crane shall be guaranteed against defects in material and/or workmanship for a period of 2 years after Substantial Completion.

END OF SECTION
SECTION 15080
VALVES AND PIPING SPECIALTIES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Check valves, plug valves, air valves, gauges, and all other special piping appurtenances

1.2 DESCRIPTION

A. Furnish all labor, equipment and materials necessary to install all valves, hose connections, hydrants, valve boxes, and other special piping appurtenances as specified, as indicated on the Drawings, and as necessary to provide complete piping systems as intended that are not expressly specified in other sections of the Specifications.

1.3 QUALITY ASSURANCE

A. Products shall be new, the latest standard product of reputable manufacturers, and shall have replacement parts available.

B. Potable water system materials shall bear the seal of approval of the National Sanitation Foundation (NSF).

C. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels will be rejected.

1.4 SUBMITTALS

A. Submit Shop Drawings and manufacturer’s catalog data, literature, illustrations and specifications.

1. Submit Shop Drawings of valves and valve operators including dimensions, net assembled weight of each size valve furnished, construction details, and materials of components.

2. Submit manufacturer’s installation instructions.

3. Submit manufacturer’s maintenance instructions and complete parts lists.
B. Certificates

Submit a Certificate of Compliance, together with supporting data, from the materials supplier(s) attesting that valves, accessories and specialties meet or exceed specification requirements.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver valves and accessories to the job site in the manufacturer’s boxes or crates. Mark each valve as to size, type and installation location.

B. Seal valve ends to prevent entry of foreign matter into valve body.

C. Store valves and accessories in areas protected from weather, moisture and possible damage.

D. Do not store materials directly on the ground.

E. Handle valves and accessories to prevent damage to interior and exterior surfaces.

1.6 JOB CONDITIONS

A. Investigate conditions affecting this work and coordinate with other contractors to prevent interference between structural, mechanical and electrical features.

B. The Drawings generally show small-diameter pipe diagrammatically, and do not necessarily indicate all fittings, valves, and other items required for a complete operating system. Provide all such valves, fittings and specialties to complete the systems as intended.

C. Provide necessary valve wheels, keys, wrenches, levers and stem extensions. Locate to assure accessibility and operability throughout the operating range without interference. Install valve stem supports, guides and operators. For buried valves, provide valve boxes and stem extensions to grade. Provide valve accessories of the same manufacturer as the valve, unless otherwise specified elsewhere.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide valves and piping specialties of the size and type indicated on the Drawings.

B. Cast iron valve material shall meet or exceed the requirements of ASTM A126, Class B.

C. Valve flanges shall conform to ANSI B16.10, (125# and 250# class) as applicable.
D. Mechanical joint valve ends shall conform to ANSI/AWWA C111/A21.11.

E. Screwed valve ends shall conform to ANSI B2.1; American Standard Taper pipe threads.

F. Valves shall be of a design that requires no more than 50 lbs. pull on the hand wheel or standard valve wrench to provide positive shutoff against rated working pressure.

2.2 CHECK VALVES

A. Flange Joint Swing Disc Check Valves

1. The valve shall have a heavy-duty body constructed of high-strength cast iron conforming to ASTM A126 Class B with integral flanges, flat faced and drilled per ANSI B16.1 Class 125 or Class 250 and be suitable for horizontal or vertical installation.

2. The valve body shall be of the full waterway type, designed to provide a net flow area of not less than the nominal inlet pipe size when swung open no more than 25 degrees. The valve shall have a replaceable bronze or stainless-steel body seat. The body shall have a bolted steel cover allowing complete access to and removal of all internal components while the valve is in the line.

3. Valve disc shall be cast iron and faced with a renewable resilient seat ring of rubber or other suitable material, held in place by a follower ring and stainless-steel screws.

4. The disc arm shall be ductile iron or steel, suspended from and keyed to an austenitic stainless-steel shaft which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable.

5. The valve shall be supplied with an outside lever and adjustable counterweight to initiate valve closure. Final closure shall be dampened by means of a single, side-mounted bronze air-cushion assembly directly mounted to the valve body on machined pads. The amount of cushioning shall be easily adjustable without the need for pre-charged air chambers. Commercial air cylinders which pivot and/or are attached with fabricated brackets are not acceptable.

6. The valve shall swing open smoothly at pump start and close quickly and quietly upon pump shutdown to prevent flow reversal. When closed, the valve shall seat drip-tight.
7. The valve shall be GA Industries, Inc. Figure 250-D, or approved equal.

B. All check valves shall be designed so that all parts may be removed for inspection or replacement through the top of the valve with the valve in position.

2.3 PLUG VALVES

A. Plug valves shall be Milliken Millcentric Figure 601, DeZurik Model PEF, or approved equal.

B. Plug valves shall be of the non-lubricated eccentric type with resilient faced plugs. Buried force main valves shall be furnished with mechanical joint connections, AWWA C111. Non-buried force main valves shall be furnished with flange joint connections. Port areas of all plug valves shall be at least 100% of full pipe area.

C. Valve bodies shall be of ASTM A126, Class B cast iron in compliance with AWWA Standard C504, Section 5.4. Exposed nuts, bolts, springs, washers, etc. shall be stainless steel. Resilient plug facings shall be of neoprene, suitable for use with sewage.

D. Valves shall be furnished with corrosion resistant seats which comply with AWWA Standard C507, Section 7, paragraph 7.2 and with AWWA Standard C504-74, Section 8, paragraphs 8.4, 8.5, 8.6, 8.6.2, 8.6.3., 8.6.4, 8.6.5, 8.6.6.

E. Valves shall be furnished with replaceable sleeve type bearings in the upper and lower journals. These bearings shall comply with AWWA Standard C507, Section 8, paragraphs 8.1, 8.3, and 8.5 and with AWWA Standard C504, Section 9.

F. Valve shaft seals shall comply with AWWA Standard C507-73, Section 10, and with AWWA C504, Section 10.

G. Valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI Standard B16-1. Pressure rating shall be 175 psi. Valves shall be capable of providing drip-tight shutoff up to the full rating with pressure in each direction.

H. All 4” and smaller non-buried valves shall be furnished with lever actuators. All 6” and larger non-buried valves shall be furnished with gear reduction hand wheel actuators.

I. Valve operators shall be completely enclosed in an air, water, and oil-tight housing mounted directly on the valve and providing access to the valve stem packing. The housing shall comply with AWWA Standard C504, Sections 11.2.3 and 11.3. Both worm gear shafts and gear quadrants shall be furnished with replaceable sleeve type bearings the same as the valve bearings. Shaft seals shall be provided to seal all external shafting. Valves shall be completely sealed including the valve stem packing box. Open and closed stops shall be provided to comply with AWWA C504, Section
11.3.

J. Valves to be direct buried shall be provided with roadway valve boxes as specified in this Section.

2.4 AIR RELEASE VALVE

A. Combination Air Valves: Consisting of an air release valve and an air and vacuum valve factory piped into a compact assembly. The combination assembly shall automatically release air, gas or vapor under system operating pressure and shall also allow air to re-enter the system during draining or when a vacuum occurs. Combination valve designs shall feature long bodies and float stem components so that the operating mechanisms are kept free from contact with the sewage during operation. Valve construction as follows:

1. Valve Bodies and Covers: Cast iron, ASTM A 126, Class B.
2. Inlet Size: 2-inches.
3. Outlet Size: 1-inch, NPT.
5. Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.
7. Valve Float Stem and Guide: Type 304 Stainless Steel.
8. Valve Float: Stainless Steel, ASTM A 240.
10. Back flushing and Cleaning Accessories: Factory assembled to the combination valve and consisting of an inlet shut-off valve, a blow-off valve, a clear water inlet valve, section of rubber hose and quick disconnect couplings.

B. Acceptable Manufacturers:

1. Val-Matic Valve and Manufacturing Corp.; Model No. 802 BW or approved equal.

2.8 CORPORATION STOPS

A. Brass or red-brass alloy body, ASTM B62.
B. AWWA C800 threaded inlet end for tapping.

C. Outlet end suitable for service pipe intended.

2.9 VALVE BOXES

A. Valve boxes shall be two-piece, cast iron, screw-type adjustable, 5-1/4” diameter with heights as indicated on the Drawings. Lids shall be drop-type, marked SEWER. All pieces shall have a protective coating of coal tar epoxy.

B. Valve boxes shall be as manufactured by Tyler or approved equal.

2.10 PRESSURE GAUGES (LIQUID SERVICE)


B. 4-1/2" dial size. Stainless steel dial, black lines and numbers.

C. Pressure range as indicated. Graduations and figure intervals proportioned to range.

D. Polypropylene bushed, stainless steel rotary movement, micro-adjustable pointer. Minimum pressure stop, over-pressure protection. Adjustable zero set point adjustment screw which does not require removal of gauge case.

E. Accuracy to 1% of full-scale range.

F. 1/8" NPT bottom connection. Shutoff cock.

G. When indicated on the contract drawings, provide cadmium-plated diaphragm gauge seal; 316 ELC diaphragm, flushing connection, stopcock.

H. Gauges shall be manufactured by either Ashcroft, US Gauge, or approved equal.

2.11 HOSE COUPLINGS

A. Cam-locking quick-coupler

B. MPT coupler socket

C. FPT adapter plug

D. Side levers

E. Stainless steel construction
F. Buna N gaskets

G. Shall meet MIL-C-27487 specifications

2.12 EXTENSION STEMS

A. Extension stems shall be provided for operation of valves where required. Stems shall be made from extra heavy galvanized steel pipe. Extension stems shall be complete with coupling for attachment to valve stem for non-rising stem valves and stem coupling for OS&Y gate valves. Extension stems shall be sized so as to transmit full torque from the operating mechanism to the valve stem without binding, twisting or bending.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves and accessories in accordance with the manufacturer’s instructions.

B. Inspect joint surfaces for structural soundness and thoroughly clean before installation.

3.2 ADJUSTMENT

A. Check and adjust valves and accessories for smooth operation.

END OF SECTION
SECTION 15091

ODOR CONTROL VENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, equipment and materials necessary to install an odor control vent on each pump station wet well.

B. The intended purpose of the odor control vent is to remove H2S gases from vented wet well air to prevent disturbing odors.

1.2 SUBMITTALS

A. Submit Shop Drawings and manufacturer’s catalog information for the odor control vent.

PART 2 - PRODUCTS

2.1 ODOR CONTROL VENT

A. Vent shall be Wager Company Model 2050 or ENGINEER-approved equal.

B. Vent body shall be powder coated aluminum plate housing.

C. Unit shall contain 50 lbs. of dry-scrubbing media that is engineered for the removal of H2S gas. The media shall be housed in a corrugated plastic container.

D. The airflow shall be designed for passive applications. The configuration shall be arranged so that contaminated air flows into the bottom inlet flange and is forced upward through the media bed and discharged through ventilated openings.

E. Components of the odor control vent shall include:

1. Aluminum plate body, power coated

2. 50 lbs. of odor-controlling media engineered in pellet form designed for removal of H2S gas. Media must be non-hazardous before and after it is spent. Vents that contain activated alumina media or carbon will not be accepted.

3. 6” flanged connection

4. Tamper proof lockable hook and security latches
5. Disposable media corrugated plastic insert

F. Vent materials:
   1. Fabricated aluminum plate
   2. Corrugated plastic canister
   3. Latches and hooks in 316SS

G. Media Specification:
   1. Moisture content: 35% max.
   2. Crush strength: 35% - 70% max.
   3. Abrasion: 4.5% max.
   4. Pellet diameter: 1/16” – 1/4”
   5. Only UL-certified media will be accepted.

PART 3- EXECUTION

3.1 SPARE PARTS
   A. Provide 50 lbs. of additional spare media housed in a corrugated plastic container for each odor control vent.
SECTION 15210

COMPRESSED AIR INJECTION SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for a compressed air injection system for the purpose of odor control for air piping materials and air compressor including air pressure tank, electric motor and starter, receiver, all necessary piping, fittings, valves, gages, switches and all necessary accessories, connections and equipment.

1.2 APPLICABLE PUBLICATIONS

A. Referenced Standards

1. American Society of Mechanical Engineers (ASME):
   a. B16.22-2013 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

2. ASME Boiler and Pressure Vessel Code

3. BPVC Section VIII-1-2013 Rules for Construction of Pressure Vessels, Division 1

   d. B62-2009 Standard Specification for Composition Bronze or Ounce Metal Castings
   e. B88-2009 Standard Specification for Seamless Copper Water Tube
5. American Welding Society (AWS):
   a. A5.8/A5.8M AMD1-2011 Specification for Filler Metals for Brazing and Braze Welding

6. International Code Council (ICC):
   a. IPC-2012 International Plumbing Code

7. Manufacturer Standardization of the Valve and Fittings Industry, Inc (MSS):
   a. SP-70-2011 Gray Iron Gate Valves, Flanged and Threaded Ends
   b. SP-71-2011 Gray Iron Swing Check Valves, Flanged and Threaded Ends
   c. SP-72-2010a Ball Valves with Flanged or Butt-Welding Ends for General Service
   d. SP-80-2013 Bronze Gate, Globe, Angle, and Check Valves
   e. SP-110-2010 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
   f. SP-123-2013 Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

8. National Electrical Manufacturers Association (NEMA):
   a. 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum)

   a. 70-2011 National Electrical Code (NEC)

10. Underwriters' Laboratories, Inc. (UL):
    a. 508-1999 (R2013) Standard for Industrial Control Equipment
1.3 SUBMITTALS

A. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, model numbers, applications, standard compliance, performance curves, and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information including the following:

1. Piping
2. Supporting elements
3. Valves
4. Pressure gages
5. Air pressure regulating valves
6. Automatic drain valves
7. Vibration isolation
8. Quick couplings
9. Pipe assemblies
10. Air Compressor System:
    a. Characteristic performance curves
    b. Efficiency
    c. Compressor; manufacturer and model
    d. Compressor operating speed
    e. Capacity; (free air delivered at indicated pressure)
    b. Type of bearing in compressor
    c. Type of lubrication
    d. Capacity of receiving air pressure tank
    e. Type and adjustment of drive
    f. Electrical motor; manufacturer, frame and model
    g. Speed of motor
    h. Current characteristics and HP of motor

B. Certifications: Brazing and welding certificates of the installer(s).

C. Operation and Maintenance Manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.4 QUALITY ASSURANCE

A. The Contractor shall obtain the services of a qualified engineer or technician from the compressor manufacturer to review final installation, and testing of the compressor. After satisfactory installation of the equipment, the engineer or technician shall provide a signed certification that the equipment is installed in accordance with the manufacturer’s recommendations.

1.5 AS-BUILT DOCUMENTATION

A. Operation and Maintenance Manuals shall be updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operation and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final system certification testing. As-built drawings are to be provided, and a copy of them on AutoCad version 2018, provided on compact disk or DVD.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Pipe for general service compressed air system shall be drawn temper, Type "K" or "L" seamless copper tube, conforming to ASTM B88, //ASTM B819// with wrought copper solder joint fittings conforming to ASME B16.22.

1. Copper unions shall conform to ASME B16.22 or MSS SP-123.

2. Silver Brazing Filler metals shall be BCuP series, copper phosphorus alloys for general duty brazing conforming to AWS A5.8/A5.8M.
2.2 VALVES

A. Ball valves 3 inches and smaller shall be full port, two or three piece ball valve conforming to MSS SP-110. The ball valve shall have a SWP rating of 150 psig and a CWP rating of 600 psig. The body material shall be Bronze ASTM B584, Alloy C844.

B. Check valves smaller than 4 inches shall be Class 125, bronze swing check valves with non-metallic Buna-N disc. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 200 psig. The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62 and PTFE or TFE disc.

2.3 SPECIALTIES

A. Pressure Gages: Pressure gages permanently installed in the system or used for testing purposes shall be listed for compressed air service and shall include a snubber or pulsation dampener and an isolation valve for maintenance access.

1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 3/4 inches, for compressed air, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be labeled for appropriate service, and marked "USE NO OIL".

B. Air Pressure Regulating Valves:

1. Air pressure regulating valves under NPS 3 inches shall be pilot or diaphragm operated, bronze body and trim, direct acting, spring loaded manual pressure setting adjustment and rated for 200 psig inlet pressure. Delivered pressure shall not vary more than 0.1 psig for each 1.0 psig variation in inlet pressure.

2. OptiFlo Model OP-200 1” or ¾” Flow and Pressure Controller, or equal.

C. Shut off ball valves shall be constructed according to the ASME BPVC Section VIII and be National Board Certified, labeled, and factory sealed. The ball valve shall be lever operated manual type 2-piece constructed of brass body with blowout proof valve for compressed air service. The manufacturer is Milwaukee Valve rated for no less than 200 psig or approved equal.

D. The ¾” check valve on the main airline shall have brass body and internal parts rated for 250 psig minimum working pressure. The ¾” check valve manufacturer is Comrader or approved equal. The ½” and ¼” air check valves shall have brass body and internal parts rated for 250 psig minimum working pressure. The check valves manufacturer is CDI or approved equal.
E. The main airline flow switch shall be a single solenoid ¼” brass valve with non-locking manual override rated for no less than 200 psig as manufactured by Parker or approved equal.

2.4 TUBE AND PIPE ASSEMBLIES

A. All air tubes and piping and fittings including clamps, couplings, splicers shall be suitable for compressed air service of nominal diameter indicated and rated for 200 psig minimum working pressure.

B. All air tubes and piping shall be ¾”, ½” and ¼” copper rated for no less than 200 psig as manufactured by Mueller Industries, Anvil or approved equal.

C. Pipe couplings shall be two-piece straight through, threaded brass or stainless steel O-ring or gasket seal swivel coupling with barbed ends for connecting two sections of pipe.

2.5 AIR COMPRESSOR FOR AIR INJECTION SYSTEM

A. The packaged air compressor, air pressure tank and receiver shall be a factory assembled, wired, piped, and tested that deliver air of quality equal to intake air. The packaged air compressor shall be horizontally tank mounted on a 250-gal air pressure tank as manufactured by Champion or approved equal. The air compressor motor shall be a 4 cylinder 7.5 HP 60 Hz air cooled simplex continuous duty capable of delivering at least 26 acfm at 175 psig and at least 30 acfm at 125 psig. The packaged air compressor shall be capable of operating against a pressure of 175 psig. The Sound level of the compressor package shall not exceed 77 dB(A) when measured in the free field conditions at one meter. Compressor assembly shall have an equipment identification nameplate and data.

