

Alpenglow Community Park Project

DOCUMENT 009113 – ADDENDUM NO. 03

1.1 PROJECT INFORMATION

- A. Project Name: Alpenglow Community Park Project.
- B. Owner: Bend Park and Recreation District.
- C. Owner Project Number: 016.
- D. Landscape Architect: Environmental Science Associates.
- E. Date of Addendum: 11/13/2020.

1.2 NOTICE TO BIDDERS

- A. This Addendum is issued through Premier Builders Exchange pursuant to the Instructions to Bidders and Conditions of the Contract. This Addendum serves to clarify, revise, and supersede information in the Project Manual, Drawings, and previously issued Addenda. Portions of the Addendum affecting the Contract Documents will be incorporated into the Contract by enumeration of the Addendum in the Owner/Contractor Agreement.
- B. The Bidder shall acknowledge receipt of this Addendum in the appropriate space on the Bid Form.
- C. The date and time for receipt of bids is unchanged by this Addendum.
 - 1. Bid Date: 11/19/2020.
 - 2. Bid Time: 2:00 p.m., local time, at which time and place bidding will be closed.

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- D. Substitution Request Accepted: Section 33 41 00, C3.03; Eric'sons Dura Trench, Model: 10C24CI &DTPF12-MDSS15ZSA, 12" precast trench drain and 10" cast iron ADA grate are accepted for substitution.
- E. Substitution Request Accepted: Sheet E5.02, Fixture Type S1; Gardco, ECF-S-32L-530-NW-G2-AR-4-UNV-DD-BZ is accepted for substitution.

1.3 ATTACHMENTS - SHEETS

- A. This Addendum includes the following attached Sheets:
 - 1. L2.06, MATERIALS PLAN 6, dated 11/12/2020, (reissued)
 - 2. L2.07, MATERAILS PLAN 7, dated 11/12/2020, (reissued)
 - 3. L2.08, MATERIALS PLAN 8, dated 11/12/2020, (reissued)
 - 4. L2.14, MATERIALS PLAN ENLARGEMENT, dated 11/12/2020, (reissued)
 - 5. S0.1B, GENERAL STRUCTURAL NOTES BRIDGE, dated 11/12/2020, (reissued)
 - 6. S5.1B, STRUCTURAL DETAILS: FOUNDATIONS, dated 11/12/2020, (reissued)
 - 7. S5.2B, STRUCTURAL DETAILS: FOUNDATIONS, dated 11/12/2020, (reissued)
 - 8. P0.02, SCHEDULES – MECHANICAL/PLUMBING, dated 11/12/2020, (reissued)

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1.4 ATTACHMENTS - REVISIONS TO DIVISIONS 02 - 49 SPECIFICATION SECTIONS

- A. Specification Section 03 15 15, Elastomeric Bearing Pads (new section)
- B. Specification Section 22 30 00, Plumbing Equipment, (reissued)
- C. Specification Section 26 06 30, Photovoltaic Systems (reissued)
- D. Specification Section, 32 31 00, Fences and Gates (reissued)
- E. Specification Section, 33 11 00, Water System (reissued)

1.5.1 RESPONSE TO QUESTIONS SUBMITTED

- A. Question 1: Although the Solaredge Battery Off-Grid Interface designed in the plans does indicate on the data sheets that it will integrate with a generator, after discussions with Solaredge it has come to light that technology does not currently exist and it is unclear if or when it will in the future

1. Response:

- a. The SolarEdge Off-Grid interface as shown in the plans will require firmware update(s) to allow for multiple inverter connections which is anticipated in Q1 of 2021 and firmware update(s) to allow for a generator connection which is anticipated in Q2 of 2021. The Off-Grid interface is provided with (1) 40A/3P circuit breaker. An additional 40A/3P circuit breaker will be needed and supplied by the contractor for the integration of a second inverter once the firmware update is available. All hardware for the inverters and Off-Grid Interface will be compatible with the newly available firmware. Updates in firmware will be a uploaded via a cellular network.

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- b. The bidding contractor will also need to complete the Energy Hub Course Curriculum from SolarEdge and pass the course in order to be an approved contractor.

B. Question 2: Request clarification on climbing boulder footings

1. Response:

- a. Section 11 67 33, Climbing Walls, Paragraph 1.05, A., d., specifies submittals related to this item.
- b. The climbing boulder footings shall be designed by a structural engineer per manufacturer’s recommendations and will be customized for each boulder.
- c. The actual footing size and depth will be determined by the structural calculations based on actual boulder characteristics after fabrication. The approximate boulder footing sizes are as follows:

Climbing Boulder	Live Load	Dead Load	Approx. Footing Size	Approx. Footing Depth
Climbing Boulder (Zone 1)	TBD	TBD	36'-0" x 16'-0"	See generic footing detail
Climbing Boulder (Zone 2)	TBD	TBD	34'-0" x 16'-0"	See generic footing detail
K2 Boulder (Zone 2, 3)	2,500 lbs	950 lbs	14'-0" x 8'0"	4-inch slab

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K1 Boulder (Zone 3)	8,125 lbs	640 lbs	15'-0" x 7'-6"	4-inch slab
K3 Boulder (Zone 3)	8,875 lbs	1,750 lbs	13'-9" x 8'-7"	8-inch pad with rein- forcement
K4 Boulder (Zone 3)	11,250 lbs	2,500 lbs	17'-8" x 8'-10"	8-inch pad with rein- forcement

- C. Question 3: Will the Engineer of Record allow the fabricators to keep a similar shape and member sizing and change the splice locations to something that would allow shipping? Another question was whether there could be member sizing changes to help with the splicing or is the design set and no design alternatives would be considered?

1. Response:

- a. Splicing modifications could be considered upon review and approval by the engineer of record.

- D. Question 4: Dimensions are not clear for the bridge joint and suppliers are asking if there any other material specs other than what is detailed on S5.1B?

1. Response:

- a. See Specification Section 03 15 15, Elastomeric Bearing Pads (new section).

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- b. Thermal expansion is expected in the range of +/-1" for this bridge. Therefore the joint material will need to allow for approximately +50% and/or -50% of the specified width to allow for the 1" delta. If the material does not provide this flexibility the width of the joint should be increased accordingly (thus the "min" noted in our detail) to provide the +/- 1" of expansion/contraction.
- E. Question 5: Bid Item 40 – Timber railing on top of the retaining walls – is there any material specs for these? Grade of wood, any finishes or coatings, species, etc?
 - 1. Response: Specification Section 06 10 00, Rough Carpentry, that addresses PT DF #2 or better. See 1/L7.04 and 5/S5.2B for Timber guardrail details.
- F. Question 6: Conduit for Wire: There is a detail showing all wire to be run in conduit and then there for "Detail 6 Typical Trenching" but then on the Detail A "Irrigation Box Setup" it shows wires coming into box with no conduit. Can you confirm if the intent is to have ALL wire run in conduit ?
 - 1. Response: For detail 6, Sheet L5.09, disregard control wires installed in 1" conduit for direct bury 2-wire system.
- G. Question 7: The planting legend refers to a bid alternate for sod, but there is no sod alternate on the Schedule of Values.
 - 1. Response: Sheet L6.08, PLANTING LEGEND, disregard reference to Bid Alternate – Sod. Not included in the Bid.
- H. Question 8: With the truss heights of 15' transporting the truss to site is potentially a problem. Did the district work with a specific fabricator when designing the truss?
 - 1. Response:

The bridge is designed with a bolted splice condition at the midspan (see detail 4/S6.1B) which allows for flexibility in transport. The bridge sides on each end of the

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splice (2 sides x 2 pieces per side due to splice = 4 total pieces) to be shipped to the site, and field welded.

END OF DOCUMENT 00 9113

SECTION 03 15 15
ELASTOMERIC BEARING PADS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plain elastomeric bearing pads
2. Fabric-reinforced laminated bearing pads
3. Steel-reinforced laminated bearing pads

1.02 REFERENCES

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

- | | | |
|-----|-----------------|---|
| 1. | ASTM A36/A36M | Specification for Carbon Structural Steel |
| 2. | ASTM A570-A570M | Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled Structural Quality |
| 3. | ASTM A611 | Specification for Steel, Sheet and Strip, Carbon Cold-Rolled Structural Quality |
| 4. | ASTM D395 | Test Methods for Rubber Property – Compression Set |
| 5. | ASTM D412 | Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers |
| 6. | ASTM D429 | Test Methods for Rubber Property – Adhesion to Rigid Substrates |
| 7. | ASTM D518 | Test Methods for Rubber Deterioration – Surface Cracking |
| 8. | ASTM D573 | Test Method for Rubber – Deterioration in an Air Oven |
| 9. | ASTM D1149 | Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber |
| 10. | ASTM D2240 | Test Method for Rubber Property – Durometer Hardness |
| 11. | ASTM D4014 | Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges |

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M251 Plain and Laminated Elastomeric Bridge Bearings

1.03 MEASUREMENT AND PAYMENT PROCEDURES

- A. Measurement: Elastomeric bearing pads will not be measured separately for payment.
- B. Payment: Elastomeric bearing pads will be paid for as part of the indicated contract unit price or lump-sum price for the associated "Railroad Bridge" work as indicated in the Bid Schedule.

