SECTION 01 55 13

ACCESS ROADS AND PARKING AREAS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide temporary construction roads, walks, parking areas, and appurtenances required during the Project for use by CONTRACTOR, other contractors employed on the Project, OWNER's, facility managers, and emergency vehicles.
   2. Temporary roads and parking areas shall be designed and maintained by CONTRACTOR and shall be fully passable to vehicles in all weather conditions.

B. Use of Existing Access Roads:
   1. CONTRACTOR is allowed to use OWNER's existing roads starting on the Effective Date of the Contract and satisfying other Contract requirements relative to starting the Work.
   2. Prevent interference with traffic on existing roads and parking areas. Always keep access roads and entrances serving the Site clear and available to OWNER, facility manager, and their respective employees; emergency vehicles; and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.
   3. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER from expenses and losses caused by CONTRACTOR's operations over existing roads, drives, and parking areas.
   4. Schedule deliveries to minimize use of driveways and Site entrances.

1.2 SITE ACCESS

A. Site Access:
   1. CONTRACTOR access to the Site shall be via Trilith Studios entrance **on Veterans Parkway.**

1.3 CONTRACTOR PARKING

A. CONTRACTOR employee vehicles shall park in construction staging area(s).

B. Park construction vehicles and equipment in work areas off permanent roads and parking areas, in areas of the Site designated for CONTRACTOR staging.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Materials for temporary roads and parking areas shall comply with the Contract Documents' requirements for permanent roads, drives, and parking areas.

B. Traffic controls shall comply with requirements of authorities having jurisdiction. When such authority is the OWNER or facility manager, and no requirements are indicated, comply with the standard specifications of the state department of transportation in the area of the Project.

PART 3 – EXECUTION

3.1 TEMPORARY ROADS AND PARKING AREAS

A. Temporary Roads and Parking in Same Areas as Permanent Pavement:
   1. Provide temporary roads and parking areas adequate to support and withstand traffic and construction loads during the Project. Locate temporary roads and parking areas in same location as permanent roads and parking areas. Extend temporary roads and parking areas, within construction limits indicated, as required for construction operations.
   2. Coordinate elevations of temporary roads and parking areas with permanent roads and parking areas.
   3. Prepare subgrade, subbase, and base for temporary roads and parking areas in accordance with the Contract Documents requirements for permanent roads, drives, and parking areas.
   4. Where required by subgrade conditions and construction loads and traffic, provide geosynthetic separation fabric as required on compacted subgrade for subbase support and separation of subbase and subgrade materials.
   5. Re-condition granular subbase of temporary roads and parking areas, including removing and properly disposing of granular material that has become intermixed with soil, re-grading, proof-rolling, compacting, and testing.

3.2 TRAFFIC CONTROLS

A. Traffic Controls:
   1. Provide temporary traffic controls at intersections of temporary roads with each other and with parking areas, including intersections with other temporary roads, intersections with public roads, and intersections with permanent access roads at the Site.
   2. Provide temporary warning signs on permanent roads and drives and provide temporary "STOP" signs for traffic on temporary roads where required and at entrances to permanent pavement.
   3. Comply with requirements of authorities having jurisdiction. When such authority is the OWNER or facility manager, and no requirements are

indicated, comply with the standard specifications of the state department of transportation in the area of the Project

3.3 MAINTENANCE OF ROADS

A. General:
   1. Maintain temporary roads and parking to continuously provide at the Site access for construction vehicles and trucks, OWNER and facility manager vehicles, deliveries for OWNER and facility manager, emergency vehicles, and parking areas for OWNER's and facility manager's personnel.
   2. Public roads shall be passable at all times unless a road closure is allowed in writing by authority having jurisdiction.
   3. When granular material of temporary roads and parking without hard surfacing become intermixed with soil or when temporary roads otherwise create a nuisance, remove intermixed granular-and-soil material, and replace with clean granular material as required.
   4. Provide snow and ice removal for temporary roads and parking areas.

B. Cleaning and Dust Control:
   1. Cleaning: Clean paved surfaces over which construction vehicles travel. Perform cleaning not less often than the frequency indicated in Section 01 74 05, Cleaning, or more frequently as directed by ENGINEER, by mechanical sweeping or other means acceptable to ENGINEER.
   2. Clean the following surfaces:
      a. Roads within limits of the Project.
      b. Permanent roads at the Site between the Site entrance and the work areas, and between the Site entrance and construction parking and staging areas.
      c. Public roads that require sweeping and cleaning due to construction operations.
   3. Dust Control:
      a. Control dust resulting from construction activities to prevent nuisances at the Site and in nearby areas.
      b. Comply with Section 01 41 27, Earthmoving and Dust Control, and Section 01 57 00, Temporary Controls.

C. Protection of Underground Facilities: Comply with the General Conditions, as may be modified by the Supplementary Conditions, Section 01 71 33, Protection of the Work and Property, and other requirements of the Contract Documents.

3.4 REMOVALS AND RESTORATION

A. Removals:
   1. Remove temporary roads, drives, walks, and parking areas that are not intended for, or acceptable for, integration into permanent pavement. Return areas of temporary roads, drives, walks, and parking to pre-construction condition unless otherwise required by the Contract Documents.

2. Remove temporary gates, fencing, and traffic controls associated with temporary roads and parking areas.
3. Where areas of temporary roads and parking will be permanently landscaped, remove pavement, granular subbase, geosynthetic (where required by ENGINEER), soil, and other materials that do not comply with the Contract Documents regarding fill, subsoil, and landscaping.
4. Remove and properly dispose of materials contaminated with oil, bitumen, and other petrochemical compounds resulting from CONTRACTOR's operations, and other substances that might impair growth of plants and lawns.

B. Restoration:
1. Repair or replace paving, curbs, gutters, and sidewalks affected by temporary roads and parking, and restore to required conditions in accordance with authorities having jurisdiction.
2. Restore to pre-construction conditions existing roads, walks, and parking areas damaged by CONTRACTOR, subject to approval of the owner of affected roads, drives, walks, and parking areas.

+ + END OF SECTION + +

SECTION 32 12 00

FLEXIBLE PAVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install flexible, hot-mix, hot-laid, asphalt concrete pavement.
   2. The Work includes:
      a. Preparation such as sawcutting, milling where shown or indicated, cleaning, and other preparation for installing flexible pavements.
      b. Providing asphalt concrete paving materials.
      c. Providing tack coat material.
      d. Providing pavement markings where shown or indicated.
      e. Providing quality controls and testing.
   3. For LEED certification, comply with Section 01 35 63, Sustainable Certification Project Requirements.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before flexible paving Work.
   2. Notify other contractors in advance of installing flexible paving to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before flexible paving Work.

C. Related Sections:
   1. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AASHTO M320, Specification for Performance-Graded Asphalt Binder.
   2. AASHTO MP1a, Specification for Performance-Graded Asphalt Binder.
   3. AI MS-2, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
   4. ASTM C1371, Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
   5. ASTM C1549, Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
   6. ASTM D242/D242M, Specification for Mineral Filler For Bituminous Paving Mixtures.
   7. ASTM D692/D692M, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.

8. ASTM D946/D946M, Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
9. ASTM D977, Specification for Emulsified Asphalt.
10. ASTM D1073, Specification for Fine Aggregate for Bituminous Paving Mixtures.
11. ASTM D1188, Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
12. ASTM D2726, Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
13. ASTM D2950, Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
14. ASTM D3549, Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
15. ASTM D6690, Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
16. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
17. ASTM E408, Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
18. ASTM E1918, Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
19. ASTM E1980, Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
20. FS TT-P-115, Paint, Traffic, Highway, White and Yellow.
21. USGBC LEED-NC, Reference Guide, For New Construction and Major Renovation.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Asphalt Concrete Production Facility:
      a. Production facility for asphalt concrete, tack coat materials, and other bitumastic materials shall be certified by the Georgia Department of Transportation (GDOT) for furnishing such materials for GADOT highways.
   2. Contractor's Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials provided under this Section.
      b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
      c. Testing laboratory shall be experienced in the types of testing required.
      d. Selection of testing laboratory is subject to Engineer's acceptance.