B. The air pressure tank shall be a vertical tank with capacity of no less than 175 psia. The tank’s working pressure differential shall not exceed 40-50 psig such as the lowest tank pressure is no less than 125 psig. The discharge connection size is ¾”. The tank shall be bearing appropriate code symbols and markings. The interior finish shall be corrosion resistant. The tank shall include a safety valve, pressure gage, drain, and pressure regulating valves. The packaged air compressor unit shall be secured to a mounting frame strong enough to resist movement due to a seismic event.

C. The automatic control panel shall house local control and protection functions. The control panel shall comply with NEMA 250 Type 2 and UL 508. The motor controllers shall be full voltage, combination magnetic type with under-voltage release feature and motor circuit protector type disconnecting means and short circuit protective device. The control voltage shall be 208 volts or less. The motor overload protection shall consist of overload relays in each phase. Starting devices shall consist of Hand-off-Auto selector switch in cover of control panel plus pilot device for automatic control.
D. Compressed air system shall include discharge air pressure gage, air filter maintenance indicator, hour meter, compressor discharge air and coolant temperature gages, and control transformer. For connection to alarm system, an alarm signaling device shall annunciate when low pressure air and trip point have occurred.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Piping and valves installed adjacent to equipment shall be located to allow for the required service clearances.

B. Air piping shall be installed with a minimum 1 percent slope downward in direction of flow.

C. Nipples, flanges, unions, transitions, and special fittings, and valves shall be installed with pressure ratings same as or higher than system pressure rating.

D. Only eccentric reducers shall be installed where compressed air piping is reduced in direction of flow, with bottoms of both pipes and reducers fitting flush.

E. Branch connections shall be installed from the top of the main compressed air line.

F. Pipes shall be installed free of all sags and bends.

G. Piping shall be cut square and accurately with a tube cutter (sawing is not permitted) to measurements determined at place of installation and worked into place without springing or forcing the pipe. The tube shall be reamed to remove burrs, being careful not to expand tube and that no chips of copper remain in the line. Care shall be exercised in handling equipment and tools used in cutting or reaming of pipe to prevent oil or grease being introduced into piping.

H. Suitably brace piping and valves against sway and vibration to prevent strain on pipe or joints in accordance with NFPA 99. Bracing shall consist of brackets, anchor chairs, rods, and structural steel for vibration isolation.

I. If an installation is unsatisfactory to the Owner, the Contractor shall correct the installation at no cost to the Owner.

3.2 PRELIMINARY STAGE TESTS

A. Preliminary tests shall be performed by the contractor prior to testing witnessed by the Owner. Tests shall be pneumatic and shall use dry, oil-free compressed air.
B. Testing of any system for any purpose shall include preliminary testing by swabbing joints under test with standard soap solution and observing for bubbles at internal pressures not in excess of 5 psi.

C. When testing reveals system leakage, isolate and repair the leaks, replace defective materials where necessary, and retest the system until there is no loss of pressure.

3.3 STARTUP AND TESTING - Components herein will be tested as part of the force mains and pump station systems.

A. As recommended by product manufacturer and listed standards and under actual or simulated operating conditions, pneumatic tests shall be conducted to prove piping system integrity and full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system. Tests shall be pneumatic and shall use dry, oil-free compressed air.

B. The tests shall include initial piping purge test, initial pneumatic test for positive-pressure gas systems, initial cross-connection test, and initial standing positive-pressure gas piping tests, system capacity, control function, and alarm functions.

C. This requirement entails both the compressed air and air injection systems. Pneumatic tests shall be performed utilizing a test pressure equal to the MAWP of 175 psi. Test pressure shall be maintained for a minimum period of four hours to ensure the temperature in the piping system stabilizes, then the pressure is refreshed and held for two hours with no loss of pressure. Pneumatic testing performance shall be in accordance with industry safety standards with the pressure gradually increased in increments of 25% of the MAWP until the required test pressure is reached. At each interval, the system pressure shall be held long enough for piping strains to stabilize. If leaks are observed, the leaks shall be identified, the system de-pressurized and repairs made before proceeding.

D. Other than standard piping flanges, plugs, caps and valves, only use commercially manufactured expandable elastomer plugs for sealing off piping for test purposes. Published safe test pressure rating of any plug used shall be not less than three times the actual test pressure being applied. During pneumatic testing evacuate personnel from areas where plugs are used.

E. Remove components that could be damaged by test pressure from piping systems to be tested.

F. Perform valve-operating tests and drainage tests to insure valves do not leak when operating under pressure and are correctly labeled.

G. Check piping system components, such as valves, for proper operation under system test pressure.
H. Duration of a test will be determined by the Owner and will be for a minimum of 60 minutes with a maximum of 24 hours. Test may be terminated by direction of the Owner at any point after it has been determined that the pressure leak test has been satisfied.

I. Prepare and maintain test records of all air piping systems tests. Air piping systems entails the connections between the compressor and the air pressure tank, between the air pressure tank and branched air lines, and between these airlines and air injection points on the force main. Records shall show City and Contractor test personnel responsibilities, dates, test gage identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates.

J. System verification and final testing shall be conducted comprising of a system verifier standing pressure test, verifier cross-connection test, verifier piping purge test, verifier final tie-in test, verifier operational pressure test, verifier piping particulate test, verifier piping purity test, labeling, and source equipment verification test.

K. When any defects are detected, correct defects and repeat test at no additional costs to the Owner. When testing reveals system leakage, isolate and repair the leaks, replace defective materials where necessary, and retest the system until there is no loss of pressure.

L. The Owner will observe startup and Contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Owner's Representative. Provide a minimum of 7 days prior to notice.

3.5 DEMONSTRATION AND TRAINING

A. Instruct Owner personnel in operation and maintenance of the system.

END OF SECTION
SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. All items of labor, materials and equipment, not specified in details on Drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI American National Standards Institute, Inc.
ASTM American Society for Testing and Materials
IEEE Institute of Electrical and Electronic Engineers
IPCEA Insulated Power Cable Engineers Association
NEC National Electrical Code of National Fire Protection Association
NEMA National Electrical Manufacturers Association
NESC National Electrical Safety Code
UL Underwriters' Laboratories

B. Qualification of Manufacturers:

1. Various materials specified herein shall be as supplied by manufacturers listed under PRODUCTS.

C. Quality Control:

1. All equipment shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at time of bidding. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.
1.3 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections.

2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the manufacturer's drawings.

3. Submit manufacturer's latest publications for the following items:

   a. Conduit and Fittings
   b. Wire
   c. Outlet Boxes
   d. Junction Boxes
   e. Pull Boxes
   f. Electrical and Control Equipment Enclosures including Equipment Layouts
   g. Individually Mounted Circuit Breakers
   h. Panelboards
   i. Transformers
   j. Receptacles
   k. Switches
   l. Unit-strut
   m. Conduit Link Seals

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit:

1. PVC conduit shall be Schedule 40.

2. Rigid steel conduit shall be mild steel piping, zinc coated, and of sufficient weight and toughness to withstand cracking and peeling during bending. Galvanizing to be a coating of zinc of uniform thickness applied by either electrolytic or hot metal dip process.
3. Rigid aluminum conduit shall be 6063-T1 aluminum alloy and shall comply with Federal Specification WW-C-540C.

4. Each piece of rigid conduit to be straight, free from blisters and defects, cut square and taper reamed, finished in 10’ lengths and threaded at each end. Couplings shall be supplied at one end and a protective sleeve for the other end. All threads shall be clearly cut. Each length of conduit shall bear Underwriters' Label.

5. PVC coated galvanized rigid steel conduit shall have a permanent plastic coating factory applied to a minimum thickness of 40 mils and a urethane internal coating. PVC coated conduit shall be Plasti-Bond Red H2OT as manufactured by Robroy Industries, Ocal Blue as manufactured by the Occidental Coating Company or Perma-Cote Supreme as manufactured by Perma-Cote Industries.

6. Flexible nonmetallic conduit shall conform to Articles 350 and 351 of the NEC and shall be UL listed. All flexible nonmetallic conduit shall have nonmetallic screw-in type connectors and couplings. All flexible conduit shall be liquid-tight type.

7. Minimum size of rigid conduit shall be 3/4”. Minimum size of flexible conduit shall be 1/2”.

B. Wire:

1. Wire shall be type THHN/THWN, except for underground wiring, which shall be type XHHW. All wiring shall be stranded copper with 600 volt insulation. Aluminum wire will not be acceptable.

C. Instrumentation Cable:

1. Instrumentation cable for analog signal wiring shall be #18 AWG twisted shielded pairs with tinned copper conductors, 600 volt polyethylene insulation, a continuous foil shield with 100% coverage, and a tinned copper drain wire. The instrumentation cable shall be Beldon #9341, or equal.

D. Cast Fittings:

1. Cast fittings for steel conduit shall be made of rust resisting alloy of iron or steel. An iron fitting shall be cast malleable iron thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed.

2. Cast fittings for aluminum conduit shall be made of aluminum.

3. Each cast fitting shall be provided with heavy threaded hubs to fit the conduit used. A cast fitting shall be used on all exposed conduit runs except at impractical locations where factory ells may be used.
4. All cast fittings used for PVC coated conduit shall be PVC coated and shall be Form 8 with encapsulated screws.

5. All fittings in wet locations shall be gasketed.

E. Outlet Boxes:

1. Each outlet box shall be sized in accordance with current editions of all Federal, State and local codes.
2. All outlet boxes shall have mounting lugs or ears for mounting wiring devices and covers. Each outlet box shall be equipped with an appropriate cover.
3. Outlet boxes shall be cast type of same construction as cast fittings described above.

F. Junction Boxes:

1. Junction boxes shall be cast type, and shall be of same construction as cast fittings, unless noted otherwise on the Drawings.
2. Junction boxes identified on the Drawings as NEMA 4X aluminum shall be constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.
3. Label all junction boxes with an engraved nameplate fastened to the junction box.

G. Pull Boxes:

1. Pull boxes shall be NEMA 4X aluminum, constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.
2. Label all pull boxes with an engraved nameplate fastened to the pull box.

H. Explosion-proof Junction Boxes:

1. Explosion-proof junction boxes shall be provided where indicated on the Drawings, and shall be Crouse-Hinds, Killark or Appleton.
2. Provide conduit sealing hubs as indicated on the Drawings.
3. Label the junction boxes with an engraved nameplate fastened to the junction box.

I. Electrical and Control Equipment Enclosures:

1. The electrical and control equipment enclosures shall be a NEMA 4X 316 stainless steel enclosure with access doors, and shall be sized as required for the installation of the equipment inside the enclosure.
2. The enclosure shall be constructed of 10 gauge stainless steel with continuously welded seams. Panel doors shall have full length stainless steel piano hinges. The door hardware shall be stainless steel.

3. The enclosure doors shall have a lockable handle with a 3-point latching system.

4. Provide two (2) LED light fixtures in each enclosure. Each light fixture shall be a four foot enclosed LED light fixture.

5. The electrical and control equipment enclosures shall be manufactured by Gamlet in York, PA, or equal.

J. Individually Mounted Main Circuit Breaker:

1. Main circuit breaker shall be individually mounted, thermal-magnetic trip, quick-make, quick-break, size and NEMA enclosure as indicated on the Drawings. The minimum interrupting capacity shall be 30,000 amperes rms symmetrical at 480 volts.

2. The main circuit breaker shall be service entrance rated and shall be Square D or Eaton.

K. Panelboards:

1. Panelboards shall be dead front automatic circuit breaker type suitable for connection to the system characteristics and with circuit breakers as called for on the panel schedules. Circuit breakers shall be thermal-magnetic type with quick-make, quick-break operating mechanism and with trip indication. Trip indication shall be clearly indicated by breaker handle taking a position between "ON" and "OFF". All 2-pole and 3-pole breakers shall be common trip. Breakers shall be plug-in type.

2. Bus bars and lugs shall be plated copper. The ampere rating of the main bus bars and lugs on each panelboard schedule shall be considered a minimum. Larger ampere rating main bus bars and lugs may be required to accommodate the number of poles indicated on the panelboard schedules or to accommodate large wire sizes. Breakers used as switches shall be rated for that purpose.

3. Panelboard box shall be made of code gauge galvanized steel, factory assembled as a complete unit and large enough to provide ample wiring space.

4. Panelboard front shall be complete with door and flush chrome plated pin type cylinder lock and catch. All panelboards shall be keyed alike. Front shall have adjustable indicating trim clamps which are completely concealed when the door is closed. Door shall be mounted with completely concealed hinges.

5. Unless otherwise noted on plan, panelboard shall have all breakers with a minimum
interrupting capacity of 10,000 Amps symmetrical and boxes with a minimum width of 14”.

6. Panels shall be factory prime coated and finish coated with baked acrylic enamel.

7. Panelboards shall be furnished with a surge protective device (SPD) where indicated on the Drawings. The SPD shall have a minimum 160kA rating.

8. Panelboards shall be Square D or Eaton.

L. Transformers:

1. Transformers shall be energy efficient, size and voltage as indicated on Drawings, dry type, ventilated, wall mounted with 115ºC rise insulation. Transformers shall have copper windings,

2. Transformers shall be energy efficient, DOE 2016 compliant, with 220ºC insulation system.

3. Transformers shall be Square D or Cutler-Hammer.

M. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R:

1. Duplex receptacles shall be 3-wire, U-ground, to meet Federal Specification WC 596f.

2. Color shall be ivory. Receptacles shall be Bryant #5362, A-H #5362, P & S #5362, Hubbell #5362, Leviton #5362 or Woodhead #5362DW.

N. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R (G.F.I. Type):

1. All receptacles noted, as G.F.I. receptacles shall be 20 Amp ground fault circuit interrupter receptacles. Receptacles shall be the "Standard" End- of-Line" type, which protects itself only. "Feed-Thru" installation will not be permitted. Devices shall be Class A, UL listed.

2. Provide a weatherproof cover for G.F.I. receptacles where indicated on the Drawings. Cover shall be self-closing and UL listed.

O. Switches:

1. Local control switches, other than those mounted on a panelboard, shall be 20 ampere, 120-277 volt, AC, meeting Federal Specification WS 896F.

2. Color shall be ivory. Switches shall be single pole, double pole, three-way, four-way or type as noted. Switches shall be Bryant #4900 Series, A-H #1990, P & S #20ACI, Hubbell #1221 or Leviton #1221.
P. Wall Plates:

1. Local control switches, receptacles and similar wiring devices shall be provided with stainless steel wall plates with beveled edges. Plates shall be same manufacturer as wiring device used.

2. At locations where FS condulets are used for switches or receptacle outlets, an FS condulet plate shall be used. Plates shall have beveled or rounded edges and shall fit flush with all sides of the FS condulet.

Q. Uni-strut:

1. Uni-strut shall be used to support conduit and electrical equipment. All uni-strut shall be 316 stainless steel.

R. Conduit Link Seals

1. Conduit link seals shall be installed in all core-drilled holes for sealing around the conduit. All link seal bolts shall be stainless steel.

S. Fire Resistant Foam Sealant:

1. All penetrations through floors and walls shall be sealed with Nelson Firestop Products CLK, Cat. #AA492, silicon based sealant, or equal.

2. All wall or floor penetration openings shall be as small as possible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conduit:

1. All direct buried conduit shall be PVC coated galvanized rigid steel, unless noted otherwise on Drawings.

2. All conduits in concrete duct banks shall be PVC unless noted otherwise on the Drawings. Where duct bank conduits turn up above finished grade, they shall be PVC coated galvanized rigid steel.

3. All exterior exposed conduit above finished grade shall be rigid aluminum.

4. All conduit in the electrical and control equipment enclosures shall be PVC Schedule 40.

5. All wiring shall be run in conduit.
6. Install conduit so wires may be removed and replaced at a later date.

7. Short runs of flexible nonmetallic conduit with separate ground wire shall be used for connection of motors and instrumentation.

8. Running threads will not be permitted. Use an approved threaded coupling or a suitable union where required. Setscrew couplings will not be permitted.

9. Space supports for conduit not more than 5’ apart. Support conduit by one-hole malleable iron pipe straps or beam clamps. Where it is impractical to use beam clamps and where conduit is installed on building surfaces, use back straps and approved fastening devices with malleable iron pipe straps. All straps and clamps for PVC coated conduit shall be permanently PVC coated by same manufacturer as conduit.

10. Provide conduit expansion fittings in aluminum conduit at 30’-0” intervals.

11. All conduit penetrations into electrical equipment enclosures shall be made using conduit hubs. PVC coated rigid steel conduit systems shall use PVC coated conduit hubs.

12. Bend conduit only by use of an approved pipe bending machine or hickey so the conduit will always retain its cylindrical shape. PVC coated conduit shall be bent and threaded only with tools manufactured for that purpose.

13. If the PVC coating on conduit and fittings is damaged during installation, the damaged conduit or fitting shall be replaced in its entirety by the contractor. Repairing damaged conduit with touch-up paint will not be acceptable.

14. Install metallic electrical warning tape above all underground duct banks and conduit. Tape shall be 6” wide with yellow background and black letters. Letters shall read “CAUTION ELECTRICAL LINE BURIED BELOW”. Install tape 6” below finished grade.

B. Outlet Boxes:

1. An outlet box shall be furnished and installed at each outlet, firmly in place, and set true and square.

2. All outlet boxes shall be supported from the building structure, independent of the entering conduit. All unused knockouts must remain closed.

C. Wiring:

1. The voltage drop at the end of any circuit shall not exceed 3% of the normal line voltage under full load. No wires smaller than #12 AWG shall be used for branch circuits; pilot and control circuits shall not be smaller than #14 AWG.
2. Care shall be exercised in pulling wire into conduit so as not to injure insulation. Use pulling compound as required.

3. Conductors shall be continuous from outlet to outlet. Splice only within outlet or junction boxes.

4. Balance circuits across the phase wires of the branch and distribution panels. Run separate neutral wires for all circuits.

5. Switches shall not be connected to the neutral conductor.

6. Power and control wiring shall be run in separate conduits. AC and DC circuits shall be run in separate conduits.

7. All wiring shall conform to the following color code:
   a. 480 Volt, 3 Phase: Brown, Orange, Yellow - Phase Wires
      Gray - Neutral Wire
   b. 240 Volt, 1 Phase: Black, Red - Phase Wires
   c. 120 Volt, 1 Phase: Black - Phase Wire
      White - Neutral Wire
   d. Control Wires: 120V AC - Red 24V dc - Blue
   e. Ground Wires: Green

8. AC control wires energized from a source external to the control panel power source shall be yellow.

9. All control wiring shall be tagged at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers and terminal strip numbers shown on the control panel wiring diagrams.