1.04 DEFINITIONS

- A. As used in these Specifications, the word "elastomer" or "elastomeric" means "rubber"; the words are interchangeable.

1.05 BIDDER DESIGN REQUIREMENTS

- A. The basis of design for all bearing pads shall be in conformance with Method A of the *AASHTO LRFD Bridge Design Specifications*, Section 14.7.6.

1.06 SUBMITTALS

- A. Provide calculations, design drawings, and shop drawings for the design, fabrication, and construction of the bidder designed item. The calculations and drawings shall bear the seal and signature of a registered engineer in the state of Oregon and shall be submitted to the Architect/Engineer for approval prior to fabrication.
- B. Manufacturer's Product Data: Submit manufacturer's product and testing data of elastomeric bearing pads for review prior to shipping.
- C. Certificates of Compliance: Submit certificates of compliance certifying that materials and fabrication of elastomeric bearing pads comply with these specifications as applicable.

PART 2 PRODUCTS

2.01 TYPES OF BEARING PADS

- A. Plain Elastomer Type: Molded elastomeric compound, or cut from previously molded strips or slabs, or extruded and cut to length, with smooth surfaces and cut edges.
- B. Fabric-Reinforced Laminated Type: Laminated pads consisting of alternate layers of elastomeric compound and glass fabric reinforcement bonded together, with top and bottom layers of reinforcement uniformly covered with 1/8 inch of elastomer.
- C. Steel-Reinforced Laminated Type: Laminated pads consisting of alternating steel laminates and internal elastomer laminates bonded together, with top and bottom layers of steel reinforcement uniformly covered with 1/4 inch of elastomer. Exposed sides shall be covered with 1/8 inch of elastomer.

2.02 MATERIALS

- A. Elastomeric Compound/Elastomer: Virgin crystallization-resistant polychloroprene as the raw elastomer. Physical requirements of the elastomeric compound include the following:
1. Physical Properties
 - a. Hardness: ASTM D2240, Type D durometer, 60, plus or minus 5.
 - b. Tensile Strength: ASTM D412, 2250 psi minimum.
 - c. Ultimate Elongation: ASTM D412, 400 percent minimum.
 - d. Elastomer Compounds classified as Low-Temperature Zone D, Grade 4 or 5, meeting the requirements of *AASHTO LRFD Bridge Design Specifications*, Table 14.7.5.2-1, "Low-Temperature Zones and Minimum Grades of Elastomer"
 2. Heat Resistance: ASTM D573, 70 hours at 212 degrees F.
 - a. Change in durometer hardness: plus 15 points maximum.
 - b. Change in tensile strength: minus 15 percent maximum.
 - c. Change in ultimate elongation: minus 40 percent maximum.
 3. Compression Set: ASTM D395, Method B,
 - a. 22 hours at 212 degrees F: 35 percent maximum.
 4. Low Temperature Test: ASTM D746, Procedure B
 - a. Brittleness at minus 55 degrees F: No Failure
 5. Ozone Cracking: ASTM D1149, 100 pphm ozone in air by volume, 20 percent strain, 104 plus or minus 2 degrees F, 100 hours mounting procedure A in accordance with ASTM D518: no cracks.
 6. Adhesion (Peel Test): ASTM D429, Method B, bond made during vulcanization: 40 pounds per square inch.
- B. Fabric Laminates: Fabric reinforcement shall be woven from one-hundred percent glass fibers of "E" type yarn with continuous fibers. Minimum thread count in either direction shall be 25 threads per inch. Fabric shall have either a crow foot or an 8 Harness Satin weave. Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each direction. Fabric reinforcement shall be single ply at top and bottom surfaces of the pad and double ply within the pad.

- C. Steel Laminates: Steel for internal reinforcement laminates shall conform with the following requirements as indicated:
 - 1. Steel 3/16-inch Thick and Over: Steel plate conforming to ASTM A36/A36M.
 - 2. Steel Under 3/16-inch Thick: Steel sheet conforming to ASTM A570/A570M, Grade C or D, or ASTM A611, Grade C or D.
- D. Adhesive: Adhesive for the installation of bearing pads to concrete and steel bearing surfaces shall be a solvent-free adhesive as appropriate for this particular installation.

2.03 FABRICATION

- A. Plain elastomer bearing pads and laminated steel bearing pads shall conform to the applicable requirements of ASTM D4014. Laminated fabric bearing pads shall conform to the applicable requirements of AASHTO M251.
- B. Pads 1/2 inch or less in thickness shall be either all elastomer or laminated. Pads over 1/2 inch thick shall be laminated. Stacking of individually laminated pads to attain thicknesses over 1/2 inch is not acceptable.
- C. Plain elastomer bearing pads shall be molded individually, or cut from previously molded strips or slabs, or extruded and cut to size. Cutting shall produce a smooth surface and no heating of the elastomer.
- D. Laminated pads shall have reinforcement every 1/2 inch through the entire thickness. Reinforcement shall be parallel to the top and bottom surfaces of the pad. Elastomer and reinforcement together shall not exceed 1/2 inch in thickness per lamination.
- E. Laminated bearing pads shall be molded as a single unit under pressure and heat. Bonding of elastomer to reinforcement laminates shall be carried out during molding. Elastomer at outer edges of bonds to external load plates shall be shaped to avoid stress concentrations.
- F. Internal steel laminates shall be free of sharp edges. Top and bottom steel laminates shall be covered uniformly with 1/4 inch of elastomer. Sides shall be covered uniformly with 1/8 inch of elastomer.
- G. External load plates shall be protected from rusting.
- H. Comply with ASTM D4014 and AASHTO M251 for fabrication tolerances.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install elastomeric bearing pads at locations indicated in accordance with indicated details.
- B. Apply adhesive to clean concrete bearing surface to a minimum thickness of 1/8 inch, and set bearing pads on adhesive bed as indicated.

3.02 QUALITY ASSURANCE

- A. Sample and test elastomeric bearing pads in accordance with AASHTO M251 Section 8, and as further described below.
 - 1. Compressive Strain of Laminated Bearings:
 - a. Test each sampled laminated pad for compressive strain. The compressive strain in any layer of a laminated pad shall not exceed 9% at 1250 psi average unit pressure for the full-size laminated pad.
 - 2. Proof Load Testing: AASHTO M251, Section 8.8.2
 - a. Proof load each bearing pad by using a compressive load of 1800 psi for laminated pads and 1200 psi for plain elastomeric pads. Reject bearing pads if bulging patterns imply laminate placement does not satisfy design criteria and manufacturing tolerances, or if bulging suggests inadequate laminate bond. Also reject bearing pads if there are three separate surface cracks greater than 1 /16 in wide by 1 /16 in deep.
- B. Provide bearing pad test data and certification prior to shipping. Test results and samples must verify compliance with product specifications.
- C. The cost of all bearing pad testing is incidental to the bearing pads.

3.03 DEFECTIVE WORK

- A. General: The following reinforcing steel work will be considered defective and shall be removed and replaced by the contractor at no additional cost to the owner:
 - 1. Bars with kinks or bends not shown on drawings.
 - 2. Bars damaged due to bending or straightening.
 - 3. Bars heated for bending.
 - 4. Reinforcement not placed in accordance with the drawings and/or specifications.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Water Heaters
 - 2. Domestic Water Expansion Tank
 - 3. Related Sections
- B. Division 01, General Requirements
- C. Division 22, Plumbing
- D. Section 22 40 00, Plumbing Fixtures
- E. QUALITY ASSURANCE
- F. Regulatory Requirements: Water heaters to meet state energy code requirements.