B. Regulatory Requirements:
   1. Reference Specifications and Details:

a. Comply with applicable requirements of GDOT Standard Specification Construction of Transportation Systems.

2. Obtain required highway and street rights-of-way work permits.
3. Jurisdiction:
   a. Paved areas to be constructed are jurisdiction of Owner.

C. Quality Assurance Testing:
   1. Quality assurance testing is in addition to source quality control testing, when required, and field quality control testing required under Article 3.4 of this Section.
   2. Materials used in the Work may require testing and retesting, as directed by Engineer, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at Owner's expense, including retesting of rejected materials and installed Work, shall be performed at Contractor's expense.
   3. Contractor's Quality Assurance Testing Laboratory Scope:
      a. Use of testing laboratory shall not relieve Contractor of responsibility for providing materials and the Work in compliance with the Contract Documents.
      b. Quality assurance testing laboratory shall perform the following, unless evidence of material compliance with reference specifications indicated in Paragraph 1.3.B of this Section , is submitted to Engineer by Contractor and asphalt concrete production facility:
         1) Test in accordance with AI MS-2.
      c. To facilitate testing services, Contractor shall:
         1) Secure and deliver to testing laboratory and Engineer (when requested by Engineer) representative Samples of materials that Contractor proposes to furnish and that are required to be tested.
         2) Furnish such labor as is necessary to obtain and handle Samples at the Site or at asphalt concrete production facility and other material sources.
         3) Advise testing laboratory and Engineer sufficiently in advance of operations to allow for completion of quality assurance tests and for the assignment of personnel.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit the proposed asphalt concrete mix design for each asphalt concrete material, and other bituminous materials, required under this Section, providing complete data on materials, including location in the Work, source, material content and percentages, temperatures and all other pertinent data. Indicate proportion of bituminous material from reclaimed asphalt pavement.

b. Proposed gradation for each aggregate to be used in flexible paving. Submit gradation test results for the same material furnished on a previous project. Indicate the proportion of reclaimed asphalt pavement.

c. In lieu of the information required under Paragraphs 1.4.A.1.a and 1.4.A.1.b, above, submit certificates of compliance with the reference specifications indicated in Article 1.3 of this Section, for each for the following:
   1) Each mix design required.
   2) Bituminous materials required.
   3) Aggregates to be used in flexible paving, from each material source and each required gradation.
   4) Density of uncompacted asphalt concrete material.
   5) Density of previously-compacted, previously-tested asphalt concrete material.
   6) Density and voids analysis for each asphalt concrete material test specimen.
   7) Evidence of asphalt concrete plant inspection and compliance with the reference specifications indicated in Article 1.3 of this Section.
   8) Proportion of reclaimed asphalt pavement in bituminous materials and aggregate.

B. Informational Submittals: Submit the following:
   1. Quality Assurance Test Data Submittals and Source Quality Control Submittals:
      a. Submit for quality assurance tests and source quality control tests required.
   2. Delivery Tickets:
      a. Submit copy of delivery ticket for each load of asphalt concrete, tack coat materials, and other materials obtained from asphalt concrete production facility, signed by Contractor
   3. Field Quality Control Submittals:
      a. Submit results of required field quality control testing.

1.5 SITE CONDITIONS

A. Weather Limitations:
   1. Temperature:
      a. For base course and binder course paving lifts equal to or greater than two inches thickness, atmospheric temperature shall be 40 degrees F and rising.
      b. For surface course paving or other pavement courses in lifts less than two inches thick, temperature of surface on which pavement is to be placed shall be 50 degrees F or greater.
   2. Prohibitions:
      a. Do not place flexible paving materials when weather is foggy or during precipitation.

b. Do not place flexible paving materials when the base on which the material will be placed contains moisture in excess of optimum.
c. Place flexible paving materials only when Engineer concurs that weather conditions are suitable.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:
1. Provide subbase course of the thickness shown or indicated, in accordance with Contract Drawings
2. Flexible Pavement Courses:
a. Provide the flexible pavement courses indicated below.
b. All Pavement:
1) Base Course: 8 inches compacted thickness.
2) Binder Course: 5 inches compacted thickness.
3) Surface Course (Wearing Course or Top Course): 1 ½" inches compacted thickness.

2.2 ASPHALT CONCRETE MIXES

A. Asphalt Concrete Mixtures (Superpave): Provide Superpave-type hot-mix asphalt concrete, consisting of a mixture of asphalt binder, oil, and aggregate, designed and manufactured in accordance with AI MS-2 and the following.
1. 25 mm Superpave
2. Surface Course 9.5 mm Superpave (Type 2)

2.3 BITUMINOUS MATERIALS

A. Bituminous Materials for Asphalt Concrete:
1. Bituminous materials for asphalt concrete shall comply with the reference specifications indicated in Article 1.3 of this Section, for the asphalt concrete mixes specified.
a. Provide asphalt binder for asphalt concrete used for publicly-owned highways, streets, and roads and for all Superpave asphalt concrete. Material shall comply with AASHTO M320 or AASHTO MP1a, performance grade suitable for the climate at the Site.
b. Provide asphalt cement for parking lots, driveways, and other pavements that are not part of publicly-owned highways, streets, or roads. Material shall comply with ASTM D946, penetration grade suitable for the pavement at the Site, or ASTM D3381, viscosity grade suitable for the pavement at the Site.

c. Provide materials such as oil and asphalt primers in accordance with reference specifications of the authority having jurisdiction over public roadways at the Site.

2. Bituminous Materials from Reclaimed Asphalt Pavement (RAP): When use of RAP in bituminous materials is acceptable, comply with requirements for RAP in Article 2.4 of this Section.

B. Tack Coat:
1. Tack coat shall be emulsified asphalt.
2. Provide tack coat complying with ASTM D977, Type SS-1h.

C. Crack Sealant:
1. Provide sealant complying with ASTM D6690, Type I, hot-applied type.

2.4 AGGREGATES IN FLEXIBLE PAVEMENTS

A. Aggregates for Asphalt Concrete – General:
1. Aggregate material shall comply with the following:
a. Coarse Aggregate: ASTM D692/D692M; crushed stone, gravel, or blast furnace slag.
b. Fine Aggregate: ASTM D1073; natural sand or sand manufactured from stone, gravel, or blast furnace slag.
c. Mineral Filler: Finely-ground mineral particles such as limestone dust, portland cement, or other inert material complying with ASTM D242/D242M, and free of foreign matter.

B. Reclaimed Asphalt Pavement (RAP):
1. Processed material obtained by milling or full depth removal of existing asphalt concrete pavement may be used as aggregate in asphalt concrete base course and binder course.
2. Maximum proportion of RAP in the asphalt concrete provided shall comply with requirements of the reference specifications indicated in Article 1.3 of this Section.
3. When RAP is used, comply with Contract Documents requirements for the applicable asphalt concrete course mix design, bituminous materials, and aggregates.

2.5 SOURCE QUALITY CONTROL

A. Tests: Obtain and test samples in accordance with AI MS-2. Testing is responsibility of Contractor or asphalt concrete production facility. Submit results to Engineer.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine the subbase and base on which flexible paving will be installed. Notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Do not place materials on subgrades, or subbase that is muddy or has water thereon.

3.2 PREPARATION

A. Preparation: Before starting installation of flexible paving, perform the following:
   1 Grade Control: Establish and maintain throughout flexible paving installation the required lines and grades, including crown and cross-slope for each asphalt concrete course during construction operations.
   2. Prepare subgrade and provide subbase for flexible pavement in accordance with Contract Drawings. Before installing flexible pavement, obtain Engineer's concurrence that subgrade and subbase are suitable for installing flexible pavement.
   3. Provide appropriate maintenance and protection of traffic measures during placement of pavement.