D. Splices:

1. Make all splices using solder less connectors. Use wire nut connectors composed of expandable spring steel shell and PVC insulator for size #14 through #8. Temperature rating shall be 105°C. For size #6 and larger, use bolted-type tinned copper pressure connectors, either the straight coupling type or the split bolt type. All connectors #6 and larger shall be wrapped with UL approved linerless rubber splicing tape rated to 69 KV and vinyl plastic electrical tape to the same thickness as the insulation of the wire. Electrical tape shall be Scotch 33+, or equal.
E. Lugs:

1. All lugs used with copper wire and cable shall be tinned copper. Aluminum will not be accepted.

F. Panels:

1. Furnish a typed list identifying all circuits and insert in frames provided inside of panel doors.

G. Mounting Heights:

1. Mounting heights and exact locations of all equipment shall be verified by the Owner before roughing in.

END OF SECTION
SECTION 16060
GROUNDING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials required to complete all work necessary for an electric service and branch distribution grounding system. System shall include but not be limited to all grounding electrodes, ring conductors, connectors, and miscellaneous accessories such as bonding lugs, bushings and jumpers in accordance with the current edition of the National Electrical Code and as specified herein.

2. In addition to grounding/bonding connections required to comply with NEC provisions, a grounding ring system shall be installed as indicated herein or on the Drawings. This system is intended to provide bonding between all process and structural components and the electrical distribution system grounding. The description "process piping" where included herein shall be understood to mean all metallic piping systems where they occur on the site. Other process and structural components shall be grounded as specifically described herein to provide a complete system with all metallic components at the site bonded together.

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI American National Standards Institute, Inc.
ASTM American Society for Testing and Materials
IEEE Institute of Electrical and Electronic Engineers
NEC National Electrical Code of National Fire Protection Association
UL Underwriters' Laboratories

1.3 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings and types of materials.
2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the Drawings and in these Specifications. All pertinent Specification and Drawing requirements shall be indicated on the manufacturer's drawings. Submit shop drawings on the following:

a. Grounding Electrodes  
b. Grounding Conductors  
c. Grounding Conductor Connectors  
d. Conduit Grounding Bushings  
e. Conduit Grounding Jumpers  
f. Exothermic Weld Process and Components  
g. Grounding System Resistance Test Equipment  
h. Grounding System Test Point Sleeves

B. Literature:  

1. Submit manufacturer's latest publications for each item.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Grounding Electrodes:

1. Grounding electrodes shall be 10'-0" long, 3/4" diameter copper clad steel. Exterior shall be electrolytic copper metallically bonded to a round one-piece carbon steel rod. The electrodes shall be fabricated so as to prevent mushrooming of rod head during driving, or a steel-driving stud, manufactured for such a purpose, shall be used.

2. Electrodes shall conform to the requirements of UL Specification No. 467 (ANSI C-33.8-1972).

3. Electrodes shall be Blackburn, Carolina or equal.
B. Ground Conductors:

1. Electric service ground conductor shall be sized in accordance with NEC Article 250-66 and shall be connected to the associated building/structure grounding ring as well as all other equipment and building components required by the NEC.

2. The grounding rings shall be annealed temper, stranded, bare, copper, uncoated type. Individual members of stranded conductor shall meet the requirements of ASTM B3, and the overall fabrication shall meet the requirements of ASTM B8 for stranded conductors.

3. Size of grounding ring conductors shall be #4/0 AWG.

4. All connections between the grounding ring and the individual equipment or building/structure components called for to be grounded herein shall be made using #2/0 AWG copper cable of the same type as the grounding rings.

C. Grounding Jumpers:

1. UL listed jumpers shall be provided on all metallic conduit expansion fittings whether or not the circuit is provided with a separate ground conductor. Jumpers shall be braided, tinned copper, factory connected as a single assembly to two galvanized steel U-bolts. OZ Gedney Type "BJ" (for steel conduit), or equal.

D. Grounding Bus:

1. All power distribution equipment, motor control centers, panelboards, load centers, terminal boxes, transformers, etc. shall be furnished with a factory installed grounding bus or termination point.

E. Electrical Conduit Grounding Bushings:

1. Conduit connectors shall be insulated bushing type for grounding and bonding. Fitting shall have ground lug terminal as well as a bonding setscrew in the circumference of the bushing. Appleton "G1B" series, OZ Gedney "BLG" series, Steel City "BG" series or equal.

F. Exothermic Weld Connections:

1. All underground grounding system connections shall be exothermically welded, including all cable connections to grounding electrodes (rods), concrete reinforcing and any other utilities required to be grounded but are not accessible from above grade.
2. The welding process shall use a mixture of copper oxide and aluminum packaged according to connection type in plastic tubes. The packages shall be nonexplosive and shall not be subject to spontaneous ignition.

3. All welding materials used shall be Cadweld as manufactured by Erico Products, Inc. or equal and shall meet or exceed the requirements of IEEE Standards 80 and 837 and as listed in MIL 419.

G. Exposed Mechanical Type Grounding System Connectors:

1. The following equipment, structural and nonstructural components at the site shall be connected with a #2/0 AWG, soft-drawn, stranded, tinned copper, bare grounding conductor with the described materials or fitting to the associated building or structure grounding ring. (These items are in addition to the electrical distribution grounding requirements described elsewhere herein.) In addition to the component and fitting manufacturers listed herein and on the Standard Details, fittings and components manufactured by Burndy, OZ Gedney, Dossert or Teledyne/Penn-Union will also be accepted:
   a. Main Circuit Breaker
   b. Emergency Generator

2. Components used for grounding conductor connections shall be as indicated herein or on the Drawings.

H. Grounding Conductor Connection Lugs:

1. Grounding conductor connection lugs shall be aluminum for all connections to aluminum materials. Grounding conductor connection lugs for connections to all other materials shall be copper. All aluminum-to-copper connections shall be made according to the lug manufacturer's recommendations using an appropriate cleaning and oxidation prevention compound, Penetrox A-13 or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Grounding system shall comply with the current edition of the National Electrical Code, the current edition of the National Electrical Safety Code and as specified herein.

2. Flexible conduit to motors shall not be used as a ground conductor.
3. All ground conductors shall be copper and sized according to the requirements of the NEC, Table 250-66 and Table 250-122 as applicable.

4. All conduits shall be furnished with a separate ground conductor. Conduits shall not be used as a ground conductor.

5. All metallic electrical conduits shall be bonded to the equipment ground terminal, ground wire or ground bus using an insulated ground bushing and jumpers sized as required by the NEC. Bond shall be provided at all conduit terminations.

6. Flexible jumpers (bonding straps) shall be installed where conduit expansion fittings occur.

7. Ground conductors shall be green, insulated stranded type where installed in conduit.

8. Grounding ring and all associated conductors shall be soft drawn, stranded copper, size 4/0, bare type.

9. Unless otherwise indicated on the drawings or in the specifications, all copper-to-copper or copper-to-steel splices and terminations for ground ring and connections to the ground ring shall be made by controlled exothermic reaction welding process, using the appropriate fittings for the process employed. Steel shall be ground or filed, and copper conductors shall be cleaned, to ensure all surfaces are clean, dry and free from oxide before welding process is performed.

10. System ground ring and top of ground electrodes shall be direct buried to a minimum depth of 24" and a maximum depth of 30". Electrodes shall be driven straight down, perpendicular to the finished grade.

11. Ground electrodes in the ground ring shall be installed at no less than 10' intervals nor greater than 20' intervals.

12. The term "grounding ring" shall be understood to mean a copper conductor, as specified of this Section, buried and connected to grounding electrodes (driven rods) at + 15'-0" intervals, to completely encircle the associated building or structure. Splices in and connections to the copper conductor and grounding electrodes shall be made using an exothermic weld process, as described of this Section.
13. All metallic water piping systems shall be connected to the ground ring at two locations. Where flow meters, valves, flexible piping or any type of nonmetallic connection occur in a piping system, a bonding jumper shall be installed around the device to ensure ground continuity. Jumpers installed under other portions of these specifications, such as reference grounds for process flow meters, etc., shall not be used to replace or be considered as grounding system jumpers.

14. The ground ring shall be furnished with a test point as indicated on the drawings. The test point shall consist of a 6" diameter, Schedule 40 PVC conduit brought flush with finished grade and extending down to 4" below point on ground rod where ring conductor is attached. The PVC shall be notched as required to prevent stress on the ground ring conductor if the PVC conduit is pushed downward from grade for any reason. Provide threaded end cap on top of PVC conduit. End cap shall be labeled "GROUND TEST POINT".

15. Testing of actual ground resistance shall be made by the Contractor before any finish landscaping is accomplished. Testing shall not be performed until all underground connections are made and buried and after all structural steel has been connected to the ground ring. Test shall be made at the ground ring using a megger type ground tester and the "fall of potential" test method. Maximum resistance at the test point shall be 5 ohms unless otherwise noted. Where measured values exceed the above figures, the Contractor shall install additional electrodes at no additional cost to the Owner until further tests indicate the ground resistance has been reduced to the specified limit.

END OF SECTION
SECTION 16210

ELECTRIC SERVICE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials to install a complete electric service to each pump station including termination, metering, conduit, vaults, junction boxes, transformer pads, and all equipment and labor required, as indicated on Drawings and specified herein. Power Company is First Energy (Potomac Edison).

2. Service characteristics of the electric service for each pump station are 277/480 volt, 3 phase, 4 wire wye.

1.2 QUALITY ASSURANCE

A. Contact Power Company for specific instructions regarding service requirements before beginning work. Complete system must meet with power company approval.

B. All work shall be in accordance with the WV Customer Guide for Electric Service - https://www.firstenergycorp.com/content/dam/customer/service%20requests/files/Customer-Guide-for-Electric-Service-WV.pdf

C. Power company representative is Mark Bayer with First Energy Corp.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Service Conduits:

1. Service conduits shall be PVC Schedule 40, electrical grade.

B. Service Disconnect Switch:

1. Provide a service disconnect switch for the electric service as shown on the Drawings.
C. Vaults:
   1. Precast concrete vaults for the service extension to the Northport Pump Station are pre-purchased by the Power Company and are awaiting delivery by AC Miller, Martinsburg, WV.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRIC SERVICE

A. Service Conduits:
   1. Service conduits shall start where shown on the Drawings and run underground to a junction box or the transformer pad (installed by contractor) and continue to the service disconnect switch. The service conduits shall be furnished and installed by the Contractor.

B. Vaults
   1. Service to the Northport Pump Station requires the installation of precast concrete vaults where shown on the Drawings. The Contractor shall coordinate delivery with AC Miller, Martinsburg, WV.

C. Service Conductors:
   1. The service conductors will be furnished and installed by the power company in the service conduit.

D. Metering:
   1. The electric meter base shall be furnished and installed by the Contractor.

E. Costs:
   1. All power company costs for the installation of the electric service will be paid by the Owner.

END OF SECTION
SECTION 16230

EMERGENCY GENERATOR SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish two (2) complete diesel emergency generator systems, one for each Pump Station including generator, prime mover, muffler, exhaust system, cranking battery, battery charger, control panel, sub-base fuel tank, water jacket heater, generator mounted circuit breaker, sound attenuated weatherproof enclosure, and all other necessary material required to complete the system.

2. Furnish and install an automatic transfer switch for each emergency generator.

B. Generator Requirements:

1. Each emergency generator shall be rated for continuous standby service at 60 Hz, 0.8 power factor, 277/480 volts, 3 phase, 4 wire. Refer to Plans for KW and KVA rating for each generator.

1.2 QUALITY ASSURANCE

A. Standards: The engine generator set, and all accessories, shall meet the requirements of:

- UL Underwriters' Laboratory
- NEC National Electrical Code
- NEMA National Electrical Manufacturer's Association
- NFPA National Fire Protection Association (Pamphlets 30, 31, 37, 110)
- MIL-STD 705 B

B. Quality Control:

1. All components of the emergency generator system shall be new and of the most current and proven design.

2. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency system conditions.
3. This generator set system shall be assembled, tested and shipped by one supplier so that there is one source of supply and responsibility.

4. The Supplier shall be a factory trained and certified manufacturer's representative and shall maintain a complete service facility. The service facility shall be capable of making delivery to the generator set site all generator set parts within 48 hours of placing the order. The Supplier shall employ a manufacturer trained and certified technician on a full time basis at the service facility capable of making repairs and responding to service calls within 24 hours of notice. Certified proof of this requirement shall be available from the Supplier.

C. Testing:

1. Prototype tests performed on a generator set of the same size and type, required by these specifications, shall be submitted and approved with the shop drawings, required below. The test procedures and results shall be certified by an independent testing laboratory. The tests shall be performed in accordance with NFPA 110 and shall document the following:
   
a. Maximum power level

b. Maximum motor starting capacity

c. Voltage dip

d. Fuel consumption

e. Engine-generator cooling air flow

f. Governor response time

g. Alternator temperature rise per NEMA MG1-22.40

h. Harmonic analysis and voltage Wave Form Deviation per MIL-STD-705 B, method 601.4

i. Three (3) phase short circuit test for mechanical and electrical strength

2. Factory tests of the generator set to be supplied shall be conducted in accordance with procedures certified by an independent testing laboratory. The manufacturer shall successfully test the generator set to be supplied, document items 1 a-i above and submit the test results for approval before shipping the generator set to the job site. A two-hour load bank test shall be performed and the results submitted before shipping the generator set.
D. Acceptance Tests:

1. Acceptance testing of the installed generator set shall be conducted by a factory-trained representative of the generator set manufacturer. An authorized representative of the Owner shall witness the acceptance tests. The test results shall be submitted to and approved by the Owner before the generator set is accepted. The Supplier shall furnish all testing equipment, materials, etc., including fuel needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the Supplier shall be corrected and, if warranted or requested by the Owner, the test shall be reperformed prior to acceptance. Final O&M Manuals shall be submitted before the acceptance tests commence.

2. The acceptance tests shall be performed during an eight-hour field test during which the manufacturer's representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum, a load bank test, performed in accordance with NFPA 110 section 5-13.2 shall be conducted in accordance with ANSI S 2.41-1985. The load tests shall use dry type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters. Load bank testing shall be performed for a period of four (4) hours at the full rated load of the generator. Salt-water brine tank load banks are not acceptable for this purpose and are disallowed and will not be utilized for this test.

1.3 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information including the following:

   a. Engine generator system plan, elevation and dimensional drawings clearly indicating all aspects of the system including points for each of the inter-connections required.

   b. Engine generator/exciter control cubicle layout and component descriptions.

   c. Sub-base fuel tank, piping schematic and fuel line connection information.
d. Fuel consumption rate curve at various loads, ventilation and combustion CFM requirements.

e. Exhaust muffler and vibration isolator.

f. Schematic ladder and control wiring diagrams for the generator system.

g. Printed literature and brochures describing the system including all sizing requirements and components specified.

h. The weight of the engine, generator and complete system.

i. Points of measurement and maximum vibration readings (measured as velocity) for the installed system recommended by the manufacturer.

j. Battery, battery rack and battery charger literature and description.

k. Sound attenuated weatherproof housing.

l. The specified standby KW of the generator shall be for continuous electrical service during interruption of the normal utility power source and this shall be certified to this effect by the manufacturer for the actual unit supplied.

m. Factory prototype test results performed on a unit of this size and type documenting items (a) through (l) listed in 1.02 C above.

n. Automatic Transfer Switch

B. Operation and Maintenance Manuals:

1. Submit required number of copies of an operation and maintenance manual for the complete emergency generator system. The manual shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. The manual shall include, at the least, all data bearing on the specific generator system necessary for maintenance, operation, parts repair and replacement including all accessories and electrical controls, fire-code safety and operator safety measures, and lubrication schedule. A copy of the approved shop drawings shall be included in the manual. Manual shall be submitted and approved before system will be accepted.

C. Installation Certificate:

1. A factory technician shall inspect the installed generator system and certify in
writing to the installer that it is installed in accordance with the manufacturer's recommendations before the system is initially started. The technician shall be present for the initial start-up and make recommendations to resolve any defects experienced. A copy of the installation certificate must be submitted to the Owner before the generator set is conditionally accepted.

1.4 MANUFACTURER

A. The manufacturer of the generator set shall be Caterpillar, Cummins Onan or Kohler.

PART 2 - PRODUCTS

2.1 GENERATOR EQUIPMENT

A. Engine:

1. The engine shall be the water-cooled in-line or V-type, compression ignition diesel. It shall meet specifications when operating on No. 2 diesel fuel. The engine shall be equipped with filters for fuel, lube oil, intake air, lube oil cooler, fuel transfer pump, fuel priming pump, one foot of flexible fuel line between engine and rigid supply, and gear-driven water pump.

2. The engine shall be controlled by an electronic governor. The governor shall maintain isochronous frequency regulation from no load to full load.

3. The engine shall be equipped with automatic safety controls, which will shut down the engine in the event of low oil pressure, high water temperature, overspeed and overcrank.

4. The engine shall be remote starting with a 2 wire, solenoid shift electric starter.

B. Generator:

1. The generator shall be a three phase, single-bearing, synchronous-type built to NEMA standards, rated for continuous standby at service. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material on end coils to reduce possible fungus and/or abrasion deterioration. The generator shall incorporate a resettable thermal protector for exciter/regulator protection against extended low power factor loads. The generator shall be capable of accepting full nameplate load in one step.

2. A generator-mounted, volts-per-hertz type exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be ±1% from no load to full rated load. Voltage level adjustment shall be a minimum of ±5%. The solid-state regulator module shall be shock-mounted.
and epoxy-encapsulated for protection against vibration and atmospheric deterioration. Voltage dip due to motor starting current shall not exceed 20% under the maximum load conditions.

3. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system over current devices.

4. The alternator shall be 105°C rise at standby rating.

C. Cooling System:

1. The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when the generator set is delivering full rated load at an ambient temperature of 125°F.

2. The engine cooling system shall be filled with a solution of 50% ethylene glycol. Cooling system shall be pretreated by supplier for inhibition of internal corrosion.

3. The engine shall be equipped with a radiator having a blower type fan. The radiator shall have a duct adapter flange, and shall be equipped with a fan guard and core guards.

D. Starting System:

1. The engine shall be equipped with a DC electric starting system of sufficient capacity to crank the engine at a speed, which will allow full diesel starting of the engine. The motor voltage shall be as recommended by the engine manufacturer.

2. Fully automatic generator start/stop controls shall be provided in the generator control panel to start the generator automatically from a contact in the automatic transfer switch.

3. When the engine starts, the starting control shall automatically disconnect the cranking controls. The cranking disconnect means shall be electrically self-regulating to prevent recranking for a definite time after source voltage has reduced to a low value. If engine fails to start, or any safety device operates while engine is running, engine shall be stopped immediately and starting control locked out, requiring manual resetting.

4. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed and overcrank. Controls shall include a 10-second cranking cycle.
limited to 3-5 attempts before lockout.