1.02 SUBMITTALS

- A. Submit the following:
 - 1. Product data for each item specified.
 - 2. Operating and Maintenance Data

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Water Heaters:
 - 1. Gas Water Heater:
 - a. State
 - b. Bradford-White
 - c. A.O. Smith
 - d. Other Manufacturers: Submit substitution request.
 - 2. Backflow Preventers:

- a. Watts
- b. Other Manufacturers: Submit substitution request.

B. Domestic Water Expansion Tank:

1. Amtrol, Bell & Gossett
2. Armstrong
3. Wheatley
4. Taco
5. Or equal.

2.02 WATER HEATERS

A. Gas Water Heater (Storage Type, Power Direct Vent):

1. Gas water heater constructed of heavy gauge steel with glass lining.
2. Insulate tank with foam insulation to comply with ASHRAE 90 standard and local codes, with a baked enamel steel jacket.
3. ASME pressure and temperature relief valve.
4. Factory installed and provided; high temperature limiting device, drain valve, low water protective device, dielectric nipples, flue baffle, heat traps, inlet dip tube, heating system supply and return inlet and outlet, suspended sacrificial anode rod.
5. Heater and burner, UL listed.
6. Refer to schedules for capacity and efficiency.
7. Safety Controls: CSD-1 and as required by current local codes for automatic operation.
8. Venting: Unit to be suitable for category IV direct venting, side wall vent for cold climates, UL-1738 polypropylene venting.

B. BACKFLOW PREVENTERS

1. Reduced Pressure Backflow Assembly (RPBA) Type:
 - a. 2-1/2-inch Size and Larger:
 - b. Flanged ends with non-rising stem shutoff valves, cast iron main valve body and cover with epoxy coated interior, bronze main valve trim, bronze differential relief valve with stainless steel 316 trim and four test cocks.

- c. Maximum working pressure of 150 psi unless scheduled.
- d. Include alarm upgrade including flood sensor, cellular signal alert. Based on WATTS SentryPlus Alert.
- e. Model: WATTS PVS-7000

C. DOMESTIC WATER EXPANSION TANK

- 1. Diaphragm type of welded steel, constructed and stamped in accordance with ASME code for 150 psi working pressure.
- 2. Heavy-duty butyl diaphragm meets FDA requirements for potable water supply.
- 3. Support with steel legs or bases for vertical installation or steel saddles for horizontal installation.
- 4. Pre-charged with compressed air to minimum fill pressures as indicated on the Drawings.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

- A. Install per manufacturer's installation instructions and in accordance with all applicable codes.
- B. Provide pressure/temperature relief valve on storage tanks. Provide piping from relief valve to floor drain utilizing a 1-inch air gap at discharge point.
- C. Support:
 - 1. Install water heater oriented so that controls and devices needing service and maintenance have adequate access.
 - 2. Install water heaters level.
 - 3. Provide required strapping to structure and floor in accordance with code requirements.
- D. Gas Supply:
 - 1. Provide gas pipe with drip leg, tee, gas cock, union, and specialties as detailed on the Drawings.
 - 2. Provide gas pipe of size shown on drawings or the full size of unit inlet connection.
 - 3. Install piping so as not to interfere with service of units.

E. Water Piping:

1. Provide hot and cold water piping to units with shutoff valves, unions, and specialties as detailed on the Drawings.
2. Provide recirculating water line to unit with shutoff valve, check valve, and union.

F. Flue:

1. Connect flue to draft hood or direct vent with gastight connection.
2. Refer to Section 23 51 00, Breechings, Chimneys, and Stacks for flue material.
3. Plastic vent materials (PVC, CPVC, ABS, etc.) are not allowed.
4. Flue size and routing in accordance with manufacturer's installation instructions.

G. Combustion Air Direct Vent

1. Connect vent to water heater with gastight connection.
2. Refer to Section 23 31 01, HVAC Ducts and Casing-Low Pressure for vent material.
3. Vent size and routing in accordance with manufacturer's installation instructions.

H. BACKFLOW PREVENTERS

- I. Install at height and location suitable for testing purposes by the local governing authority.
- J. Provide funnel drain below reduced pressure backflow device for collecting periodic discharge and testing purposes.
- K. Pipe 2-inch indirect waste from funnel drain to floor sink. Discharge indirect waste above floor sink utilizing a 1-inch air gap.

END OF SECTION

SECTION 26 06 30
PHOTOVOLTAIC SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Photovoltaic system requirements.
- B. Photovoltaic modules, ~~cCrystalline sSilicon—Standard Efficiency.~~
- C. Photovoltaic module mounting system, ~~mMechanically aAttached~~
- D. Photovoltaic inverters.
- E. Mounting Option – Roof Mounted.
- F. Monitoring system.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 26, Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29, Hangers and Supports for Electrical Systems.
- D. Section 26 05 33 Raceways and Boxes for Electrical Systems.
- E. Section 26 05 53, Identification for Electrical Systems.
- F. Section 26 24 16, Panelboards

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM E927 - Solar Simulation for Terrestrial PV Testing.
- C. ASTM E1038 - Test Method for Determining Resistance of PV Modules to Hail by Impact with Propelled Ice Balls.
- D. ASTM E1171 - Test Method for PV Modules in Cyclic Temperature and Humidity Environments.
- E. ASTM E1328 - Terminology Relating to PV Solar Energy Conversion.
- F. ASTM E1462 - Test Methods for Solar Insulation Integrity and Ground Path Continuity of PV Modules.

- G. ASTM E1596 - Test Methods for Solar Radiation Weathering of PV Modules.
- H. ASTM E1799 - Test Methods for Visual Inspection of PV Modules.
- I. ASTM E1802 - Test Methods for Wet Insulation Integrity Testing of PV Modules.
- J. ANSI FM 4478 - Approval Standard for Rigid Photovoltaic Modules.
- K. IEC 61215-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1: Test Requirements.
- L. IEC 61215-1-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-1: Special Requirements for Testing of Crystalline Silicon Photovoltaic (PV) Modules.
- M. IEC 61215-1-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-2: Special Requirements for Testing of Thin-Film Cadmium Telluride (CDTE) Based Photovoltaic (PV) Modules.
- N. IEC 61215-1-3 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-3: Special Requirements for Testing of Thin-Film Amorphous Silicon Based Photovoltaic (PV) Modules.
- O. IEC 61215-1-4 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-4: Special Requirements for Testing of Thin-Film Cu(In,Ga)(S,Se)₂ Based Photovoltaic (PV) Modules.
- P. IEC 61215-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 2: Test Procedures.
- Q. IEEE 1547 - Standard for Interconnecting Distributed Resources with Electric Power Systems.
- R. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- S. NECA 412 - Standard for Installing and Maintaining Photovoltaic (PV) Power Systems.
- T. NECA 690 - Solar PV Systems.
- U. NECA 705 - Interconnected Electric Power Production Sources.
- V. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- W. NFPA 70 - National Electrical Code.
- X. SunSpec Information Model.
- Y. SunSpec Common Smart Inverter Profile.
- Z. SunSpec Communication Signal for Module-Level Rapid Shutdown.

- AA. UL 489B - Outline of Investigation for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures for Use with Photovoltaic (PV) Systems.
- BB. UL 1449 - Standard for Surge Protective Devices.
- CC. UL 1699B - Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection; Current Edition.
- DD. UL 1703 - Flat Plate Photovoltaic Modules and Panels.
- EE. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.
- FF. UL 1741 SA - Advanced Distributed Energy Resource Testing.
- GG. UL 2579 - Low-Voltage Fuses - Fuses for Photovoltaic Systems.
- HH. UL 2703 - Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels
- II. UL 869A - Reference Standard for Service Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for photovoltaic system components.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Roof-Mounted Arrays: Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
5. Coordinate system installation with Battery Energy Storage System (BESS). Ensure acceptable PV system disconnecting means are provided to electrically isolate the PV system from the BESS and vice versa.

- ##### B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Include adequate instruction on the electrical hazards associated with photovoltaic systems and appropriate safety procedures to be followed.

- C. Rebates and Incentives: Assist in preparing and submitting documentation as required for Owner to secure funds from available federal and state, rebate and incentive programs. Notify Owner of any time constraints affecting program qualification.

- 1. Include copies of documentation with submittals.