C. Surface Preparation:
   1. Repair surface defects in existing pavement to provide uniform surface to receive new pavement.
   2. Provide crack sealant to completely fill cracks more than 1/16-inch wide in areas shown or indicated on the Drawings.
   3. Clean existing surfaces over which asphalt concrete pavement will be installed, by removing from the surface foreign material, excess asphalt concrete, excess joint sealant, and crack filler, and other undesirable matter.
   4. Provide tack coat as indicated in Article 3.3 of this Section.

3.3 INSTALLATION OF FLEXIBLE PAVING

A. General:
   1. Provide final pavement surfaces of uniform texture, at required grades and cross-sections.
   2. Construct roadways to the lines, grades, and typical sections shown or indicated.

B. Installation of Asphalt Concrete:
   1. Asphalt concrete mixture shall be transported to the site of paving and placed as soon as possible after mixing.
   2. Placement of each asphalt concrete course shall be completed over the full width of the section under construction during each day's paving operations.
   3. Spread and finish asphalt concrete courses by means of self-propelled mechanical spreading and finishing equipment. Compacted thickness of layers placed shall not exceed 150 percent of specified thickness unless approved in writing by Engineer.

4. Compaction:
    a. Rollers:
        1) Use sufficient rolling equipment to satisfactorily compact and finish the quantity of asphalt concrete placed. There shall be not less than two rollers on the Project at all times. When acceptable to Engineer, one of the rollers may be a pneumatic-tire roller.
        2) During rolling operations, roller speed shall not exceed three miles per hour. When sufficient number of rollers is not available, reduce the quantity of asphalt concrete placed to accommodate the available rollers' speed.
        3) Required rollers shall be at the Site, in acceptable operating condition, prior to placing of asphalt concrete.
        4) Use of vibratory rollers in lieu of steel-wheeled rollers is acceptable, however when thickness of asphalt concrete is one-inch or less, rolling shall be in the static mode.
    b. Rolling of initially-placed asphalt concrete material, or breakdown rolling, shall begin as soon as the asphalt concrete mixture will bear the roller without undue displacement.
    c. Rolling shall be longitudinal, overlapping on successive trips by not less than one-half roller rear wheel width, and not more than three-quarters of roller rear wheel width. Alternate trips of the roller shall be of slightly different lengths.
    d. At all times, roller motion shall be slow enough to avoid displacing the asphalt concrete.
    e. Operate rollers continuously from breakdown of laid asphalt concrete through finish rolling.
    f. Perform finish rolling using a steel-wheeled roller or a vibratory steel-wheel roller operating in the static mode.
    g. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
    h. At each location not accessible to roller, thoroughly compact asphalt concrete with tampers and finish, where necessary, with a hot smoothing iron to provide uniform, smooth layer over the entire area so compacted.
5. Each compacted asphalt concrete course shall be within plus or minus 1/4-inch of the indicated thickness.
6. Placement of Adjacent Strips of New Asphalt Concrete:
    a. When more than one width of asphalt concrete material will be placed, a six-inch wide strip of asphalt concrete adjacent to the area on which the future material is to be placed shall not be rolled until such future material is placed.
    b. Do not leave the unrolled strip unrolled for more than two hours after placement, unless the six-inch unrolled strip is first heated with a joint heater.
    c. After the first strip or width of asphalt concrete is compacted, place, finish, and compact the second width or strip as required for the first width, except that rolling shall be extended to include the six-inch strip of the first width not previously compacted.

C. Construction Joints:
   1. Construction joints shall be made in such a manner as to ensure a neat junction, thorough compaction, and bond throughout.
   2. Provide a transverse joint extending over the full width of the strip being laid and at right angles to its centerline at end of each workday and at other times when the placement of hot-mix asphalt concrete will be suspended for a period of time that will allow asphalt concrete mixture to chill.
   3. Thoroughly compact by rolling the forward end of a freshly laid strip of asphalt concrete before the asphalt concrete mixture becomes chilled. When the Work is resumed, the end shall be cut vertically for the full depth of the layer.

D. Joining of Pavements:
   1. When pavement is to join existing or previously-laid pavement, the existing or previously-laid pavement shall be neatly and carefully edged to allow for overlapping and feathering of the subsequent course of asphalt concrete material.
   2. Where new pavement is to meet existing pavement, the existing pavement shall be sawcut and notched.
   3. Where new pavement will meet existing asphalt pavement, remove existing pavement 12 inches onto undisturbed existing pavement course at edges where new pavement will meet existing pavement.
   4. Tack Coat:
      a. Provide tack coat material at the following locations:
         1) At edges where new pavement will connect to existing or previously-installed pavement.
         2) On surface of existing or previously-installed pavement course over which new pavement will be installed, prior to placement of the subsequent pavement course. Tack coat may be deleted when a succeeding layer of asphalt pavement is being applied over a freshly-placed asphalt pavement course that has been subjected to very little or no traffic, with approval of Engineer
         3) Where new pavement will abut curbing, concrete gutters, drainage structures and frames, manhole cover frames, valve boxes, and similar items.
      b. Tack Coat Installation: Install tack coat immediately prior to installing pavement. Place pavement while tack coat is wet. Apply tack coat in accordance with reference specification indicated in Article 1.3 of this Section.

E. Curing:
   1. Do not allow traffic onto pavement until directed by Engineer. Traffic will not be allowed on new asphalt concrete pavement until surface temperature is less than 140 degrees F.
   2. Hold construction traffic on new pavement to a minimum as acceptable to Engineer.

F. Asphalt Concrete Curbs: Provide extruded asphalt curbs of the height and profile indicated on the Drawings.

G. Defective Pavement Work:
   1. When directed by Engineer, remove and replace defective flexible paving Work. Cut out such areas of defective pavement and fill with fresh asphalt concrete materials, compacted to required density.

3.4 FIELD QUALITY CONTROL

A. Site Tests:
   1. Responsibility:
      a. CONTRACTOR shall employ field quality control testing laboratory to perform the following:
         1) Perform field density tests to verify that required compaction of asphalt materials has been obtained.
         2) Test the proposed materials for compliance with the Contract Documents, as directed by Engineer.
         3) Submit reports of all test results to Engineer and Owner.
      b. Authority Field Quality Control Testing Laboratory:
         1) Technicians representing the testing laboratory will inspect materials at the Site and perform required testing. When the materials furnished or Work performed do not comply with the Contract Documents, field quality control testing laboratory technician shall direct the attention of Engineer and Contractor to such non-compliance.
         2) Testing laboratory personnel shall not act as foreman or perform other duties for Contractor. The Work will be checked as it progresses, but failure to detect defective Work shall not in any way prevent the later rejection of such defective Work when defect is discovered. Failure to detect defective Work as it occurs does not obligate Engineer to final acceptance. Testing laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, nor to approve or accept any portion of the Work.
   2. Asphalt Concrete Mix Temperature: Measure temperature at time of placement, record, and submit to Engineer.
   3. Surface Smoothness:
      a. Test finished surface of each flexible paving course for smoothness, using a ten-foot straightedge applied parallel to and at right angles to centerline of paved areas.
      b. Check surfaced areas at intervals as directed by Engineer.
      c. Surfaces will be acceptable relative to smoothness when measurements are equal to or less than the following:
         1) Base Course: 3/8-inch vertical in ten feet horizontal.
         2) Binder Course: 3/8-inch vertical in ten feet horizontal.
         3) Surface Course (Wearing Course): 1/4-inch vertical in ten feet horizontal.

6) Surfaces will be acceptable when variance is equal to or less than 1/4-inch from the template.

d. Elevation: Finished surface of pavement shall be within plus or minus 1/2-inch of elevations shown or indicated.