5. The automatic engine starting control shall incorporate industrial control type elements throughout, which must operate at 80% battery voltage. Relays shall be equipped with silver-gold contacts of the wiping type and shall have adequate pressure to insure reliable performance at battery voltage.

6. Batteries:

   a. A lead/acid storage battery set of the heavy-duty starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated for a minimum of 172 hours and shall be of sufficient capacity to provide for 1½ minutes total cranking time without recharging. It shall be sized for the cold cranking amps as recommended by the battery manufacturer. A wood bottom, fiberglass treated, battery rack and necessary cables and clamps shall be provided. The battery rack shall be isolated from the engine to protect it from excessive vibration, and shall be readily accessible for service and/or removal.

7. Battery Charger:

   a. A 10-amp current limiting battery charger shall be furnished to automatically recharge the batteries. The charger shall include overload protection, silicon diode-full wave rectifiers, voltage surge suppressors, DC ammeter, and AC over current protection. AC input voltages shall be the same as the generator output voltage.

   b. The battery charger shall be mounted inside the generator housing.

E. Jacket Water Heater:

1. Provide an engine mounted thermostatically controlled water heater to maintain the engine jacket water temperature at 100°F. Heater shall be sized as recommended by the manufacturer.

2. The heater for the generator shall operate on 120 volts, 1 phase power.

F. Sub-base Fuel Tank:

1. Furnish and install a sub-base fuel tank under the generator. The fuel tank shall be sized to run the generator for 24 hours at full load. The minimum size of the fuel tank shall be 140 gallons.

2. Tank shall be double wall construction, with a float switch between walls. Float switch shall be wired to an alarm light on the generator control panel.
3. Tank shall have a fuel level gage mounted next to fill pipe.

4. Tank shall have a low fuel level float switch, which shall be wired to an alarm light on the generator control panel.

5. Fill and vent pipes shall be as recommended by manufacturer, and installed by the Contractor.

6. Exact location of fill pipe and vent shall be coordinated with Owner.

7. All fuel connections at the engine shall be made using wire reinforced flexible hose.

G. Exhaust System:

1. Provide a critical type exhaust silencer, including stainless steel flexible exhaust fitting, properly sized according to the manufacturer's recommendation. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer. The silencer shall be manufactured by Maxim, or equal.

2. Provide taps for drainage with petcock drain valves, drip cap, rain cap, wall thimble and accessories.

3. The exhaust silencer shall be installed inside the generator housing.

4. The exhaust piping and muffler shall be insulated with insulating blankets.

H. Engine Generator Set Mounting:

1. The engine generator shall be mounted in perfect alignment on an all welded preformed structural steel I-beam or C channel skid type sub-base which shall provide for attachment of all specified engine and generator accessories.

2. Provide spring-type vibration isolators for mounting between the engine generator set mounting rails and the sub-base fuel tank. The size and quantity of isolators shall be as recommended by the manufacturer.

I. Generator Control Panel:

1. Provide a generator-mounted control panel. The control panel shall be mounted on the generator terminal box and shall be vibration isolated. The generator control panel shall contain, but not be limited to, the following equipment:
a. Digital AC Voltmeter  
b. Digital AC Ammeter  
c. Digital AC Frequency Meter  
d. Ammeter - Voltmeter Phase Selector Switch  
e. Automatic Starting Controls  
f. Voltage Level Adjustment Potentiometer  
g. Run-stop-remote switch and remote start-stop terminals  
h. Alarm lights for low oil pressure, low engine temperature, high water temperature, overspeed, overcrank, low fuel tank level and fuel tank leak  
i. Engine Temperature and Pressure Gauges  
j. DC Charging Volts and Ampere Gauges  
k. Running Time Meter  
l. Dry Contacts for run indication, common alarm, low fuel tank level and fuel tank leak wired to terminal strips  
m. Panel illumination lights and switch  

J. Generator Circuit Breaker:  

1. A main line molded case 3-pole circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually as an isolation switch and automatically during overload and short circuit conditions.  

2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electrical Manufacturer's Association, and National Electrical Code.  

3. The circuit breaker shall be mounted in a NEMA 12 type enclosure, adjacent to the generator control panel.
K. Weatherproof Enclosure:

1. Provide a weatherproof, sound attenuated 16 gauge painted aluminum enclosure for the generator. The enclosure shall be drip-proof to prevent water from entering enclosure and shall be provided with heavy-duty “lockable” latches to ensure tamper-proof security and safety. Sound shield shall be provided with lifting eyes for ease of installation.

2. The enclosure shall have solid access doors with door handles keyed alike. Doors shall have 3-point latches, stainless steel butt hinges, stainless steel door holders, and rain gutters above doors.

3. The enclosure shall have an advanced sound-attenuation design. The noise at 7 meters shall be 71 dBA or less, at full load.

L. Painting:

1. The complete generator set shall be painted with the manufacturer’s standard prime and finish paint system. Observed nicks, damage, rust, etc. to the paint system of the installed generator set shall be prepared, primed and finish coated in the field prior to conditional acceptance.

2.2 AUTOMATIC TRANSFER SWITCH

A. General:

1. Furnish and install a 480 volt, 3 pole, 4 wire NEMA 12 automatic transfer switch for utility and generator service. The transfer switch shall be suitable for continuous operation. Refer to plans for ampacity ratings.

2. The transfer switch shall consist of a double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. The transfer switch and controller shall be products of the same manufacturer.

B. Automatic Transfer Switch:

1. The transfer switch shall be a double-throw switch operated by a single coil mechanism momentarily and electrically. Operating current for transfer shall be obtained from the source to which the load is to be transferred. Failure of any coil or disarrangement of any parts shall not permit a neutral position. The switch shall be positively locked mechanically on either source without the use of hooks, latches, semi-permanent magnets, or contacts. All contacts and coils shall be readily accessible for replacement from the front of the panel without major disassembly of associated parts.
2. The transfer switch shall be arranged to close a contact for remote starting of the diesel generator, after a time delay of 0-6 seconds, after power failure or drop in any phase voltage to 70 percent of line voltage. During the delay period, the load circuits shall not be disconnected from the normal service lines.

When the generator is delivering not less than 95 percent of rated voltage and frequency, the load circuits shall be transferred. Retransfer to normal service shall be automatic when full line voltage and phase are restored after a time delay of 0 to 60 minutes. Provisions shall also be made for manual transfer to the generator. After transfer to normal source, the generator shall continue to run for 5 minutes (adjustable 0 to 60 minutes) unloaded, shall shut down and shall be ready to start upon the next failure of the normal source or for manual start-up. If the generator should fail while carrying the load, retransfer to the normal source after a short delay shall be made upon restoration of the normal power. The pick-up and drop-out settings of the phase voltage-sensing relays shall be completely adjustable in the field from 70 percent to 100 percent pick-up and drop-out.

3. The transfer switch shall be equipped with a three phase power monitor to indicate a failure of the normal power.

4. The transfer switch shall be equipped with a test button, and auxiliary contacts as required to show that the switch is in the normal or emergency position. Provide pilot lights on the enclosure door to indicate the switch position.

5. Auxiliary contacts shall be provided for remote indication of the transfer switch position. The contacts shall be wired to a terminal block inside the switch enclosure.

6. The transfer switch shall have a load test switch to simulate normal power failure.

7. The transfer switch shall be furnished with an in-phase monitor.

8. The controller shall incorporate a 7-day solid-state exercise clock to set the day, time and duration of the generator exercise period. Furnish a selector switch to enable the generator to be exercised with or without load.

9. Minimum withstand and closing ratings of the transfer switch shall be in accordance with UL 1008.

10. The automatic transfer switch shall be the same manufacturer as the emergency generator.
PART 3 - FIELD SERVICES

3.1 TECHNICAL SERVICES

A. The manufacturer of the emergency generator shall furnish a qualified technician, whose qualifications are acceptable to the Owner, to provide the following services:

1. Inspection of the installation of the emergency generator system
2. Start-up
3. Performance testing
4. Operating adjustments
5. Instruction of Owner's personnel
6. Assistance at final inspection

B. These services shall include not less than two 8-hour workdays on-site comprising a minimum of two trips per generator.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials to complete lighting fixture installation and associated items indicated, specified herein or both. Fixtures of size and type specified herein shall be supplied, installed and connected for each outlet indicated on the Drawings. Furnish and install lamps in each fixture.

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

1. Fixtures shall be U.L. listed.

2. All fixtures shall meet all Federal, State and local required criteria.

3. All light fixtures shall be mounted in accordance with manufacturer's recommendations.


5. The installation must comply with the amended National Electrical Code of the National Fire Protection Association.

B. Qualification:

1. When more than one name of manufacturer of fixture is listed in these specifications, the first manufacturer and number determine the style and quality.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit manufacturer's latest publication of each fixture including ballast information, construction details, light distribution details and/or coefficients.
PART 2 - PRODUCTS

2.1 MATERIALS

A. LED Drivers:

1. LED light driver shall be of high efficiency.

2. LED light driver shall allow operation of all other LEDs in the event of an LED failure.

B. Light Fixture Schedule:

1. PA: Pole mounted, 120 volt, high efficiency LED architectural site fixture. The fixture shall have IP66 rated borosilicate glass optics, 4000K, 70 CRI minimum, forward throw lighting distribution. The fixture housing shall be constructed of die-cast copper-free aluminum with epoxy powder finish. The fixture shall have stainless steel latches and hardware, and shall be wet location rated. The LED light engines shall be rated for 100,000 hours at 25°C. The fixture shall have photoelectric control. Fixture shall be mounted on a 5” square, 15 foot high aluminum pole with dark bronze finish. Provide stainless steel anchor bolts for the installation of each pole. Fixture shall be Holophane Mongoose LED #MGLED-4-4K-AS- F-L-A-Z.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation:

1. Contractor shall furnish supports for the light fixtures.

2. The fixture manufacturer's catalog numbers describing the various types of fixtures shall be used as a guide only and do not include all the required accessories or hardware that may be required for a complete installation. The Contractor shall be responsible for furnishing, at no additional cost to the Owner, all required accessories and hardware for a complete installation.

3. All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance by the Owner and Engineer.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall obtain the services of a subcontractor who shall provide a complete integrated Pump Control System (PCS) for the wastewater pump stations consisting of solid state reduced voltage (SSRV) motor starters, control panels, instrumentation, programmable controller system hardware and software, a spread spectrum radio system, and software programming as shown on the Drawings and as specified in Division 17. This subcontractor will hereafter be referred to as the Pump Control System Supplier. The System Supplier shall have total responsibility for the design, programming, testing, start-up and implementation of the Pump Control System.

2. The Pump Control System Supplier shall be one of the following System Integrators. No other suppliers will be accepted without approval prior to the bid:

C.I. Thornburg Company, Inc. Micro-Tech Designs, Inc. 4034
Altizer Ave. 4312 Black Rock Rd.
P.O. Box 2163 Suite 1
Huntington, WV 25722 Hampstead, MD 21074
304-523-3484 410-239-2885
Contact: Randy Clark Contact: Cameron Farzanfar

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI American National Standards Institute
IEEE Institute of Electrical and Electronic Engineers
ISA International Society of Automation
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
UL Underwriters' Laboratories, Inc.
B. Quality Control:

1. All components of the Pump Control System shall be new and of the most current and proven design. All components shall be suitable for the intended application and shall be installed and wired in strict accordance with the manufacturer’s requirements. The System Supplier shall provide all necessary transformers, power supplies, fusing, and grounding required to meet the manufacturer’s requirements.

2. The complete system must comply with all Federal, State, Municipal, or other authority’s laws, rules, or regulations.

3. All control panels, and their components and materials, shall bear the label of the Underwriters’ Laboratory. All control panels shall be UL listed as a complete assembly.

C. Equipment Manufacturers:

1. The Pump Control System Supplier shall base his bid on providing the manufacturers specified under Division 17 for all equipment furnished for the System. No substitutes will be allowed without prior approval.

1.3 SUBMITTALS

A. General:

1. Submit in accordance with Section 01300.

B. Shop Drawings:

1. Submit required number of detailed shop drawings for all equipment being provided for the Pump Control System. Shop drawings shall be submitted within 60 days of the date of Notice to Proceed.

2. Shop drawings shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly, and indexed. Separate shop drawing submittals shall be made for each of the following:

   a. SSRV Motor Starters
   b. Control Panels
   c. Spread Spectrum Radio System
   d. Instrumentation
e. Programmable Controller System Hardware and Software

f. Customized HMI Graphic Screens

3. Refer to specification sections for specific shop drawing requirements.

4. The System Supplier shall submit a complete set of engineered drawings for the SSRV Motor Starters, Control Panels, and Programmable Controller System hardware. These engineered drawings shall be similar to the Contract Drawings, and shall be done by the System Supplier using AUTOCAD. The drawing size shall be 11"x17". These drawings shall include, but not be limited to, the following:


   b. SSRV Motor Starter elevations and details showing door mounted devices and dimensions. Three line wiring diagrams for each motor starter showing power and control wiring, starter components and devices, terminal numbers, and interconnecting wiring.

   c. Control panel elevation, details, front and back panel layout, and wiring diagrams showing terminal numbers and interconnecting wiring. The control panel layout drawings shall include dimensions for the location of all panel-mounted devices.

   d. Programmable controller system power wiring diagrams and I/O wiring diagrams showing terminal numbers and interconnecting wiring.

C. Installation, Operation and Maintenance Manuals:

1. Submit required number of copies of installation, operation and maintenance manuals for all equipment being provided for the Pump Control System.

2. Installation, operation and maintenance manuals shall be submitted in 3- ring loose-leaf binders, and shall be complete, neat, orderly and indexed. Separate binders shall be submitted for each of the following:

   a. SSRV Motor Starters

   b. Control Panels

   c. Spread Spectrum Radio System

   d. Instrumentation

   e. Programmable Controller System Hardware

   f. Programmable Controller System Software

   g. Customized HMI Graphic Screens
PART 2 - PRODUCTS

2.1 SEE SPECIFIC SECTIONS FOR PRODUCTS

PART 3 – EXECUTION

3.1 COORDINATION

A. The Pump Control System Supplier shall attend an initial coordination meeting with the Engineer, the Contractor and the Owner to review the scope of the project and the project schedule.

3.2 RADIO PATH SURVEY

A. The System Supplier shall perform a radio path survey to confirm the radio path from each pump station to the Wastewater Treatment Plant, and to determine the exact mounting location and height of the antennas at each site.

B. The radio survey shall be performed using the same type of radios that will be installed in the project. The System Supplier shall provide all necessary equipment and hardware to perform the radio survey.

C. A radio survey report shall be submitted as a shop drawing submittal.

3.3 FACTORY ACCEPTANCE TEST

A. The System Supplier shall conduct a factory acceptance test for the Pump Control System prior to shipment of the equipment. The factory test shall be conducted at the supplier’s facility and shall demonstrate the control system was designed and performs in accordance with the Specifications and Drawings. All equipment furnished for the Pump Control System shall be assembled and inter-wired so that it functions as a complete system for the factory acceptance test.

B. The System Supplier shall provide all necessary equipment and hardware required to conduct the factory test.

C. The factory acceptance test shall demonstrate the proper operation of all control logic described in the Description of Operation, and all system hardware and software. The factory test shall be witnessed by the Engineer and the Owner.

D. Submit an itemized test procedure and schedule for the factory acceptance test to the Engineer for his review prior to the actual test.
3.4 RECORD DRAWINGS

A. Submit required number of record or as-built drawings for the Pump Control System prior to the delivery of any equipment to the site. Provide an as-built drawing in the control panel.

B. Following start-up and commissioning of the system, the System Supplier shall make all necessary changes to the as-built drawings and re-submit required number of final as-built drawings. A final as-built drawing shall also be provided in the control panel.

3.5 SYSTEM INSTALLATION, START-UP AND COMMISSIONING

A. System Installation:

1. The System Supplier shall provide on-site supervision and advice to the installing contractor to insure the system is installed in accordance with the specifications and the manufacturer’s requirements.

2. All field wiring to the equipment furnished by the System Supplier shall be performed under the electrical portion of the Contract unless noted otherwise on the Drawings.

B. System Start-Up:

1. Start-up the control system by energizing the system equipment and testing the operation of all hardware, software, process control logic, and all customized software programs.

2. All start-up and testing shall be scheduled, performed in an orderly sequence, and conducted in the presence of and to the satisfaction of the Engineer and the Owner.

C. System Commissioning:

1. Calibrate all instrumentation, and place the complete control system into operation. The commissioning of the system shall include the overall calibration and tuning of all control loops and sequences to provide stable control of the pumps. The validity of all inputs and outputs for the system shall be checked and corrected during the system commissioning.

2. The System Supplier shall provide someone on-site for the length of time necessary for system installation, start-up and commissioning.
3.6 FINAL ACCEPTANCE TEST

A. Following the commissioning of the Pump Control System, and the issuance of the Certificate of Substantial Completion to the Contractor by the Engineer, a final acceptance test shall be conducted for a period of 30 consecutive days. This test shall be scheduled with the Owner and the Engineer and shall not begin until the System Supplier receives written approval to start. During that time period, the system shall operate satisfactorily and in compliance with the Specifications. The System Supplier shall promptly correct any problems that occur during the final acceptance test.

B. Following the successful completion of the final acceptance test, a certificate of final acceptance will be issued to the System Supplier.

3.7 EXPANSION OF SYSTEM I/O

A. The System Supplier shall include in his cost for this Contract the addition of ten (10) I/O points to the system as directed by the Engineer. These additional I/O points will originate from the spare I/O. The Supplier's allowance shall include all costs to add these points to the system including drawing changes, software programming, and field verification.

3.8 ADDITIONAL SOFTWARE CONFIGURATION AND PROGRAMMING

A. The System Supplier shall include in his cost for this Contract, sixteen (16) additional man-hours of on-site time for software configuration and programming. This time shall be utilized for changes and/or additions that may be required after the commissioning of the system. The Supplier's cost for these additional man-hours shall include software documentation changes.

3.9 TRAINING

A. During the final acceptance test, the System Supplier shall arrange for the instruction and training of the Owner in the operational procedures of the system. At the end of the training, the Owner shall have, as determined by the Engineer, sufficient knowledge to operate the system. This training shall be for two people for one (1) day, and shall be conducted at the pump station sites. This training shall be in addition to the training specified in the other Division 17 sections.

END OF SECTION
SECTION 17150

SOLID STATE REDUCED VOLTAGE MOTOR STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish and install a solid state reduced voltage (SSRV) motor starter for each sewage pump as shown on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI American National Standards Institute
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
UL Underwriters Laboratories, Inc.

B. The motor starters shall be built to applicable NEMA standards and be suitable for use as a component to meet NEC requirements. Motor starters shall be listed by Underwriters Laboratories (UL).

C. Quality Control:

1. The motor starters shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete the installation.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and elevations. Shop drawings shall include manufacturer’s literature and complete information on the following:
a. Solid State Reduced Voltage Motor Starters
b. Starter Enclosure
c. Starter Disconnect Switch
d. Starter Fuses
e. Selector Switches
f. Pilot Lights
g. Relays
h. Seal Leak Relays
i. Elapsed Time Meters
j. Panel Layout Drawings
k. Wiring Diagrams

1.4 MANUFACTURER

A. The Solid State Reduced Voltage Motor Starters shall be Allen-Bradley SMC Flex, or equivalent by Square D.

PART 2 - PRODUCTS

2.1 SOLID STATE REDUCED VOLTAGE MOTOR STARTERS

A. General:

1. The solid state reduced voltage motor starters shall provide a soft start and shall limit the current during motor starting. The solid state starters shall have an electronic overload and a built-in SCR bypass to bypass the SCRs when the motor is up to full speed.

2. The solid state starters shall have a LCD display and a keypad for programming and configuring the starter.

3. Provide protective modules containing metal oxide varistors for each starter to protect the power components from electrical transients.

4. Provide an IEC isolation contactor for each starter.

5. The starters shall operate on 480 VAC, 60 Hz line power, and shall not be affected by voltage fluctuations of ±10% or frequency fluctuations of ±2%. The starters shall include phase-to-phase and phase-to-ground protection, and transient voltage surge protection.
6. The motor starters shall be designed to operate a 460 volt, 3 phase, submersible AC induction motor. Refer to Drawings for motor horsepower. The starter output amp rating shall exceed the motor nameplate FLA rating.

B. Starter Enclosure:

1. Each motor starter shall be mounted in a NEMA 12 disconnect enclosure sized to dissipate the heat generated by the starter. Provide ventilation louvers as required.

C. Starter Disconnect Switch:

1. A main flange-mounted disconnect switch shall be mounted in the starter enclosure to disconnect power to the motor starter. The disconnect switch shall be sized for the full output current rating of the starter.

D. Starter Fuses:

1. Provide fuses on the line side of the motor starter for branch circuit protection. The fuses shall be as recommended by the starter manufacturer.

E. Motor Starter Controls:

1. Each motor starter shall be furnished with start/stop controls as indicated on the Drawings and in the Description of Operation.

2. These controls shall include, but not be limited to, the following:
   a. Motor Starter Auxiliary Contact
   b. Motor Starter Fault Contact

F. Starter Keypad Module:

1. A keypad module shall be mounted on the starter enclosure for digital set-up of the motor starter, starter parameter review and starter fault annunciation.

2.2 STARTER CONTROL COMPONENTS

A. Control Transformer:

1. Provide a control power transformer for each motor starter control circuit. Control transformers shall be 480 volts to 120 volts and shall be protected according to code. Size shall be as required plus 100 VA additional capacity.
B. Selector Switches:

1. Selector switches shall be non-illuminated. Switches shall be 30.5 mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks as indicated on the Drawings or in the Description of Operation. Provide a gray legend plate for each switch with white marking as indicated on the Drawings. Selector switches shall be Allen-Bradley Bulletin 800T, NEMA Type 4/13, or equal by Square D.

C. Pilot Lights:

1. Pilot lights shall be LED, push to test, transformer type. They shall be 30.5 mm, heavy-duty, oil tight. Voltage rating shall be 120 volts. Color caps shall be green for "run", red for "alarm". Provide a gray legend plate for each switch with white marking as indicated on the Drawings. Pilot lights shall be Allen-Bradley Bulletin 800T, NEMA Type 4/13, or equal by Square D.

D. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the drive enclosure. Contact configuration shall be 3PDT. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized.

2. Relays shall be Idec RR Series, or equal.

E. Seal Leak Relays:

1. Provide a seal leak relay for the sewage pump inside the starter enclosure to monitor a pump seal leak alarm. Coordinate the specific requirements for the seal leak relay with the pump manufacturer.

F. Elapsed Time Meters:

1. Elapsed time meters shall be time totalizer, non-resettable. They shall have a synchronous motor, which shall drive a set of digit readout wheels to indicate the total time the unit is energized. Readout shall be five-digit including 1/10 digit. Range shall be 0 to 9999.9 hours. Voltage rating shall be 120 volts.

2. Elapsed time meters shall be ENM Series T50.

G. Control Wiring:

1. All 120 VAC control wiring shall be red. Wiring for 24vdc PLC inputs shall be blue.
2. All wiring in the motor starter enclosure shall be labeled.

H. Control Terminal Block:

1. Provide a control terminal block in the starter enclosure to terminate all control wiring from the field. All terminals shall be labeled.

I. Nameplates:

1. Provide an engraved lamacoid nameplate on each starter enclosure. Nameplate shall be black with white letters and shall be engraved as indicated on the Drawings. Minimum size of engraving shall be 1/2".

2.3 SPARE PARTS

A. Provide the following spare parts for the motor starters provided:

1. Six (6) Fuses for each size and type utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer’s part number.

PART 3 - EXECUTION

3.1 FIELD SERVICES

A. Start-up and Testing:

1. Provide the services of a manufacturer’s representative to start-up, adjust and test each SSRV motor starter. Demonstrate start/stop control and fault diagnostics in response to both manual and automatic starter controls.

2. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide four (4) hours of on-site training on the solid state reduced voltage motor starters. Training shall be specific for the motor starters provided and shall include theory of operation, maintenance and troubleshooting procedures. All training shall be performed by a qualified manufacturer’s training specialist.

END OF SECTION
SECTION 17200
CONTROL PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish and install the following control panels for the Pump Control System:
   
a. War Admiral Pump Station Control Panel
   
b. Northport Pump Station Control Panel

2. The control panels shall be provided by the Pump Control System Supplier and shall be complete, and include all components and wiring as shown on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

A. Regulations and Standards:

   ANSI    American National Standards Institute
   IEEE    Institute of Electrical and Electronic Engineers
   ISA     International Society of Automation
   NEC     National Electrical Code
   NEMA    National Electrical Manufacturers Association
   UL      Underwriters' Laboratories

B. The control panel components shall be of the most current and proven design. Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the control panels. The components provided by the System Supplier shall be compatible with the functions required and shall form a complete working system.

C. The control panels shall be UL listed as a complete assembly in accordance with UL-508.

1.3 SUBMITTALS

A. Shop Drawings:
1. Submit shop drawings on the control panels in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall include a complete bill of material, catalog information, descriptive literature of all components, UPS load study, wiring diagrams, and panel layout drawings showing dimensions to all devices.

PART 2 - PRODUCTS

2.1 CONTROL PANEL COMPONENTS

A. Control Panel Enclosure:

1. The control panel enclosure shall be designed and sized in accordance with the requirements of the Drawings and as specified herein. Control panel enclosures shall be manufactured by Hoffman, or equal.

2. Wall mounted steel enclosures shall be NEMA 12, constructed of 14 gauge steel with continuously welded seams. Panel shall have piano type hinged doors with neoprene gasket. Following fabrication, the control panel shall be degreased, cleaned and treated with a phosphatizing process, then primed and painted inside and out with an industrial grade enamel. The inside of the control panel shall be painted white. The exterior of the control panel shall be painted gray.

3. Wall mounted stainless steel control panel enclosures shall be NEMA Type 4X, constructed of 14 gauge, Type 316 stainless steel.

4. The control panel components shall be properly identified with an engraved nameplate mounted on the inside of the panel. All components not mounted on the front of the panel shall be mounted to a subpanel. All wiring shall be installed in a neat, workmanlike manner and shall be grouped, bundled, supported and routed horizontally and vertically to provide a neat appearance. All wires leaving the panel shall be terminated at the terminal strips inside the enclosure. Terminals and wires shall be identified in accordance with the Supplier’s panel wiring diagrams.

5. Provide a copper grounding plate inside the control panel for terminating all ground wires.

6. Provide a plastic data pocket inside each control panel.

B. Enclosure Light Fixture:

1. Provide an LED light fixture in control panels where indicated on the Drawings to illuminate the enclosure. The light fixture shall have a low profile design with a non-yellowing lens cover and a manual switch. The light fixture shall be Hoffman.
C. Control Circuit Breakers:

1. Circuit breakers shall be quick-make, quick-break thermal magnetic molded case type, individually mounted and identified. Circuit breakers shall be Allen-Bradley Bulletin 1492-CB, or equal.

D. Transient Voltage Surge Suppressors:

1. Provide a 120 volt, 1 phase transient voltage surge suppressor in control panels where indicated on the Drawings to protect the panel components from damage which may occur from transient overvoltages caused by lightning or surges on the incoming power line.

2. The surge suppressors shall have an indication light and an alarm contact to indicate if the unit has failed.

3. Surge suppressors shall be Citel, or equal by Phoenix Contact.

E. Uninterruptible Power Supply (UPS):

1. Provide a UPS in control panels where indicated on the Drawings to power the equipment in the panel. The UPS shall provide lightning and surge protection, spike attenuation, galvanic isolation, noise isolation, and a regulated 120 volt, 1-phase power supply. The power output shall be continuous with no interruptions.

2. The UPS shall be sized by the System Supplier based on the maximum power requirements of the control panel and for a minimum run time of 10 minutes. The UPS shall be furnished with two (2) alarm contacts to indicate when the UPS is operating on battery power and when the UPS battery needs replaced.

3. The UPS shall be Allen-Bradley Bulletin 1609, or equal.

F. 24 Volt DC Power Supplies:

1. 24 volt DC power supplies shall be mounted in control panels, where indicated on the Drawings, to supply 24 volt DC power for the 24 volt DC programmable controller inputs and for the 2-wire instrumentation. Provide a redundancy module for each pair of power supplies, so that if one power supply fails, the other power supply will continue to supply the total load. The power supplies shall be sized as required.

2. The 24 volt DC power supplies shall be Phoenix Contact Quint, Allen-Bradley Bulletin 1606, or equal.
G. Selector Switches:

1. Selector switches shall be 30.5mm, heavy-duty, non-illuminated. Switches shall have double-break silver contacts. Switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks on switches where indicated on the Drawings or in the Description of Operation. Provide a legend plate for each switch with white marking as indicated on the Drawings. Selector switches shall be Allen-Bradley Bulletin 800H, NEMA 4X, or equal by Square D.

H. Push Buttons:

1. Push buttons shall be 30.5mm, heavy-duty, non-illuminated. Push buttons shall have double-break silver contacts. Push buttons shall be momentary contact type, color-coded as indicated on the Drawings. Push buttons shall have flush heads. Provide a gray legend plate for each push button with white marking as indicated on the Drawings. Push buttons shall be Allen-Bradley Bulletin 800H, NEMA 4X, or equal by Square D.

I. Pilot Lights:

1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Lens color shall be as indicated on the Drawings. Provide a gray legend plate for each pilot light with white engraving as indicated on the Drawings. Pilot lights shall be Allen-Bradley Bulletin 800H, NEMA 4X, or equal by Square D.

J. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the panel enclosure. Terminals for relays having AC coils shall be pin type, and terminals for relays having DC coils shall be blade type. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be Idec RR Series, or equal.

K. Intrinsically Safe Relays:

1. Provide an intrinsically safe relays in control panels where indicated on the Drawings.

2. The intrinsically safe relays shall be a single channel repeater with a DPDT set of output contacts and shall operate on 120 volts AC.
3. The intrinsically safe relays shall be Stahl I.S. Isolators Type 9170, or equal.

L. Intrinsically Safe Barriers:

1. Provide an intrinsically safe barrier in the control panel for the signal cable from the wet well level transducer. The intrinsically safe barriers shall be Stahl, or equal.

M. Fuses:

1. All fuses shall be sized as required for the circuit they are protecting. Fuses shall be Bussmann, touch-safe type, or equal.

N. Terminal Blocks:

1. Terminal blocks shall be provided in each control panel for terminating field wiring. All terminal blocks shall be rated for 600 volts AC, and shall be identified with a permanent machine printed marking in accordance with the terminal numbers shown on the panel wiring diagrams.

2. Terminal blocks for 24vdc inputs shall be blue.

3. Provide 20% spare terminal blocks in the control panel.

4. Terminal blocks shall be Allen-Bradley Bulletin 1492-W4, or equal.

O. Wiring:

1. All wiring shall be stranded copper. Control wiring shall be 16 gauge, 600 volt, Type MTW. Power wiring shall be 600 volt, Type MTW, sized as required.

2. All analog signal wiring shall be 18 gauge twisted pairs with foil shield and drain wire, with 300 volt, 90°C insulation. Drain wires shall be grounded at one end only.

3. All wiring and terminal strips shall be isolated by voltage levels to the greatest extent possible.

4. All wiring shall conform to the following color code:

   a. 120 volt, 1 phase: Black, White

   b. 24vdc: Blue

   c. 120 VAC Control Wires: Red
d. Ground Wires: Green

5. 120 VAC control wires energized from a source external to the control panel power source shall be yellow.

6. Wiring for intrinsically safe circuits shall be purple.

7. All control wiring shall be tagged at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers shown on the control wiring diagrams, and shall match terminal strip numbers.

P. Nameplates:

1. Provide laminated phenolic nameplates on the front of each control panel. Nameplates shall be black with white engraved letters. Engraving shall be as indicated on the Drawings. Minimum size of engraving shall be 1/4”.

2.2 SPARE PARTS

A. Provide the following spare parts for the control panels:

1. One (1) 24 volt DC power supply for each size utilized
2. Two (2) general purpose relays for each type utilized
3. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer’s part/stock number.

PART 3 - EXECUTION

3.1 FIELD SERVICES

A. Start-up and Testing:

1. Test the operation of each control panel and all controls.
2. Start-up each control panel and place the control panel into operation.
3. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

END OF SECTION
SECTION 17250
SPREAD SPECTRUM RADIO SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish and install a complete spread spectrum Ethernet radio system as shown on the Drawings and specified herein to provide for remote monitoring of the wastewater pump stations from the Charles Town WWTP.

2. Furnish and install a directional antenna, antenna cable, and associated accessories for each radio as indicated on the Drawings. Furnish and install all mounting hardware required for the installation of each antenna.

3. Perform all programming required to integrate the spread spectrum radio system into the Wastewater Pump Station SCADA System.

B. Description of Operation:

1. The Description of Operation for the Wastewater Pump Stations is contained in Section 17500. All system configuration and programming shall be performed to meet the requirements of this description.

1.2 QUALITY ASSURANCE

A. Regulations and Standards:

ANSI American National Standards Institute
IEEE Institute of Electrical and Electronic Engineers
ISA International Society of Automation
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
UL Underwriters' Laboratories

B. All spread spectrum radio system components shall be of the most current and proven design. Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the radio system. The components provided shall be compatible with the functions required and shall form a complete working system.
1.3 SUBMITTALS

A. Shop Drawings:

1. Submit detailed shop drawings on the spread spectrum radio system in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall include a complete bill of material, catalog information, descriptive literature of all components, wiring diagrams, and mounting details. Submit shop drawings on the following:

   a. Spread Spectrum Ethernet Radios
   b. Radio Software
   c. Radio Antennas and Mounting Hardware
   d. Antenna Grounding Kits
   e. Antenna Cable
   f. Lightning Arrestors
   g. Antenna Towers

1.4 WARRANTY

A. Provide a five (5) year warranty on the Ethernet radios. The warranty shall start on the date of start-up for the radio system.

PART 2 - PRODUCTS

2.1 SPREAD SPECTRUM RADIOS

A. Ethernet Radios:

1. The Ethernet radios shall meet FCC rules for unlicensed operation in the 902-928 MHz band. The radio shall use the frequency hopping spread spectrum technique for data transmission.

2. The radios shall be capable of functioning as a master, repeater or slave.

3. The radios shall have user selectable 128/192/256-bit AES encryption security features.

4. The radios shall have a selectable receive sensitivity of 125, 250, and 500 kbps
5. The radios shall have an RJ45 Ethernet port, and RS-232 and RS422/485 serial ports. The Ethernet transmission rate shall be 10/100 Mbps.

6. The Ethernet radios shall operate on 24vdc power and shall have a carrier power of 1 watt.

7. The radios shall be furnished with configuration and diagnostic software to configure the radio and to diagnose the radio communications.

8. The Ethernet radios shall be Phoenix Contact trusted wireless Ethernet radios, Model RAD-ISM-900-EN-BD.

9. The radios shall meet the following specifications:
   a. Mounting: Din Rail
   b. Dimensions: 2.1" x 3.9" x 4.5"
   c. Weight: 0.65 pounds
   d. Case Material: Polyamide PA non-reinforced with aluminum heatsink
   e. Temperature Range: –40° to + 65°C (–40° to 149°F)
   f. Humidity: 10-95% non-condensing
   g. Degree of Protection: IP20
   h. LED Indicators: Status and communication
   i. Supply Voltage: 11-30 vdc
   j. Current Consumption: 250mA at 24vdc
   k. RF Link Contact: 0.5A at 30vdc

2.2 ANTENNAS AND MISCELLANEOUS HARDWARE

A. Omni Directional Antennas:

1. The omni directional antennas shall be fiberglass enclosed and shall be furnished with a heavy duty mounting bracket and two stainless steel U-bolts for mounting the antenna.
2. The antenna shall be furnished with an integral N type female connector located at the bottom of the antenna.

3. The antenna shall meet the following specifications:

   a. Frequency Range: 900 MHz
   b. Gain: 8.0 dBi
   c. Impedance: 50 Ohms
   d. Horizontal beam width: 360º
   e. Vertical beam width: 15º
   f. Wind velocity rating: 125 mph
   g. Operating temperature: -40 ºC to 80 ºC
   h. Surge Protective Device: Provide for each antenna.
      (1) Insertion loss: <0.15 dB, maximum
      (2) Impedance: 50 ohms
      (3) Max. discharge surge current (8/20) μs: 10 kA
      (4) Product and manufacturer: Phoenix Contact, CN-UB COAXTRAB

4. The omni antennas shall be Phoenix Contact, RAD-ISM-900-ANT-OMNI, or equal.

B. YAGI Directional Antennas:

   1. The directional antennas shall be YAGI antennas with all welded construction. The antennas shall be aluminum with a Teflon impregnated powder coat finish.

   2. The antennas shall be furnished with a heavy duty mounting bracket and two stainless steel U-bolts for mounting the antenna.

   3. The antennas shall be furnished with an integral pigtail mounted N type female connector in a 16” length. The pigtail connector shall be a one-piece weatherproof cable, factory sealed.
4. The antennas shall meet the following specifications:
   a. Frequency Range: 902-960 MHz
   b. Gain: 5.0 dBi
   c. Impedance: 50 Ohms
   d. Horizontal beam width: 168º
   e. Vertical beam width: 78º
   f. Wind velocity rating: 125 mph
   g. Operating temperature: -40 ºC to 80 ºC
   h. Surge Protective Device: Provide for each antenna.
      (1) Insertion loss: <0.15 dB, maximum
      (2) Impedance: 50 ohms
      (3) Max. discharge surge current (8/20) μs: 10 Ka
      (4) Product and manufacturer: Phoenix Contact, CN-UB COAXTRAB

5. The YAGI antennas shall be Phoenix Contact, RAD-ISM-900-ANT-YAGI, or equal.

C. Antenna Grounding Kits:

1. Furnish and install an antenna grounding kit for each antenna for grounding the coaxial cable. The grounding kit shall include a factory assembled ground strap, a preformed rubber boot, clamps, and accessories for a complete, weatherproof system. All weatherproof seals shall be performed using heat shrink tubing.

2. The grounding kit shall be Times Microwave Systems, Andrew Heliax, or equal.
D. Antenna Cable:

1. The antenna cable shall be a flexible, low loss RF cable. The cable shall have a minimum bending radius of 1 ½ inches, and shall be weatherproof and resistant to UV radiation. The cable shall have RF shielding greater than 90dB (greater than 180dB crosstalk).

2. The cable shall meet the following specifications:
   a. Weight: 0.131 lbs/ft
   b. Operating Temperature Range: -40 to 85 degrees C
   c. Installation Temperature Range: -40 to 85 degrees C
   d. Cutoff Frequency: 9.3 GHz
   e. Velocity of Propogation: 87%
   f. Voltage Withstand: 4000VDC
   g. Peak Power: 40kW
   h. DC Resistance:
      (1) Inner Conductor: 0.53 ohms/1000 ft
      (2) Outer Conductor: 1.2 ohms/1000 ft
   i. Jacket Spark: 8000VRMS
   j. Capacitance: 23.4 pF/ft
   k. Inductance: 0.058 uH/ft
   l. Shielding Effectiveness: >90dB
   m. Phase Stability: <10ppm/Degree C
   n. Attenuation: 2.5 dB/100ft. @900MHz

3. The antenna cable shall be Times Microwave, Model LMR-600, ½” Foam Type, Flexible Communications Cable, or equal.
E. Lightning Arrestor/Bulkhead Adapters:

1. The lightning arrestor/bulkhead adapter shall be capable of protecting against surges up to 5000 amperes. The arrestor shall present a constant impedance in the transmission line.

2. The lightning arrestor shall be furnished with a Type N female connector and shall meet the following specifications:
   a. Maximum Power Rating: 375 watts
   b. Power Rating @ 800 to 1000 MHz: 50 watts
   c. Maximum surge current: 50 kA

3. The lightning arrestors shall be PolyPhaser Model IS-B50LN-C2, or equal by Phoenix Contact.

F. Additional Hardware:

1. The additional hardware specified herein is required to complete the antenna connections between the spread spectrum radios and the antennas. The hardware required is listed below:
   a. Cable Connectors:
      (1) The cable connectors shall be 1/2” Type N male Captivated Connector for LMR 600 Cable; Times Microwave, Model EZ-600-NMC.
   b. Cable Stripping Tool:
      (1) The cable stripping tool shall be for preparing LMR-600 cable for connector attachment; Times Microwave, Model ST-600C.
   c. Cable Jumpers:
      (1) The cable jumpers shall be a 2 foot section of RG-58A/U cable with N type male connectors at both ends. Each jumper shall consist of the following:
         (a) 1 each 2 ft. section of RG58A/U cable; Belden, Model 8259.
         (b) 2 each N type male crimp connectors; Cambridge, Model CPN-1.
         (c) 1 lot of installation to assemble the cable jumper; TESSCO, P/N 8701.
2.3 SPARE PARTS

A. Provide the following spare parts for the spread spectrum radio system:
   1. Two (2) Radios
   2. Two (2) Lightning Arrestors
   3. One (1) Omni Antenna
   4. One (1) Yagi Antenna

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer’s part/stock number.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install radio antennas as indicated on the Drawings. Antennas shall be securely fastened to the structure that they are being mounted on. All mounting hardware shall be 316 stainless steel.

B. Install concrete foundations for the antenna towers. The foundations shall be installed per the tower manufacturer’s requirements and shall include reinforcing steel.

3.2 SYSTEM CONFIGURATION

A. Set up and configure the radio system to perform all radio communication required for a complete operating system.

B. Provide the services of a Phoenix Contact field services representative for one day (8 hours on-site) to assist in the configuration and start-up of the radio system.

3.3 SYSTEM TESTING

A. Test the operation of each radio in the system. All testing shall be conducted in the presence of the Owner and the Engineer.

END OF SECTION
SECTION 17300
INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish and install all instrumentation and provide services as specified herein or as indicated on the Drawings. Instrumentation shall be provided by the Pump Control System Supplier.

1.2 QUALITY ASSURANCE

A. Regulations and Standards:

UL Underwriters' Laboratories
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
ANSI American National Standards Institute
IEEE Institute of Electrical and Electronic Engineers
ISA International Society of Automation

B. All instrumentation equipment supplied shall be of the most current and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the instrumentation equipment. The equipment provided by the System Supplier shall be compatible with the functions required for the Pump Control System.

C. All necessary fuses and cables required for instrumentation equipment shall be provided with the equipment.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on all instrumentation in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Submittals shall include a complete bill of material, catalog information, descriptive literature of all components and wiring diagrams.
PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. Wet Well Submersible Level Transducer:

1. The wet well submersible level transducer shall be an industrial submersible pressure transducer, submerged in the wet well to sense the sewage level in the wet well. The transducer shall be furnished with an integral signal cable with a molded cable seal.

2. The transducer shall have a weatherproof housing constructed of 316 stainless steel. The transducer shall have a 2.75” sensing area and an integral diaphragm protector.

3. The transducer shall be designed for installation in a Class 1, Division 1, Group C and D hazardous location.

4. The transducer cable shall be a polyethylene jacketed shielded cable. Length of cable shall be as required for transducer installation. Provide a stainless steel cable hanger to support the cable.

5. The pressure transducer shall be a 2-wire device with dc power being provided from the Pump Station Control Panel. The transducer shall output a 4-20mA dc signal, which is proportional to the wet well level.

6. The level transducer shall be factory calibrated for the range indicated on the schedule below. Provide an aneroid bellows and lightning arrestor for each transducer.

7. The transducer shall operate in a temperature range of -20°C to +60°C.

8. The transducer accuracy shall be ±0.25% of the full-scale range.

9. The wet well level transducers shall be KPSI Series 750.

SCHEDULE OF SUBMERSIBLE LEVEL TRANSDUCERS

<table>
<thead>
<tr>
<th>Location</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>War Admiral Pump Station Wet Well</td>
<td>Wet Well Level</td>
</tr>
<tr>
<td>Northport Pump Station Wet Well</td>
<td>Wet Well Level</td>
</tr>
</tbody>
</table>
B. Magnetic Flow Meters:

1. Magnetic flow meters shall be of the low frequency and short form characterized coil design. The characterized field principle of electro-magnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the flow rate.

2. The metering tube shall be constructed of Type 304 stainless steel. The meter body shall be carbon steel. The flow meter shall have a flanged body to fit between ANSI Class 150 pipe flanges. The flow meter shall have a polyurethane liner and Type 316 stainless steel electrodes. The electrodes shall be bullet nose type. Liners and electrodes shall be suitable for municipal sewage. Provide all required mounting hardware, stainless steel grounding rings and grounding straps for the installation of the magnetic flow meter.

3. The coils, which generate the field, shall be inside the pipe wall and shall be encapsulated in epoxy resin and encased behind the meter lining material. The ratio of flow velocity to reference voltage signals generated shall be compatible with the readout instrument without the necessity of circuit modifications. The meter shall have an average power consumption of 60 watts. Accuracy of the meter shall be ±0.5% of rate.

4. The meter housing shall be splash-proof and weather resistant design. The meter shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics.

5. Complete zero stability shall be inherent characteristic of the meter system. This shall eliminate the requirement for valving downstream of the meter for creating a full pipe zero flow condition for calibration purposes. Meter systems requiring field zero adjustment will not be acceptable.

6. The magnetic flow meters shall be factory calibrated on an approved test stand with certified accuracy traceable to NIST, compliant with the ISO 17025 standard, and third party accreditation by a national verification agency such as A2LA. Calibration curves shall be submitted for each flow meter for 3 points within the specified flow range.

7. The flow meter shall have a remote mounted microprocessor based, NEMA 4X flow transmitter. The flow transmitter shall have an LCD display to indicate the flow rate. The transmitter shall convert the meter’s DC pulsed signal to a linear 4-20mA dc signal which is proportional to the flow rate.

8. The flow transmitter shall operate on a 120 volt AC, 60 Hz power source and shall have RFI protection. Provide signal cables to connect the flow transmitter to the flow meter. Length of cable shall be as required for the installation (See Electrical Drawings).
9. The Magnetic Flow Meters shall be Endress & Hauser Promag 53W, or Rosemount Model 8750WA.

**SCHEDULE OF MAGNETIC FLOW METERS**

<table>
<thead>
<tr>
<th>Flow Range</th>
<th>Location</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 2,000 GPM</td>
<td>War Admiral Pump Station</td>
<td>Pump Station Flow</td>
</tr>
<tr>
<td>0 – 800 GPM</td>
<td>Northport Pump Station</td>
<td>Pump Station Flow</td>
</tr>
</tbody>
</table>

**C. Float Switches:**

1. Each float switch shall consist of a single pole, mercury switch in a smooth, chemical resistant polypropylene casing with integral 2-wire cable. The mercury switch shall be furnished in a normally open or closed configuration and shall be permanently molded to the signal cable at the factory. The flooding float switches should be normally closed.

2. Signal cable shall be minimum #18 AWG. Length of cable shall be as indicated on schedule below.

3. Specific gravity of sensors shall be 0.95-1.10. Sensors shall remain operable at temperature down to 0°C and up to 90°C. Mercury switch contacts shall operate on 24 volts DC.

4. Provide a 316 stainless steel mounting bracket for the wet well float switches, and for the flooding float switches.

5. The float switches shall be Anchor Scientific Roto-Float.

**SCHEDULE OF FLOAT SWITCHES**

<table>
<thead>
<tr>
<th>Cable Length</th>
<th>Mounting Bracket</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 feet</td>
<td>WMS-2</td>
<td>War Admiral Pump Station Wet Well Level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northport Pump Station Wet Well Level</td>
</tr>
<tr>
<td>20 feet</td>
<td>WMS</td>
<td>War Admiral Pump Station Flow Meter Vault Flooding</td>
</tr>
<tr>
<td>20 feet</td>
<td>WMS</td>
<td>Northport Pump Station Flow Meter Vault Flooding</td>
</tr>
</tbody>
</table>
2.2 INSTRUMENT NAMEPLATES

A. Provide a laminated phenolic nameplate for each instrument. The nameplates shall be black with white engraved letters, and they shall be mounted on the front of each instrument or instrument enclosure, or where applicable attached to the instrument with a plastic wire tie. An instrument nameplate schedule shall be submitted to the Engineer for approval prior to performing any engraving.

PART 3 - EXECUTION

3.1 INSTALLATION ASSISTANCE AND INSPECTION

A. Provide the services of manufacturer’s service representatives to assist in installation for all instrumentation specified herein.

B. Each manufacturer’s representative shall inspect the installation of each of their instruments, and shall issue an installation certificate to the Owner and the Engineer for each instrument certifying that the instrument has been installed in accordance with the manufacturer’s recommendations.

3.2 CALIBRATION

A. Provide the services of manufacturer’s service representatives to calibrate all instrumentation provided. All calibration shall be performed in the presence of the Owner and the Engineer. The calibration of each instrument shall be performed after the instrument installation certificate has been issued.

B. Each manufacturer’s representative shall issue a calibration certificate to the Owner and the Engineer for each instrument certifying that the instrument has been calibrated and is ready to be placed into service. The calibration certificates shall indicate the calibrated range or setpoint for each instrument.

3.3 PROGRAMMING

A. Program the new automatic telephone dialer to provide alarm notification for all of the existing alarms that are currently wired to the existing telephone dialer.

B. Program the new automatic telephone dialer to provide alarm notification for the new pump station alarms.

C. Test all existing alarms, and new alarms, to demonstrate that the dialer calls out when each alarm occurs.

3.4 TRAINING

A. Provide six (6) hours of training on the instrumentation provided.
B. All training shall be performed by a representative from the manufacturer and shall be specific to the instruments provided. Training shall include theory of operation, maintenance requirements, calibration methods and function of instrument in the Pump Control System.

END OF SECTION
SECTION 17400

PROGRAMMABLE CONTROLLER SYSTEM

PART 1 - GENERAL

1.1. DESCRIPTION

A. Work Included:

1. Furnish all labor and materials required for a complete programmable controller system consisting of programmable controllers, I/O modules, operator interface terminals, power supplies, power and communication cables, software packages, software programming, and all other associated equipment as specified herein and as indicated on the Drawings.

B. System Configuration:

1. The system shall be configured as shown on the Pump Control System Drawings and as described in the Description of Operation.

C. Description of Operation:

1. The Description of Operation for this project is contained in Section 17500. All system configuration and programming shall be performed to meet the requirements of this description.

1.2. QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI American National Standards Institute
IEEE Institute of Electrical and Electronic Engineers
NEC National Electrical Code
NEMA National Electrical Manufacturers Association

B. Quality Control:

1. All equipment and software supplied shall be of the most current and proven design. The Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the programmable controller system. The completed system and the equipment provided shall be compatible with the functions required and shall be a complete working system.
C. Manufacturer:

1. The programmable controller system shall be manufactured by Allen-Bradley. All model numbers shown on the Drawings are Allen-Bradley numbers.

1.3. SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on each of the items listed below in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects, and shall include a complete bill of material, catalog information, descriptive literature of all components, and applicable wiring diagrams.

   a. Programmable Controllers
   b. Programmable Controller Power Supplies
   c. Input and Output Modules
   d. Operator Interface Terminals
   e. Ethernet Switches
   f. Power and Communication Cables
   g. Programming Software
   h. System Programming
   i. Operator Interface Screens

1.4. MEETINGS

A. Operator Interface Meeting:

1. The System Supplier shall attend and participate in one (1) meeting with the Engineer and the Owner to discuss the layout, color conventions, and control strategies for the operator interface screens. This meeting will be held at Charles Town.

PART 2 - PRODUCTS

2.1. SYSTEM HARDWARE

A. Programmable Controllers:
1. Provide an Allen-Bradley CompactLogix 1769-L33ER programmable controller in control panels where indicated on the Drawings. Each programmable controller shall be mounted with input and output (I/O) modules as shown on the Drawings.

2. Each programmable controller shall be furnished with 2MB of user memory, and a Secure Digital (SD) flash memory card. The PLC program shall be stored on the Secure Digital card.

B. Programmable Controller Power Supplies:

1. Provide an Allen-Bradley power supply for each programmable controller. The power supply shall be sized as required for the power consumption of the system.

C. Operator Interface Terminals:

1. A programmable operator interface terminal shall be flush mounted in each pump station control panel to display graphic displays, alarm messages and process values, and to provide an interface for the operator to change process setpoints.

2. Each operator interface shall have a 10.1" TFT color touch screen and shall have a NEMA 4X rating.

3. The operator interfaces shall be networked to the PLCs via Ethernet. The operator interface shall be furnished with enough memory to meet the requirements of the Description of Operation plus 20 percent spare memory.

4. The operator interface terminal shall operate on 120VAC power.

5. The operator interface terminals shall be Allen-Bradley PanelView Plus 7 1000 Touch.

D. Ethernet Switches:

1. Provide an industrial Ethernet switch in control panels where indicated on the Drawings to network the PLCs, and the operator interface terminals.

2. The Ethernet switches shall be a stand-alone unit operating on 24vdc power.

3. The Ethernet switches shall be Stratix, Moxa or N-tron.

2.2. COMMUNICATIONS CABLES

A. Ethernet Cable:
1. Provide Cat 6 Ethernet cable to network the PLC and operator interface terminal to the Ethernet switches.

2.3. PROGRAMMING SOFTWARE

A. Programmable Controller Programming and Documentation Software:

1. Provide a windows based programming and documentation software package for programming the Allen-Bradley programmable controller using a personal computer as a programming terminal. This software package shall be utilized by the System Supplier to program the programmable controller.

2. The programming and documentation software shall be Rockwell Software RSLogix Studio 5000, Professional Edition.

3. At the completion of the project, the PLC firmware and software shall be upgraded to the latest version.

4. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

B. Operator Interface Programming Software:

1. Provide a windows based programming software package to program the operator interface using a personal computer. The operator interface shall be programmed by the System Supplier in accordance with the requirements of the Description of Operation.


3. At the completion of the project, the operator interface software shall be upgraded to the latest version.

4. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

2.4. SPARE PARTS

A. Provide the following spare parts for the programmable controller system:

1. One (1) Programmable Controller

2. One (1) Programmable Controller Power Supply

3. One (1) 16 Point 24vdc Input Module
4. One (1) 8 Point 24vdc Output Module

5. One (1) 8 Point Analog Input Module

6. One (1) 4 Point Analog Input Module

7. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.1. SOFTWARE PROGRAMMING

A. PLC Programming:

1. Program the PLCs to meet the requirements of the Description of Operation.

2. All programming shall be annotated and documented with rung numbers, descriptive comments and I/O identification comments. The beginning of each major sub-system shall be identified in the PLC program.

B. Operator Interface Programming:

1. General:

   a. Program each operator interface terminal to meet the requirements of the Description of Operation. All programming and graphic screen development shall be performed as required for a complete and operational system.

2. Graphic Displays:

   a. Dynamic graphic displays shall be programmed in each operator interface for the process equipment and its associated control strategies. The graphic displays shall be interactive with live data from the PLC.

   b. The graphic displays shall include all digital and analog points being monitored by the PLC system.

   c. The graphic displays shall indicate the auto/manual status, run status and alarms for all system equipment.
d. The graphic displays shall allow the pump station operator to set and adjust all process setpoints, and timer settings for control of the system equipment.

e. The configuration of each graphic screen shall be reviewed with and approved by the Owner and the Engineer.

3. Alarms:

a. All alarms shall be displayed on the alarm display screen on the operator interface.

4. Monitoring of Process Variables:

a. All process variables being monitored by the PLC System shall be displayed by the operator interface.

3.2. TESTING

A. Field Testing:

1. Test the operation of each PLC I/O point after the PLC System is installed.

2. Analog points shall be tested using a signal generator. Each point shall be tested at 0, 25, 50, 75 and 100% of its full scale range.

3. Test the operation of each graphic screen programmed in the operator interface to verify the digital and analog points display correctly on the screen.

4. Test all control strategies to verify that they function correctly.

5. Test all alarms in the system to verify that they display correctly.

6. All testing shall be conducted in the presence of, and to the satisfaction of, the Owner and the Engineer.

3.3. TRAINING

A. On-Site Training:

1. Provide eight (8) hours of training for the Owner on the operation of the PLC System and the operator interface terminals. Training shall be conducted at each of the pump station sites.

END OF SECTION
SECTION 17500

DESCRIPTION OF OPERATION FOR WASTEWATER PUMP STATIONS

1.1 PUMP CONTROL SYSTEM CONFIGURATION

A. General Description

1. The Pump Control System for the Wastewater Pump Stations consists of solid state reduced voltage starters, pump station control panels, instrumentation, a programmable controller system, and a spread spectrum Ethernet radio system, which will all be integrated to form a complete control system for the following wastewater pump stations:
   a. Northport Pump Station
   b. War Admiral Pump Station

B. Solid Stated Reduced Voltage Starters

1. Individual solids state reduced voltage (SSRV) starters will be provided for each sewage pump. The SSRV starters will be mounted in the Control Equipment Enclosure, which is pad mounted at the pump station site.

C. Pump Station Control Panels

1. A control panel will be provided for each pump station to control the sewage pumps. The control panel will be mounted in the Control Equipment Enclosure. The control panel will house the following:
   a. Circuit Breakers
   b. Surge Protection Device
   c. Uninterruptable Power Supply (UPS)
   d. Programmable Logic Controller (PLC)
   e. Operator Interface Terminal
   f. Spread Spectrum Ethernet Radio
   g. Ethernet Switch
   h. 24vdc Power Supplies
i. Control Relays

2. The operator interface terminal and the Ethernet radio will be networked to the PLC via Ethernet.

3. The operator interface terminal will be programmed to perform the following functions:
   a. Display Graphic Screens of the Pump Station
   b. Display Process Variables
   c. Display Alarm Messages
   d. Display Setpoint Screens

D. Ethernet Radio System

1. A spread spectrum Ethernet radio system will be provided for the wastewater pump stations to transmit data from the pump stations to the Charles Town Wastewater Treatment Plant (WWTP). The radio system will consist of the following components:
   a. Ethernet radios
   b. Omni and Yagi directional antennas
   c. Antenna cable
   d. Lightning arrestors for the antenna cable

2. The Ethernet radios will be unlicensed radios operating in the 902-928 MHz band. The radios will be Phoenix Contact Trusted Wireless radios.

E. Master PLC

1. An existing CompactLogix PLC is installed in the Control Building at the Charles Town WWTP to function as a Master PLC for the Wastewater Pump Station SCADA System. This PLC, is designated as PLC-CB, will poll the PLCs located at the following pump stations:
   a. Northport Pump Station - PLC-N
   b. War Admiral Pump Station - PLC-WA
2. When each of the above PLCs is polled by the Master PLC, the data in the pump station PLC shall be transmitted to the Master PLC.

F. HMI Software

1. Trihedral HMI software is installed at the Charles Town WWTP for monitoring and control of the treatment plant. The software is installed on the operator workstation located in the Control Building. The existing HMI software shall be programmed to monitor each of the wastewater pump stations constructed under this Contract.

1.2 SEWAGE PUMPS

A. General Description

1. Three rail-mounted submersible sewage pumps will be installed in each pump station wet well to pump the influent wastewater from the wet well to the wastewater collection system. The three pumps will operate in the lead/lag1/lag2 scenario, and they will be designated as Sewage Pumps No. 1, No. 2 and No.3.

2. A solid state reduced voltage (SSRV) starter will be provided for each sewage pump. The SSRVs will be mounted in the Control Equipment Enclosure.

3. A submersible level transducer will be installed in the wet well to monitor the sewage level in the wet well. The level transducer will output a 4-20mA level signal proportional to the wet well level to the PLC for level monitoring by the programmable controller. The wet well level shall be displayed on the operator interface located on the Pump Station Control Panel.

4. Float switches will be mounted in the wet well for back-up control of the sewage pumps should the transducer or PLC fail, and for alarm indication. Each float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. The float switches will be designated as follows:

   a. Wet Well Low Level
   b. Wet Well High Level
   c. Lead Float
   d. Lag1 Float
   e. Lag 2 Float
   f. All Pumps Off Float

B. Pump Motor Controls
1. A solid state reduced voltage (SSRV) starter will be provided for each sewage pump. Each SSRV starter will be mounted in an enclosure which will house the following:
   a. Motor Circuit Protector (MCP)
   b. Isolation Contactor
   c. Solid State Reduced Voltage Motor Starter
   d. Control Transformer
   e. H/O/A Selector Switch
   f. Run Relay
   g. Run Indication Light
   h. Starter Fault Relay
   i. Starter Fault Alarm Light
   j. Motor Overtemp Alarm Relay
   k. Motor Overtemp Alarm Light
   l. Seal Leak Monitor Relay
   m. Seal Leak Alarm Relay
   n. Seal Leak Alarm Light
   o. Elapsed Time Meter

2. Each pump H/O/A switch will have an auxiliary normally open contact that will close when the switch is placed in the "auto" position. This contact will be wired to the PLC for switch position monitoring.

3. Each pump motor starter will have a run contact that will close when the starter is energized and up to speed. This contact will be wired to a run relay located in the starter enclosure and to a run indication light on the enclosure. The run relay will have two normally open contacts that will close when the relay is energized. One contact will be wired to the elapsed time meter located on the starter enclosure, and the other contact will be wired to the PLC for run status monitoring.
4. Each pump motor starter will have a starter fault contact that will close if a starter fault occurs. This contact will be wired to a starter fault relay in the starter enclosure and to a starter fault alarm light on the enclosure. The starter fault relay will have a normally open contact that will close when the relay is energized. This contact will be wired to PLC for starter fault alarm monitoring.

C. Programmable Controller Inputs and Outputs

1. The programmable controller inputs and outputs for the Sewage Pumps will be wired to and from the PLC located in the Pump Station Control Panel.

2. Digital Inputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Sewage Pump No. 1 H/O/A Switch &quot;Auto&quot; Position</td>
<td>H/O/A Switch on Pump Starter</td>
</tr>
<tr>
<td>b. Sewage Pump No. 1 Running</td>
<td>Run Relay in Pump Starter</td>
</tr>
<tr>
<td>c. Sewage Pump No. 1 Starter Fault</td>
<td>Starter Fault Relay in Pump Starter</td>
</tr>
<tr>
<td>d. Sewage Pump No. 1 Motor Overtemp</td>
<td>Motor Overtemp Alarm Relay in Pump Starter</td>
</tr>
<tr>
<td>e. Sewage Pump No. 1 Seal Leak</td>
<td>Seal Leak Alarm Relay in Pump Starter</td>
</tr>
<tr>
<td>f. Sewage Pump No. 2 H/O/A Switch &quot;Auto&quot; Position</td>
<td>H/O/A Switch on Pump Starter</td>
</tr>
<tr>
<td>g. Sewage Pump No. 2 Running</td>
<td>Run Relay in Pump Starter</td>
</tr>
<tr>
<td>h. Sewage Pump No. 2 Starter Fault</td>
<td>Starter Fault Relay in Pump Starter</td>
</tr>
<tr>
<td>i. Sewage Pump No. 2 Motor Overtemp</td>
<td>Motor Overtemp Alarm Relay in Pump Starter</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>j</td>
<td>Sewage Pump No. 2 Seal Leak Seal Leak Alarm Relay in Pump Starter</td>
</tr>
<tr>
<td>k</td>
<td>Sewage Pump No. 3 H/O/A Switch &quot;Auto&quot; Pump Starter</td>
</tr>
<tr>
<td>l</td>
<td>Sewage Pump No. 3 Running Run Relay in Pump Starter</td>
</tr>
<tr>
<td>m</td>
<td>Sewage Pump No. 3 Starter Fault Starter Fault Relay in Pump Starter</td>
</tr>
<tr>
<td>n</td>
<td>Sewage Pump No. 3 Motor Overtemp Motor Overtemp Alarm Relay in Pump Starter</td>
</tr>
<tr>
<td>o</td>
<td>Sewage Pump No. 3 Seal Leak Seal Leak Alarm Relay in Pump Starter</td>
</tr>
<tr>
<td>p</td>
<td>Lead Sewage Pump No. 1/Alternate/No. 2 Lead Pump Selector Switch on Pump Station</td>
</tr>
<tr>
<td>q</td>
<td>Selector Switch “No. 1” Position Control Panel</td>
</tr>
<tr>
<td>r</td>
<td>Lead Sewage Pump No. 1/Alternate/No. 2 Selector Switch “Alternate” Position</td>
</tr>
<tr>
<td>s</td>
<td>Lead Sewage Pump No. 1/Alternate/No. 2 Selector Switch “No. 2” Position</td>
</tr>
<tr>
<td>t</td>
<td>Wet Well Low Level Intrinsically Safe Relay in Pump Station Control Panel</td>
</tr>
<tr>
<td>u</td>
<td>Wet Well High Level Intrinsically Safe Relay in Pump Station Control Panel</td>
</tr>
</tbody>
</table>
3. Digital Outputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Destination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Sewage Pump No. 1 Start/Stop</td>
<td>Pump Start Relay in Pump Station Control Panel</td>
</tr>
<tr>
<td>b. Sewage Pump No. 2 Start/Stop</td>
<td>Pump Start Relay in Pump Station Control Panel</td>
</tr>
<tr>
<td>c. Sewage Pump No. 3 Start/Stop</td>
<td>Pump Start Relay in Pump Station Control Panel</td>
</tr>
</tbody>
</table>

4. Analog Inputs (4-20mA):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Pump Station</td>
<td>Submersible Level Wet Well Level Transducer in Wet Well</td>
</tr>
</tbody>
</table>

D. Description of Operation

1. The three sewage pumps will be controlled by the individual H/O/A selector switches located on the pump starters. The "hand" and "off" positions of the H/O/A selector switches provide for manual start/stop control of the pumps. When the pump H/O/A switches are in the "auto" position, the sewage pumps will be automatically controlled by the pump station PLC in response to the pump station wet well level as follows:

a. Level setpoints will be programmed in the PLC for the following wet well levels:

- Wet Well Low Level
- Pump Stop
- Lead Pump Start
- Lag Pump Start
- Wet Well High Level

b. The level setpoints shall be adjustable via the operator interface located on the Pump Station Control Panel, or via the HMI software at the Charles Town WWTP.

c. The lead pump will be selected by the No. 1/Alternate/No. 2 selector switch on the Pump Station Control Panel. The pump not selected as the lead pump, will become the lag pump. When the switch is in the "alternate" position, the PLC will alternate the lead/lag status of the sewage pumps after each pumping cycle.
d. When the sewage level in the wet well rises to the elevation of the "lead pump start" level setpoint, a timer in the PLC will be started. If this timer times out and the sewage level is still at or above the "lead pump start" level setpoint, the PLC will start the lead sewage pump. When the lead pump is started, it will continue to run until the sewage level is pumped down to the "pump stop" level setpoint. When this occurs, the PLC will shut down the lead pump.

e. When the sewage level in the wet well rises to the elevation of the "lag pump start" level setpoint, a timer in the PLC will be started. If this timer times out and the sewage level is still at or above the "lag pump start" level setpoint, the PLC will start the lag sewage pump. When the lag pump is started, it will continue to run until the sewage level is pumped down to the "pump stop" level setpoint. When this occurs, the PLC will shut down the lag pump.

2. If the sewage level in the wet well is drawn down to the "wet well low level" setpoint, a timer in the programmable controller will be started. If this timer times out and the low-level condition still exists, the PLC will shut down the sewage pumps. When this occurs, a "Wet Well Low Level" alarm message shall be displayed on the operator interface, and a wet well low-level alarm shall be displayed by the HMI software.

3. If the sewage level in the wet well rises to the elevation of the "wet well high level" setpoint, a timer in the programmable controller will be started. If this timer times out and the high-level condition still exists, a "Wet Well High Level" alarm message shall be displayed on the operator interface, and a wet well high-level alarm shall be displayed by the HMI software.

4. The "wet well low level" float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. This relay will have a normally open contact that will be wired to the back-up relay logic in the control panel and a normally open contact that will be wired to the PLC for wet well low-level monitoring. If the sewage level in the wet well is drawn down to the elevation of the low-level float switch, the low-level relay will be energized and the PLC will shut down the sewage pumps. When this occurs, a "Wet Well Low Level Detected by Low Level Float" alarm message shall be displayed on the operator interface, and a wet well low level detected by low level float alarm shall be displayed by the HMI software.

5. The "wet well high level" float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. This relay will have a normally open contact that will be wired to the PLC for wet well high-level monitoring. If the water level in the wet well rises to the elevation of the high-level float switch, the high-level relay will be energized, and a "Wet Well High Level Detected by High Level Float" alarm message shall be displayed on the operator interface,
and a wet well high level detected by high level float alarm shall be displayed by the HMI software.

6. The PLC will continuously monitor the analog signal received from the wet well level transducer. If an error is detected with the level transducer signal (less than 4mA or greater than 20mA), a "Level Transducer Failure, Pumps on Float Switch Control" alarm message shall be displayed on the operator interface, and a level transducer failure, pumps on float control alarm shall be displayed by the HMI software. When this occurs, the PLC will automatically switch the wet well level control to the float switches. The float switches will remain in control until the alarm condition for the level transducer is corrected. The float switches and the PLC will provide automatic start/stop control of the pumps as follows:

   a. The "wet well low level” and “wet well high level” float switches will be wired to individual intrinsically safe relays located in the Pump Station Control Panel. These relays will each have a normally open contact that will be wired to the back-up relay logic in the control panel and a normally open contact that will be wired to the PLC for pump control.

   b. When the sewage level in the wet well rises to the level of the "wet well high level" float switch, the PLC will start the lead pump. When the lead pump is started, it will continue to run until the sewage level in the wet well is drawn down to the level of the "wet well low level" float switch. When this occurs, the PLC will shut down the lead pump.

7. Relays and timers will be provided in the Pump Station Control Panel to enable the sewage pumps to be controlled by the float switches if the programmable controller fails. This relay logic will serve as a back-up to the control logic programmed in the PLC and will be initiated as follows:

   a. A control relay will be wired to an output from the PLC so that it is always energized whenever the programmable controller is operating. A normally closed contact on this relay will be wired in series with the wet well float switch relay logic control of the sewage pumps. If the programmable controller fails, the relay will be de-energized and the relay contact will close. When this occurs, the wet well float switches will provide automatic start/stop control of the pumps.

8. The PLC will provide failure monitoring for each sewage pump as follows:

   a. When a pump H/O/A switch is in the "auto" position and the pump gets a signal to start, a failure timer in the programmable controller will be started. If this timer times out and the pump run relay is not energized, a "Sewage Pump Failure" alarm message shall be displayed
on the operator interface, and a sewage pump failure alarm shall be displayed by the HMI software.

9. The PLC will provide starter fault monitoring for each sewage pump as follows:

a. If a starter fault occurs, the pump will shut down and the starter fault relay will be energized. When this occurs, a "Sewage Pump Starter Fault" alarm message shall be displayed on the operator interface, and a sewage pump starter fault alarm shall be displayed by the HMI software.

10. Each sewage pump motor will be furnished with normally closed motor thermal switches in the motor windings. The thermal switches will be wired to a motor overtemp alarm relay located in the starter enclosure. The overtemp relay will have two normally open contacts and a normally closed contact, which will change state when the relay is energized. One of the normally open contacts will be wired to a motor overtemp alarm light on the starter enclosure, and the other normally open contact will be wired in series with the motor starter control circuit. The normally closed contact will be wired to the PLC. If a motor high temperature occurs, one or more of the thermal switches will open, and the motor overtemp alarm relay will be de-energized. When this occurs, a "Sewage Pump Motor Overtemp" alarm message shall be displayed on the operator interface, and a sewage pump motor overtemp alarm shall be displayed by the HMI software.

11. Each sewage pump will be furnished with a seal leak sensor in the pump casing to detect a leakage of water into the oil chamber. The seal leak sensor will be wired to a seal leak monitor relay located in the SSRV starter enclosure. A normally open contact on the monitor relay will be wired to a seal leak alarm relay in the starter enclosure, and to a seal leak alarm light on the enclosure. The seal leak alarm relay will have a normally open contact that will close when the relay is energized, which will be wired to the PLC. If a seal leak occurs, a "Sewage Pump Seal Leak" alarm message shall be displayed on the operator interface, and a sewage pump seal leak alarm shall be displayed by the HMI software.

12. If a sewage pump experiences a failure, starter fault, motor overtemp, or seal leak, the PLC will lock out this pump, and will index the other pump to become the lead pump.

E. Sewage Pump Alarms

1. The following alarms for the Sewage Pumps at each pump station shall be displayed on the operator interface located on the Pump Station Control Panel:
a. Sewage Pump No. 1 Failure  
b. Sewage Pump No. 1 Starter Fault  
c. Sewage Pump No. 1 Motor Overtemp  
d. Sewage Pump No. 1 Seal Leak  
e. Sewage Pump No. 2 Failure  
f. Sewage Pump No. 2 Starter Fault  
g. Sewage Pump No. 2 Motor Overtemp  
h. Sewage Pump No. 2 Seal Leak  
i. Sewage Pump No. 3 Failure  
j. Sewage Pump No. 3 Starter Fault  
k. Sewage Pump No. 3 Motor Overtemp  
l. Sewage Pump No. 3 Seal Leak  
m. Wet Well Low Level  

n. Wet Well Low Level Detected by Low Level Float  
o. Wet Well High Level  
p. Wet Well High Level Detected by High Level Float  
q. Wet Well Level Transducer Failure, Pumps on Float Control

2. The following alarms for the Sewage Pumps shall be displayed and logged by the HMI software located at the Charles Town WWTP:

a. War Admiral PS Sewage Pump No. 1 Failure  
b. War Admiral PS Sewage Pump No. 1 Starter Fault  
c. War Admiral PS Sewage Pump No. 1 Motor Overtemp  
d. War Admiral PS Sewage Pump No. 1 Seal Leak  
e. War Admiral PS Sewage Pump No. 2 Failure  
f. War Admiral PS Sewage Pump No. 2 Starter Fault  
g. War Admiral PS Sewage Pump No. 2 Motor Overtemp  
h. War Admiral PS Sewage Pump No. 2 Seal Leak  
i. War Admiral PS Sewage Pump No. 3 Failure  
j. War Admiral PS Sewage Pump No. 3 Starter Fault  
k. War Admiral PS Sewage Pump No. 3 Motor Overtemp  
l. War Admiral PS Sewage Pump No. 3 Seal Leak
m. War Admiral PS Wet Well Low Level  

n. War Admiral PS Wet Well Low Level Detected by Low Level Float  
o. War Admiral PS Wet Well High Level  
p. War Admiral PS Wet Well High Level Detected by High Level Float  
q. War Admiral PS Wet Well Level Transducer Failure, Pumps on Float Control  
r. Northport PS Sewage Pump No. 1 Failure  
s. Northport PS Sewage Pump No. 1 Starter Fault  
t. Northport PS Sewage Pump No. 1 Motor Overtemp  
u. Northport PS Sewage Pump No. 1 Seal Leak  
v. Northport PS Sewage Pump No. 2 Failure  
w. Northport PS Sewage Pump No. 2 Starter Fault  
x. Northport PS Sewage Pump No. 2 Motor Overtemp  
y. Northport PS Sewage Pump No. 2 Seal Leak  
z. Northport PS Sewage Pump No. 3 Failure  
aa. Northport PS Sewage Pump No. 3 Starter Fault  
bb. Northport PS Sewage Pump No. 3 Motor Overtemp  
cc. Northport PS Sewage Pump No. 3 Seal Leak  
dd. Northport PS Wet Well Low Level  

e. Northport PS Wet Well Low Level Detected by Low Level Float  

ff. Northport PS Wet Well High Level  
gg. Northport PS Wet Well High Level Detected by High Level Float  
hh. Northport PS Wet Well Level Transducer Failure, Pumps on Float Control  

1.2 PUMP STATION FLOW METERING  

A. General Description  

1. A magnetic flow meter will be provided on the common sewage pump discharge line to meter the pump station flow. The flow meter will be located below grade in a meter vault.  

2. The magnetic flow meter will output a voltage signal proportional to the flow rate to a flow transmitter mounted in the Control Equipment Enclosure. The flow transmitter will convert the voltage signal to a 4-20mA analog signal proportional to the flow rate and output this flow signal to the PLC. The pump
station flow shall be displayed on the operator interface located on the Pump Station Control Panel.

3. The HMI software shall display, trend and totalize the flow from each pump station.

B. Programmable Controller Inputs

1. The programmable controller input for the Pump Station Flow signal will be wired to the PLC located in the Pump Station Control Panel.

2. Analog Inputs (4-20mA):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Pump Station Flow</td>
<td>Magnetic Flow Meter Flow Transmitter</td>
</tr>
</tbody>
</table>

1.3 FLOODING SENSORS

A. General Description

1. A flooding sensor consisting of a normally closed mercury float switch will be installed in the Meter Vault at each pump station to sense a flooding condition. The float switch will be suspended 1-inch above the vault floor.

B. Programmable Controller Inputs

1. The flooding float switch located in the Meter Vault will be wired to the PLC located in the Pump Station Control Panel.

2. Digital Inputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Meter Vault</td>
<td>Float Switch in Meter Vault</td>
</tr>
<tr>
<td>Flooding</td>
<td></td>
</tr>
</tbody>
</table>

C. Description of Operation

1. If flooding occurs in the Meter Vault and water builds up on the floor to the elevation of the flooding float switch, a "Meter Vault Flooding" alarm message shall be displayed on the operator interface located on the Pump Station Control Panel, and a meter vault flooding alarm shall be displayed by the HMI software.
D. Flooding Sensor Alarms

1. The following alarm for the Flooding Sensor at each pump station shall be displayed on the operator interface located on the Pump Station Control Panel:

   a. Meter Vault Flooding

2. The following alarms for the Flooding Sensors shall be displayed and logged by the HMI software at the Charles Town WWTP:

   b. Northport PS Meter Vault Flooding
   c. War Admiral PS Meter Vault Flooding

1.4 EMERGENCY GENERATORS

A. General Description

1. A diesel emergency generator will be pad mounted outside at each wastewater pump station to provide standby power for the pump station loads. Each generator will be installed in a sound-attenuated weather-proof enclosure, and will be furnished with a double-walled sub-base fuel tank.

2. An automatic transfer switch will be provided for each generator to sense a failure of the normal utility power and transfer the pump station loads to the emergency generator. The transfer switch will be located in the Electrical Equipment Enclosure.

3. Each transfer switch will be furnished with position indication contacts to indicate when the transfer switch is in the “normal” and “emergency” positions. The “emergency” position contact will be wired to the PLC in the Pump Station Control Panel for switch position monitoring by the PLC.

B. Programmable Controller Inputs

1. The programmable controller inputs for the Emergency Generator will be wired to the PLC located in the Pump Station Control Panel.

2. Digital Inputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Automatic Transfer Switch</td>
<td>Automatic Transfer Switch</td>
</tr>
<tr>
<td>Emergency Position</td>
<td></td>
</tr>
<tr>
<td>b. Emergency Generator Running</td>
<td>Run Relay in Generator Control Panel</td>
</tr>
</tbody>
</table>
c. Emergency Generator Common Alarm
   Alarm Relay in Generator Control Panel

d. Emergency Generator Low Fuel Level
   Alarm Relay in Generator Control Panel

e. Emergency Generator Fuel Tank Leak
   Alarm Relay in Generator Control Panel

C. Description of Operation

1. The automatic transfer switch will continuously monitor the incoming power source. When a failure of the utility power source occurs, control logic in the transfer switch will start the emergency generator. When the generator is putting out the required voltage and frequency, the transfer switch will transfer the pump station loads to the generator. When the transfer switch transfers to the emergency position, a normally open contact on the switch will close. This contact will be wired to the PLC for monitoring of the transfer switch position by the programmable controller.

2. A generator run relay will be provided in the generator control panel. A normally open contact on this relay will be wired to the PLC for generator run status monitoring by the

3. programmable controller. If the generator is running, an “Emergency Generator Running

4. alarm message shall be displayed on the operator interface, and an emergency generator running alarm shall be displayed by the HMI software.

5. A common alarm relay will be provided in the generator control panel to indicate a generator alarm. A normally open contact on this relay will be wired to the PLC. If a generator alarm occurs, an “Emergency Generator Common Alarm” message shall be displayed on the operator interface, and an emergency generator common alarm shall be displayed by the HMI software.

6. A low-level switch will be installed in the generator fuel tank to indicate a low level in the tank. This switch will be wired to a fuel tank low level alarm relay in the generator control panel. A normally open contact on this relay will be wired to the PLC. If a low-level alarm occurs, an “Emergency Generator Low Fuel Level” alarm message shall be displayed on the operator interface, and an emergency generator low fuel level alarm shall be displayed by the HMI software.

7. A leak sensor will be installed in the generator fuel tank to indicate a leak in the tank. This sensor will be wired to a fuel tank leak alarm relay in the generator control panel. A normally open contact on this relay will be wired to
the PLC. If a leak alarm occurs, an “Emergency Generator Fuel Tank Leak” alarm message shall be displayed on the operator interface, and an emergency generator fuel tank leak alarm shall be displayed by the HMI software.

D. Emergency Generator Alarms

1. The following alarms for the Emergency Generator at each pump station shall be displayed on the operator interface located on the Pump Station Control Panel:
   a. Emergency Generator Running
   b. Emergency Generator Common Alarm
   c. Emergency Generator Low Fuel Level
   d. Emergency Generator Fuel Tank Leak

2. The following alarms for the Emergency Generators shall be displayed and logged by the HMI software located at the Charles Town WWTP:
   a. Northport PS Emergency Generator Running
   b. Northport PS Emergency Generator Common Alarm
   c. Northport PS Emergency Generator Low Fuel Level
   d. Northport PS Emergency Generator Fuel Tank Leak
   e. War Admiral PS Emergency Generator Running
   f. War Admiral PS Emergency Generator Common Alarm
   g. War Admiral PS Emergency Generator Low Fuel Level
   h. War Admiral PS Emergency Generator Fuel Tank Leak

1.5 CONTROL PANEL POWER MONITORING

A. General Description

1. A power failure relay and a surge protective device (SPD) will be provided in each Pump Station Control Panel to monitor the incoming power to the panel and to protect the PLC from transient voltages that may occur due to lightning or surges on the incoming power line.

B. Programmable Controller Inputs

1. The programmable controller inputs for Power Monitoring in the Pump Station Control Panel, and in the Control Building PLC Panel, will be wired to the PLC in the control panel.
2. Digital Inputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Control Panel Power Failure</td>
<td>Power Failure Relay in Control Panel</td>
</tr>
<tr>
<td>b. Control Panel SPD Failure</td>
<td>Failure Contact in SPD</td>
</tr>
</tbody>
</table>

C. Description of Operation

1. A power failure relay will be provided in each control panel. The relay will be energized continuously by the main incoming power to the panel. The programmable controller will provide power failure monitoring for the control panel as follows:

   a. A normally closed contact on the power failure relay will be wired to the PLC. Under normal circumstances, the relay will be energized and this contact will be open. If the main incoming power supply fails, the relay contact will close, and a "Control Panel Power Failure" alarm message shall be displayed on the operator interface, and a control panel power failure alarm shall be displayed by the HMI software.

2. The surge protective device located in the control panel will each be furnished with a normally open failure contact. This contact will be wired to the PLC in the panel. If an SPD failure occurs, this contact will close, and a “Control Panel SPD Failure” alarm message shall be displayed on the operator interface, and a control panel failure alarm shall be displayed by the HMI software.

D. Control Panel Power Monitoring Alarms

1. The following alarms for Control Panel Power Monitoring at each pump station shall be displayed on the operator interface located on the Pump Station Control Panel:

   a. Control Panel Power Failure
   b. Control Panel SPD Failure

2. The following alarms for Control Panel Power Monitoring shall be displayed and logged by the HMI software located at the Charles Town WWTP:

   a. Northport PS Control Panel Power Failure
   b. Northport PS Control Panel SPD Failure
   c. War Admiral PS Control Panel Power Failure
   d. War Admiral PS Control Panel SPD Failure
1.6 24 VDC POWER SUPPLIES

A. General Description

1. Two 24vdc power supplies will be provided in each Pump Station Control Panel. The 24vdc power supplies will provide power for the Ethernet switch, spread spectrum radio, 24vdc programmable controller inputs, and the 2-wire instruments. The power supplies will be wired in parallel through a redundancy module so that if one power supply fails, the other power supply will continue providing 24vdc power.

B. Programmable Controller Inputs

1. The programmable controller inputs for the 24vdc power supplies will be wired to the PLC located in the corresponding control panel.

2. Digital Inputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 24vdc Power Supply No. 1 Failure</td>
<td>Alarm Contact in Power Supply</td>
</tr>
<tr>
<td>b. 24vdc Power Supply No. 2 Failure</td>
<td>Alarm Contact in Power Supply</td>
</tr>
</tbody>
</table>

C. Description of Operation

1. The PLC will provide failure monitoring for the 24vdc power supplies in the control panel as follows:

   a. A normally closed contact on each power supply will be wired to the PLC in the control panel. When the power supply is operating, this contact will be open. If a power supply fails, this contact will close, and a "24vdc Power Supply Failure" alarm message shall be displayed on the operator interface, and a 24vdc power supply failure alarm shall be displayed by the HMI software.

D. 24vdc Power Supply Alarms

1. The following alarms for the 24vdc Power Supplies at each pump station shall be displayed on the operator interface located on the Pump Station Control Panel:

   a. 24vdc Power Supply No. 1 Failure
   b. 24vdc Power Supply No. 2 Failure
2. The following alarms for the 24vdc Power Supplies shall be displayed and logged by the HMI software located at the Charles Town WWTP:
   a. Northport Farms PS 24vdc Power Supply No. 1 Failure
   b. Northport Farms PS 24vdc Power Supply No. 2 Failure
   c. War Admiral PS 24vdc Power Supply No. 1 Failure
   d. War Admiral PS 24vdc Power Supply No. 2 Failure

1.7 UNINTERRUPTIBLE POWER SUPPLIES

A. General Description

1. An uninterruptible power supply (UPS) will be provided in each Pump Station Control Panel to provide continuous power for the equipment in the control panel.

B. Programmable Controller Inputs

1. The programmable controller inputs for the UPS will be wired to the PLC located in the Pump Station Control Panel.

2. Digital Inputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Origination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. UPS on Battery Power</td>
<td>UPS in Control Panel</td>
</tr>
<tr>
<td>b. UPS Battery Low</td>
<td>UPS in Control Panel</td>
</tr>
<tr>
<td>c. UPS Failure</td>
<td>UPS Failure Relay in Control Panel</td>
</tr>
</tbody>
</table>

C. Description of Operation

1. The UPS will be furnished with a normally open contact that will close when the UPS is operating on battery power. This contact will be wired to the PLC in the corresponding panel. When normal power fails and the UPS is operating on battery power, a timer in the programmable controller will be started. If this timer times out and the UPS is still on battery power, a “UPS on Battery Power” alarm message shall be displayed on the operator interface, and a UPS on Battery Power alarm shall be displayed by the HMI software.

2. The UPS will be furnished with a normally open contact that will close when the UPS battery is low. This contact will be wired to the PLC. If the UPS battery
is low, a timer in the programmable controller will be started. If this timer times out and the UPS battery low alarm is still present, a “UPS Battery Low” alarm message shall be displayed on the operator interface, and a UPS battery low alarm shall be displayed by the HMI software.

3. A UPS failure relay will be provided in the control panel for the UPS. This relay will be energized continuously by the UPS. The programmable controller will provide failure monitoring for the UPS as follows:

   a. A normally closed contact on the UPS failure relay will be wired to the programmable controller. When the UPS in the control panel is operating, the relay will be energized and this contact will be open. If the UPS fails, the relay contact will close and a “UPS Failure” alarm message shall be displayed on the operator interface, and a UPS failure alarm shall be displayed by the HMI software.

4. Each UPS failure relay will have two normally open contacts and two normally closed contacts in addition to the normally closed contact being utilized for failure monitoring of the UPS. The UPS will be wired through two normally open relay contacts, and the 120 VAC power will be wired through two normally closed relay contacts. If the UPS fails, the UPS failure relay will be de-energized and the 120 VAC power will power the control panel.

D. Uninterruptible Power Supply Alarms

1. The following alarms for the Uninterruptible Power Supply at each pump station shall be displayed on the operator interface located on the Pump Station Control Panel:

   a. UPS on Battery Power
   b. UPS Battery Low
   c. UPS Failure

2. The following alarms for the Uninterruptible Power Supplies shall be displayed and logged by the HMI software located at the Charles Town WWTP:

   a. Northport PS UPS on Battery Power
   b. Northport PS UPS Battery Low
   c. Northport PS UPS Failure
   d. War Admiral PS UPS on Battery Power
   e. War Admiral PS UPS Battery Low
   f. War Admiral PS UPS Failure
1.8  PLC FAILURE MONITORING

A. General Description

1. A relay will be provided in each Pump Station Control Panel to monitor the status of the PLC in the control panel.

B. Programmable Controller Outputs

1. The programmable controller monitoring relay for the PLC will be energized continuously by an output from the PLC.

2. Digital Outputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Destination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. PLC Failure</td>
<td>PLC Monitoring Relay in Control Panel</td>
</tr>
</tbody>
</table>

C. Description of Operation

1. The programmable controller monitoring relay for the PLC in the control panel will be energized by an output from the programmable controller so that it is continuously energized whenever the PLC is operating. A normally closed contact on this relay will be wired to a PLC failure light on the control panel. If the programmable controller fails, the monitoring relay will be de-energized, and the relay contact will close indicating an alarm condition.

2. A normally open contact on the PLC monitoring relay located in the Control Building PLC Panel will be wired to the existing automatic telephone dialer for notification of a PLC Failure alarm.

1.9  OPERATOR INTERFACE TERMINAL

A. General Description

1. A programmable operator interface terminal will be provided on each Pump Station Control Panel to display alarm messages and process values, and to provide a means for the operator to change process setpoints in the PLC.

B. Description of Operation

1. Whenever an alarm occurs, a corresponding alarm message will be displayed on the operator interface as previously described in the Description of Operation.
2. An alarm message will remain in the system until its corresponding alarm is cleared.

1.10 AUTOMATIC TELEPHONE DIALER

A. General Description

1. The existing automatic telephone dialer located in the Control Building at the Charles will provide continuous monitoring of the treatment plant alarms and the wastewater pump station alarms. When an alarm occurs, the dialer will call a series of pre-programmed telephone numbers until one of the numbers answers. When the dialer is answered, it will deliver a message by means of a computer type synthesized voice indicating the alarm that exists.

B. Programmable Controller PLC-CB Outputs

1. The programmable controller outputs for the wastewater pump station alarms will be output from PLC-CB located in the Control Building PLC Panel.

2. Digital Outputs (24vdc):

<table>
<thead>
<tr>
<th>Description</th>
<th>Destination Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Northport PS</td>
<td>Alarm Relay in Control Building PLC Panel</td>
</tr>
<tr>
<td>Common Alarm</td>
<td></td>
</tr>
<tr>
<td>b. War Admiral PS</td>
<td>Alarm Relay in Control Building PLC Panel</td>
</tr>
<tr>
<td>Common Alarm</td>
<td></td>
</tr>
</tbody>
</table>

C. Description of Operation

1. The pumping station alarms shall be programmed to two common alarm outputs in PLC-CB. The alarm outputs will be wired to relays in the Control Building PLC Panel. A normally open contact on each relay will be wired to the automatic telephone dialer for notification of a pump station alarm.

2. A one-minute time delay shall be programmed in PLC-CB for each common alarm output to allow the plant operator time to acknowledge the alarm before the dialer initiates its calling sequence.
1.11 AIR INJECTION SYSTEM

A. General Description

1. A 7.5 HP air compressor unit will be sourcing an air pressure tank to inject air into the force main. The pressure in the tank will be set within the range of 140-175 psig and shall not drop lower than 140 psi, for optimal operation. A pressure regulator will be tied in-between the air compressor and pressure tank to ensure PSI level is maintained at no less than 140 psig.

B. Description of Operation

1. Air from the air pressure tank will be fed into the force main to lower H2S levels. Air will be injected whenever the well pumps are running.

2. While the system is on, the overall pressure in the tank shall not be lower than 140 psig. The pressure regulator shall control the air compressor and turn on and off when the lead (or lag) pump in the wet well turns on and off, respectively, to maintain the minimum pressure of 140 psig.

END OF SECTION