1.05 SUBMITTALS

- A. See Section 26 05 00, Common Work Results for Electrical for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, details, and description of operation including rapid shutdown functionality.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
- D. Shop Drawings: Include the following as a minimum.
 - 1. Dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables.
 - 2. System interconnection schematic diagrams showing all factory and field connections.
 - 3. Proposed locations of roof penetrations and proposed methods for sealing.
 - 4. Raceway and conductor sizing.
 - 5. Grounding and bonding details.
- E. Design Data: Include the following as a minimum.
 - 1. Structural calculations, certified by structural engineer, for equipment and mounting system.
 - 2. Electrical calculations for array and associated equipment other than the basis of design products and configuration.
 - 3. DC source and output circuit voltage drop calculations.
 - 4. PV System annual energy production estimates.
 - a. Present production in hourly, daily, weekly, monthly intervals for year one; monthly and annual intervals over a 20 year time frame.

- b. Utilizing historical TMY3 weather data from nearest NREL's weather station.
 - c. Assume a once annual cleaning of all PV System modules.
 - d. Documentation of calculation assumptions (efficiencies, losses, etc.) used to derive the annual energy production estimate.
- F. Certify that products of this section meet or exceed specified requirements.
- G. Certify that work of this section does not void roof warranty.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- I. Manufacturer's detailed field-testing procedures.
- J. Manufacturer's detailed startup procedures.
- K. Rebate and incentive documentation.
- L. Source quality control test reports.
- M. Field quality control test reports.
 - 1. Include manufacturer's field reports.
- N. Commissioning Report.
- O. Operation and Maintenance Data: Include the following as a minimum.
 - 1. Detailed information on system operation, equipment programming and setup.
 - 2. Replacement parts.
 - 3. Recommended maintenance procedures and intervals.
 - 4. Contact information for entity that will be providing contract maintenance and trouble call-back service.
- P. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- Q. Maintenance contracts.

R. Project Record Documents:

1. Include the following as a minimum:
 - a. Plan view drawings of PV array(s) with serial number mapping for each module and each inverter.
 - b. Updated one-line diagrams including as a minimum:
 - 1) Conduit sizes and lengths.
 - 2) Conductor size and lengths.
 - 3) Identify PV source circuits, PV output circuits, and inverter input circuits.
 - c. Updated one-line diagrams of Rapid Shutdown system including as a minimum:
 - 1) System components with tags.
 - 2) System component locations.
 - 3) System cabling sizes and lengths.

S. Software: One copy of software provided under this section.

T. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00, Product Requirements, for additional provisions.
2. Extra Photovoltaic Modules: Two.

U. Certification of Manufacturer Training

1. **Certificates of completion associated with training as required under Part 1.06.F.2.a.**

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Structural Designer Qualifications: Registered structural engineer licensed in the State in which the Project is located.
- D. Electrical Designer Qualifications: Registered electrical engineer licensed in the State in which the Project is located experienced in the design of photovoltaic systems.

- E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- F. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience with photovoltaic systems of similar size, type, and complexity.
 - 1. Licensed in the State in which the Project is located to install photovoltaic systems.
 - 2. Manufacturer's authorized installer.
 - a. **Installer has completed all PV inverter manufacturer training and examinations associated with the system components to be installed.**
 - 1) **SolarEdge Fundamentals Training**
 - 2) **SolarEdge Energy Hub Standalone Inverter Installation**
 - 3) **SolarEdge Energy Hub Technical Essentials**
 - 3. Energy Trust of Oregon Trade Ally.
 - 4. Supervisor: North American Board of Certified Energy Practitioners (NABCEP) certified PV Installer or three years experience supervising the installation of photovoltaic systems.
 - 5. Installer Personnel: At least 2 years of experience installing photovoltaic systems.
- G. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 - 1. Contract maintenance office located within 50 miles of project site.
- H. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment during shipping, handling, and storage to comply with manufacturer's requirements and to prevent damage to the module glass.
 - 1. Damage to the modules include physical, condensation, temperature changes, sun, chemical, and other.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 WARRANTY

- A. See Section 01 78 00, Closeout Submittals, for additional warranty requirements.
- B. Specified warranties indicate minimum requirements. Provide additional warranties or extended warranty periods where required to qualify for rebate and incentive programs.
- C. Photovoltaic Modules:
 - 1. Provide minimum 20 year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
 - 2. Provide manufacturer warranty guaranteeing minimum 90 percent of rated power output for 10and minimum 80 percent of rated power output for 25 years.
- D. Photovoltaic Module Mounting System: Provide minimum 20 year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- E. Photovoltaic Inverters: Provide minimum 10 manufacturer warranty covering repair or replacement due to defective materials or workmanship.

1.09 SUBSTITUTIONS

- A. See Section 01 60 00 - Product Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: As indicated under product article below.
- B. Photovoltaic Modules, Crystalline Silicon- Standard Efficiency:
 - 1. **REC ~~Twinpeak-2~~Group Solar**
- C. Photovoltaic Inverters:
 - 1. SolarEdge;
- D. Photovoltaic Module Power Optimizer:
 - 1. SolarEdge;
 - 2. **Balance of System (BoS)**~~All other components~~
 - a. SolarBOS
 - b. Square D
 - c. Eaton

d. **Approved alternatives.**

e. — SMA

E. Photovoltaic Module Mounting System- Mechanically Attached:

1. **S-5 PVKIT 2.0**

2. **Approved alternates for standing-seam metal roof attachment of PV modules, racking and associated BoS.**

F. Monitoring System:

1. SolarEdge;

a. Inverters to be equipped with cellular modem cards.

b. Contractor to initiate cellular data contract in consultation with project owner.

G. Source Limitations: For each type of component, furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 PHOTOVOLTAIC SYSTEM REQUIREMENTS

A. Design and provide complete photovoltaic system consisting of photovoltaic modules and associated balance of system components necessary for connection to facility electrical system.

B. System Description:

1. Photovoltaic array is roof-mounted in location indicated on the drawings.

2. Orientation of array is as indicated on the drawings.

3. Photovoltaic DC system is ungrounded.

4. System does not include interconnection with utility grid (off-grid system).

5. Utility metering configuration: Not applicable.

6. System includes a battery storage system.

7. System includes an engine generator.

8. System includes a DC system surge protection.

9. System includes a monitoring system.

10. System does not include data acquisition provisions.

11. System includes a data acquisition and supervisory control provisions compatible with microgrid system.

C. Capacity:

1. Minimum Expected Annual Energy Production: 30,000 kWh, as calculated by National Renewable Energy Laboratory's PVWatts calculator or approved equivalent.
2. Total Nominal Rated Power Output of Array: Equal to or greater than the rated output of the basis of design array.
3. Nominal Rated Power Output of Individual Modules: Equal to or greater than the rated output of the basis of design module.

D. Size:

1. Array: Designed to fit within the area designated on the drawings.
2. Individual Modules: Exact size as basis of design module.

E. Appearance:

1. Only systems with similar appearance to basis of design system will be considered.
2. Arrange array such that modules are aligned with uniform spacing.
3. Make no alterations affecting appearance of building exterior or interior without approval of Architect.
4. Final determination of acceptable appearance is by Architect.

F. Fire Resistance Rating: Provide photovoltaic module and mounting system combination that together with the roof covering form a system listed in accordance with UL 1703 to provide a fire rating equal to or better than the required fire rating of the roof.

G. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, building seismic risk category, expansion and contraction of system components due to annual temperature fluctuations, and other structural design considerations of the installed location.

1. Comply with ASCE 7.
2. Comply with SEAOC PV2.
3. Include structural calculations demonstrating compliance with submittals.

H. Provide photovoltaic system and associated components suitable for continuous operation under the service conditions at the installed location.

- I. Provide products listed, classified, and labeled as suitable for the purpose intended.
- J. Provide photovoltaic system and associated components that qualify for available federal, state rebate and incentive programs.
- K. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.
- L. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with UL 1699B as required for compliance with NFPA 70.
- M. Rapid Shutdown of Photovoltaic Systems on Buildings: Provide listed equipment arranged to provide rapid shutdown with a single point of operation in accordance with NFPA 70.
- N. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- O. Arrange array to provide adequate access to rear of string(s) for maintenance.
- P. Arrange array to minimize shading during peak production periods.
- Q. Roof-Mounted Arrays:
 - 1. Arrange array such that normal roof drainage is not affected.
 - 2. Arrange array to maintain required safety clearances from edges of roof as indicated.
 - 3. Arrange array to maintain access and clearance requirements for other roof-mounted equipment.
 - 4. Arrange array to avoid spanning of expansion joints.
 - 5. Arrange to minimize the negative impacts of shading from structures or other obstructions by electrically isolating the PV source and output circuits associated with PV modules that are subject to localized shading from other modules within the array.
 - a. A shaded PV module is considered to be any PV module that is wholly or partially shaded from 9:00 AM to 3:00 PM for any day of the year.
 - b. A partially shaded module is any module that has more than half of its photovoltaically active surface in shade.