4. Density:
   a. Test Method: ASTM D295. nuclear method; test one sample every 1,000 square yards of pavement. Test for each asphalt concrete course installed.
   b. In addition, when directed by Engineer, compare density of in-place flexible paving materials against laboratory specimen or certificates on same asphalt pavement mixture, using nuclear density device.
   c. Criteria for Acceptance: Density of in-place asphalt pavement material shall be not less than 90 percent of the recorded laboratory specimen or certificate density. Density shall be not greater than 98 percent.
5. Repair holes from test specimens in accordance with this Section's requirements for repairing defective Work.

3.5 ADJUSTING

A. Frames and Covers:
   1. Set frames of drainage structures, manholes, valve boxes, and similar items to final grade. Adjust frames of existing structures and frames furnished under other Sections. Frames shall be substantially similar elevation to finished surface course of pavement.
   2. Replace covers and gratings of existing structures immediately following adjusting associated frames. Install covers and gratings of structures provided under the Project as quickly as possible.
   3. Where there is a delay between adjusting of frames and installation of surface course, provide temporary bituminous material around perimeter of each frame to smooth vehicle access over the frame. Maintain and repair temporary bituminous material as required until placement of surface course. Remove temporary bituminous material before installing surface course.

B. Pavement Adjustment:
   1. Repair or replace in manner acceptable to Engineer areas of pavement that are observed to pond or collect water.

3.6 CLEANING

A. Cleaning: After completing the paving operations, clean surfaces of excess or spilled bituminous materials, excess asphalt concrete, and foreign matter.

3.7 PROTECTION

A. Protect finished pavement until pavement has become properly hardened and cool.

B. Cover openings of drainage structures, manholes, valve boxes, and similar items in the paved area until permanent coverings are provided.

+ + END OF SECTION + +

SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
   2. Extent of piping is shown on the Drawings. Piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:
   1. Section 31 20 00, Earth Moving.
   2. Section 09 91 00, Painting.
   3. Section 33 05 05, Buried Piping Installation.
   4. Section 40 05 05, Exposed Piping Installation.
   5. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
   2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
   3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   6. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
   7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   8. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
   9. ASTM C283, Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
   10. ASTM D714, Test Method for Evaluating Degree of Blistering of Paints.

11. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
12. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.
13. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
14. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
15. ASTM G62, Test Methods for Holiday Detection in Pipeline Coatings.
16. ASTM G95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
17. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
18. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
19. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
20. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
21. ANSI/AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
22. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
23. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
24. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
25. European Standard (EN), EN 598: Ductile Iron Pipe, Fittings, Accessories and Their Joints for Sewerage Applications.
26. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
27. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
28. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
29. NSF/ANSI 61, Drinking Water System Components - Health Effects.
30. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
31. SSPC Painting Manual, Volume 1, Para. XIV.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
      b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions, and shall be able to

show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:
1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:
1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation:
1. Shop Drawings:
a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.
2. Samples:
a. Submit Sample of pipe and fitting with each type of lining, for use at the Site to verify continuity, surface gloss, and color, as applicable, via visual inspection.
3. Test Procedures: For linings and coatings in pipe and fittings.

B. Informational Submittals: Submit the following:
1. Certificates:
a. Submit certificate signed by manufacturer of each product that product

conforms to applicable referenced standards and the Contract Documents.

2. Source Quality Control Submittals:
   a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
   b. Lining and coating test coupons.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:
   1. Piping systems shall be suitable for their intended use.
   2. Joints shall be as specified in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by ENGINEER.

B. Ductile Iron Pipe, Joints, and Fittings:
   1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
      a. Pressure Rating: As specified in piping schedule in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.
   2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
      a. Pressure Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
      b. Special Thickness Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
   3. Pipe Joints:
      a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
         1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other

deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.

2) Bolts: Comply with ANSI B18.2.1.
   a) Exposed: ASTM A307, Grade B.
   b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
3) Nuts: Comply with ANSI B18.2.2.
   a) Exposed: ASTM A563, Grade A, Heavy hex.
   b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.

b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   1) Glands: Ductile iron.
   2) Gaskets: Plain tip.
   3) Bolts and Nuts: High strength, low alloy steel.
   4) Manufacturers: Provide products of one of the following:
      a) Clow Water Systems Company
      b) Atlantic States Cast Iron Pipe Company
      c) Canada Pipe Company, Ltd.
      d) McWane Cast Iron Pipe Company
      e) Pacific States Cast Iron Pipe Company
      f) Griffin Pipe Products Co.
      g) American Cast Iron Pipe Co.
      h) U.S. Pipe and Foundry Co.
      i) Or equal.

c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   1) Gaskets: Vulcanized SBR, unless otherwise specified.
   2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
   3) Products and Manufacturers: Provide one of the following:
      a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
      b) Fastite Joint by American Cast Iron Pipe Company.
      c) Tyton Joint by U.S. Pipe and Foundry Company.
      d) Or equal.

d. Grooved End Joints: Comply with ANSI/AWWA C606.
   1) Gaskets: Flush seal type designed for ductile iron that complies with or exceeds requirements of ASTM D2000

2) Bolts and nuts: As specified for flanged joints.
3) Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
4) Products and Manufacturers: Provide one of the following:
   a) Victaulic, Style 31.
   b) Or equal.

e. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of ENGINEER.
1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
   a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
   b) MJ Coupled Joint, by American Cast Iron Pipe Co.
   c) MJ Field Lok, by U.S. Pipe and Foundry Co.
   d) Or equal.
2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
   a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.
   b) Lok-Ring Joint, or Flex-Ring Joint, by American Cast-Iron Pipe Company.
   c) TR Flex Joint, by U.S. Pipe and Foundry Company.
   d) Snap-Lok, by Griffin Pipe Products Company.
   e) Or equal.

4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
   a. Material: Ductile iron.
   b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and/or ANSI/AWWA C153 and ANSI/AWWA C111.
   a. Material: Ductile iron.
   b. Glands: Ductile iron.
   c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.

C. Cement-mortar Lining:
1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

D. Couplings:
1. Refer to Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.

E. Specials:
   1. Transition Pieces:
      a. Provide suitable transition pieces (adapters) for connecting to existing piping.
      b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
   2. Taps:
      a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
      b. Provide corporation stops where shown or required.
      c. Where pipe wall thickness or tap diameter will not allow engagement of 8 full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.B.3.a of this Section for four-inch through 12-inch diameter pipe, and Paragraph 2.1.B.3.b. for 14-inch through 54-inch diameter pipe.
      d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.
   3. Tangential Outlets:
      a. Provide tangential outlet fittings where shown or indicated.
      b. Weld-on fittings are acceptable.
      c. Flanged and grooved end joints are not allowed.

2.2 MARKING FOR IDENTIFICATION

A. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
   1. Name or trademark of manufacturer.
   2. Weight, class or nominal thickness, and casting period.
   3. Country where cast.
   4. Year the pipe was produced.
   5. Letters “DI” or “Ductile” shall be cast or metal stamped

B. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
   1. Flange manufacturer’s mark, size, and letters “DI” cast or stamped on the flanges.
   2. Fabricator’s mark if other than flange manufacturer.
   3. Length and weight.

C. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:

1. Manufacturer's identification.
2. Pressure rating.
3. Nominal diameters of openings.
4. Country where cast.
5. Number of degrees or fraction of the circle on bends.
6. Letters "DI" or "Ductile" cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

A. General Coating Requirements:
   1. Coating types are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Exposed Pipe and Fittings:
   1. Surface Preparation:
      a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
      b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
      c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
   2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.
   3. Field painting shall comply with Section 09 91 00, Painting.

C. Buried Pipe and Fittings:
   1. Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

B. Visually inspect at the Site coated or lined pipe and fittings with ENGINEER and compare to approved Samples to verify lining continuity, surface gloss, and color, as applicable. Notify pipe manufacturer of damaged or unacceptable products. Pipe manufacturer shall visit the Site and perform testing to verify conformance

with the Contract Documents to determine if products require replacement or repair. Repair or replace unacceptable products at no cost to OWNER.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.

B. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 60 05

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, calibrate, test, start-up, and place in satisfactory operation a complete and operating instrumentation and control system. Scope of work includes:
      a. Furnishing all components required for the RTU including the enclosure, processor, modem, relays, and associated equipment.
      b. Field mounting of instrumentation.
      c. Integrating of new process control equipment into new control panel and control signals to/from VFD.
      d. Communications to/from the new RTU enclosure to the Owner's SCADA system.

B. Coordination:
   1. Instrumentation and Controls:
      a. Instrumentation and Controls equipment as shown and specified herein shall be furnished, installed, and placed into satisfactory operation by an Instrumentation and Controls subcontractor. Programming of PLC and configuration of OIT software is part of the work and shall be programmed and configured by J.K. Duren or owner approved programmer.
      b. Some panels and equipment are furnished under other Specification Sections under this Contract. Coordinate with Suppliers of these panels and equipment to provide fully functional system in accordance with the Contract Documents and that interfaces with the control system.
      c. The Input/Output List (I/O List) in this section identifies the I/O required RTU-32. The I/O List is for coordinating signals between field instrumentation and equipment provided by other suppliers.
   2. To centralize responsibility, materials, equipment, configuration, and startup provided under this Section shall be furnished by a single contractor.
   3. CONTRACTORS shall provide materials and equipment from a single

manufacturer to the greatest extent possible.

4. CONTRACTOR shall perform all work described in this section per the OWNER's SCADA System Standards.
5. I&C Subcontractor's responsibilities:
    a. Prepare all instrumentation and control equipment submittals in accordance with the contract documents.
    b. Proper interfacing of instrumentation and control equipment with field equipment, instruments, devices, and panels, including required interfacing with packaged control systems furnished by other equipment suppliers, and required interfacing with the Site's electrical system.
    c. Review and coordination with manufacturers, Suppliers, and other contracts of Shop Drawings and other CONTRACTOR submittals for equipment, valves, and appurtenances for ensuring proper interfacing of hardware, and locations and installation requirements of inline devices and instrument taps.
    d. Direct, detailed oversight of installation of instruments, panels, consoles, cabinets, wiring and other components, and related wiring and piping connections. Reinstallation or replacement of any instrumentation and controls component or electrical conduit and wiring resulting from absence of detailed oversight shall be provided at no additional cost to the OWNER.
    e. Calibrating, source quality control, field quality control, and start-up of the system.
    f. Responsibility for correction period obligations for instrumentation and control system.
    g. Training of operations and maintenance personnel in operation and maintenance (including calibration and troubleshooting) of the instrumentation and control system.

C. Related Sections:
    1. Division 01, General Requirements
    2. Division 26, Electrical
    3. Section 13 34 24, Prefabricated Booster Pump Station

1.2 REFERENCES

The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature, define parameters of configuration and construction, in addition to specific details in this Specification and the Contract Drawings:

1. ISA, Instrument Society of America.
2. UL, Underwriters' Laboratories, Inc.
3. AWWA, American Water Works Association.
4. NEMA, National Electrical Manufacturers Association.
5. OSHA, Occupational Safety and Health Administration.
6. ANSI, American National Standards Institute.
7. NFPA, National Fire Protection Association.
8. SAMA, Scientific Apparatus Manufacturers Association.
9. JIC, Joint Industrial Council.
10. IEEE, Institute of Electrical and Electronic Engineers.
11. NEC, National Electrical Code.
12. FM, Factory Mutual.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Field Instruments:
         i. Manufacturer’s product name and complete model number of devices proposed for use, including manufacturer’s name and address.
         ii. Instrument tag number in accordance with the Contract Documents.
         iii. Data sheets and manufacturer’s catalog literature. Provide data sheets in accordance with ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets using a format similar to ISA 20.
         iv. Description of construction features.
         v. Performance and operation data.
         vi. Installation, mounting, and calibration details; instructions and recommendations.
         vii. Service requirements.
         viii. Dimensions of instruments and details of mating flanges and locations of closed tanks, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
         ix. Range of each device and calibration information.
         x. Descriptions of materials of construction and listing of NEMA ratings for equipment.
      b. Field Wiring and piping diagrams, include the following:
         i. Wire and pipe size and type
         ii. Terminal numbers at field devices and in panels
         iii. Color coding.
         iv. Conduit numbers in which wiring will be located.

v. Locations, functional names, and manufacturer's designations of items to which wiring to piping are connected.

c. Electrical control schematics in accordance with NFPA 79. Drawings shall be in accordance with convention indicated in Annex D of the NFPA 79. Typical wiring diagrams that do not accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.

d. Stock list or bill of materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for components mounted in or on the panel or enclosure.

e. Instrumentation and Controls Equipment:

i. Submit the following general information:

a. Detailed block diagram showing system hardware configuration and identifying model numbers of system components.

b. Software listings for operating system, applications, and HMI.

c. Software language and organization.

d. Format, protocol and procedures for data transmission and communications with input/output modules and peripheral devices, including wide area network (WAN) or local area network (LAN).

e. Input/Output Information:

i. Input/output (I/O) point listing with I/O module cross-reference identification.

ii. I/O module cross-reference identification based on I/O address list developed by I&C Subcontractor.

f. Database listing, including all I/O points.

ii. Complete point-to-point interconnection wiring diagrams of field wiring associated with the system. Diagrams shall include the following:

iii. Field wiring between each equipment item, panel, instruments, and other devices, and wiring to control stations, panelboards, and motor starters. Some of this equipment may be specified in other Divisions, CONTRACTOR is responsible for providing complete point-to-point interconnection wiring diagrams for control and monitoring of that equipment.

iv. Numbered terminal block and terminal identification for each wire termination.

v. Identification of assigned wire numbers for interconnections. Assign each wire a unique number.

vi. Schedule showing the wiring numbers and the conduit number in which the numbered wire is installed.
vii. Junction and pull boxes through which wiring will be routed.
viii. Identification of equipment in accordance with the Contract Documents.

2. Product Data:
   a. Product data for field instrumentation in accordance with requirements for Shop Drawings in this section.
   b. Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.
   c. Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.
   d. Product data for I&C equipment, including software and hardware. Requirements for software product data are included in requirements for Shop Drawings under this Section
3. Factory Acceptance Test Procedure: Submit factory testing procedures that will be performed to fulfill requirements of the Contract Documents. Test procedure shall include the following:
   a. Visual inspection of components and assembly.
   b. Description of hardware operational testing.
   c. Description of software demonstration.
   d. Description of testing equipment to be used.
   e. Sign-off sheets to be used at time of testing.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions:
      a. Shipping, handling, storage, installation, and start-up instructions.
   2. Source Quality Control Submittals:
      a. Factory test reports and results.
   3. Field testing reports.
      a. Installation inspection and check-out report.
      b. Submit detailed written report of results of each visit to Site by I&C Subcontractor's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Submit in accordance with Section 01 78 23, Operation and

Maintenance Data.

b. Include complete up-to-date system software documentation. Provide hardcopy and electronic copies.

c. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

d. Final calibration sheets for each installed instrument signed by factory-authorized technician.

2. Record Documentation:

a. Prepare and submit record documents in accordance with Section 01 78 39, Project Record Documents.

b. Revise all system Shop Drawing submittals to reflect as-built conditions in accordance with the following.

1) Two copies of each revised Shop Drawings and documentation to replace out-dated drawings and documentation contained in operation and maintenance manuals. Submit half-size black line drawings for each drawing larger than 11 inches by 17 inches. Include specific instructions for out-dated drawing removal and replacement with record documents submittal.

2) Half-size black line prints of wiring diagrams applicable to each control panel shall be placed in clear plastic envelopes and stored in a suitable print pocket or container inside each control panel.

3) Submit CADD drawings of the point-to-point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

1.4 STORAGE AND HANDLING

A. Prior to packaging, each manufacturer or Supplier shall securely attach tag number and instructions for proper field handling and installation to each instrument.

B. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Power Supplies:

1. Electrically powered equipment and devices shall be suitable for operation on 115-volt plus-or-minus 10 percent, single-phase, 60 Hertz plus-or-minus two Hertz, power supply. If different voltage or closer regulation is required, provide suitable regulator or transformer at no additional cost to OWNER.
2. Provide appropriate power supplies for field instruments requiring power source less than 115 volts. Power supplies shall be mounted in control panels or enclosures installed near associated instrument or in field panels.
3. Power supplies shall be capable of minimum of 130 percent of maximum simultaneous current draw.
4. Provide power on-off switch or air circuit breaker for each item provided under this Section that requires electric power.

B. Signal Requirements:
   1. Control system shall use four to 20 mA DC analog signals, unless otherwise shown or indicated.
   2. Provide signal converters and repeaters where required. Adequately size power supplies for signal converters and repeater loads.

C. Surge Protection Requirements:
   1. Provide surge protection to protect electronic instrumentation and control systems from surges propagating along signal and power supply cabling. Protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than instrument surge withstand level, and be maintenance-free and self-restoring.
   2. Provide instruments in suitable metallic cases, properly grounded. Ground wires for surge protectors shall be connected to good earth ground and, where practical, run each ground wire individually and insulated from other wires. Mount protectors within instrument enclosure or in separate junction box compatible with the area designation coupled to the enclosure.

D. Miscellaneous:
   1. General:
      a. Instrumentation components shall be heavy-duty types, constructed for continuous service.
      b. System shall consist of equipment models currently in production.
      c. Materials and equipment, including cabling and interconnections, shall be in accordance with Division 26, Electrical, and manufacturer’s recommendations, unless indicated otherwise in the Contract Documents.
      d. Materials and equipment shall, where applicable, be in accordance with UL standards and be so marked and labeled.

2. Provide surge protection for instruments and other control system components that could be damaged by electrical surges.
3. Field-mounted instruments and system components shall be constructed for use in humid and corrosive service conditions. Field-mounted instrument enclosures, junction boxes and appurtenances shall have NEMA rating appropriate for hazardous rating requirements shown or indicated on Electrical Drawings, instrument data sheets, and elsewhere in the Contract Documents.
4. Miscellaneous hardware such as fittings, fasteners, and screws, be Type 316 stainless steel or other appropriate material to prevent galvanic reactions, and shall be suitable for service intended. Piping stands shall be provided for fastening instruments as required. Provide threaded pipe stands with flange bolted to slab. Use carbon steel piping and flanges painted in accordance with Section 09 90 00, Coatings.
5. Data processing equipment and relays with interconnections to field devices shall be wired through field wiring terminal blocks in the panel. Terminals as part of relay base are unacceptable.
6. Arrange panel-mounted instruments, switches, and other devices ergonomically for functional use and ease of maintenance. Similar types of panel-mounted devices shall be by one same manufacturer and of the same model line.
7. Equipment furnished shall be of modular construction and be capable of field expansion through installation of plug-in circuit cards and additional cabinets as necessary.
8. Field- and panel-mounted instruments shall be tagged with equipment number and nomenclature indicated in the Contract Documents; if not so indicated, tag in accordance with approved Shop Drawings.
9. Coordinate ranges and scales specified in the Contract Documents with manufacturer of the equipment actually furnished for operability over the intended range. Complete the coordination prior to submitting Shop Drawings to ENGINEER.
10. Treat field-mounted devices with anti-fungus spray.
11. Protect field-mounted devices from exposure to high and freezing temperatures to provide complete operability under the environmental conditions indicated in the Contract Documents.

E. Environmental Conditions:
   1. Provide control system suitable for continuous operation under the following conditions:
      a. Indoor Instruments:
         1) Ambient Temperature: Zero degrees F to 120 degrees F.

2) Relative Humidity: 100 percent, maximum.

b. Outdoor Instruments

1) Ambient Temperature: -15 degrees F to 120 degrees F.

2) Relative Humidity: 100 percent, maximum.

2. Protect outdoor-mounted field instruments from direct sunlight by providing sunshade for instruments. Construct sunshade out of non-corrosive material. Sunshade shall withstand wind velocity of 70 miles per hour.

2.2 PANELS

A. General Provisions:

1. Provide electrical components and devices, support hardware, fasteners, and interconnecting wiring and piping required to provide control panels complete and operational.
2. Locate and provide hardware so that connections can be easily made and there is ample room for servicing each item.
3. Prevent movement by adequately supporting and restraining devices and components mounted on or within panel.
4. Provide panels with sub-panels for installation of all internally mounted hardware.
5. Provide numbered terminal strips for terminating field wiring and wiring from other panels, unless otherwise shown or indicated.
6. Provide copper grounding studs for hardware requiring grounding.
7. Provide the following convenience accessories inside each panel:
   a. One 120 vac, 20-amp duplex, grounding type receptacle.
   d. Duplex receptacle shall have a dedicated circuit breaker.
9. Panels to be located in non-hazardous (non-classified) environments shall comply with UL 50 and UL 508A.
10. CONTRACTOR is responsible for detailed layout and design of panels, in accordance with the Contract Documents. Base cutouts and design on instrument manufacturers' requirements.
11. Provide easily accessible pocket built into panel door to enclose "as built" panel wiring diagrams.
12. Panels shall be UL-listed and labelled.

B. Identification:

1. Provide laminated plastic nameplate for identification of panels. Use self-tapping stainless-steel screws for fastening nameplates to panels. When self-tapping screws may degrade panel's NEMA rating, retain NEMA rating intact by using gaskets on each side of panel surface and use retaining plate

on the panel back that is same size as nameplate. When gaskets and retaining plate are used, use full-penetration screws with nuts.

2. Panel identification nameplates shall have 1/2-inch high engraved letters.
3. Tag electric components and devices mounted within panels with high adhesive labels.
4. Identify terminal strips with nameplate engraved as "TB-XX" where "XX' is the numerical identification of terminal strip.
5. Identify terminals within each terminal strip with sequential numbers and wire numbers.
6. Internal panel wiring shall be color-coded and numerically identified with unique wire numbers affixed at each end of each wire. Color coding shall be in accordance with panel wiring color code table, below:

Panel Wiring Color Code Table

Description	Color
110 vac panel power before fuses or breakers	Black
Controlled 110 vac power (e.g., after relay contacts, selector switch contacts, and similar equipment.)	Red
110 vac power source from devices external to panel	Yellow
110 vac neutral	White
24 vdc positive power from power supplies	Brown
24 vdc negative power from power supplies	
Controlled 24 vdc power (e.g., after PLC output contacts, relay contacts, and similar)	Blue
24 vdc positive power from devices external to panel	Orange
24 vdc negative power from devices external to panel	
24 vdc four to 20 mA DC signal cable	Grey with red positive, clear negative
Grounding wire	Green

C. Panel Construction Features:

1. Control panels located inside electrical room prefabricated building shall be rated NEMA 12 with the following features:
   a. Fabricate enclosures using minimum 14-gauge steel for wall- or frame-mounted enclosures and minimum 12-gage for free standing enclosures. Steel shall be free of pitting and surface blemishes. Reinforcing, with a smooth-brushed finish.
   b. Continuously weld exterior seams and grind smooth. Surface grind panel to completely remove corrosion, burrs, sharp edges, and mill scale.
   c. Reinforce sheet steel with steel angles where required to adequately support devices and equipment and ensure rigidity and to preclude resonant vibrations.
   d. Panel shall be flat within tolerance of 1/16-inch over two-foot by two-foot area, or flat within tolerance of 1/8-inch for larger surface area.

Acceptable out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections

e. Use pan type construction for doors. Door widths shall not exceed three feet.
f. Mount doors with full-length heavy-duty piano hinge with stainless steel hinge pins.
g. Provide oil resistant gasket completely around each door or opening.
h. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.
i. Use stainless steel fasteners throughout.
j. Provide interior mounting panels and shelves constructed of minimum 12-gage steel with white enamel finish.
k. For prints, provide steel pocket with white enamel finish.
l. Provide enclosure mounting supports as required for floor, frame, or wall mounting as required.
m. Completely clean interior and exterior surfaces so surfaces are free of corrosive residue, oil, grease, and dirt. Apply zinc phosphatizing for corrosion protection.