2.03 PHOTOVOLTAIC MODULES

- A. Acceptable Module Types: Only crystalline silicon modules are acceptable

B. General Requirements:

1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 600 V DC; complying with IEC 61215-1 and IEC 61215-2 and listed as complying with UL 1703.
2. Crystalline Silicon Photovoltaic Modules:
 - a. Comply with IEC 61215-1-1.
 - b. Photovoltaic conversion efficiency: 17% [KH1] or greater.
3. Hail impact rating that meets or exceeds a Class 2 or higher rating per FM Approval Standard 4478, Rigid Photovoltaic Modules; or ANSI 4478, American National Standard for Rigid Photovoltaic Modules. At a minimum, the hail rating should be per IEC 61215 using a 45 mm (1-3/4 in.) or greater ice ball.
4. Frame: Black.
5. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
6. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.
7. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).
8. Power Rating Tolerance: Plus 10 or minus 5 percent
 - a. Include flash test data for each module with source quality control reports to demonstrate compliance.

C. Basis of Design: REC Twinpeak 2 Mono Series

2.04 PHOTOVOLTAIC INVERTERS:

- A. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
- B. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with UL 1741SA; listed with an approved certification date on the California Energy Commission database of eligible inverters for California Rule 21 Phase 1, 2, and 3 grid interconnection requirements; furnished with the following features:
 1. Maximum power point tracking (MPPT).
 2. LCD display.

3. Integral AC disconnect.
 4. Integral DC disconnect.
 5. Integral DC ground fault detection and interruption (GFDI).
 6. Communications Interface:
 - a. As required for connection to system indicated.
 - b. RS-485 communications card as required to provide supervisory control and data acquisition to each inverter.
 - c. Bi-directional, SunSpec compliant, communication over the following protocols to a third party monitoring and control system.
 - 1) MODBUS TCP
 - 2) MODBUS RTU
 7. The inverter able to operate unattended in an automatic pre-programmed failsafe mode.
 8. Display screen or ability to connect display screen to provide read-out of operational system states, input, and output voltages, AC currents, wattage, etc. and permit local programming and control of the inverter.
- C. Total Harmonic Distortion: Less than five percent.
- D. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
1. Outdoor Locations: Type 3R.
- E. Basis of Design:
1. PV-INV-A: Solar Edge SE 6000H-US
 2. PV-INV-B: Solar Edge SE 7600H-US

2.05 SYSTEM BACKUP INTERFACE:

- A. General Requirements:
1. Self-contained hardware with the ability to provide interconnection from multiple sources including Photovoltaic array, battery storage system and generator.
 2. Total number of inverter inputs: 3
 3. Service entrance rated.

B. Basis of Design: SolarEdge BI-EUSGN-01

2.06 BATTERY ENERGY STORAGE SYSTEM (BESS)

A. Provide a grid-interactive capable BESS complete as described below and as indicated on the Drawings:

1. Installation of self-contained BESS complete with integral battery energy storage modules, battery management system (BMS), NEMA rated enclosure, controls and switchgear/disconnect.
2. Integrate complete BESS into the facility electrical system without impact to the power quality and in-compliance with all applicable Codes, manufacturer requirements.
3. Provide labeling as required by the local AHJ.
4. Commissioning of BESS by manufacturer technician or manufacturer trained technician that includes testing and verification of charge and discharge cycles under all mode of operation.
5. Wall mounted.

B. Total energy: 9.8kWH

C. Basis of Design: LG Chem RESU10H.

2.07 PHOTOVOLTAIC MODULE POWER OPTIMIZER

A. General Requirements:

1. Efficiency: 99.5%
2. Module-level monitoring capability.
3. Module-level voltage shutdown.
4. Meets NEC requirements for arc fault protection (AFCI)
5. Meets NEC requirements for Photovoltaic Rapid Shutdown System (PVRSS)

B. Basis of Design: SolarEdge Power Optimizer for North America P400

2.08 BALANCE OF SYSTEM COMPONENTS

A. Photovoltaic Module Mounting System:

1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in the location indicated, including all necessary hardware and accessories.

2. Support Structure and Associated Hardware Materials: Use aluminum or galvanized steel.
 3. Tilt Angle: 0 degrees. The photovoltaic array shall follow the angle of the roof.
 4. Basis of Design: S-5! PVKIT 2.0
 5. Roof-Mounted Arrays:
 - a. Acceptable System Types: non-penetrating systems complying with specified requirements will be considered for this project.
 - b. Provide system compatible with the roof at the installed location.
 - c. Module Tilt Angle: no tilt.
- B. Disconnect Switches:
1. Switches for DC System: Rated for 600 V DC.
- C. Surge Protective Devices for DC System:
- a. Rated for 600 V DC.
 - b. Listed and labeled as complying with UL 1449, Type 1.
 - c. Surge Current Rating: Not less than 50 kA per mode.
 - d. UL 1449 Nominal Discharge Current (I-n): 20 kA.
- D. Molded-Case Circuit Breakers and Switches for DC System: Rated for 600 V DC; listed as complying with UL 489B.
- E. Fuses:
1. Fuses for DC System: Rated for 600 V DC.
 2. Fuses for Protection of Photovoltaic Strings and Arrays: Photovoltaic fuses listed as complying with UL 2579.

2.09 SOURCE QUALITY CONTROL

- A. Factory test the following products to verify operation and performance characteristics. Include test reports with submittals.
1. Photovoltaic modules.
 2. Photovoltaic inverters.
 3. Battery Energy Storage System

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Use open circuiting, short circuiting, or opaque covering to disable modules, array or portions of array prior to installation and service.
- B. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install photovoltaic system in accordance with NECA 412.
- D. Provide required support and attachment in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
- E. Mount equipment such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor, ground, or working platform.
- F. Circuiting Requirements. in Addition to Requirements of Section 26 05 19, Low Voltage Electrical Power Conductors and Cables:
 - 1. Wiring Methods:
 - a. Unless otherwise indicated, use exposed module factory-installed cables (not routed inside building) for module interconnections.
 - b. Unless otherwise indicated, use PV wire type single-conductor cable (not routed inside building) for wiring between string(s) and junction box(es).
 - c. Unless otherwise indicated, use type THHN/THWN-2 single-conductor building wire in suitable raceway for wiring between junction box(es) and point of interconnection.

- d. Secure exposed cables in accordance with NFPA 70. Where possible, conceal behind array.
 - e. Install cables in suitable raceway where readily accessible or where required by authority having jurisdiction.
 - f. Use suitable twist-on insulated spring connectors, mechanical connectors or compression connectors for photovoltaic circuit splices and taps.
2. Photovoltaic DC System Conductor Color Code:
- a. Ungrounded System:
 - 1) Positive: Red.
 - 2) Negative: Black.

Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with NFPA 70.

- G. In Addition to Requirements of Section 26 05 26, Grounding and Bonding for Electrical Systems:
- 1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.

Provide auxiliary electrodes for photovoltaic array grounding in accordance with NFPA 70.
- H. Identification Requirements, in Addition to Those Specified in Section 26 05 53, Identification for Electrical Systems:
- 1. Color for Photovoltaic System Identification Nameplates and Labels: White text on red background unless otherwise required by NFPA 70 or authorities having jurisdiction.
 - 2. Use identification nameplate or means of identification acceptable to authority having jurisdiction to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means. Locate at each photovoltaic system disconnecting means. Verify format and descriptions with authorities having jurisdiction.
 - 3. Use identification nameplate to identify each photovoltaic system disconnecting means with text "PV SYSTEM DISCONNECT".
 - 4. Use identification nameplate or identification label to identify systems equipped with rapid shutdown and associated rapid shutdown switch(es). Format, descriptions, and locations to comply with NFPA 70 and requirements of authorities having jurisdiction.

5. Use identification nameplate or identification label to identify the information required by NFPA 70 for marking of direct-current photovoltaic power sources. Locate at each DC disconnect means requiring marking.
6. Where the inverter output connection is located in a panelboard on the opposite (load) end from the input feeder location or main circuit location in order to meet requirements of NFPA 70, use identification nameplate or identification label to identify the overcurrent device with the word message "Warning; Inverter output connection; Do not relocate this overcurrent device".
7. Use warning labels to identify electrical hazards for photovoltaic system disconnecting means. Include the word message "Warning - Electric Shock Hazard; Terminals on the line and load sides may be energized in the open position" or approved equivalent.
8. Use warning labels, identification nameplates or identification labels to identify electrical hazards for photovoltaic systems equipped with DC ground-fault protection in accordance with NFPA 70. Include the word message "Warning - Electric Shock Hazard; If a ground fault is indicated, normally grounded conductors may be ungrounded and energized".
9. Use wire and cable markers to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
10. Use voltage markers, identification labels, stenciled text or suitable permanent marking approved by authority having jurisdiction to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies with the text "Warning: Photovoltaic Power Source" at maximum intervals of 10 feet in accordance with NFPA 70.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00, Quality Requirements, for additional requirements.
- B. See article "SYSTEM STARTUP" below for additional requirements related to testing and inspection.
- C. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- D. Inspection and testing to include, at a minimum:
 1. Inspect each system component for damage and defects.
 2. Verify that equipment enclosures, boxes, and associated connections installed outdoors are weatherproof.
 3. Verify proper wiring connections have been made and check for conductor continuity. Verify proper polarity.

4. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 5. Perform insulation resistance tests.
 - a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
 6. Measure and record ambient conditions, including date and time, ambient temperature, cell temperature, solar irradiance in the module plane and wind speed.
 7. Measure and record open circuit voltage of each string.
 8. Measure and record voltages at the inverter AC and DC inputs.
 9. Measure and record operating current for each string, sub-array, and array.
 10. Measure and record AC output power.
 11. Perform inverter functional test.
 - a. Grid-Tied Inverters: Include simulation of loss of power and subsequent power restoration.
 12. Verify proper operation of monitoring system.
- E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- F. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - a. Record all system operations and malfunctions.
 - b. If a malfunction occurs, start diagnostic period over after correction of malfunction.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.
- H. Repair roof or adjacent roof-mounted items damaged as a result of work of this section.

3.05 SYSTEM STARTUP

- A. Provide services of a manufacturer's authorized representative to assist in performing system startup. Include manufacturer's detailed startup procedures with submittals.

- B. Obtain Owner's approval prior to performing system startup.
- C. Prepare and start system in accordance with manufacturer's instructions.
- D. After the installation and initial start-up of the PV System is complete, perform a test and log in the presence of the Architect and/or Owner. Provide an engineer to monitor the system during the tests, to check details of the installation and to instruct the operators. This engineer will be required for a period of not less than 2 days for instruction and tests. Include the cost for this engineering service in the Contractor's bid. Furnish instruments to conduct the tests and connect devices required to obtain data required.
- E. Field Test Requirements:
 - 1. Record data and results as required to prepare the Commissioning Report submittal as detailed in Section 3.5.C.
 - 2. Additional test data include:
 - a. Test the AC line voltage at PV system AC disconnect(s) to confirm that it is within 2 percent of system rated line to line and line to ground voltage. Record voltage data.
 - b. Test the continuity of DC fuses (if applicable) to be installed in each DC string junction box.
 - c. Test PV array open circuit DC voltage at each inverter DC disconnect switch to ensure voltage is within proper limits according to the inverter manufacturer's installation manual.
- F. PV System Commissioning Report
 - 1. Provide a commissioning report that conforms to the SunSpec Alliance Best Practices Guide for Commissioning for PV Performance (D42039-1).
 - 2. Include the following sections with associated data and results:
 - a. PV system information and data collected at time of commissioning:
 - 1) System name, address location.
 - 2) System size, type (fixed, tracking), module, inverter, pitch and azimuth.
 - 3) As-built system derate factors:
 - a) Module mismatch loss.
 - b) DC wiring loss.
 - c) PV module nameplate mismatch loss.

- d) Power optimizer loss (if applicable).
- e) AC wiring loss.
- f) Step-up transformer loss (if applicable).
- 4) Name of person(s) performing the tests and reporting the results.
- 5) Test equipment used (monitoring/model, irradiance sensor, temperature sensor, etc.)
- 6) Period of time for measurements.
- 7) Number of measurements taken and used.
- 8) Irradiance measured (and conversion of POA to GHI if appropriate).
- 9) Temperature measured (and conversion of ambient to module/cell if appropriate).
- 10) Wind Speed Measured.
- 11) AC power measured.
- b. Calculation of the Power Performance Index (PPI) and associated findings:
 - 1) Calculation method and associated system derate factors used to calculate PPI.
 - 2) PPI calculated (measured kWac to expected kWac).
 - 3) Uncertainty of the test results and acceptable tolerances.
 - 4) Notes on significant findings or observances.
 - 5) Summary and narrative of the outcome, with an action plan, if required.
- c. PV source circuit performance data in the form of the following information for each electrically isolatable PV string within the overall PV array:
 - 1) Performance Factor.
 - 2) Fill Factor.
 - 3) Short Circuit Current (Isc).
 - 4) Open Circuit Voltage (Voc).
 - 5) Maximum Power Current (Imp).
 - 6) Maximum Power Voltage (Vmp).

- 7) String Maximum Power (Pmax).
- 8) I-V curve graph test results for each string.

3.06 CLEANING

- A. Clean modules using only methods recommended by manufacturer to avoid scratches and other damage. Clean exposed surfaces on other components to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 01 91 13, General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00, Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00, Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of photovoltaic system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Walk-thru of the installed and operational PV equipment identifying the function and maintenance requirements for each component.
 3. PV system status monitoring and configuration capabilities and methods for local and remote access to monitoring and configuration utilities.
 4. Review of PV System O&M binder materials.
 5. Supervised control of PV system operation by authorized Facility Owner personnel.
 - a. At a minimum, place the PV system into standby mode, perform a complete maintenance shutdown (de-energization) of the PV system, perform a complete energization of the PV system and place the PV system into normal run mode following a standby command.
 6. Provide minimum of one day of training.
 7. Instructor: PV inverter manufacturer's authorized representative who is thoroughly knowledgeable of the specific installation.

8. Location: At project site.

3.09 PROTECTION

- A. Protect installed products from subsequent construction operations.

3.10 MAINTENANCE

- A. See Section 01 70 00, Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of photovoltaic system for two years from date of Substantial Completion, to include the work described below; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
 - 1. Conduct site visit at least once every six months to perform inspection, testing, and preventive maintenance. Conduct tests similar to those made during original field quality control testing. Submit report to Owner comparing test results with those of original tests along with evaluations and recommendations.
- C. Provide trouble call-back service upon notification by Owner:
 - 1. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION

SECTION 32 31 00

FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Fences, gates, and gateways of woven wire fabric, chain link fabric, or combinations, to the lines and grades shown or directed.
2. All dimensions shown on the plans are horizontal and vertical measurement. Actual quantities required for the installation may be greater depending on the slope of the terrain.

B. Related Sections

1. Section 03 30 00 – Cast-in-place Concrete

1.02 DEFINITIONS

- A. Fencing - Fence, gates, gateways, and appurtenances, regardless of kinds and types.
- B. Gates - Swinging units to provide an opening in the fence line.
- C. Single Gate - A unit of 16 feet or less.
- D. Double Gate - Two single gate units used together for an opening of more than 16 feet.
- E. Gateway - Supported fence wire or fabric stretched between gate posts and fastened by bars, wire hinges and locking devices.
- F. Panel - That portion of fence between adjacent posts.
- G. Run - As used in this specification, run is defined as the length of fence between end posts, intermediate end posts, corner posts, and gate posts.

1.03 SUBMITTALS

- A. Shop Drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- B. Product Data
- C. Submit to Owner's Representative two sets of manufacturer's technical data and installation instructions for each item, with list of accessory items. Clearly indicate options of size, model and finish.

- D. Quality Assurance/Control Submittals
- E. Manufacturer: Company having manufacturing facilities in the United States with 5 years' experience specializing in manufacturing of chain link fence products.
- F. Fence Contractor: Contractor having 5 years' experience installing similar projects in accordance with ASTM F567.