D. Electrical Systems:
1. Power Source and Internal Power Distribution:
a. Provide in the panel, near where incoming power is terminated, nameplate with panel power supply source, type, voltage, and circuit number.
b. Protect incoming 120 vac power feeds to power the panel by providing lightning and surge arrestors, properly connected to grounds.
c. Provide panels with internal 120 vac power distribution system with properly-sized and -rated circuit breakers to distribute power. Power not more than six devices from a single breaker. When power supplies are included in the panel, not more than two power supplies shall be powered from a single breaker. Convenience receptacles and interior panel lights shall have their own breakers. When one or more field instruments require 120 vac power from the panel for instrument power, power not more than three instruments from a given breaker.
d. Provide space for a minimum of two spare breakers in each panel.
2. Electrical Systems:
a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 volts at 85 degrees C for single conductors, color-coded and labeled with wire identification.

b. For DC signal wiring, use shielded cable with 18-gage conductors. DC field signal wiring terminal strips shall be capable of handling wires up and including No. 12 size.
c. For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by the NEC (NFPA 70) .
d. Inside of panels, route DC signal wiring separately from power wiring with minimum separation distance of six inches.
e. Use covered Panduit to route internal panel cables and wiring. Panduit in each section of panel shall be appropriately sized to accommodate the quantity of wires to be routed with a spare capacity of 40 percent.
f. Install wire troughs inside panels along horizontal or vertical routes to present a neat appearance. Angled runs are unacceptable.
g. Wiring that is routed without Panduit shall be adequately supported and restrained to prevent sagging or other movement. Use of adhesive anchors to support or restrain wiring is unacceptable.
h. Terminate internal panel wiring using forked, insulated, crimp-on connectors; soldered connectors are unacceptable. Provide panels with 600-volt rated barrier type terminal strips mounted on Din rails. Identify terminal strips as indicated in this Section. Identification devices shall be self-stick, plastic tape strips with permanent, machine-printed numbers.
i. Wiring in panels shall be installed such that, if wires are removed from any one device, power will not be disrupted to other devices.
j. Provide spare terminals equal in number to 20 percent of terminals used for each type of wiring (e.g., DC signal and AC power).
k. Provide ground terminals to terminate the shield wire of shielded cables. Termination of more than two shielded wires on a single ground terminal is unacceptable.
l. Provide a single copper bus bar with 5/16-inch diameter copper grounding stud to connect the panel to external ground. Panel's internal grounds shall be terminated to the bus bar.
m. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
n. When DC power or low voltage AC power is required, furnish and install in the panel required power supplies and transformers.
o. Provide complete wiring diagram of "as-built" circuitry enclosed in transparent plastic.
p. Terminal blocks for 4-20 mA DC signals shall be fused and knife disconnect type. Fused terminal blocks shall have LED blown fuse indication.

3. Provide complete wiring diagram of "as-built" circuitry enclosed in transparent plastic.

2.3 REMOTE TERMINAL UNIT (RTU)

A. Remote Terminal Unit Panel

1. Provide remote terminal unit (RTU) panel with real-time alarm, monitoring, and control features, and radio communication capability.
2. RTU shall have the capability to report pump start/stops and daily pump runtimes with graphs, wet well tank level monitoring, integrated site activity logs, and automated pump problem analysis of daily runtimes.
3. RTU shall generate and deliver real time alarms via phone call, text message, email, and to an existing HMI software through an OPC data link. Each alarm shall be logged with a time stamp for tracking and reporting purposes.
4. RTU panel shall include all necessary hardware for a complete installation, such as cellular radio, battery backup, antenna with cable and mounting hardware.
5. RTU shall have the following minimum features.
    a. Power Supply: 120 VAC to 12 VAC, 1.2 A UL class II/III transformer.
    b. Enclosure: For indoor Installation
    c. Mounting: Wall mounting
    d. Data Reporting
        i. Alarm Data: Real time
        ii. Pump State: Real time
        iii. Analog Reporting: Every 2 minute or on 5% Change
        iv. Device Health: Hourly
    e. Digital Inputs:
        i. 24 built-in dry digital inputs including 4 configurable HSC inputs
    f. Analog Inputs:
        i. 4-20mA input range
        ii. 2 built-in Channels
    g. Digital Outputs:
        i. 16 built-in dry digital inputs including 2 configurable PWM Outputs.
    h. Analog Outputs:
        i. Included expansion module to support up to two 4-20mA output channels.
    i. Ethernet (Modbus TCP/IP) communication support for expansion modules.
    j. Operating Temperature: -10°C to +60°C

B. Antenna Hardware

3. Antenna

a. Omnidirectional multiband LTE antenna and ground impulse suppressors shall be furnished for radio communication.
b. Location of antennas shall be determined by Contractor at the time of installation.
c. Requirements:
i. Frequency: 698-960/1710 to 2700 MHz
ii. Gain: 5 dB
iii. Impedance: 50 Ohm
iv. Connector: Integral N-Female
d. Manufacturer:
i. Signal Booster
ii. Or equal

4. LMR-400 Antenna Cable:
a. Ultra low loss coax cable (<1dB)
b. Connector: N-Male on both ends
c. Coaxial cable grounding kit
5. In-line Cable Surge Protectors

2.4 DATA SHEETS – PRIMARY SENSORS AND FIELD INSTRUMENTS

A. General
1. Primary sensors and field instruments shall be in accordance with the "data sheets" included in Part 3 of this specification.

2.5 IDENTIFICATION

A. Input/Output List Identification
1. I/O point list contains information required to configure PLC I/O interface hardware, and to indicate range conversion or signal functions.
2. "POINT NUMBER" is an alphanumeric character string. For example, for the point "MP-FI-806-0123" the following apply:
a. The first two characters (MP) refer to the specific plant area (MP = Main Pump, for example).
b. The third character is the functional identifier and conforms with ANSI/ISA S5.1. In the example, "F" represents flow.
c. The fourth (and sometimes fourth and fifth) alphabetical character (I) is the function identifier. In the example, the "I" represent indication input.
d. The first three-digit number (806) identifies the P&ID number.
e. The next four-digit number (0123) identifies the loop or field device.
f. Suffix, where required, is used for distinguishing between similar variables.

3. "DESCRIPTION" is an alphanumeric character string up to 40 characters in length. Points described as "SPARE" indicate pre-wired I/O.
4. "SIGNAL TYPE" is one of the following:
   a. AI indicates analog input.
   b. DI indicates discrete input.
   d. AO indicates analog output.
   e. DO indicates momentary, maintained or latched discrete output.

C. ISA Identification
1. A = Miscellaneous Analytical.
2. B = Burner, Combustion.
3. C = Chlorine Residual/Gas.
4. D = Density.
5. E = Voltage.
6. F = Flow.
7. G = Intrusion.
8. H = Hand.
9. I = Current.
10. J = Power.
11. K = Time.
12. L = Level.
13. M = Motor.
14. N = pH.
15. O = Oxygen.
16. P = Pressure.
17. Q = Quantity.
18. R = Radioactivity.
19. S = Speed, Frequency.
20. T = Temperature.
21. U = Common.
22. V = Vibration.
23. W = Torque (Weight or Force).
24. X = Hazardous Gas.
25. Y = Event, State or Presence (Switch Position).
26. Z = Position, Dimension.

C. Function Identifier:
1. A = Available / In Auto (input)
2. B = Backward Rotation (input)
3. C = Full Closed (input)
4. D = Full Open (input)

5. E = Close/Energize (output)
6. H = High (input)
7. I = Input (Analog)
8. L = Low (input)
9. N = Open (output) or Control Mode (input)
10. O = Output (Analog)
11. R = Running (input)
12. S = Start (output)
13. T = Stop (output)
14. U = Malfunction or Alarm (input)
15. V = Slow (output)
16. W = Slow (input)
17. X = Selector Switch (input)

2.6 PROCESS CONTROL DESCRIPTION

A. Programming of the controller is part of the Integrators scope of work. Process Control Description below are provided for informational .

B. Reference Drawing: I-04

C. PUMPS
   1. The pump system consists of 2 pumps (32-P-01 and 32-P-02) which are VFD operated.
   2. System Operation
      a. Pumps will operate on a Duty-Standby sequence. Pump No. 1 will be the primary pump, while Pump No. 2 will be secondary. Each pump shall have local controls on the VFD to manually operate the pump which has Local/Off/Remote selection, Start/Stop controls, Speed Control, and Status and Alarm indication lights. The primary pump will operate for normal daily turnover of water in the tank, for a period determined by the end user. Operation time could change based on the daily demand during peak periods.
      b. IN REMOTE MODE
         i. Operations of pumps will be disabled from local use and all pump operations will be from SCADA Workstations at the Owner Control Room.
         ii. The primary pump will operate daily at a set time determined by the end user. The pump will run once the Tank Level Pressure high setpoint has been meet and the Pressure Switch has not been triggered.

iii. Once the pump starts, it will be at a predetermined reduced speed of 77% and should gradually ramp up as the tank is drains.
iv. The pump will shut-off once the Tank Level Pressure low setpoint has been meet or the Pressure Switch has been triggered.

c. IN LOCAL MODE
i. Operations of pumps will be disabled from SCADA and all pump operations will be controlled locally, but SCADA will still have visibility of pumps status and alarms.
ii. All timers for pump start/stop will be disabled and pumps can only be started manually.
iii. To start the pumps locally, the Tank Level Pressure low and suction Pressure Switch should not be engaged.
iv. Once pumps start, the default speed should be consistent with running in remote but can be overridden locally.
v. The pump will shut-off once the suction Pressure Switch has been triggered.

D. PRESSURE TRANSMITTER
1. There are 3 pressure transmitters on the system PIT-3201, PIT-3202, and PIT-3203. Display, trend, and record all pressures.
2. PIT-3201 will be utilized to monitor the level inside the elevated storage tank.
a. The pressure inside the base of the tank will be used to determine the water surface elevation in the tank.
b. When the high level setpoint is reached, the tank control valve solenoid will de-energize and the main tank control valve will close.
3. PIT-3202, is utilized for display to monitor the distribution system pressure..
4. PIT-3203, located in the booster pump house, is utilized to monitor the pressure on the common pump discharge and for operation of the booster pumps.

E. PRESSURE SWITCH
1. There are 2 Pressure Switches, one on the inlet line of each pump, PSL-3211 and PSL-3221will be utilized to monitor the inlet of each pump to determine of there is adequate flow for the pumps.

F. PRESSURE SUSTAINING VALVE
1. The Pressure Sustaining Valve will be located on the inlet of the tank and booster pump station. The valve will fill the elevated storage tank while throttling to maintain a set upstream pressure in the distribution system. Once

the tank has reached the high level setpoint the valve will close, indicating the elevated storage tank is full.

2. While the system is in remote, once the pumping cycle is complete and the elevated storage tank has reached the low level pressure setpoint, the valve will open after a pre-determined timer delay has been met to refill the tank.

G. FLOW METER

1. The Flow Meter FIT-3201 is located on the pump inlet header, and is utilized for monitoring flow. Display, trend, record station flow.

2.7 SOURCE QUALITY CONTROL

A. Factory Inspection:

1. Inspect each panel, console, device, and cabinet before testing and before shipping. Inspection shall include, but not be limited to the following:
   a. Verify all "Approved as Corrected" comments on Shop Drawings were implemented.
   b. Verify presence of and accuracy of nameplates and tags.
   c. Verify that wire sizes and color-coding comply with the Contract Documents.
   d. Verify presence of terminal blocks, terminal block numbers, and required quantity of spares.
   e. Verify annunciator window engravings and quantity of spare windows comply with the Contract Documents.
   f. Verify proper wiring practices and grounding.
   g. Verify enclosure flatness, finish, and color.
   h. Verify anchoring of wire bundles between subpanels and front panel-mounted devices.
   i. Verify presence of applicable items specified in this Section.
   j. Check and verify software licenses for latest release and license types.

B. Panel Operational Testing:

1. Test all input/output components to verify that internal panel wiring is properly terminated at correct locations. Verify initial ranges and settings.
2. Test all system hardware and software to verify proper operation as stand-alone units. Test shall include, but not be limited to, the following:
   a. Power distribution and breaker ratings to match approved Shop Drawings.
   b. Power fail/restart tests.
   c. Diagnostics checks.

d. Demonstrate that all specified equipment functional capabilities are working properly.
e. Check and verify process displays are in accordance with approved Shop Drawings.

3. Test components and devices requiring data transmission to verify that communication between such components is working properly. Verify communication by using the same media required for the completed system at the Site as indicated in the Contract Documents.
4. Perform integrated system test with all system equipment and simulated inputs/outputs connected to verify that equipment is performing properly as an integrated system.
5. Simulation devices shall be of suitable quality to not mask control panel defects.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Environmental Requirements:
1. Do not install instruments in areas where construction may cause instrument to be damaged, without providing adequate protection for said instrument.

B. Installation of Instrumentation:
1. Secure field-mounted instruments to stands or brackets in accordance with manufacturer's recommendations, approved or accepted (as applicable) submittals, and the Contract Documents.
2. Locate sensors where shown on the Drawings. Confirm exact locations in the field with ENGINEER.
3. Install all devices so that devices are readily accessible for service and do not cause potential hazards.

B. Services and Operator Instructions

1. Provide repairs or replacement of defective materials, equipment or workmanship, including with respect to equipment, the services of factory-trained servicemen.
2. In addition to the calibration required for check-out, provide two additional calibrations on all instruments. The first re-calibration shall be approximately six months after acceptance of the system, and the second shall be approximately eleven months after acceptance. As part of each calibration, provide two copies of the calibration sheets, a detailed list of deficiencies (should any be found), and a statement that the entire system is in proper operation and condition (except for the deficiencies noted) and shall be turned over to the OWNER.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. System Check-Out and Start-Up Responsibilities:
      a. CONTRACTOR shall perform check-out and start-up of all system components.
      b. Check and approve the installation of all instrumentation and control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.
      c. CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and start-up.
      d. CONTRACTOR shall furnish ENGINEER an Installation Inspection Report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by an authorized representative of the CONTRACTOR.

B. Loop Status Reports: Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the CONTRACTOR and OWNER:
   1. Project Name, Test Date, name of the person whom the CONTRACTOR authorized to conduct the test and CONTRACTORs Name.
   2. Loop Number.
   3. Tag Number for each component.
   4. Check-offs/sign-offs for each component: Tag/identification; installation; termination (wiring and tubing); scale, range, and setpoint as applicable; and calibration/adjustment (four-point for analog, set point for switches) rising and falling.

5. Check-offs/sign-offs for the loop: Panel interface terminations; I/O interface terminations; I/O signal operation; inputs/outputs operational (received/sent, processed, adjusted); total loop operation; process controller scaling and adjustment; and space for comments.

C. Loop Checks:
   1. CONTRACTOR shall test all I/O from the field device to the PLC terminals and verify that the PLC has received the signal.
   2. Loop checks shall be documented using OWNER-approved Input/Output Status Sign-Off forms.

D. Functional Test:
   1. CONTRACTOR shall demonstrate operation of each device and the connection to the PLC and SCADA System. Test operation of pumps, valves, and instruments locally, at RTU, and remotely using FCWS SCADA system.

3.4 SUPPLEMENTS

A. The supplements listed below, following the "End of Section" designation, are part of this Specification section.

+ + END OF SECTION + +