1.04 PROJECT CONDITIONS

- A. Existing Conditions
- B. Locate all underground utilities and notify the Owner's Representative immediately if conflicts exist.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Chain-link fencing
 - 1. Chain Link Fabric, Ties, and Tension Wire - Chain link fabric, ties, and tension wire shall conform to the requirements of AASHTO M 181 supplemented and modified as follows:
 - a. Fabric shall be 9-gauge zinc-coated steel meeting Type I, Class D coating requirement, aluminum coated steel, or aluminum alloy. Use only one type on any Project. Opening size shall be 2"x2".
 - b. Wire fabric ties, wire ties, and hog rings may be zinc-coated steel wire, aluminum-coated steel, or aluminum alloy as elected, regardless of the type of wire fabric used.
 - c. Use ductile, zinc-coated steel meeting the coating requirements of ASTM A 641/A 641M, Class 1 for wire fabric ties, wire ties, and hog rings. Aluminum-coated steel wire fabric ties, wire ties and hog rings shall be coated with at least 90 g/m² (0.30 ounce per square foot).
 - d. All wire shall have a Class 2b thermally fused and bonded coating conforming to ASTM F668.
 - e. Wire coating shall be brown in compliance with ASTM F934.
 - 2. Metal Fence Posts, Braces, and Appurtenances - Metal fence posts, braces and appurtenances shall conform to the requirements indicated on the plans and the following:
 - a. Paint to match brown vinyl coating of chain link fabric.
 - b. Posts, Braces, and Appurtenances for Chain Link Fence shall conform to the requirements of AASHTO M 181. Posts for bridge protective fence shall be galvanized and conform to the requirements of ASTM A 53/A 53M, Grade B.

Braces and appurtenances for bridge protective fence shall conform to the requirements of AASHTO M 181.

3. Concrete Footings - Concrete for footings shall conform to Section 03 30 00 Cast in Place Concrete.
4. Grounding Rod - 16 mm by 2.4 m (5/8 inch by 8 foot), nonrusting, copper covered steel rod with a bronze grounding wire clamp.
5. Grounding Wire - AWG 4/0 Solid Copper or No. 6 bare aluminum wire with clamps.

B. Fence Gates:

1. General - Tubular steel gate frames shall conform to AASHTO M 181. Fabric in gates used with chain link fence shall be chain link of the same gauge and conforming to applicable requirements of Chain-link Security Fencing.
2. Hardware - All fence and gate hardware shall conform to the requirements of AASHTO M 181, except that the thickness of galvanizing shall be according to AASHTO M 232M/M 232 (ASTM A 153/A 153M).

C. Dog Off-Leash Area (DOLA) Fence

1. Welded Wire Mesh Fabric: Galvanized, as specified in the Construction Documents.
2. Posts:
 - a. End, intermediate, and corner posts shall comply with chain-link post specifications
 - b. Inline Posts
 - 1) T-Posts: Hot rolled rail steel or new billet possessing physical properties equivalent to A499.
 - (i) Length: As specified.
 - (ii) Color/Finish: Green enamel.

2.02 SOURCE QUALITY CONTROL

- A. Provide each item of equipment as a complete unit produced by a single manufacturer, including fittings, accessories bases and anchorage devices

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces or conditions where site furnishings are to be erected. Notify the Owner's Representative of any conditions detrimental to the proper and timely

completion of the work. Do not proceed with installation until unsatisfactory conditions have been corrected and are acceptable to the installer.

3.02 ASSEMBLY AND INSTALLATION

- A. Stake out locations for approval by Owner's Representative prior to initiating installation.
- B. Clear, grub and prepare the fence line area. Remove all shrubs, brush, snags, down timber, float rock, and other obstacles, including trees up to 6 inches in diameter which interfere with fence construction. If directed, preserve trees and geographic features on fence lines by varying the fence alignment to miss them.
- C. Fill or excavate ground surface irregularities which interfere with maintaining specified clearance above ground surface of the bottom wire of the fence. Limit the width as necessary to provide a clear way for the fence.
- D. Excavate for concrete footings to reasonably neat lines, but not less than the specified dimensions in soil, or not less than 18 inches deep in rock. Prevent disturbance of original ground at the sides and bottom of the excavation.
- E. Clear and grade gate openings to permit the gate to swing in a horizontal plane according to the following:
 - 1. Metal Gates - Install metal gates and fittings between gate posts previously set as specified. Firmly attach the fittings to the posts and gates. Hinge each single gate in a manner which will prevent removal of the gate without tools. Set the gate in an approximately horizontal plane to swing freely inward and outward, and so it can be fastened securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings. Gates shall swing open at least 90 degrees in each direction.
 - 2. Gateways - Construct gateways of the same material as the fence and as shown. Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.
- F. Dispose of materials removed under these provisions, including excess excavation, legally off site.
- G. Installing Posts and Braces for all fences:
 - 1. General - Set all metal end posts, intermediate end posts, corner posts, gate posts, chain link fence posts, rock protection posts and slope protection posts in concrete footings.
 - 2. Set posts to the depths shown. Reasonable variation in depths will be permitted and posts may be appropriately shortened or left slightly high, as approved by the Engineer, to:

3. Avoid unnecessary penetration or excavation in rock or other unusually firm material.
4. Obtain desired grades along the fence.
5. Set all posts vertical, except on curved alignment set posts slightly off vertical, as directed, to offset the pull of the fence fabric and wires.
 - a. Concrete Footings - Dimensions of footings shall not be less than shown and shall fill the excavated areas. Place the concrete with contact against firm soil at the sides and bottom and tamp around the posts and brace ends after the posts and braces have been brought to and firmly held in proper position. Strike off, slope or crown and smooth the surface of the concrete at the ground level to shed water. Allow to cure for at least five calendar days before subjecting the posts and braces to strain.
6. End Posts - Set end posts:
 - a. At the beginning and end of new fence construction that is not terminating at gate posts
 - b. At the end of the intersecting line of existing fences just outside the line of the new fence
7. Intermediate End Posts - Set intermediate end posts in the line of the new fence:
 - a. At each summit and at each valley in the grade of the fence where the algebraic difference in the grades of adjoining panels of fence exceeds 30%
 - b. At other points located along the new fence line to break the fence construction into approximately equal runs not exceeding the applicable lengths of runs shown
8. Corner Posts - Set corner posts as follows:
 - a. Chain Link Fences - At angle points in fence alignment where the alignment of adjoining panels of fence changes direction by 20 degrees or more.
9. Gate Posts - Set gate posts at the beginning or end of runs of fence to provide openings for gates or gateways.
10. Line Posts - Set line posts along the line of fence, between end, intermediate end, corner, and gate posts, and at the spacings shown. Line posts may be set at spacings not exceeding 25% greater than specified or at closer spacings if approved. Set a line post in the new fence line at a point in alignment with each intersecting fence line approximately 0.3 m (1 foot) from the end post of the intersecting fence line.
 - a. It is intended that the actual number of line posts will average to the number required for normal spacing.

11. Braces - Construct braces before placing of fence fabric and wires on the posts.
 - a. Metal Braces - Provide corner posts and intermediate end posts with two braces, one each direction from the post in the main fence lines. Provide end posts and gate posts with one brace in the line of the fence as shown.
 - b. Attach metal braces to the metal end, intermediate end, corner and gate posts and set in concrete footings.

H. Chain Link Fence:

1. Footings: Per drawings and Section 03 30 00 – Cast-in-place Concrete.
2. Chain Link Fence Rails and Tension Wires - Place longitudinal rails and longitudinal tension wires along the line of chain link fence, except at gates.
 - a. Rails - Attach rails to end, gate and corner posts by clamps and sockets, and thread through loop caps on the end of line posts. Provide expansion sleeves or couplings at spacings not exceeding 200 feet in longitudinal top and bottom rails.
 - b. Tension Wire - Attach tension wire to end, gate and corner posts by bands and clamps. Either thread the top tension wire through line post loop caps or hold in open slots in a manner to limit vertical movement. Tie or attach the bottom tension wire to the bottom of line posts by ties or clamps in a manner that prevents vertical movement. Provide tension wires with one turnbuckle or one ratchet take-up in each run of fence.
3. Chain Link Fence Fabric and Wire - Assemble and install chain link fence fabric and wire according to the following:
 - a. Splicing Fabric - Use spiral pickets of specified chain link fabric material for fabric splices. Use wrap or telephone type splices for tension wire and barbed wire with each end wrapped around the other wire for not less than six complete turns.
 - b. Fastening Fabric - Fasten fabric to end, gate and corner posts and to gate frames as shown. Attach fabric to line posts with wire ties at top and bottom and at intermediate spacings not exceeding 18 inches. Fasten fabric to top and bottom rails and to longitudinal tension wires with metal bands or tie wires spaced as shown, but in no case greater than 24 inches apart.

3.03 ADJUSTING AND CLEANING

- A. Remove and replace damaged and defective fence and gate components.
- B. Place excess soil materials in an on-site stockpile area.
- C. Remove excess materials from site and dispose in a legal manner.

END OF SECTION

SECTION 33 1100

WATER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Water distribution piping and related components outside the building for water service.
2. Installation of utility furnished products, including water meters.

B. Related Sections:

1. Section 13 1214: Water Feature System
2. Section 31 2000: Earth Moving for excavation, backfilling, and compacting, and geotextile fabrics.
3. Section 33 0500: Common Work Results for Utilities

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide engineering for complete in-place Water Systems.
2. Drawings for Water Systems establish basic relationship of elements for design of assemblies, systems and connections, and performance requirements of Water Systems.
3. Maintain visual design concepts as shown in Drawings.

B. Performance Requirements:

1. Comply with references for Water Systems indicated in the Drawings.
2. Size Water Systems for specific load capacities necessary for this Project.
 - a. Coordinate with fountain equipment requirements.

1.03 SUBMITTALS

- A. Product Data, for each type of product specified, including installation instructions.
- B. Field quality-control test reports
 1. Submit a record of inspection for each water system

C. Closeout Submittals:

1. As-built record drawings of water systems, including the following:
 - a. Description of piping and products used in the water system.
 - b. Actual invert elevations with location dimensions from water lines to property and building lines.
2. Operation and maintenance data for valves and backflow preventers.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of water system products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer Qualifications: Firm or assigned management staff with at least 5 years of successful installation experience on projects with water system work comparable to that required for this Project.
 - a. Installer of potable water lines must be a licensed Plumber.

B. Regulatory Requirements:

1. Comply with requirements of utility company supplying water, including requirements for connection of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

C. Provide piping materials that bear label, stamp, or other markings of specified testing agency.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping to include marking of "NSF-pw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.05 PROJECT CONDITIONS

A. Comply with requirements of Section 31 2000, "Earth Moving," for excavating, backfill, and compaction for water systems.

B. Coordination and Scheduling:

1. Coordinate Work with park activities.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed in this Specification.
- B. Substitutions: Submit in accordance with requirements of Division 01 Section "Substitutions."

2.02 PIPE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
- B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.
- C. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- D. PVC Schedule 40 Pipe: STM D 1785.
 1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

2.03 JOINING MATERIALS

- A. Provide commonly used joining materials in accordance with requirements of Section 33 0500 "Common Work Results for Utilities."
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Soldering Flux: ASTM B 813, water-flushable type.
- E. Solder Filler Metal: ASTM B 32, lead-free type with .20 percent maximum lead content.

2.04 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling of same size and pressure rating as piping to be joined, with at least equal and compatible ends.

2.05 GATE VALVES

- A. Bronze Gate Valves:
 1. Available Manufacturers:

- a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
2. Non-rising-Stem Gate Valves:
- a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80

2.06 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes.
 - 1. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 - 2. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.07 BACKFLOW PREVENTERS

- A. Reduced-Pressure, Backflow-Prevention Assemblies:
 - 1. Available Manufacturers:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
 - 2. Standard: AWWA C511.
 - 3. Operation: Continuous-pressure applications.

4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: Size as noted on plans.
6. Body:
 - a. Bronze for NPS 2 and smaller.
 - b. Ductile iron for NPS 2 ½ and larger.
7. End Connections:
 - a. Threaded for NPS 2 and smaller.
 - b. Flange for NPS 2 ½ and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
 - a. Valves:
 - 1) Ball type with threaded ends on inlet and outlet of NPS 2 and smaller.
 - 2) Iron gate valves for NPS 2 ½ and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
10. Supplied unit shall be lead free.

B. Double-Check, Backflow-Prevention Assemblies:

1. Available Manufacturers:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
2. Standard: AWWA C510.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: Size as noted on plans.

6. Body: Bronze for NPS 2 and smaller.
7. End Connections: Threaded for NPS 2 and smaller.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
 - a. Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller.
10. Supplied unit shall be lead free.

2.08 FLOW METERS AND SUBMETERS

A. Submeters

1. Available Manufacturers:
 - a. Sensus
2. Installation:
 - a. Submeters shall be installed within the same vault as the irrigation backflow valve as shown on the plans.

2.09 BACKFLOW PREVENTER VAULTS / ENCLOSURES

- A. Size and type to conform to state and local codes and providing a minimum of 6 inches clear on all sides of the device.
- B. Vaults
 1. Available Manufacturers:
 - a. Advanced Precast Products
 - b. Armorcast Products Company
 - c. Oldcastle
 2. Materials: Concrete or polymer concrete.
 3. Size: As needed to comply with Plumbing code requirements and clearances for selected double check backflow assembly.
 4. Installation: Per manufacturer's recommendation at location shown on the plans, set flush with finished grade.
- C. Freeze Protected Enclosures:
 1. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
 - a. Safe-T-Cover

- b. Aquashield
 - c. Hot Box
 - d. Watts Box
2. Standard: 1060 ASSE Class 1
 3. Structure to be insulated with a heat source adequate to maintain temperature at 40 degrees Fahrenheit and including a drain hole adequate to drain a full valve discharge.
 4. Materials: Aluminum
 5. Color: Painted, Terra Brown (RAL 8028)
 6. Size: As needed to comply with Plumbing code requirements and clearances for selected reduced pressure backflow model.
 7. Installation: Per manufacturer's recommendation at location shown on the plans.
 8. Model:
 - a. SE 15th Street Reduced Pressure Backflow:
 - 1) Enclosure: Safe-T-Cover Model 300TD-AL or approved equal, sized as necessary to provide specified clearance around selected backflow in accordance with local plumbing codes.
 - 2) Heat Source: Chromalox CPR-10-1CR or approved equal. Length required to provide adequate freeze protection to backflow and all above ground pipes and connections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas of Work, and that existing conditions will not adversely affect execution or quality of work.
 1. Report existing conditions detrimental to completion of Work.
- B. Before installation, inspect piping for apparent defects, mark, and promptly remove from site.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protection
 1. Protect existing utility lines, storm drainage lines, and underground utilities.

- a. Stake location of underground utilities and avoid trenching in those areas beyond safe limits.
 - b. Hand excavate trenches where required to avoid utility line damage.
- 2. Protect existing paving, walks, curbs, and other site improvements from damage during construction operations.
- B. Excavate trenches to depths required to achieve required cover for water lines.
- C. Stockpiling: Stockpile and protect excavated trench soil for inspection and backfilling in designated locations on-site.

3.03 EARTHWORK

- A. Refer to Section 31 2000, "Earth Moving," for excavating, trenching, and backfilling.

3.04 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the applications indicated.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 4:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 40 socket fitting; and solvent-cemented joints.

3.05 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Valves in Vaults and Above Ground:
 - a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.

3.06 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Refer to Section 33 0500, "Common Work Results for Utilities," for piping-system common requirements.

3.07 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- C. Extend water-service piping and connect to water-supply source and landscape systems in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at landscape systems until building-water-piping systems are installed.
 - 2. Terminate piping with caps, plugs, or flanges as required for piping material.
 - 3. Make connections to landscape systems when those systems are installed.
- D. Tracer Wire: 12 AWG minimum solid copper insulated High Molecular Weight Polyethylene (HMW PE) tracer wire or approved.
 - 1. Install blue tracer wire insulation a minimum of 45 mil. thick for waterlines.
 - 2. Provide waterproof joints or splices.
 - 3. Use wire rated for 30 Volt.

3.08 JOINT CONSTRUCTION

- A. Refer to Section 33 0500, "Common Work Results for Utilities," for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.09 VALVE INSTALLATION

- A. Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.10 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated.
 - 1. Include valves, test cocks and meter box.
 - 2. Install according to requirements of plumbing and health department and authorities having jurisdiction.

- B. Install reduced pressure backflow preventers that have relief drain or in other spaces subject to flooding in above ground, freeze protected enclosures in compliance with local plumbing codes.
- C. Install all other backflow preventers in underground vaults as required to comply with manufacturer's recommendations and local codes.
- D. Do not install bypass piping around backflow preventers.

3.11 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Refer to Section 33 0500, "Common Work Results for Utilities," for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water service and meter.

3.12 FIELD QUALITY CONTROL

A. Piping Tests:

1. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently.
2. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests:

1. Test at not less than one-and-one-half times working pressure for two hours.
2. Increase pressure in 50-psig increments and inspect each joint between increments.
3. Hold at test pressure for 1 hour; decrease to 0 psig.
4. Slowly increase again to test pressure and hold for 1 more hour.
5. Maximum allowable leakage is 2 quarts per hour per 100 joints.
6. Remake leaking joints with new materials and repeat test until leakage is within allowed limits

C. Prepare reports of testing activities.

3.13 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION