Petition No. 1220
Windham Solar, LLC
1219 and 1240 Voluntown Road
Griswold, CT
Interrogatories

Construction Specifications and Electrical Interconnection Questions

1. Referencing Sheet 4 – Overall Site Plan of Windham Solar LLC's (WS or Developer) Sitework Development and Management Plan (D&M Plan), WS plans to install the solar modules with a 15-degree tilt, reaching a maximum height of about 6-feet 5-inches above grade. However, Sheet No. SG301 – Rack Section & Bay Plan Views of D&M Plan indicates that WS would utilize a 25-degree angle, resulting in a maximum height of about 8-feet 8-inches above grade. Please provide the correct angle and maximum height (for both parcels). Provide revised/corrected drawings as necessary, consistent with the design considered by the Connecticut Department of Energy and Environmental Protection (DEEP) in its review and approval of the General Permit (GP).
The tilt angle for the facility will be 25 degrees. The increase in tilt angle raises the overall height of the racking from 6'-5" to 8'-8". The increase in tilt angle improves production of the facility and minimizes the effective impervious of the solar footprint. The appropriate cross section of the modules and detailed measurements of the racking can be found in the original D&M submission Exhibit F, Sheet SG301. A comparison exhibit has been created to illustrate the final design versus the approvals associated with the initial petition and DEEP submissions attached as Exhibit A.

2. Referencing Sheet 4 – Overall Site Plan of the D&M Plan, WS plans to have a 9-foot 3-inch spacing between the rows of solar panels (i.e. "aisle width"). However, Sheet SG003 – Site Plan of the D&M Plan indicates that the aisle width would be approximately 10-foot 11-inches, and Sheet 1 – Solar Module Effective Impervious Exhibit depicts an aisle width of approximately 7.7-feet. Please clarify the correct aisle width and indicate if such aisle width would be uniform for both parcels or different. Provide revised/corrected drawings as necessary, consistent with the design considered by DEEP in its review and approval of the GP.
The row spacing will be 23' and can be found in the original D&M submission Exhibit F, in SG003. The solar module effective imperious exhibit included a 15-degree tilt and a 22-foot post to post spacing. These values were chosen as a conservative approach for stormwater sizing resulting in a higher effective impervious, and ultimately more conservative stormwater basin design. The final effective impervious for the facility has been reduced approximately 80% with the final racking design. A comparison exhibit has been created to illustrate the final design versus the approvals associated with the initial petition and DEEP submissions attached as Exhibit A.

3. On August 31, 2018, the Council approved the partial D&M Plan for the tree and brush clearing (and rock construction entrance work) on the eastern parcel (i.e. 1240 Voluntown Road). However, Condition No. 3 notes that, "The final tree and brush clearing plans for 1219 Voluntown Road shall be submitted for Council review and approval in the future subsequent to the interconnection concerns being resolved and/or when mitigating plans such as battery storage/tracking panels are firm." Please respond to the following:
    a) Has WS confirmed that Eversource can accommodate the approximately 4 MW AC of solar capacity on 1219 Voluntown Road?
    Yes. Eversource can accommodate a full build out of the project and interconnect all approved 7MW.
    b) If no, what is the status of the interconnection study for the 4 MW AC and/or mitigating plans such as battery storage/tracking panels?

Interconnection design and coordination with Eversource is ongoing for the facilities associated with the 1219 parcel.

c) Indicate which of the four solar arrays (e.g. two on each property) that Eversource can accommodate at this time.
All four facilities on the 1219 parcel can be accommodated at this time.

4. Page 2 of the D&M Plan notes that, "Electrical and Structural design racking for the initial 2.0 MW AC to be constructed at 1240 Voluntown Road is also underway…" Is WS only developing the 2.0 MW AC "Project 2" on the eastern portion of 1240 Voluntown Road at this time, or is also developing the 1 MW AC "Project 1" on the western portion of 1240 Voluntown Road?
WS will be constructing (2) 1 MW AC facilities, in the location of a portion of project 1 and project 2 on the 1240 Voluntown Road parcel. Given module efficiency increases since the initial approval, each project will be 3000 modules, for a total of 6000 modules. The final electrical documents of the two 1MW facilities are attached as Exhibit B.

5. Pages 2 and 3 of the D&M Plan notes that, "Electrical Design Documents are currently at a 90% level, and illustrate the project layout, stringing, and equipment. Final documents will be issued for electrical construction mid-June and the revisions will be minor." What is the status of the final electrical design? If such design is complete, provide copies of the drawings.
The final electrical documents of the two 1MW facilities are attached as Exhibit B.

6. Referencing Sheet 4 – Overall Site Plan of the D&M Plan and based on most current design, would all three electrical interconnections be entirely overhead, or would the "M/V" portion of the interconnection depicted in blue be underground and would convert to overhead near Voluntown Road?
Each interconnection is planned to be overhead for the utility owned recloser, the primary project metering and the WS owned disconnect switch. From WS pole mounted disconnect switch MV distribution will be underground into the site, to the project's primary transformer pads. The design is represented in the final electrical documents of the two 1MW facilities attached as Exhibit B.

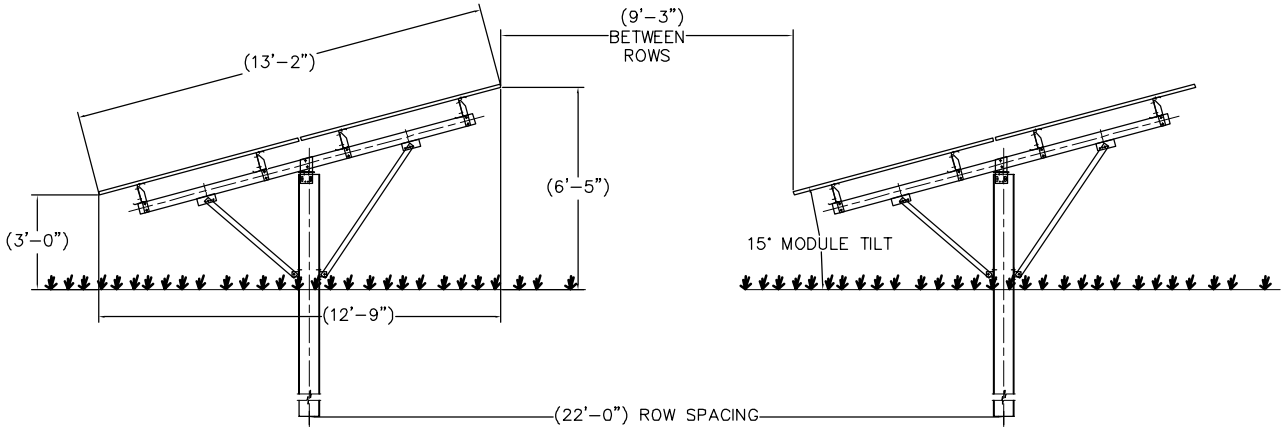
7. Page 3 of the D&M Plan notes that, "Structural racking documents are currently at a 90% level and illustrate the project racking and structural embedment depth based on field testing." If such design is complete, provide copies of the drawings stamped by a Professional Engineer duly licensed in the State of Connecticut.
Structural drawings are still at 90% for the project and are currently under review by a 3rd party engineer, prior to issuance of IFC and production of racking. Stamped drawings should be complete by 7/12/19 and will be submitted to the local AHJ for building permit submittal. The 90% drawings were provided in the original submission as Exhibit F.

Environmental Questions

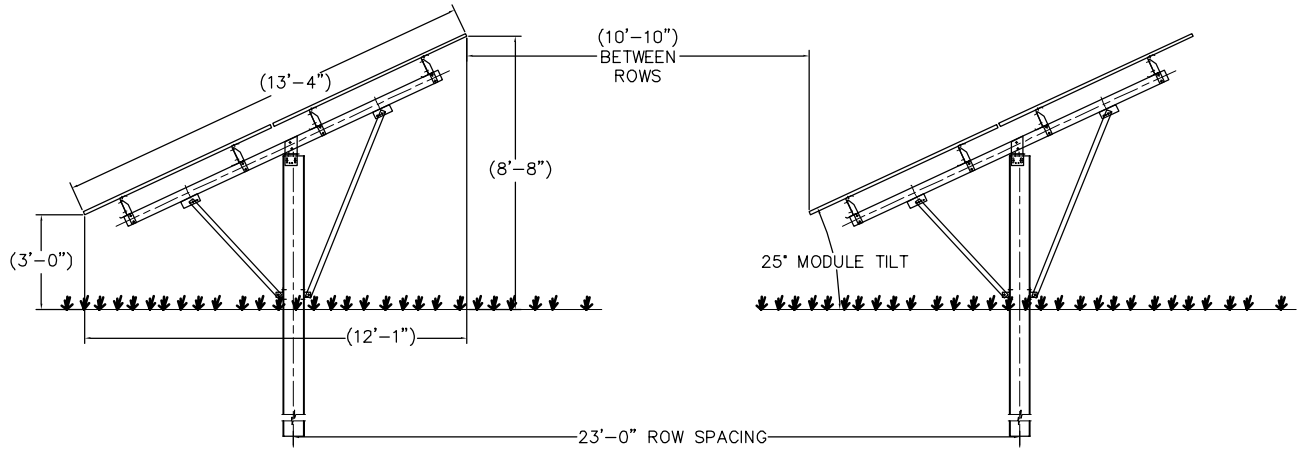
8. Referencing Sheet 4 – Overall Site Plan of the D&M Plan, how tall would the proposed double-row arborvitae hedge plantings initially be? Estimate the center to center spacing of the plantings in feet.
Initial plantings will be 6 to 8 feet tall, planted 10 feet on center, in a double staggered row, 5 feet apart.

EXHIBIT A

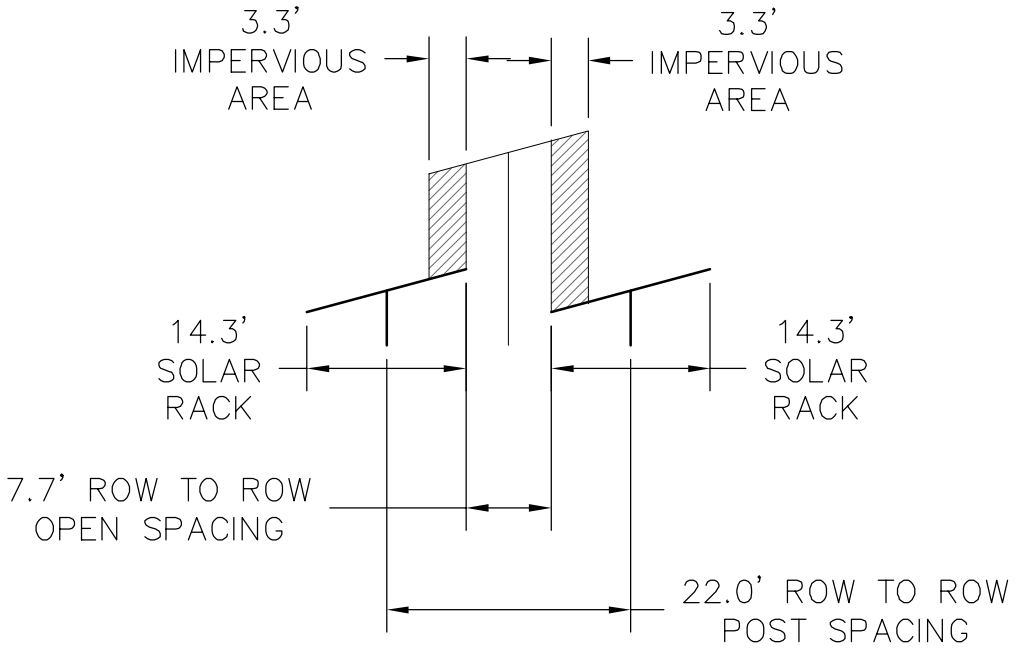
CSC APPROVAL RACKING PROFILE



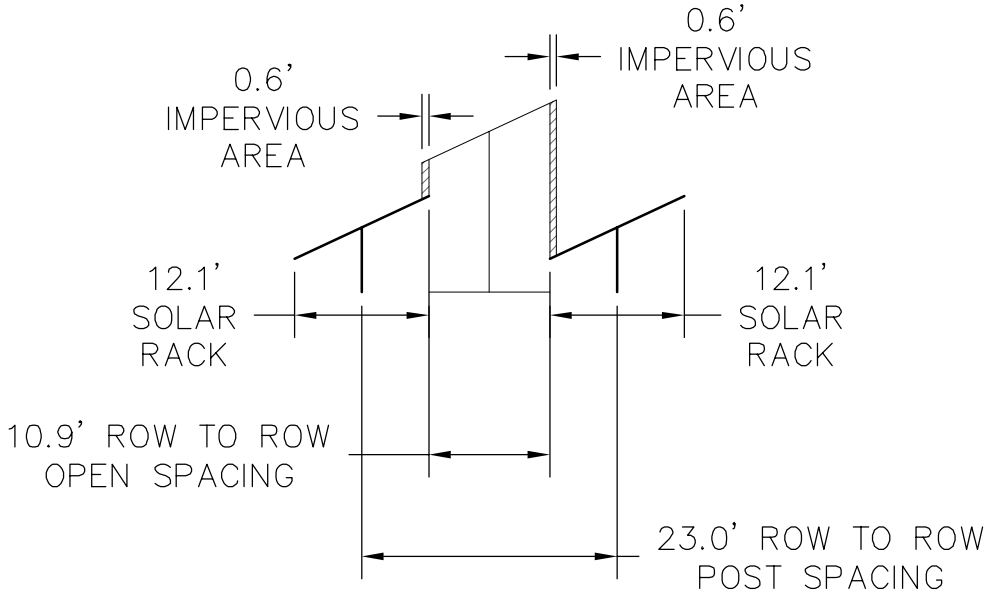
FINAL RACKING DESIGN PROFILE



DESIGN EFFECTIVE IMPERVIOUS CALCULATION
6.6' IMPERVIOUS PER LF SOLAR



ACTUAL EFFECTIVE IMPERVIOUS CALCULATION
1.2' IMPERVIOUS PER LF SOLAR



APPROXIMATELY 80% REDUCTION IN EFFECTIVE IMPERVIOUS OF RACKING LAYOUT

Voluntown Solar

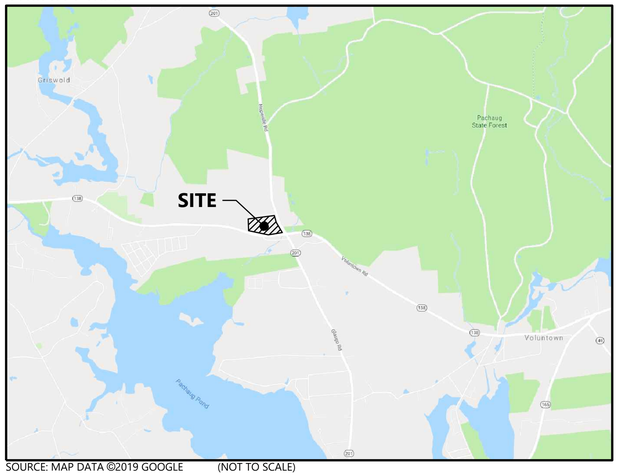
New London County, Connecticut

Electrical Design Plans

REGIONAL MAP

SOURCE: MAP DATA ©2019 GOOGLE (NOT TO SCALE)

VICINITY MAP



SOURCE: MAP DATA ©2019 GOOGLE (NOT TO SCALE)

PROJECT CONTACT INFORMATION			
TITLE	COMPANY	NAME	CONTACT NUMBER
SENIOR PROJECT MANAGER	WESTWOOD	DOUG MUTCHER	952-697-5709
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ELECTRICAL ENGINEER	WESTWOOD	BRANDON BLATTNER	952-697-5741
OWNER	ECOS ENERGY	STEVE BROYER	612-326-1500

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EXHIBIT B

PREPARED FOR:

ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar
New London County, CT

Cover

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.100

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PREPARED FOR:

ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

New London County, CT

Sheet Index

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.101

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SECTION 16010 - GENERAL PROVISIONS - ELECTRICAL

A. The work included under Division 16 shall consist of furnishing labor and materials necessary for the complete installation of lighting, power, and photovoltaic systems shown on the drawings. All work shall be complete and left in operating condition at completion of Contract.

B. Include minor items that are obviously and reasonably necessary to complete the installation and usually included in similar work. Such items include bolts, nuts, anchors, brackets, sleeves, and minor offsets in conduit, junction boxes, etc

C. Some equipment and materials provided under other divisions may require composite work crews because of trade jurisdiction. It is the Contractor's or Subcontractor's responsibility to review all Contract Documents to determine where these composite crews are required.

D. All temporary and permanent permits and licenses required in connection with this Division's work shall be the responsibility of the Contractor awarded that work.

E. Installation shall meet or exceed current applicable codes, ordinances and regulations in effect at the site. If a Contractor or Subcontractor observes that the Contract Documents are at variance with governing codes and regulations, they shall promptly notify the Engineer in writing, who will respond to such variances in writing. If the Contractor performs work knowing it is not compliant with applicable codes, and does not notify the Engineer, the Contractor shall assume full responsibility and bear all costs attributable to correcting the non-complying work.

F. The reference to Codes and Standards shall not permit a lower grade of construction where Contract Documents call for workmanship and/or materials in excess of those references.

G. Where the terms "provide" or "shall be" are used in this Division or on the drawings, they shall be taken to mean "The Contractor shall furnish and install".

H. If equipment or materials other than those specified in the design of this project are proposed to be used on this project, the Contractor and supplier shall check it for dimensional differences, electrical requirements and any other potential variances. This comparison shall be made for manufacturers specified as well as those proposed prior to requesting approval. The Contractor shall be responsible for any extra costs incurred as a result of Substitutions, including those of other contractors, such as might be due to (but not limited to) different electrical, mechanical and architectural requirements.

I. Shop Drawings:

1. Carefully examine all shop drawings noting capacity, arrangement and physical dimensions and mark the drawings as being reviewed and approved prior to submitting to the Engineer. Where catalog data is submitted which includes items which do not apply to this project, those items shall be clearly marked out or relevant items clearly noted. Any deviations from the documents shall be so noted by the Contractor or equipment supplier. The intent and requirements of the drawings and specifications shall be adhered to at all times and are not waived or superseded in any way by the shop drawing submittal or review.
2. Submit a minimum (1) electronic copy of shop drawings for review and approval. Contractor shall retain a final approved copy for incorporation in the Operation and Maintenance Manuals.
3. If returned shop drawings are marked "NO EXCEPTIONS TAKEN", no additional submittal is required. If the shop drawing is marked "MAKE CORRECTIONS NOTED", the changes noted on the shop drawings are to be incorporated, with no further resubmittal required. If marked "REVISE AND RESUBMIT", changes noted on the shop drawings are to be made and the drawings resubmitted for review. If marked "REJECTED", the equipment submitted is unacceptable and different equipment or materials need to be submitted.

J. No asbestos or PCB containing materials of any type shall be used on this Project.

K. Consult the Contract Drawings and Specifications of all other Divisions and other trades for correlating information and layout work so that it will not interfere with other trades. Verify all dimensions and conditions. If conflicts occur such that resolution is not possible by the affected trades on the job, the Engineer shall be notified and a resolution will be worked out.

L. Electrical equipment enclosures (switchboards, panelboards, transformers, relay cabinets, systems racks/cabinets, combiner boxes, etc.) shall be vacuumed and wiped clean prior to energizing and again at substantial completion.

M. Install material and equipment in accordance with Manufacturers' recommendations, instructions, and current N.E.C.A. standards.

N. Install equipment and materials to provide required access for servicing and maintenance. Coordinate final equipment location with required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

O. Record Drawings: As work progresses, in a neat and legible manner, record all changes or deviations from the contract drawings. Submit Record Drawings to Engineer for review at completion of Work. The Record Drawings will become part of the Operation and Maintenance Manual package submitted to the Owner after the completion of the project.

SECTION 16050 - BASIC MATERIALS AND METHODS

A. All materials shall be new, as specified or approved, and in original packaging. Catalog numbers specified shall be verified with vendors prior to ordering material.

B. All materials shall be listed by a NRTL (i.e. UL, ETL, etc.) and have an associated label unless special fabrication of material is required. Special fabricated material shall be fabricated using listed components and procedures.

C. Where the word "provide" is used, it shall require the electrical subcontractor to furnish and install material complete to a workable system.

D. All work shall be tested in accordance with industry accepted standards. Before testing, a thorough visual inspection shall be made to detect connection problems, damaged components, poor workmanship, inappropriate overcurrent protection, debris, etc. Testing apparatus shall be certified or demonstrated to be accurate within reasonable limits. Competent personnel familiar with the test equipment shall perform all tests. If testing procedures employed are not satisfactory to the Engineer, outside testing will be done at the electrical subcontractor's expense.

E. Electrical subcontractor to identify all electrical equipment with engraved 1/4" white letters on black plates. Inscriptions shall indicate the name, voltage, phase, wires, feeder size, feeder source and location of source, and the device number.

F. All low voltage cables shall be bundled and labeled as to their function within terminal cabinets, wireways and cable trays.

G. Branch circuitry shall match circuit numbers as shown on the drawings and as scheduled. Any required deviation shall be indicated on the as-built drawings.

H. All opening into equipment shall be sealed to prevent entry of insects and rodents.

SECTION 16110 - RACEWAYS

A. Construction shall be as per Underwriter's Laboratories Standard UL 870 for wireways, auxiliary gutters and associated fittings.

B. Wireways shall be painted steel with hinged removable cover, which can be used as either a hinged cover or set screw cover. Shall be fabricated such that the entire length of wireway and fittings permit lay-in wiring application. Cross sectional area shall be 6" x 6" minimum unless otherwise noted. Raintight wireway shall be NEMA 3R construction with gaskets and a corrosion resistant finish.

C. Where required, provide cable strain relief, grounding connectors, expansion fittings.

D. Schedule 40 PVC shall be used for all raceways where not restricted by this section or specifically noted otherwise. Schedule 80 PVC shall be used where above ground or transitions where emerging from ground and exposed to physical damage.

E. PVC conduit used above grade shall be UV resistant type.

F. Flexible liquid tight conduit shall be used on all motor, moving, and vibrating equipment connections. Use minimum 1/2" size with grounding type fittings and provide grounding conductor.

G. Conduit shall not be mounted on mechanical or other equipment which vibrates except at connection points.

H. Installations of underground wiring shall be in trench, duct or conduit or by plowing in place as specified on plans.

I. Underground raceways or direct burial cables shall be installed to meet the following requirements:

1. Spacing between exterior surfaces of underground conduits/cables shall be not less than the following:
   a. 2 inches between communications (copper) conduits/cables
   b. 2 inches between AC conduits/cables operating at not over 1000 volts
   c. 6 inches between a communications conduit/cable and any power conduit/cable (AC or DC not over 100V) in the same trench
   d. 12 inches between a communications conduit/cable and any power conduit/cable (AC or DC over 1000V) in the same trench, unless noted otherwise
   e. 6 inches between AC conduits/cables operating at over 1000 volts
   f. 6 inches between AC power conduits/cables and DC power conduits/cables.
   g. 6 inches between armored fiber optic cable or in metallic conduit and power conduits/cables (AC or DC)
2. Where crossing perpendicular, spacing between exterior surface of underground conduits/cables shall be not less than the following:
   a. 6 inches between AC and DC power conduits/cables operating at any voltage.
   b. 12 inches between conduits/cables containing AC and DC power conduits operating at any voltage and communications (copper) conduits/cables.

J. All underground raceways or wiring when specified in excavated trenches shall have backfill compacted. Refer to compaction requirements in trench compaction details. Backfill immediately around conduits/conductors to be a minimum of 3" native soil free from debris and organic material. Backfill surrounding direct buried cables shall be free of rocks 3/8" or larger, debris and organic material. Thermal conductivity of imported backfill shall be tested in accordance with ASTM D5334-08 to confirm the thermal resistivey is equal to or less than that of the native soil or, if applicable, the specific requirements on these plans.

K. Underground conduit shall be installed to allow drainage into manholes/handholes a minimum of 4 inches per 100 feet of horizontal run. Where conduits or ducts enter a manhole, handhole, or above grade cabinet, each shall be permanently identified by means of plastic fiber, laminated plastic or non-corrosive metal tags to indicate origination point.

L. When non-metallic conduit requires field bending, utilize a hot-bending appliance. Use of torches to bend conduit is unacceptable.

M. Where conduits terminate in handholes/vaults or in pad mounted equipment, terminate conduits a minimum of 4 inches above bedding or slab. Conduits shall use bell ends. Where routed through slabs, provide sleeves to allow settling/heaving of slab.

N. Where HDPE innerduct is used, Schedule 40 PVC or Schedule 80 PVC (where subject to damage) conduit shall be used for transitions to above grade.

SECTION 16120 - WIRING AND CABLE

A. Building Wire:

1. Description: Single conductor insulated wire.
2. Conductor: 98% Commercially pure copper conductors or AA-8000 series aluminum alloy compact stranded conductors
3. Insulation Voltage Rating: 600 volts and 2000 volts
4. Insulation: ANSI/NFPA 70, 90° C Type THHN-2, THWN-2, XHHW-2, RHW-2, USE-2, and PV
5. Exposed PV module wiring and combiner box feeders shall be 2000 volt tray rated PV type.
6. 600V AC wiring installed below grade shall be type XHHW-2, RHW-2, or USE-2.

B. Approved direct burial cable assembly shall be used only where approved.

C. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

D. Neatly trim and lace wiring inside boxes, equipment, and panelboards.

E. Clean conductor surfaces before installing lugs and connectors.

F. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.

G. Parallel 3-phase feeder runs in conduit shall have all three phase conductors (including neutral and ground where required) installed in each conduit. Grouping a single phase (or two phases) in a single conduit is not permitted.

H. Identification

1. Control wiring shall be marked at both ends as to its function.
2. Spare conductors shall be identified as such.

I. Direct burial wiring to meet spacing requirements under section 16110/I.

J. Aluminum cable is allowed for all MV cables and any LVAC and DC cables #6 AWG and larger unless otherwise specified.

SECTION 16125 - MEDIUM VOLTAGE CABLES

A. Cables for the 34.5 KV system shall be UD 35 KV MV-90 Listed single conductor, insulated, shielded and jacketed medium voltage type power cable with 100% insulation level, 90° C continuous operation rating, 130° C emergency rating, 250° C short circuit rating.

B. Cables for the 34.5 KV system shall be UD 35 KV MV-105 Listed single conductor, insulated, shielded and jacketed medium voltage type power cable with 100% insulation level, 105° C continuous operation rating, 130° C emergency rating, 250° C short circuit rating.

C. Cable shall have ASTM B-609 aluminum conductors with Class B stranding in accordance with ASTM B-231, moisture blocked strands, an extruded semi-conducting shield layer (40 mil min.) over the conductor for stress control, direct-burial XLPE insulation (345 mils min.), a concentric copper neutral, and moisture/chemical/oil/flame resistant PVC jacket.

D. Cables shall be Manufactured by Okonite, Prysmian, Southwire, General Cable, WTEC, or approved equal.

E. All MV cables must use cable termination kit manufactured by 3M, TE Connectivity, Eaton/Cooper, or Richards.

F. Complete installation shall be per National Electrical Code Articles 310 and 328. Do not exceed manufacturer's published maximum pulling tension or sidewall pressure. Provide sufficient slack in cable, ground and drain wires to permit elbow connectors to be moved to their respective parking stands.

G. All cables shall be labeled at each end at an accessible location for viewing. Label shall indicate circuit, phase, and destination/origination. Labels shall be black phenolic with white lettering and secured with a minimum of (2) UV-resistant zip ties.

H. Splices and terminations shall be made by an experienced journeyman whose qualifications are subject to approval by the Engineer. No splices shall be allowed unless specifically noted. No underground splices are permitted. Fiberglass splice boxes are not permitted unless approved by owner. All splices to be approved by owner.

I. Arrange phases at termination points, A-B-C from left to right or top to bottom as viewed from the front.

J. Test all cables according to IEEE Standard 400. Each power cable over 1000V shall be given a continuity test, and each medium voltage cable shall be given a continuity and a VLF test after installation and after terminations having been made. All single conductor cables shall be tested between conductors and ground with metallic shield and the other two conductors grounded to the same ground. Each conductor shall be successively tested in the same manner. Direct current voltages shall be applied with negative polarity to the cable conductor. See testing procedures as required.

K. No cable shall be permanently energized until a copy of its test record is approved by the Engineer.

L. In addition to any testing specified herein, perform testing consistent with the requirements of the applicable codes, NETA Acceptance Testing criteria, and the manufacturers' current quality assurance program.

M. Direct burial wiring to meet spacing requirements under section 16110/I.

SECTION 16130 - BOXES

A. Pull and junction boxes shall be code gauge, gasketed, painted, galvanized steel, PVC, or fiberglass. Covers shall be secured with screws.

B. Outlet boxes shall be cast malleable iron with threaded hubs or PVC and be of high conductive metal to maintain maximum electric continuity.

C. All outlets shall be equipped with outlet boxes approved for the use.

D. Covers or plates for boxes shall conform substantially to the outlet of the boxes with no projecting edges or corners.

E. Conduit fittings ("LB", "C", "T") or types approved for the location may be employed as required to facilitate pulling in conductors.

F. Provide pull and above ground junction boxes to facilitate pulling or splicing of conductors.

G. Mount boxes to allow for maximum flexibility.

H. Install grounding bushings with bonding conductor on all metallic feeder conduits entering box. Ground bushings and bonding conductors are not required on branch circuit conduits.

SECTION 16340 - MEDIUM VOLTAGE SECTIONALIZING CABINETS/MEDIUM VOLTAGE JUNCTION BOXES

A. Sectionalizing cabinets shall be designed for burial with the junction modules mounted above the ground line. Pedestals shall be in complete conformance with ANSI C57.12.28, Pad-mounted Equipment Enclosure Integrity Standard.

B. Sectionalizing cabinets shall be Manufactured by Nordic, Cooper, Hubbell, G&W, Power Design Inc., Highline, Federal Pacific, Hoffman, S&C or approved equal.

C. Enlosure shall be 3/16" nominal thickness fire resistant, laminate, fiberglass, with munsell green gel coat finish or shall be 12 gauge galvanized steel, with munsell green polyester powder coat finish. Enclosure access doors shall utilize stainless steel hinges and shall have provisions for padlocking. Doors shall have provisions for securing in the open position.

D. Provide junction panels with bushings to accommodate the size and quantity of dead break elbows indicated on drawings.

E. Provide ground bar in unit for bonding of ground conductors and concentric neutrals.

F. Provide fiberglass ground sleeve extending 36" below cabinet installed on a 6" pea rock base to allow drainage.

SECTION 16440 - DISCONNECT SWITCHES

A. All disconnect switches shall be NEMA heavy duty Type H.D., horsepower rated, and U.L. listed. Disconnects shall be Eaton, GE, Square D, Siemens or approved equal.

B. Provide auxiliary disconnect contacts for control circuits when supplied from an independent source.

C. Switch Interior - All switches shall have switch blades which are fully visible in the off position when the door is open. Switches shall be of dead-front construction with permanently attached arc suppressors hinged or otherwise attached to permit easy access to line-side lugs without removal of the arc suppressor. Lugs shall be UL listed for copper and/or aluminum cables and front removable. All current carrying parts shall be plated by electrolytic processes.

D. Switch Mechanism - Switches shall have a quick-make and quick-break operating handle and mechanism which shall be an integral part of the box, not the cover. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door in the ON position or closing of the switch mechanism with the door open. Switches shall provisions for locking the switch in both the ON and the OFF positions by padlock.

E. Enclosures shall be NEMA 3R enclosures unless otherwise specified. Raintight covers shall be securable in the open position. Enclosures shall be code gauge (UL 98) galvanized steel (NEMA 3R). They shall be treated with a rust-inhibiting phosphate and finished in gray baked enamel.

F. Install disconnect switches in an accessible location as convenient as possible to equipment served.

G. Switches shall be rated for the voltage and system type they are used for.

SECTION 16450 - GROUNDING

A. Provide complete grounding systems as described herein and as shown on the drawings.

B. All grounding components shall be listed for the purpose they are installed for. Components shall be Manufactured by AMPACT, Burndy, CADWELD, ITT Blackburn, Ilsco, or Lyncole.

C. Ground rods shall be 3/4 inch diameter by 10 feet long copper clad steel. Connecting cables shall be copper as indicated on drawings. All ground conductors exposed to the elements or in direct contact with the earth shall be tin coated or bare copper.

D. All metallic conduits, supports, cabinets, non-current carrying parts of equipment, and metallic structures shall be solidly grounded to form a continuous permanent and effective grounded system.

E. All wireways, metal enclosures, cable trays and similar parts of the electrical installation described herein shall be grounded.

F. UFER grounds shall be via exothermically weld connection to a minimum of (2) continuous 20'-0" sections of rebar encased in the concrete footings/piers with a minimum of 2" of concrete cover. Rebar shall be a minimum of a #4 and shall NOT be epoxy coated. If multiple pieces of rebar are required to provide the 20'-0" lengths, they shall be welded together to provide a continuous ground path.

G. The special attention of the Contractor is called to metallic building components and mechanical piping which must be grounded in an approved manner according to the NEC.

H. Provide a continuous grounding conductor for each feeder serving several panelboards. Connect this ground conductor to each related cabinet ground bar.

I. For LVAC circuits less than 1000 VAC not supplied by cables a with integral ground wire, provide a separate green insulated equipment grounding conductor for each single or three phase feeder and each branch circuit with a three phase protective device. Install the required grounding conductor in the common conduit with the related phase/hot and neutral conductors. Where parallel feeders are installed in more than one raceway, provide a green insulated equipment grounding conductor in each raceway.

J. Single Phase Branch Circuits for Lighting, Receptacles, Motors and Other Similar Equipment: Provide single phase branch circuits serving lighting, receptacles, motors, and other similar equipment consisting of phase, neutral, and green insulated equipment ground conductor installed in a common conduit.

K. Single Phase Branch Circuits for Special Equipment: Provide single phase branch circuits serving special equipment, and all branch circuits installed in nonmetallic or flexible conduits with a separate grounding conductor.

L. All transformers shall be bonded to the grounding electrode system as well as building steel (where applicable).

M. Bond all cable tray and equipment racks to ground with a minimum 4/0 AWG ground conductor.

N. Connections to the PV modules shall be installed such that removal of a module from the string does not interrupt the grounded conductor to another string. Sets of modules connected in series rated at 50 volts or more with or without blocking diodes, and having a single overcurrent device shall be considered a string.

O. When required by the testing plan, the resistance to earth shall be measured using a 3-point fall of potential test with the inverter station ground grid isolated. Results shall be compared to grounding model/study to verify field measured earth resistance is within the same order of magnitude as the grounding model/study.

SECTION 16475 - FUSES

A. DC fuses for PV string circuits shall be 1500Vdc rated HP15M as Manufactured by Mersen.

B. DC fuses for PV feeders shall be Class J or gPV type as Manufactured by Bussman, Mersen, or Littelfuse.

C. Fuses in switchboard, 601A and larger shall be Class L type and be Bussman Class L, Limitron KTU (or Hi Cap KRP-C), CEFCO Class L, CLL, Ferraz Shawmut Class L, Amp Trap A4BY, or Littelfuse Class L, KLP-C.

D. Fuses for feeder circuits 600A and less shall be Class RK1 and be Bussman Low Peak LPN-RK (250V) or LPS-RK (600V); CEFCO Lo-Ip LON-RK (250V) or LOS-RK (600V); Ferraz Shawmut Amp-Trap II A2D-R (250V) or A6D-R (600 V); or Littelfuse Little Peak LLN-RK (250V) or LLS-RK (600V).

E. Fuses for motor circuits shall be Class RK5 type and be Bussman Fusetron FRN-R (250V) or FRS-R (600 V); CEFCO CEFCON CRN-R (250V) or CRS-R (600V); Ferraz Shawmut Trionic TR-R (250 V) or TRS-R (600 V); or Littelfuse Slo-Blo FLN-RL (250V) or FLS-R (600V).

F. For in-line fuses and weatherproof assembly, provide Bussman Tron Type HEB fuse holder and Type KTK fuse with 1A0513 boot or equal.

G. For protection of control circuit transformers, provide Bussman Type FNQ time delay fuses or equal.

H. Install fuses to allow viewing of "Blown-Fuse" indicators through viewing windows in gear, where provided.

I. Provide label inside each switch and motor starter cover stating type of fuse required for replacement.

SECTION 16630 - COMBINER BOXES

A. Provide 1500V combiner box(s) Listed to UL 1741, complete with circuitry as necessary to protect the equipment including disconnect switch with finger-safe fuse holders having all necessary fusing. Combiner boxes shall be Eaton/Cooper, Shoals, SolarBos, Amtec, Teal, Bentek, WTEC, or approved equal.

B. A finger-safe, non-fused load break disconnect is required and it shall be interlocked to prevent the opening of the cover when the switch is in the ON position. Interlock shall be defeatable for testing purposes. Handle must be lockable in OFF position.

C. All fuse holders shall be finger-safe.

D. The combiner box shall be arranged to have a minimum number of input circuits and fuse sizes as indicated on the combiner box schedules for a negatively grounded system. Input fuse holders shall be rated to hold 32A fuses.

E. Enclosures shall be a minimum of NEMA 3/IP54 with seamless door gaskets and an integral disconnect rated as indicated on the combiner box schedules.

F. All wire terminations/lugs shall be Listed for 90°C field terminations.

G. Combiner boxes including disconnect and fuses shall be Listed for continuous operation at 100% of its collector bus/disconnect rating.

H. Provide units with integral DC surge protection devices rated for 40kA discharge current (8/20 μs) and maximum continuous operating voltage of 1500Vdc

I. Equipment shall have a nameplate installed and mounted to the front cover and indicate, at a minimum: number of input circuits, ampere rating of input circuits, voltage rating, short-circuit current rating, and integrated disconnect ampere rating.

J. Combiner box Manufacturer shall review combiner box schedules and verify combiner boxes enclosures are large enough and configured to allow termination of the size and quantity of string and feeder conductors/conduits indicated on the schedules.

K. Provide typed PV string directory inside cover to denote strings and their associated fuse/terminal number.

L. All combiner box components shall be pre-wired before arriving to site.

M. Provide a directory of combiner boxes at each inverter to facilitate location and shut down of DC sources.

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Westwood Professional Services, Inc.

PREPARED FOR:

ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

New London County, CT

Electrical Notes

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.102

ELECTRICAL SYMBOLOGY

- MOTOR
- FUSE
- SWITCH/DISCONNECT
- MV 3 POLE FUSED SWITCH/DISCONNECT
- BREAKER
- GANG-OPERATED AIRBREAK SWITCH
- TRANSFORMER
- SURGE ARRESTOR
- NON-LOAD BREAK ELBOW
- LOAD BREAK ELBOW
- DRAW OUT MEDIUM VOLTAGE CIRCUIT BREAKER
- FAULT INDICATOR, TEST POINT RESET, SEL OR EQUIVALENT
- 3-PHASE: GROUNDED WYE
- 3-PHASE: UNGROUNDED WYE
- 3-PHASE: DELTA
- HANDHOLE
- POWER METER
- PV MODULE SERIES STRING
- INVERTER
- CURRENT TRANSFORMER
- POTENTIAL TRANSFORMER
- NUMBER OF CIRCUITS IN TRENCH

PLAN LINE SYMBOLOGY

- CHAIN LINK SECURITY FENCE
- INVERTER BLOCK BOUNDARY
- COMBINER BLOCK BOUNDARY
- AC MV WIRING
- DC WIRING LEVEL 1
- DC WIRING LEVEL 2
- FIBER OPTIC LINE
- COMM CABLE
- CAB MESSENGER WIRE
- MOTOR CIRCUIT WIRE
- OVERHEAD CABLES
- DC TRENCH

EQUIPMENT LABELING KEY

		IDENTIFIER 1		IDENTIFIER 2		IDENTIFIER 3		
ITEM	BLOCK #	EQUIPMENT	NUMBER	EQUIPMENT	NUMBER	EQUIPMENT	NUMBER	EXAMPLE
PV TRANSFORMER	1	XFMR	-	-	-	-	-	1.XFMR
SWITCHGEAR	1	SWG	-	-	-	-	-	1.SWG
PANELBOARD	1	PNL	1	-	-	-	-	1.PNL1
AUXILIARY TRANSFORMER	1	XFMR	-	AUX	1	-	-	1.XFMR.AUX1
AUXILIARY PANELBOARD	1	PNL	-	AUX	1	-	-	1.PNL.AUX1
STRING INVERTER	1	PNL	1	INV	1	-	-	1.PNL1.INV1
MODULE STRING	1	PNL	1	INV	1	STR	1	1.PNL1.INV1.STR1
DISCONNECT	1	DISC	1	-	-	-	-	1.DISC1

NOTES

1. THESE SYMBOLS APPLY TO THIS ELECTRICAL SET OF CONTRACT DRAWINGS.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
3. CONTRACTOR SHALL VERIFY THAT WIRING CODE COMPLIES WITH AHJ WIRING CODE AND UTILITY REQUIREMENTS.

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Voluntown Solar

New London County, CT

Electrical Symbology & Equipment Labeling

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.103

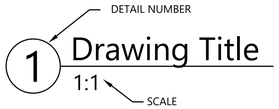
GENERAL SYMBOLOGY

NORTH ARROW

KEYNOTE

B OR MV01 CONDUCTOR ID

DETAIL TITLE



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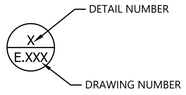

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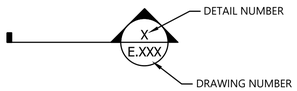

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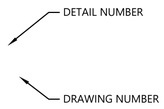
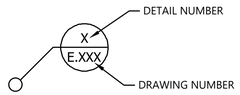


CAB TO TRENCH TRANSITION CALLOUT



ABBREVIATIONS

A,AMP	AMPERAGE
A/E	ARCHITECT/ENGINEER
ABAN	ABANDON
ABC	AGGREGATE BASE COURSE
AC	ALTERNATING CURRENT
ACC	ASPHALTIC CONCRETE PAVEMENT
ADDL	ADDITIONAL
ADJ	ADJUSTABLE/ADJACENT
AFCI	ARC FAULT CIRCUIT INTERRUPTER
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
AGGR	AGGREGATE
AIC	AMPS INTERRUPTING CAPACITY
AL	ALUMINUM
ALIG	ALIGNMENT
ALT	ALTERNATE
ANSI	AMERICAN NATIONAL STANDARDS INSTITU
APRX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
ASSY	ASSEMBLY
AUTO	AUTOMATIC
AUX	AUXILIARY
AWG	AMERICAN WIRE GUAGE
BITUM	BITUMINOUS
BKR	BREAKER
BL	BASE LINE
BLDG	BUILDING
BMP	BEST MANAGEMENT PRACTICE
BOC	BACK OF CURB
BRD	BOARD
C	CONDUIT
C&G	CURB AND GUTTER
CAB	CABINET
CB	CIRCUIT BREAKER
CCB	CONCRETE BLOCK
CCTV	CLOSED CIRCUIT TELEVISION
CE	CONCRETE EDGE
CF	CUBIC FOOT/FEET
CIP	CAST-IN-PLACE
CL	CENTERLINE
CLR	CLEAR, CLEARANCE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY RE UNIT
CO	CLEANOUT
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONTR	CONTRACTOR
CTR	CENTER
CTRL	CONTROL
CU	COPPER
DC	DIRECT CURRENT
DEMO	DEMOLITION
DIA	DIAMETER
DISC	DISCONNECT
DTL	DETAIL
DWG	DRAWING
EA	EACH
EL	ELEVATION
ELEC	ELECTRIC/ELECTRICAL
EMT	ELECTRICAL METAL TUBING
ENGR	ENGINEER
EOP	EDGE OF PAVEMENT
EQ	EQUAL
EQUIP	EQUIPMENT
EST	ESTIMATE
EXC	EXCAVATION
EXIST	EXISTING
F	FUSE
FBO	FURNISHED BY OTHERS
FG	FINISHED GRADE
FLR	FLOOR
FLUOR	FLUORESCENT
FOC	FACE OF CONCRETE/CURB
FT	FEET/FOOT
FUT	FUTURE
GEN	GENERAL
GFI	GROUND FAULT INTERRUPTER
GR	GRADE
GVL	GRAVEL
HORIZ	HORIZONTAL
HP	HORSE POWER
HT	HEIGHT
HZ	HERTZ
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IMC	INTERMEDIATE METALLIC CONDUIT
IN	INCH
INV	INVERT
JB	JUNCTION BOX (J-BOX)
KO	KNOCKOUT
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVOLT AMPERE REACTIVE
KW	KILOWATT
KWH	KILOWATT HOUR
LATL	LATERAL
LBS	POUNDS
LP	LOWPOINT
LT	LIGHT
LTG	LIGHTING
LV	LOW VOLTAGE
MA	MILLIAMPERE
MATL	MATERIAL
MAX	MAXIMUM
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MFR	MANUFACTURER
MIN	MINIMUM
MLO	MAIN LUG ONLY
MON	MONUMENT
MTD	MOUNTED
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OC	ON CENTER
PB	PUSHBUTTON
PCC	PORTLAND CONCRETE PAVEMENT
PF	POWER FACTOR
PH,Φ	PHASE
PL	PROPERTY LINE
PNL	PANEL
PROP	PROPERTY/PROPOSED
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
PWR	POWER
QTY	QUANTITY
R	RADIUS
R&R	REMOVE AND REPLACE
R&S	REMOVE AND SALVAGE
RCPT	RECEPTACLE
REF	REFERENCE
REQD	REQUIRED
RET	RETAINING
REV	REVISION
RGH	ROUGH
RM	ROOM
SAN	SANITARY
SCHED	SCHEDULE
SD	STORM DRAIN
SHT	SHEET
SL	SLOPE
SOG	SLAB ON GRADE
SPD	SURGE PROTECTOR DEVICE
SPEC	SPECIFICATION
SQ	SQUARE
SQ FT	SQUARE FEET
STA	STATION
STD	STANDARD
SW	SWITCH
SWBD	SWITCHBOARD
SY	SQUARE YARD
SYS	SYSTEM
T&B	TOP AND BOTTOM
TEL	TELEPHONE
TOB	TOP OF BERM
TOC	TOP OF CURB
TOPO	TOPOGRAPHY
TOS	TOP OF SLAB/TOE OF SLOPE
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
TYP	TYPICAL
UG	UNDERGROUND
UNO	UNLESS NOTED OTHERWISE
UPS	UNINTERRUPTIBLE POWER SUPPLY
UTIL	UTILITY
V	VOLT
VA	VOLT AMPERE
W	WATT
W/	WITH
W/O	WITHOUT
WP	WEATHERPROOF
XFMR	TRANSFORMER
XSECT	RE CROSS SECTION

EQUIPMENT CODES

AAT	AMBIENT AIR TEMPERATURE SENSOR
ANE	ANEMOMETER
ATS	AUTOMATIC TRANSFER SWITCH
BAT	BATTERY
BUS	BUS CONDUCTOR
CBK	CIRCUIT BREAKER
CBL	CABLE
CHGR	BATTERY CHARGER
CLM	CELLULAR MODEM
CMB	COMBINER BOX
CMT	CHECK METER
CNT	CONDUIT
CPC	CAPACITOR BANK
CT	CURRENT TRANSFORMER
DAM	DATA ACQUISITION MODULE
DAS	DATA ACQUISITION SYSTEM
DCI	COMBINER INPUT AT INVERTER
DCA	DISCONNECT - AC
DCD	DISCONNECT - DC
DCF	DISCONNECT - FUSED
DCH	DISCONNECT - HIGH VOLTAGE
DCM	DISCONNECT - MEDIUM VOLTAGE
GND	GROUND CONDUCTOR
GSW	GANG-OPERATED SWITCH
HPY	HORIZONTAL PYRANOMETER
INS	INSULATOR
I	INVERTER
JBM	JUNCTION BOX - MEDIUM VOLTAGE
JMP	JUMPER CONDUCTOR
LAR	LIGHTNING ARRESTOR
MBR	MAIN BREAKER
MET	METERING STATION
MPNL	METER PANEL
MTR	METER
NDS	NIGHTTIME DISCONNECT SWITCH
OHC	OVERHEAD CONDUCTOR
PAP	PLANE OF ARRAY PYRANOMETER
PEN	ROOF PENETRATION
PIL	SUPPORT PILE
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLS	POLE - STEEL
PLW	POLE - WOOD
PNL	POWER PANEL
RCB	RECOMBINER BOX
RCT	REACTOR
REL	RELAY
RMT	REVENUE METER
RTU	RTU
SA	SURGE ARRESTOR
SC	SEPARABLE CONNECTOR
STL	STRUCTURAL STEEL
SWF	SWITCH - FUSED
SWG	MEDIUM VOLTAGE SWITCHGEAR
TB	TAP BOX
TC	TRACKER CONTROLLER
TFH	TRANSFORMER - MAIN STEP-UP
TFM	TRANSFORMER - INVERTER STEP-UP
TFS	TRANSFORMER - STATION SERVICE
THS	THERMAL SENSOR
TM	TRACKER MOTOR
TT	TORQUE TUBE
UCT	UNDERGROUND CABLE TERMINATION
VT	VOLTAGE TRANSFORMER
WS	WEATHER STATION
WSS	WIND STOW SWITCHES
WVA	WFATHFR VANF

MATERIALS IN PLAN/SECTION

RIPRAP (PLAN AND/OR SECTION)

CONCRETE (PLAN AND/OR SECTION)

GRANULAR FILL (SECTION)

UNDISTURBED EARTH (SECTION)

COMPACTED EARTH (SECTION)

SAND (SECTION)

NOTES

1. THIS IS A STANDARD SYMBOLOGY AND ABBREVIATION SHEET. ALL SYMBOLS AND ABBREVIATIONS ARE NOT NECESSARILY USED ON THIS PROJECT.
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B	05/30/2019	90% SUBMITTAL
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Voluntown Solar

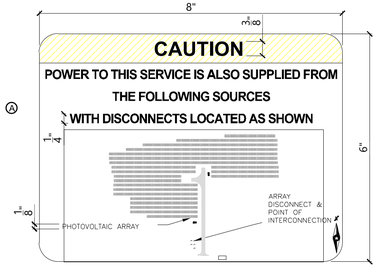
New London County, CT

General Symbology & Abreviations

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.104



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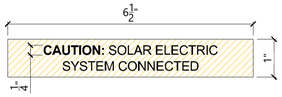

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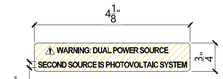

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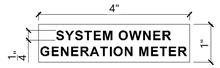

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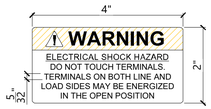

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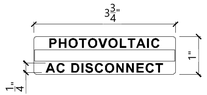

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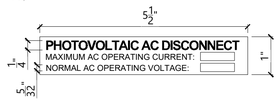

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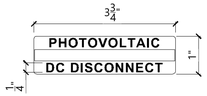

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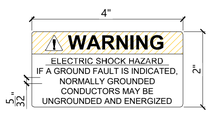

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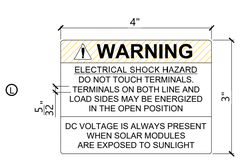

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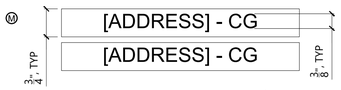

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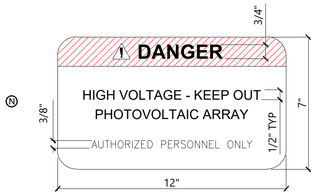

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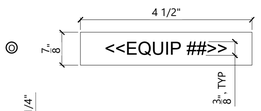

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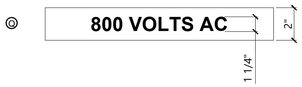

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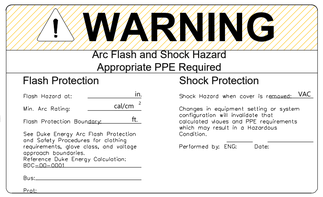

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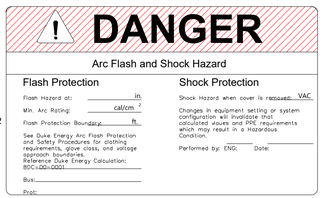

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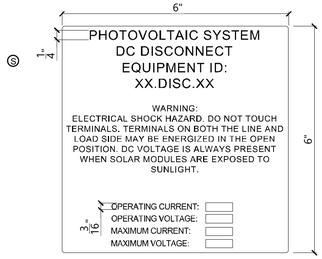

Ⓢ

LABELS AND MARKINGS LEGEND:

Ⓐ CAUTION LABEL FOR THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC DISCONNECTING MEANS. THIS PLAQUE SHALL BE APPLIED TO THE MAIN SERVICE DISCONNECTING MEANS AT THE SUBSTATION POCC. CUSTOM LABEL WITH WHITE BACKGROUND AND BLACK LETTERS. SHOW LOCATION OF ALL PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS ON SITE PLAN.

Ⓑ LABEL FOR UTILITY MAIN AC DISCONNECT. APPLIED TO SERVICE DISCONNECTING MEANS AND PHOTOVOLTAIC DISCONNECTING MEANS AT SUBSTATION. LABEL WITH RED BACKGROUND AND WHITE LETTERS.

Ⓒ CAUTION LABEL FOR PHOTOVOLTAIC SYSTEM CONNECTED. APPLIED TO ALL PHOTOVOLTAIC DISCONNECTING MEANS AND PRODUCTION METERS. APPLY TO SUBSTATION MAIN SERVICE DISCONNECT, FEEDER BREAKERS, UTILITY PRODUCTION METER AND CUSTOMER METER. LABEL WITH YELLOW BACKGROUND AND BLACK LETTERS.

Ⓓ WARNING LABEL FOR DUAL POWER SOURCE PRESENT. APPLY TO UTILITY PRODUCTION METER, CUSTOMER METER AND PULL BOXES.

Ⓔ SYSTEM OWNER'S GENERATION METER LABEL. LABEL WITH RED BACKGROUND AND WHITE LETTERS.

Ⓕ LABEL FOR REQUIRED UTILITY (PRODUCTION) METER SOCKET. LABEL WITH RED BACKGROUND AND WHITE LETTERS.

Ⓖ WARNING LABEL FOR DISCONNECTING MEANS WHERE BOTH SIDES MAY BE ENERGIZED IN THE OPEN POSITION. APPLY TO MAIN SERVICE DISCONNECT, ALL AC PHOTOVOLTAIC DISCONNECTS, AND PULL BOXES.

Ⓗ LABEL FOR AC DISCONNECTS IDENTIFICATION. LOCATED AT INVERTER STATIONS. LABEL WITH RED BACKGROUND AND WHITE LETTERS. LABEL WITH WHITE STRIPE ALONG CENTER.

Ⓘ LABEL FOR AC DISCONNECT INFORMATION. LOCATED AT INVERTER STATIONS. LABEL WITH RED BACKGROUND AND WHITE LETTERS. INFORMATION IN BLACK LETTERS WITHIN WHITE BOXES.

Ⓙ LABEL FOR DC DISCONNECT IDENTIFICATION. APPLY TO ALL COMBINER BOXES AND RE-COMBINERS. LABEL WITH RED BACKGROUND AND WHITE LETTERS. LABEL WITH WHITE STRIPE ALONG CENTER.

Ⓚ LABEL FOR INVERTER OR APPLIED BY THE INSTALLER NEAR THE GROUND-FAULT INDICATOR AT A VISIBLE LOCATION.

Ⓛ WARNING LABEL FOR DC DISCONNECTS. APPLY TO ALL COMBINER BOXES AND RE-COMBINERS.

Ⓜ LABEL FOR BUILDING ADDRESS; ONE PER SYSTEM METER AND ONE TO BE PLACED OUTSIDE OF POCC LOCATION

Ⓝ DANGER LABEL FOR CHAIN LINK SECURITY FENCE; SPACED EVERY 200 FEET AROUND PERIMETER OF ARRAY. SIGNS SHALL BE AT LEAST 14 GAUGE GALVANIZED STEEL OR ALUMINUM OR MINIMUM 3/32" THICK UV STABILIZED POLYCARBONATE OR PLEXIGLASS WITH 20 YEAR MINIMUM LIFE UV RESISTANT PAINT/LAMINATE FINISH. FASTEN TO FENCE WITH A MINIMUM OF (4) GALVANIZED STEEL OR 1/4" NOMINAL HEAVY DUTY UV STABILIZED ZIP TIES

Ⓞ GENERIC EQUIPMENT NUMBERING LABEL; ONE PER SWITCHBOARD, ONE PER PANELBOARD, ONE PER INVERTER AND ONE PER TRANSFORMER

Ⓟ CONDUIT RUN FROM COMBINER TO INVERTER. (AS NEEDED)

Ⓠ CONDUIT RUN FROM PANELBOARD TO STEP-UP TRANSFORMER. COORDINATE WITH TRANSFORMER STATION MANUFACTURER. (AS NEEDED)

Ⓡ ARC FLASH WARNING LABEL SHALL BE PLACED ON ALL EQUIPMENT AS REQUIRED BY NEC 110.16 INCLUDING, BUT NOT LIMITED TO, COMBINER BOXES, DISCONNECTS, INVERTERS, PANEL BOARDS AND SWITCHBOARDS. TOTAL QUANTITY TO BE DETERMINED BY CONTRACTOR. LABEL SHOWN IS AN EXAMPLE - VALUES WILL VARY BETWEEN EQUIPMENT. CHOOSE APPROPRIATE LABEL FOR APPROPRIATE HAZARD CONDITION. WARNING LABEL DESIGNATES INCIDENT ENERGY < 40 CAL/CM^2 AND DANGER LABEL DESIGNATES INCIDENT ENERGY >= 40 CAL/CM^2.

Ⓢ LABEL FOR DC DISCONNECT INFORMATION WHICH COMBINES LABELS G AND J ON THIS SHEET. APPLY TO ALL COMBINER BOXES.

GENERAL NOTES

1. SOLAR MODULES SHALL BE SUPPLIED FROM THE MANUFACTURER WITH MARKINGS PRE-APPLIED TO MEET THE REQUIREMENTS OF THE NEC.
2. INVERTERS SHALL BE SUPPLIED FROM THE MANUFACTURER WITH THE APPROPRIATE LABELS AND MARKINGS TO MEET THE REQUIREMENTS OF THE NEC.
3. FINAL LABEL QUANTITIES, TEXT, AND LOCATIONS TO BE DETERMINED BY CONTRACTOR.
4. THE LABELING, MARKING, IDENTIFICATION, AND GROUPING REQUIREMENTS OF THE 2017 EDITION OF THE NATIONAL ELECTRIC CODE SHALL BE APPLICABLE TO THIS PHOTOVOLTAIC PROJECT.
5. IN ADDITION TO NEC-REQUIRED LABELING, ALL MAJOR ELECTRICAL EQUIPMENT SHALL BE IDENTIFIED PER SPECIFICATIONS IN THIS PLAN SET. LABELS SHALL BE SUITABLE FOR THE ENVIRONMENT IN WHICH THEY ARE INSTALLED.
6. INTERCONNECTION EQUIPMENT AND MATERIALS, INCLUDING SHARED EQUIPMENT WITH THE UTILITY, SHALL BE LABELED PER UTILITY SPECIFICATIONS.
7. ALL WARNING, CAUTION AND/OR DANGER LABELS TO COMPLY WITH ANSI Z535.4-2011 STANDARD FOR PROPER TEXT SIZE, DESIGN, ETC.
8. BELOW IS A LIST OF MAJOR SECTIONS OF ARTICLE 690 OF THE NEC WHICH OUTLINE PV LABELING AND MARKING. THIS LIST, NOR THE EXAMPLES SHOWN ON THIS SHEET, SHOULD NOT BE CONSIDERED EXHAUSTIVE. CONTRACTOR IS REQUIRED TO UNDERSTAND THE NEC LABELING REQUIREMENTS AND APPLY THESE REQUIREMENTS TO PROJECT AS REQUIRED. SECTIONS IN *ITALICS* ARE DIRECT QUOTES FROM NEC.

   NEC 690.13(B)
   DISCONNECTING MEANS IDENTIFICATION.

   NEC 690.15
   EQUIPMENT ENERGIZED BY MORE THAN ONE SOURCE.

   NEC 690.17(E)
   WHEN BOTH TERMINALS OF A DISCONNECTING MEANS MAY BE ENERGIZED.

   NEC 690.31(G)(3)
   MARKING AND LABELING REQUIRED.

   NEC 690.31(G)(4)
   MARKING AND LABELING METHODS AND LOCATIONS.

   NEC 690.35(F)
   PHOTOVOLTAIC POWER SOURCE LABELED AT J-BOXES, COMBINER BOXES, DEVICES.

   NEC 690.53
   LABEL FOR DC PV POWER SOURCE AT PV DISCONNECTING MEANS.

   NEC 690.54
   LABEL FOR INTERACTIVE SYSTEM POINTS OF INTERCONNECTION WOTH OTHER SOURCES.

   NEC 690.56(B)
   FACILITIES WITH UTILITY SERVICE AND PV SYSTEMS.

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PREPARED FOR:

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REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar
New London County, CT

Labels & Markings

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.105

Voluntown Design Summary

Project AC Capacity:		1998 kW-AC
Project DC Capacity:		2400kW-DC

INVERTER				MODULE RACK		MODULE			ARRAY							
Block #	MAKE	MODEL	KW/KVA	MAKE	MODEL	MAKE	MODEL	WATTAGE (W)	QUANTITY OF MODULES PER STRING	QUANTITY OF STRINGS PER INVERTER	QUANTITY OF STRINGS	QUANTITY OF MODULES	QUANTITY OF INVERTERS	CAPACITY (kW-AC)	NAMEPLATE (kW-DC)	DC:AC RATIO
1	ABB	PVS-166-TL-US	166.5	RBI	25° FIX TILT	LG	LG400N2W	400	25	20	120	3000	6	999	1200.0	1.201
2	ABB	PVS-166-TL-US	166.5	RBI	25° FIX TILT	LG	LG400N2W	400	25	20	120	3000	6	999	1200.0	1.201
SITE TOTALS											240	6000	12	1998.00	2400.00	1.201

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Voluntown Solar
New London County, CT

Project Design Summary

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.106

1 Project Site Plan
1" = 40'

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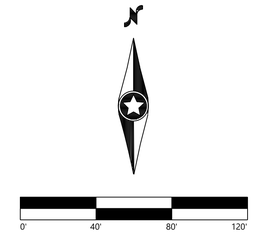


Voluntown Solar

New London County, CT

Project Site Plan

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.110

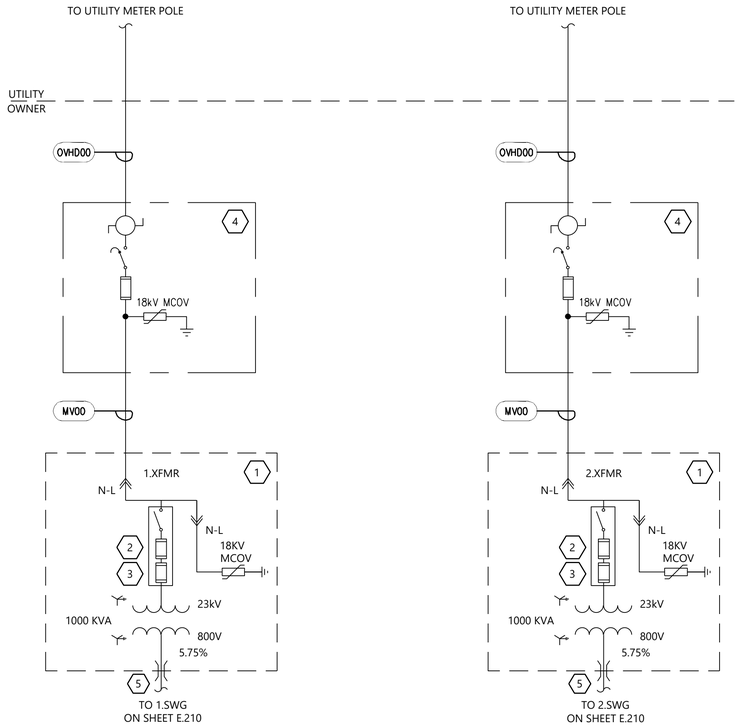
N:\902366.00\Civil\Electric\d\902366 E 100-Project Site Plan.dwg, 6/7/2019 10:09 AM Marcus Wiegandt

NOTES:

1. PROVIDE EXTERNAL SURGE ARRESTERS AT TRANSFORMERS, ELBOW CONNECTED ON THE HIGH VOLTAGE SIDE OF TRANSFORMER WHERE SHOWN.
2. INSTALL ALL EQUIPMENT AND WIRING IN ACCORDANCE WITH THE NEC, NESC, AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL UTILITY COMPANY AND LOCAL AUTHORITY HAVING JURISDICTION.
3. REFER TO SHEET E.103 MVAC EQUIPMENT LABELING REQUIREMENTS.
4. REFER TO SHEETS E.210 FOR LVAC SINGLE LINE DIAGRAM.
5. REFER TO SHEET E.220 FOR DC SINGLE LINE DIAGRAM
6. REFER TO SHEET E.800 FOR MVAC SCHEDULE.

KEY NOTES:

1. 1000 KVA, 23,000V GROUNDED WYE/800V GROUNDED WYE, Z=5.75%, 3 PHASE, 4W, 125KV BIL, TWO-WINDING PAD MOUNTED STEP-UP TRANSFORMER. HV SURGE ARRESTERS
2. CURRENT LIMITING FUSE, RATING PER ABB.
3. EXPULSION FUSE, RATING PER ABB.
4. POLE MOUNTED S&C OMNI-RUPTER GANG OPERATED LOAD BREAK DISCONNECT MANNUALLY OPERATED (147442R4-A1P1-S1) 25KV, 150KV BIL, 800A CONTINUOUS, 65KA, 24/7 UTILITY ACCESS, VISIBLE BREAK, AND UTILITY LOCKABLE.
5. MAIN SWTICHGEAR AND TRANSFORMER TO BE CLOSE COUPLED WITH PROVIDED FLEX BUSS.



WIRING SCHEDULE	
WIRING ID	**NOTES**
MV00	REFER TO MVAC SCHEDULES ON SHEET E.800 FOR CONDUCTOR SIZE AND SPECS.
OVHD00	REFER TO MVAC SCHEDULES ON SHEET E.800 FOR CONDUCTOR SIZE AND SPECS.

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Voluntown Solar

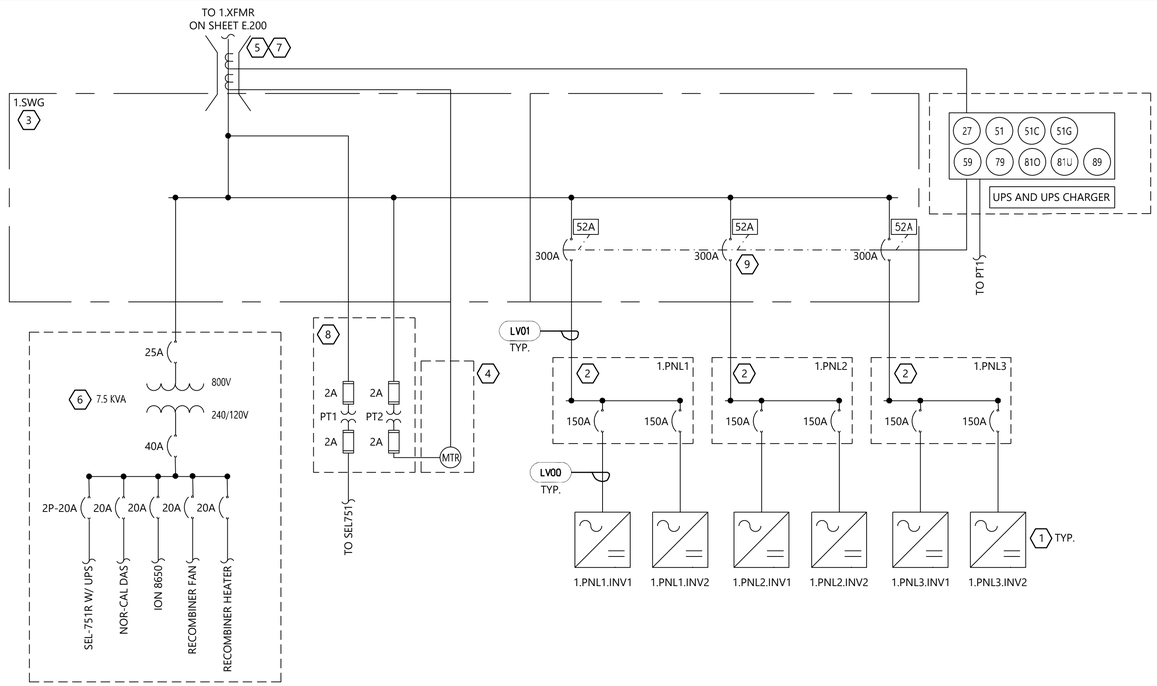
New London County, CT

MVAC Oneline Diagram

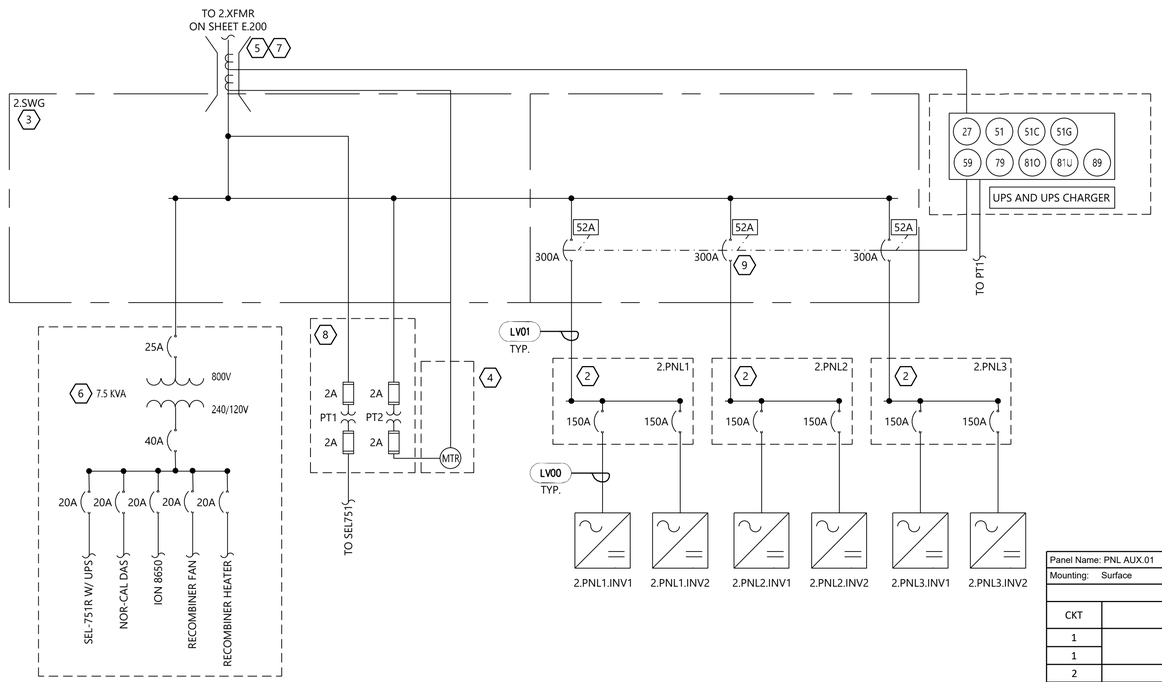
FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.200



1 Switchgear Single Line Diagram - 1.SWG



2 Switchgear Single Line Diagram - 2.SWG

NOTES:

1. INSTALL ALL EQUIPMENT AND WIRING IN ACCORDANCE WITH THE NEC, NESC, AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL UTILITY COMPANY AND LOCAL AUTHORITY HAVING JURISDICTION.
2. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
3. REFER TO SHEETS E.200 FOR MVAC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.220 FOR DC SINGLE LINE DIAGRAM
5. REFER TO SHEET E.810 FOR LVAC SCHEDULE.

KEY NOTES:

1. STRING INVERTER: ABB PVS-166.5/175-TL
   - PVS-166.5-TL-POWER MODULE - 166500 Wac - 24 STRING, 12 MPPT (2 PER MPPT)
   - 1500 Vdc. 800Vac. DC SWITCHES. ARC FAULT. SPD TYPE 2 PLUGGABLE CARTRIDGES (DC&AC)
   - NEMA4X (NEMA3R FANS)
   - 5 YEAR WARRANTY FOR INSTALLATION WORLDWIDE
2. PANEL BOARD (AC COMBINER) : BACKFEED RATED, 800V, 400A, 3PH, 3W
   - (2) X 150A, 800V ABB BREAKERS
3. AC RECOMBINER: 2500A SWITCHBOARD, 3PH, 4W, 35k AIC BACKFEED RATED. 3 BREAKER (3x300A), 3P3W
   - 800V SHUNT TRIP BREAKERS W/POSITION CONTACTS.
   - NEMA 3R WIREWAY BETWEEN XFMR AND SWITCHBOARD. HEATER & FAN.
4. ION 8650 METER, MILLBANK 7445 ENCLOSURE
6. 7.5kVA POWER CENTER 462:120 (INTALLED ON OUTSIDE)
   - PRIMARY MCCB 480V @ 25A, SECONDARY MCCB 240V @ 40A
   - (1) 2-POLE BREAKER, (4) 1-POLE BREAKER
   - 72x25"x12" AUX CABINET, INCLUDING (6) PTS, (6) SHORTING TERM BLOCKS
7. CURRENT TRANSFORMERS: 125-102, 1000:5 CT, 600VAC, 10kV BIL.
   - PART NO. PTG3-1-60-841F
8. VOLTAGE TRANSFORMERS: 840:120 (7:1), 0.3WXMY, 1.2Z @ 100%, PC&S MODEL PTG3-1-60-841F
   - METER FUSE 5.5kV, 45kA, 2.0E, VT FUSES PRIMARY 2A BUSSMAN JCD-2E. SECONDARY 2A BUSSMAN KTK-2.
9. SHUNT TRIP FOR BREAKERS KT5S2

   STATUS MONITORING FOR BREAKERS 1SDA064518R1

WIRING SCHEDULE	
WIRING ID	**NOTES**
LV00	REFER TO LVAC SCHEDULES ON SHEET E.810 FOR CONDUCTOR SIZE AND SPECS.
LV01	REFER TO LVAC SCHEDULES ON SHEET E.810 FOR CONDUCTOR SIZE AND SPECS.

Panel Name: PNL AUX.01		Voltage: 120/240			1 Phase	3Wire	Bus Rating (A): 60	
Mounting: Surface		Main CB: YES			Main CB Rating (A) 40			
Manufacturer/Model: General Electric							AIC Rating: 35KAIC	
CKT	Load Description	Breaker	Connected Load (kVA)	Phase	Connected Load (kVA)	Breaker	Load Description	CKT
1	SEL-751R W/ UPS (240V)	20/2	1.00	A	1.00	20/1	SEL-751R W/ UPS (240V)	1
1		-		B	1.00	20/1	SEL-751R W/ UPS (240V)	1
2	Nor-Cal DAS	20/1	0.50	A	0.50	20/1	Nor-Cal DAS	2
3	ION 8650	20/1	0.50	A	0.50	20/1	ION 8650	3
4	Re-Combiner Fan	20/1	0.05	B	0.50	20/1	Re-Combiner Fan	4
5	Re-Combiner Heater	20/1	0.50	B	0.50	20/1	Re-Combiner Heater	5
		Total kVA	6.55					

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Voluntown Solar

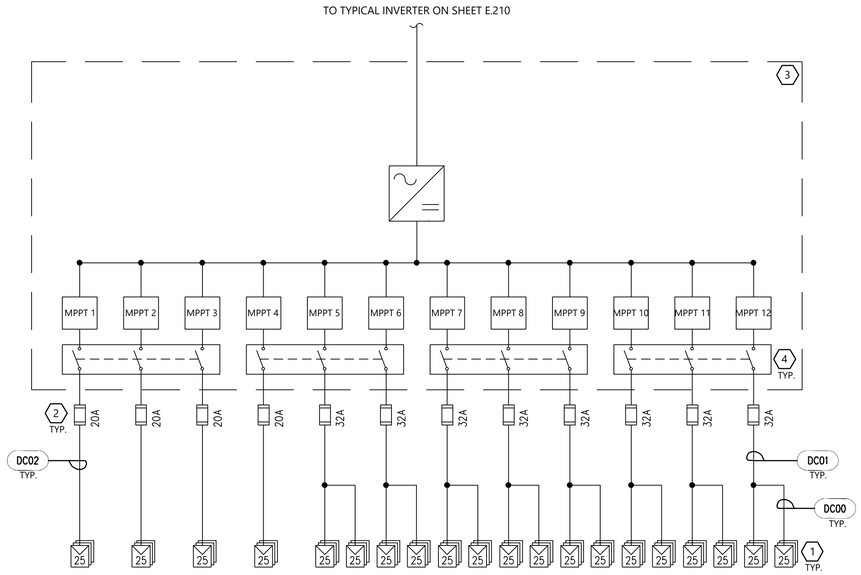
New London County, CT

LVAC Oneline Diagram

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.210



1 String Inverter Single Line Diagram

NOTES:

1. INSTALL ALL EQUIPMENT AND WIRING IN ACCORDANCE WITH THE NEC, NESC, AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL UTILITY COMPANY AND LOCAL AUTHORITY HAVING JURISDICTION.
2. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
3. REFER TO SHEETS E.210 FOR LVAC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.230 FOR INVERTER COMMUNICATION DIAGRAM.
5. REFER TO SHEET E.820-E.822 FOR DC SCHEDULES.

KEY NOTES:

1. SOLAR MODULE: LG LG400N2W-V5, 1500V, 400W, 25 CONNECT IN SERIES FOR ONE STRING.
2. FUSE ON POSITIVE CONDUCTOR ONLY.
3. STRING INVERTER: ABB PVS-166-TL-US, 3 PHASE, 3W, 800V OUTPUT. CSA TO UL 1741SA & IEEE1547 CERTIFIED.
4. DC DISCONNECT

WIRING SCHEDULE

WIRING ID	NOTES
DC00	BACK OF MODULE CONDUCTORS. REFER TO MODULE SPEC SHEET FOR SIZE AND CONNECTOR TYPE.
DC01	REFER TO DC SCHEDULES ON SHEET E.820 - E.822 FOR CONDUCTOR SIZE AND SPECS.
DC02	REFER TO DC SCHEDULES ON SHEET E.820 - E.822 FOR CONDUCTOR SIZE AND SPECS.

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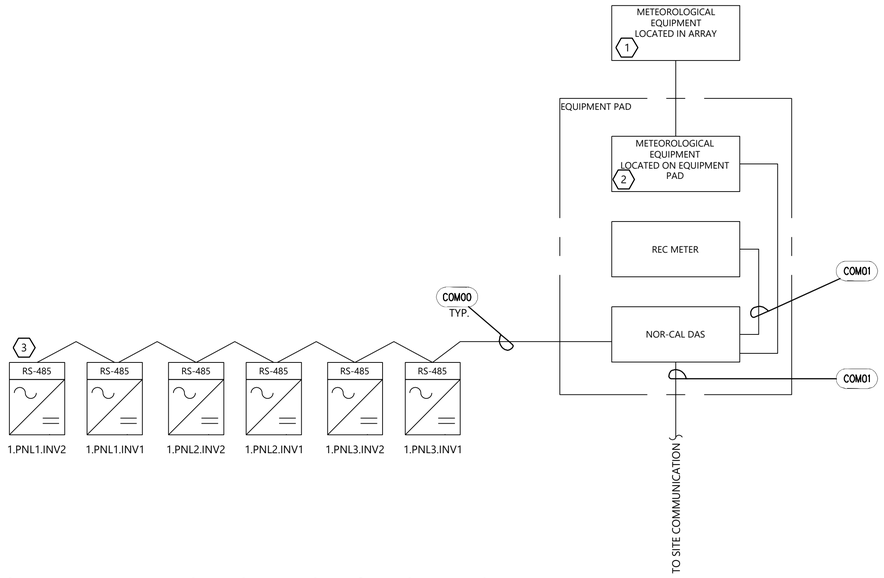
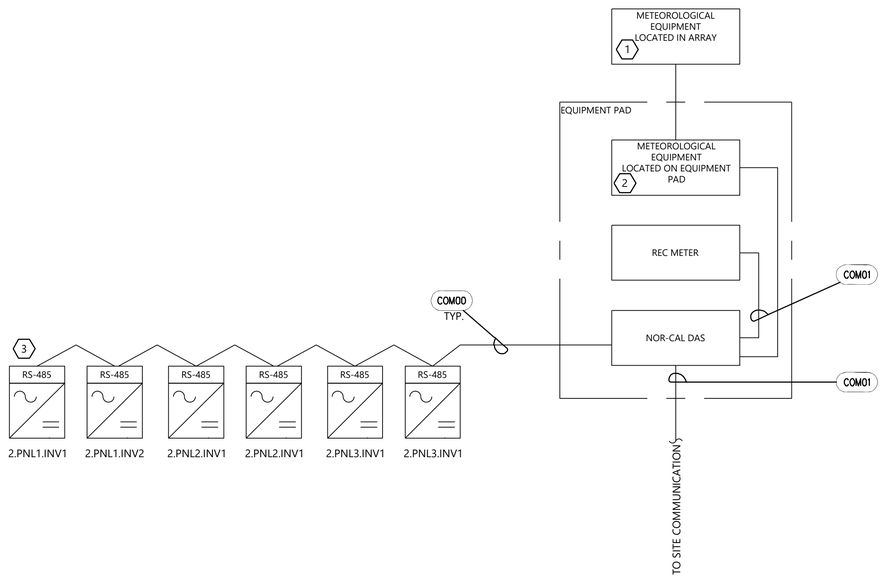
Voluntown Solar
New London County, CT

DC Oneline Diagram

FOR CONSTRUCTION
DATE: 06/07/2019
SHEET: E.220



1 Block 1 Communication Single Line Diagram



2 Block 2 Communication Single Line Diagram

NOTES:

1. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
2. REFER TO SHEET E.210 FOR LVAC SINGLE LINE DIAGRAM
3. REFER TO SHEET E.500-E.501 FOR COMMUNICATION SITE PLAN.

KEY NOTES:

1. TWO POA PYRANOMETERS, TWO BACK OF MODULE TEMP. SENSORS. SEE SHEETS E.500 & E.501 FOR LOCATIONS.
2. ONE ANEMOMETER, ONE AMBIENT TEMP SENSOR. SEE SHEETS E.500 & E.501 FOR LOCATIONS.
3. TERMINATE RS485 DAISY CHAIN AT THE END WITH A 120 OHM RESISTOR.

WIRING SCHEDULE

WIRING ID	NOTES
COM00	SHIELDED RS-485
COM01	SPEC BY NOR-CAL

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Voluntown Solar
New London County, CT

Communication Oneline Diagram

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.230

1 MVAC Routing Site Plan

1" = 40'

NOTES:

1. INSTALL ALL EQUIPMENT AND WIRING IN ACCORDANCE WITH THE NEC, NESC, AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL UTILITY COMPANY AND LOCAL AUTHORITY HAVING JURISDICTION.
2. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
3. REFER TO SHEETS E.200 FOR MVAC SINGLE LINE DIAGRAM.
3. REFER TO SHEET E.800 FOR MVAC SCHEDULES.
4. REFER TO SHEET E.650 FOR TRENCH DETAILS.

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0' 40' 80' 120'

Voluntown Solar

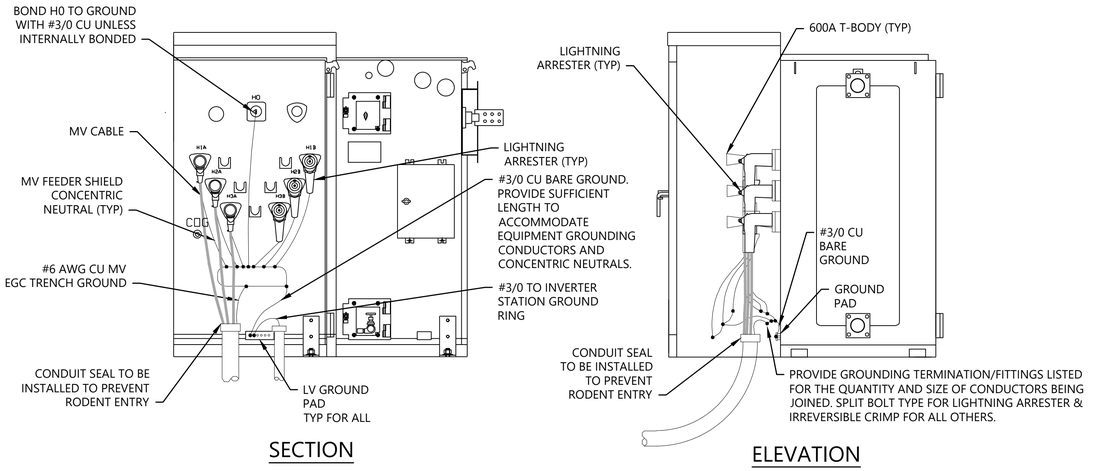
New London County, CT

MVAC Site Plan

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.300



1 Transfomer Primary Connection & Grounding

NTS

NOTES:

1. INSTALL ALL EQUIPMENT AND WIRING IN ACCORDANCE WITH THE NEC, NESC, AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL UTILITY COMPANY AND LOCAL AUTHORITY HAVING JURISDICTION.
2. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
3. REFER TO SHEETS E.200 FOR MVAC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.300 FOR MVAC SITE PLAN.
5. REFER TO SHEET E.800 FOR MVAC SCHEDULES.

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B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

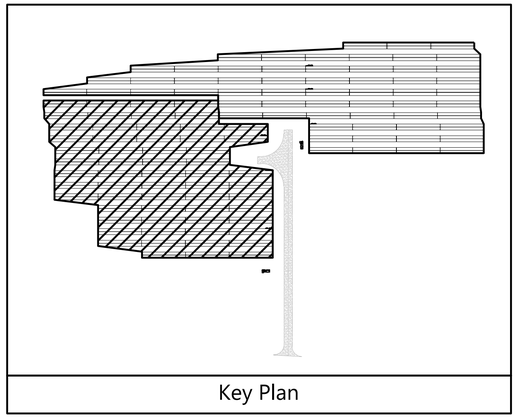
New London County, CT

MVAC Details

FOR CONSTRUCTION

DATE: 06/07/2019

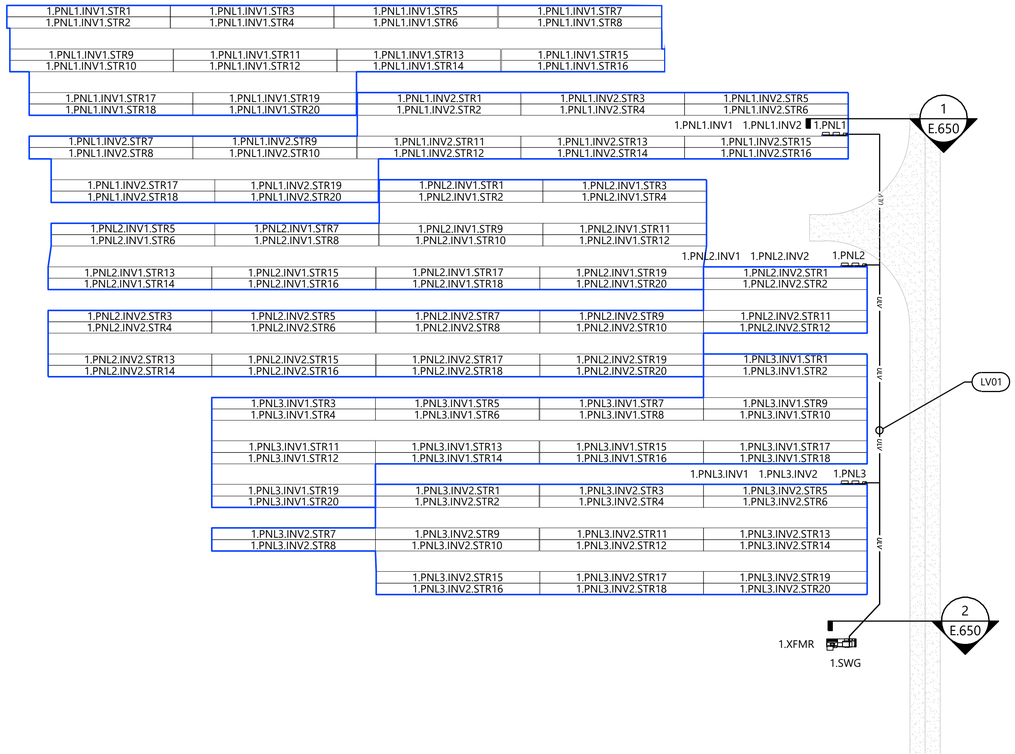
SHEET: E.350



Key Plan

NOTES:

1. INSTALL ALL EQUIPMENT AND WIRING IN ACCORDANCE WITH THE NEC, NESC, AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL UTILITY COMPANY AND LOCAL AUTHORITY HAVING JURISDICTION.
2. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
3. REFER TO SHEETS E.210 FOR LVAC SINGLE LINE DIAGRAM.
3. REFER TO SHEETS E.220 FOR DC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.810 FOR LVAC SCHEDULES.
5. REFER TO SHEET E.820-E.822 FOR DC SCHEDULES.
6. REFER TO SHEET E.650 FOR TRENCH DETAILS.



1 DC and LVAC Site Plan Block 1

1" = 40'

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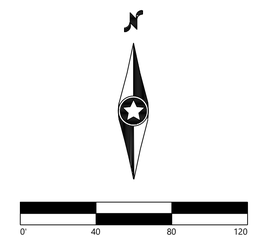


Voluntown Solar

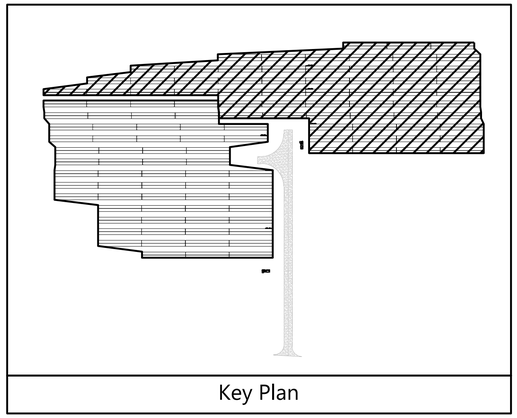
New London County, CT

DC and LVAC Site Plan Block 1

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.400



Key Plan

NOTES:

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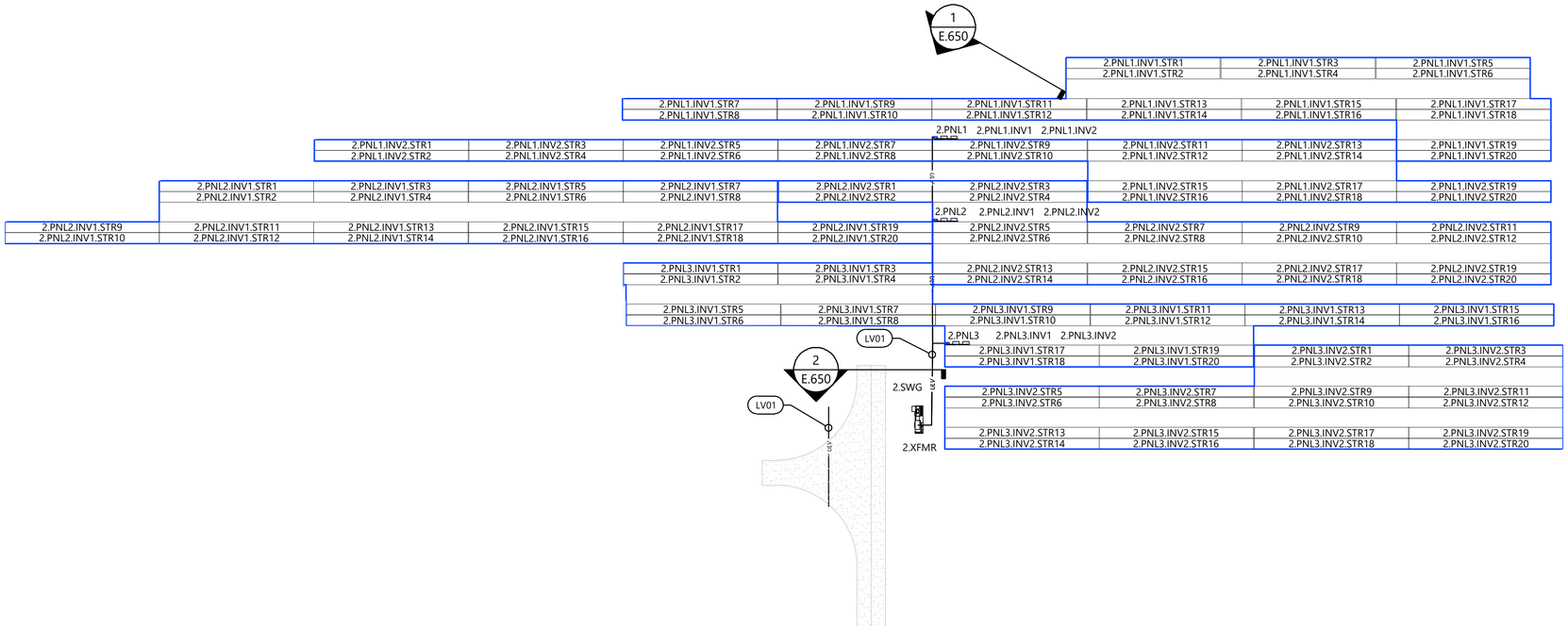
2. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
3. REFER TO SHEETS E.210 FOR LVAC SINGLE LINE DIAGRAM.
3. REFER TO SHEETS E.220 FOR DC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.810 FOR LVAC SCHEDULES.
5. REFER TO SHEET E.820-E.822 FOR DC SCHEDULES.
6. REFER TO SHEET E.650 FOR TRENCH DETAILS.



1 DC and LVAC Site Plan Block 2

1" = 40'

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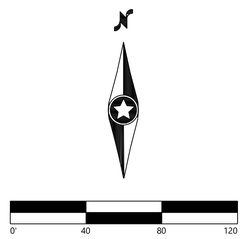


Voluntown Solar

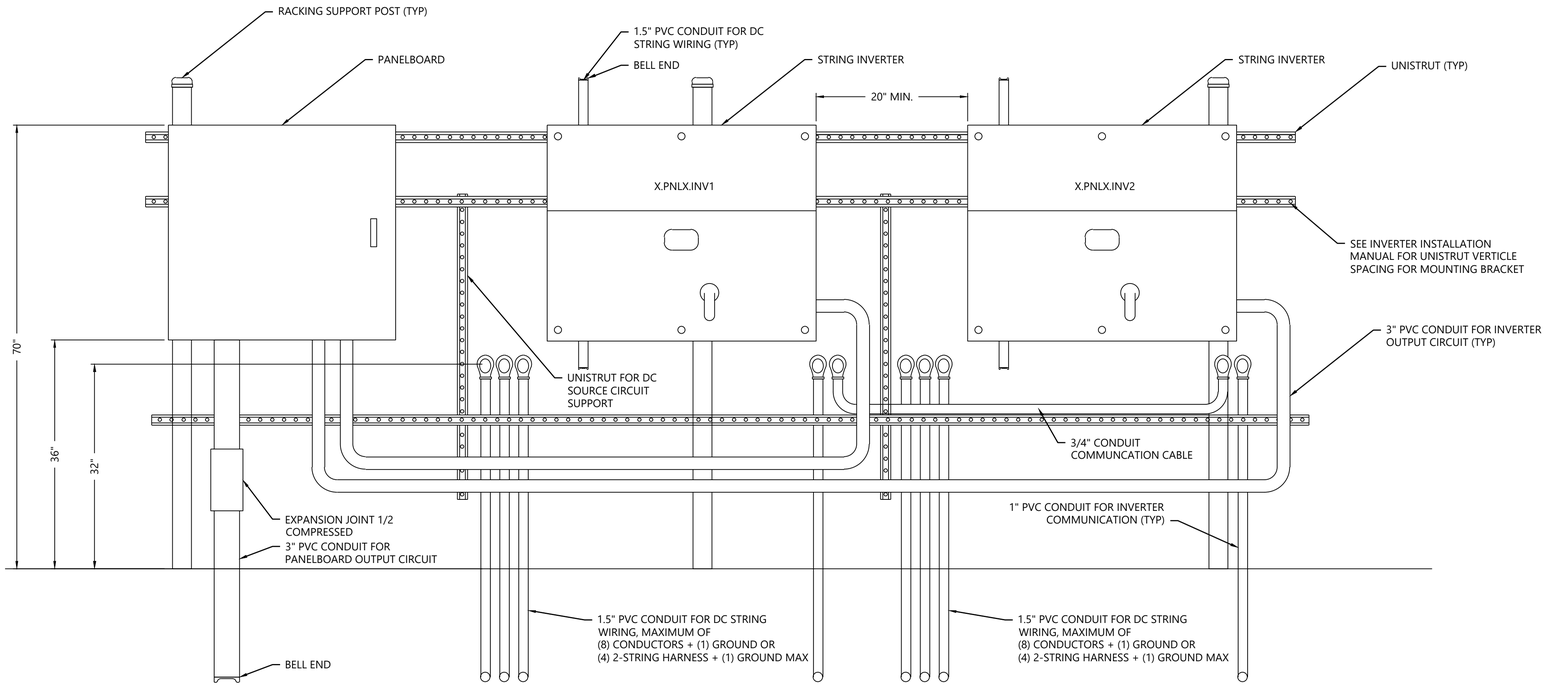
New London County, CT

DC and LVAC Site Plan Block 2

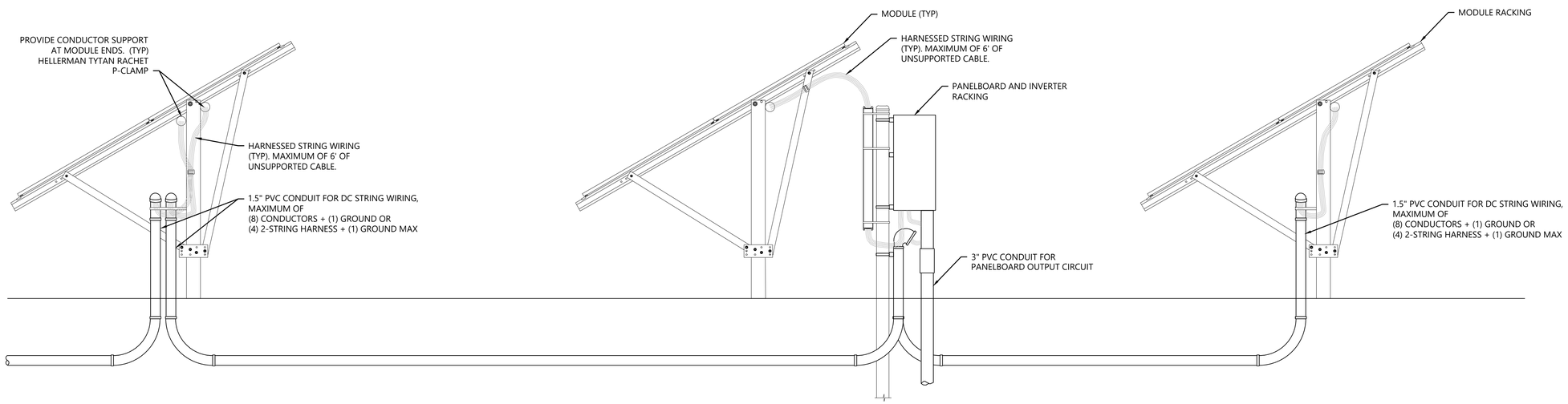
FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.401



1 Typical Inverter and Panelboard Elevation
NTS



2 Typical Inverter, Panelboard, and Module Racking Detail
NTS

NOTES:

1. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
2. REFER TO SHEETS E.210 FOR LVAC SINGLE LINE DIAGRAM.
3. REFER TO SHEETS E.220 FOR DC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.810 FOR LVAC SCHEDULES.
5. REFER TO SHEET E.820-E.822 FOR DC SCHEDULES.
6. REFER TO SHEET E.650 FOR TRENCH DETAILS.
7. ELECTRICAL EQUIPMENT BOTTOMS TO BE MOUNTED 1' ABOVE 100 YEAR FLOOD DEPTH.
8. ALL BELOW GRADE CONDUITS SHALL BE SHC 40 PVC. ALL ABOVE GRADE CONDUITS SHALL BE SHC 80 PVC.
9. PROVIDE PVC EXPANSION JOINTS FOR CONDUITS TERMINATING IN ENCLOSURES.
10. PROVIDE OPTIONAL INVERTER AC OUTPUT PLATE FOR CONDUIT FORMAT. SEE INVERTER MANUAL FOR PART #.
11. REFER TO STRUCTURAL PLANS FOR SIZE AND EMEDMENT REQUIREMENTS FOR RACKING SUPPORT POSTS.
12. CONTRACTOR TO CONFIRM LOCATION OF UNISTRUT TO COORDINATE WITH INVERTER MOUNTING RACK.
13. LOW VOLTAGE AC CONDUIT TO BE BURIED 18". CONDUCTOR TURN RADIUS IN TRENCH TO BE 8" MINIMUM.
14. INVERTER AND PANELBOARD RACKING POLES SPEC, POLE SPACING AND BURIAL DEPTH TO BE PROVIDED BY STRUCTURAL DESIGN ENGINEER.

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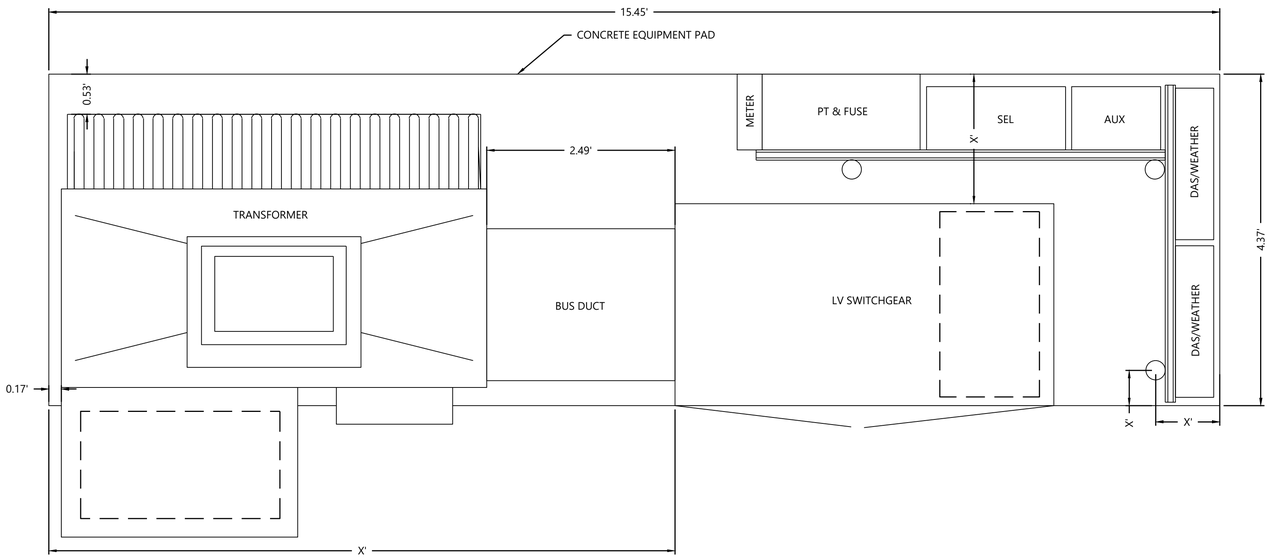
Voluntown Solar
New London County, CT

Electrical Details

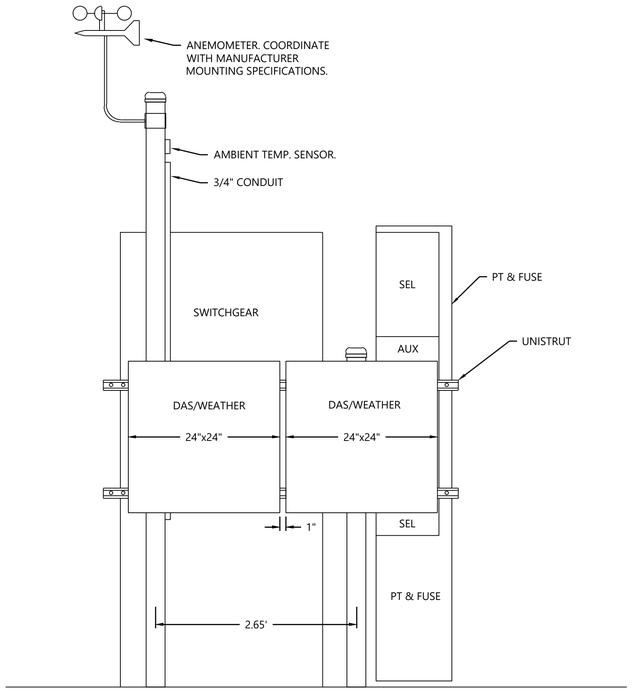
FOR CONSTRUCTION

DATE: 06/07/2019

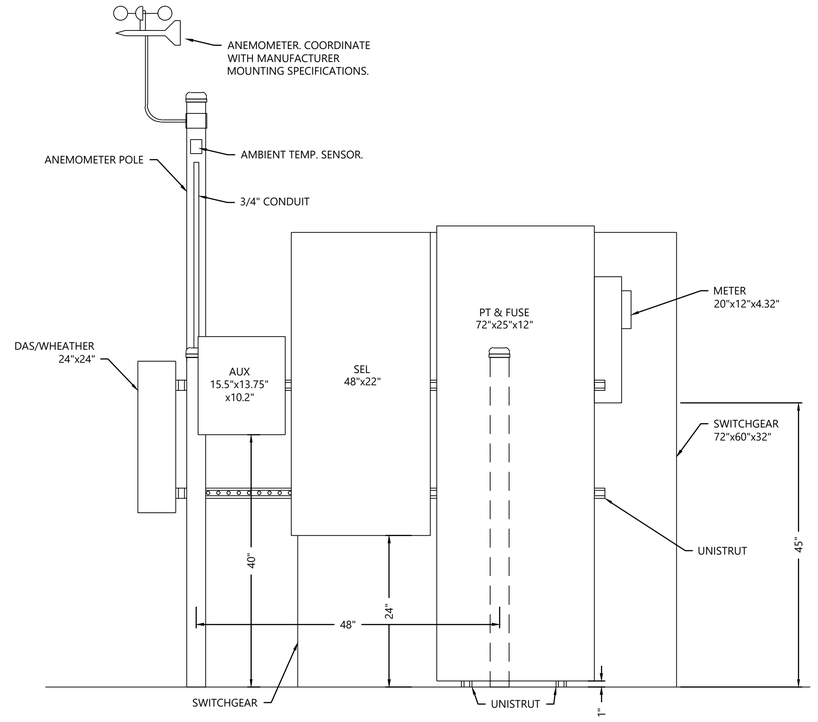
SHEET: E.450



1 Equipment Pad Layout
NTS



2 Equipment Racking Elevation
NTS



3 Equipment Racking Elevation
NTS

NOTES:

1. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
2. REFER TO SHEETS E.210 FOR LVAC SINGLE LINE DIAGRAM.
3. REFER TO SHEETS E.220 FOR DC SINGLE LINE DIAGRAM.
4. REFER TO SHEET E.810 FOR LVAC SCHEDULES.
5. REFER TO SHEET E.820-E.822 FOR DC SCHEDULES.
6. REFER TO SHEET E.650 FOR TRENCH DETAILS.
7. ELECTRICAL EQUIPMENT BOTTOMS TO BE MOUNTED 1' ABOVE 100 YEAR FLOOD DEPTH.
8. ALL BELOW GRADE CONDUITS SHALL BE SHC 40 PVC. ALL ABOVE GRADE CONDUITS SHALL BE SHC 80 PVC.
9. PROVIDE PVC EXPANSION JOINTS FOR CONDUITS TERMINATING IN ENCLOSURES.
10. WIRE SEL PT & CT TO SEL751 BOX.
11. SEE STRUCTURAL DETAILS FOR EQUIPMENT MOUNTING POLE QUANTITY, SIZE AND FOOTING.
12. CONDUIT LOCATIONS ARE APPROXIMATE. CONFIRM ALL CONDUIT LOCATIONS AND COORDINATE WITH EQUIPMENT SPECIFICATIONS.
13. ANEMOMETER/AMBIENT TEMP RACKING ELEVATION TO BE 24" ABOVE TALLEST EQUIPMENT.
14. DAS/WEATHER ENCLOSURE/SEL/PT/METER ENCLOSURES TO HAVE MINIMUM 30" WORKING CLEARANCE.
15. ALL MOUNTED EQUIPMENT EXCEPT FOR THE PT/FUSE BOX SHALL BE NO LESS THAN 24" FROM CONCRETE PAD SURFACE TO BOTTOM OF BOX.

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Voluntown Solar
New London County, CT

Electrical Details

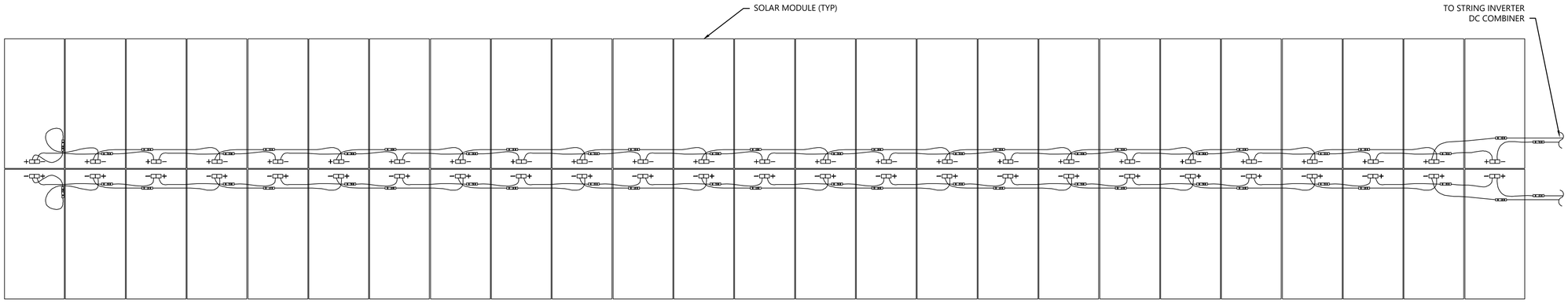
FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.451

NOTES:

1. REFER TO SHEETS E.220 FOR DC SINGLE LINE DIAGRAM.
2. REFER TO SHEETS E.400-E.401 FOR DC SITE PLANS.
3. REFER TO SHEET E.820-E.822 FOR DC SCHEDULES.



1 Typical String Wiring Detail
NTS

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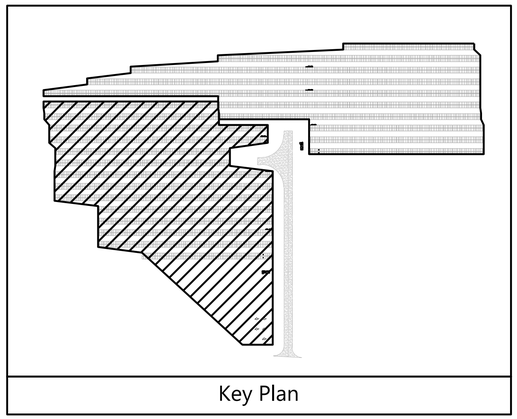
Voluntown Solar
New London County, CT

Electrical Details

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.452



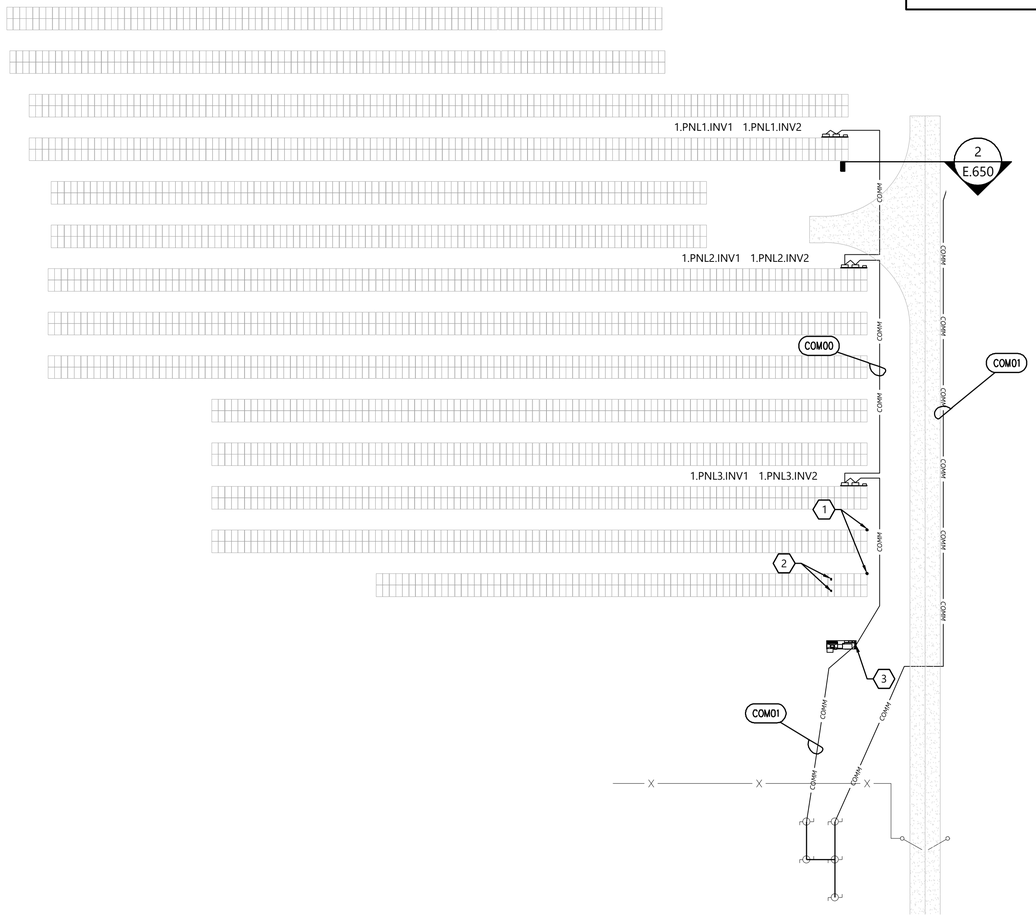
Key Plan

NOTES:

1. REFER TO SHEET E.103 FOR EQUIPMENT LABELING REQUIREMENTS.
2. REFER TO SHEET E.230 FOR COMMUNICATION ONELINES.
3. REFER TO SHEET E.550 FOR COMMUNICATION EQUIPMENT MOUNTING DETAILS.
4. REFER TO SHEET E.650 FOR TRENCH DETAILS.

KEY NOTES:

1. TWO POA PYRANOMETERS
2. TWO BACK OF MODULE TEMP. SENSORS
3. ANEMOMETER AND AMBIENT TEMP SENSOR LOCATED AT EQUIPMENT PAD.



WIRING SCHEDULE

WIRING ID	NOTES
COM00	RS-485, 1" PVC CONDUIT
COM01	SPEC BY NOR-CAL

1 Communication Site Plan Block 1
1" = 40'

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Voluntown Solar
New London County, CT

Communication Site Plan Block 1

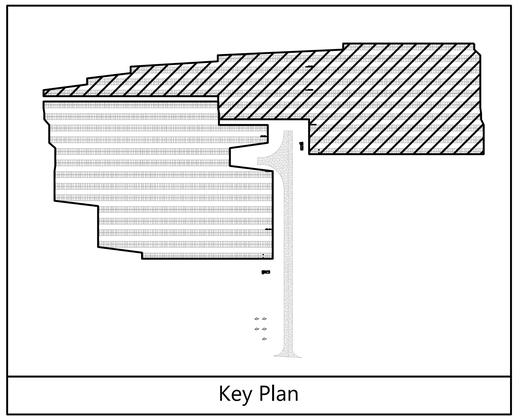
FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.500

WIRING SCHEDULE

WIRING ID	NOTES
COM00	RS-485, 1" PVC CONDUIT
COM01	SPEC BY NOR-CAL



Key Plan

NOTES:

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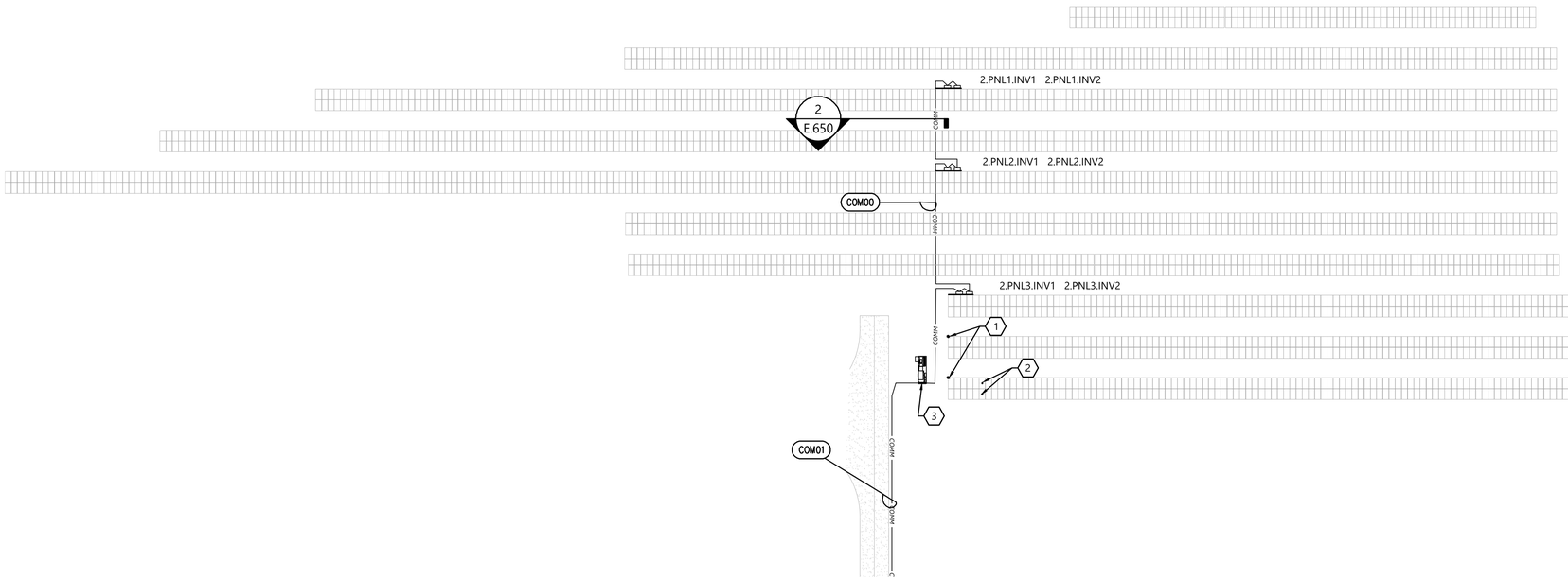
2. REFER TO SHEET E.230 FOR COMMUNICATION ONELINES.
3. REFER TO SHEET E.550 FOR COMMUNICATION EQUIPMENT MOUNTING DETAILS.
4. REFER TO SHEET E.650 FOR TRENCH DETAILS.

KEY NOTES:

1. TWO POA PYRANOMETERS
2. TWO BACK OF MODULE TEMP. SENSORS
3. ANEMOMETER AND AMBIENT TEMP SENSOR LOCATED AT EQUIPMENT PAD.



1 Communication Site Plan Block 2
1" = 40'

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Voluntown Solar

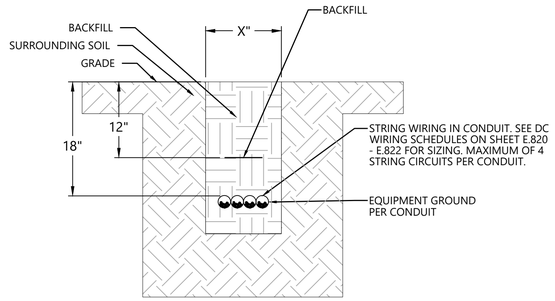
New London County, CT

Communication Site Plan Block 2

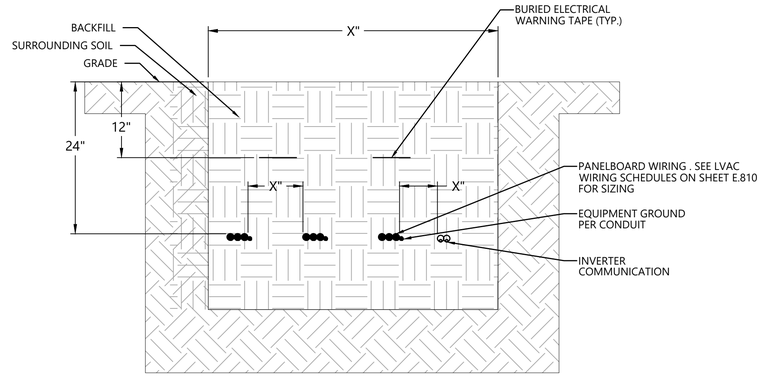
FOR CONSTRUCTION

DATE: 06/07/2019

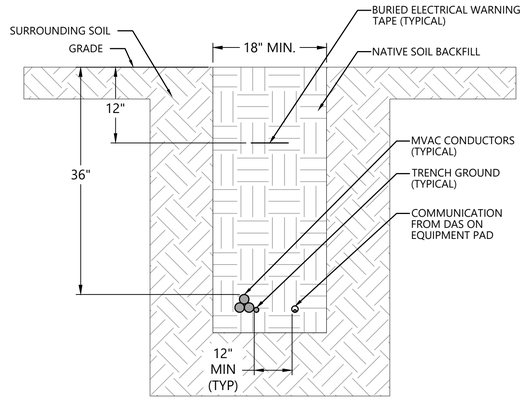
SHEET: E.501



1 Typical String Wiring Trench Detail
NTS



2 Inverter Panelboard Trench Detail
NTS



3 Typical MVAC Trench
NTS

NOTES:

1. COORDINATE WITH MVAC SCHEDULES ON SHEET E.800, LVAC SCHEDULES ON SHEET E.810, AND DC SCHEDULES AND E.820 - E.822.
2. REFER TO SHEET E.300 FOR MVAC SITE PLAN.
3. REFER TO SHEET E.400 AND E.401 FOR LVAC AND DC SITE PLANS.
4. INVERTER COMMUNICATIONS UNSPLICED.

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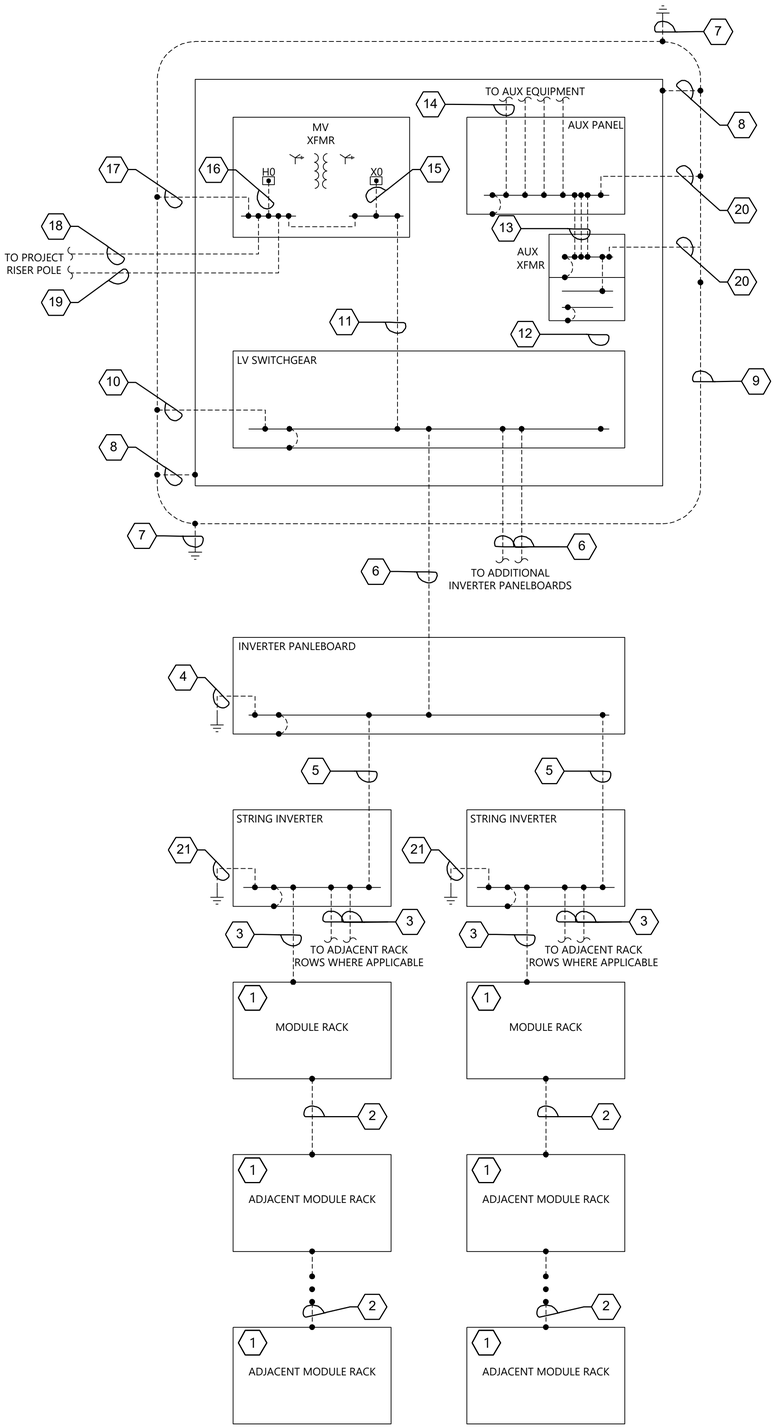
Voluntown Solar
New London County, CT

Trench Details

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.650



NOTES:

1. COORDINATE WITH MVAC SCHEDULES ON SHEET E.800, LVAC SCHEDULES ON SHEET E.810, AND DC SCHEDULES AND E.820 - E.822.
2. REFER TO SHEET E.300 FOR MVAC SITE PLAN.
3. REFER TO SHEET E.400 AND E.401 FOR LVAC AND DC SITE PLANS.
4. COORDINATE WITH ELECTRICAL EQUIPMENT MANUFACTURER SPECIFICATIONS FOR MORE DETAILS ON DEVICE GROUNDING.

KEY NOTES:

1. MODULES ARE APPROVED FOR BONDING AND GROUNDING WITH LISTED CLAMPS.
2. #6 AWG COPPER BONDING JUMPER CONNECTING ADJACENT RACKING. SEE DETAIL 3 OF SHEET E.701 FOR MORE DETAIL.
3. #6 AWG COPPER EQUIPMENT GROUND CONDUCTOR FROM MODULE RACKS TO INVERTER GROUND BUS. GROUND CONDUCTOR INSTALLED IN CONDUIT WITH MODULE DC STRING WIRING.
4. #2 AWG COPPER GROUND ELECTRODE CONDUCTOR BONDED TO EQUIPMENT RACKING SUPPORT POST. RACKING SUPPORT POST TO HAVE MINIMUM 8' EMBEDMENT.
5. #4 AWG COPPER EQUIPMENT GROUND CONDUCTOR ROUTED WITH INVERTER AC OUTPUT CIRCUIT.
6. #4 AWG COPPER EQUIPMENT GROUND CONDUCTOR ROUTED WITH PANELBOARD AC OUTPUT CIRCUIT.
7. 3/4" x 10' COPPER CLAD STEEL GROUND ROD BONDED TO GROUND RING. PLACE A MINIMUM OF 2 GROUND RODS ON DIAGONAL CORNERS OF THE GROUND RING. PLACE ONE GROUND WELL PER EQUIPMENT PAD.
8. 3/0 AWG COPPER BONDING JUMPER FROM GROUND RING TO MINIMUM OF 20' OF UNCOATED REBAR WITHIN THE AC EQUIPMENT PAD.
9. 3/0 KCMIL COPPER GROUND RING SURROUNDING THE AC EQUIPMENT PAD BURIED AT A MINIMUM DEPTH OF 30" AND 24" AWAY FROM CONCRETE EDGE.
10. 3/0 AWG COPPER GROUNDING ELECTRODE CONDUCTOR FROM LVAC SWITCHGEAR TO GROUND RING.
11. 2/0 AWG COPPER EQUIPMENT GROUND CONDUCTOR ROUTED WITH SWITCHGEAR OUTPUT CIRCUIT.
12. #10 AWG COPPER EQUIPMENT GROUND CONDUCTOR ROUTED WITH AUXILIARY TRANSFORMER HIGH SIDE CIRCUIT.
13. #10 AWG COPPER EQUIPMENT GROUND CONDUCTOR ROUTED WITH AUXILIARY TRANSFORMER LOW SIDE CIRCUIT.
14. #12 AWG COPPER EQUIPMENT GROUND CONDUCTOR ROUTED WITH AUXILIARY CIRCUITS.
15. 2/0 AWG COPPER GROUNDING JUMPER FROM XO TERMIANL ON MVAC TRANSFORMER TO LOW VOLTAGE GROUND BUS. CONTRACTOR TO CONFIRM INTERNALLY GROUNDED.
16. #8 AWG COPPER GOUNDING JUMPER FROM HO TERMINAL ON MVAC TRANSFORMER TO HIGH VOLTAGE GROUND BUS. CONTRACTOR TO CONFIRM INTERNALLY GROUNDED
17. 3/0 AWG COPPER GROUNDING ELECTRODE CONDUCTOR FROM MV TRANSFORMER GROUND BUS TO GROUND RING.
18. MVAC CONCENTRIC NEUTRAL.
19. #6 COPPER EQUIPMENT GROUND CONDUCTOR ROUTED FROM MV TRANSFORMER TO POI POLE.
20. #6 AWG COPPER GROUNDING ELECTRODE CONDUCTOR FROM GROUND RING TO EQUIPMENT GROUND BUS.
21. #6 AWG COPPER GROUND ELECTRODE CONDUCTOR BONDED TO EQUIPMENT RACKING SUPPORT POST. RACKING SUPPORT POST TO HAVE MINIMUM 8' EMBEDMENT.

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Voluntown Solar

New London County, CT

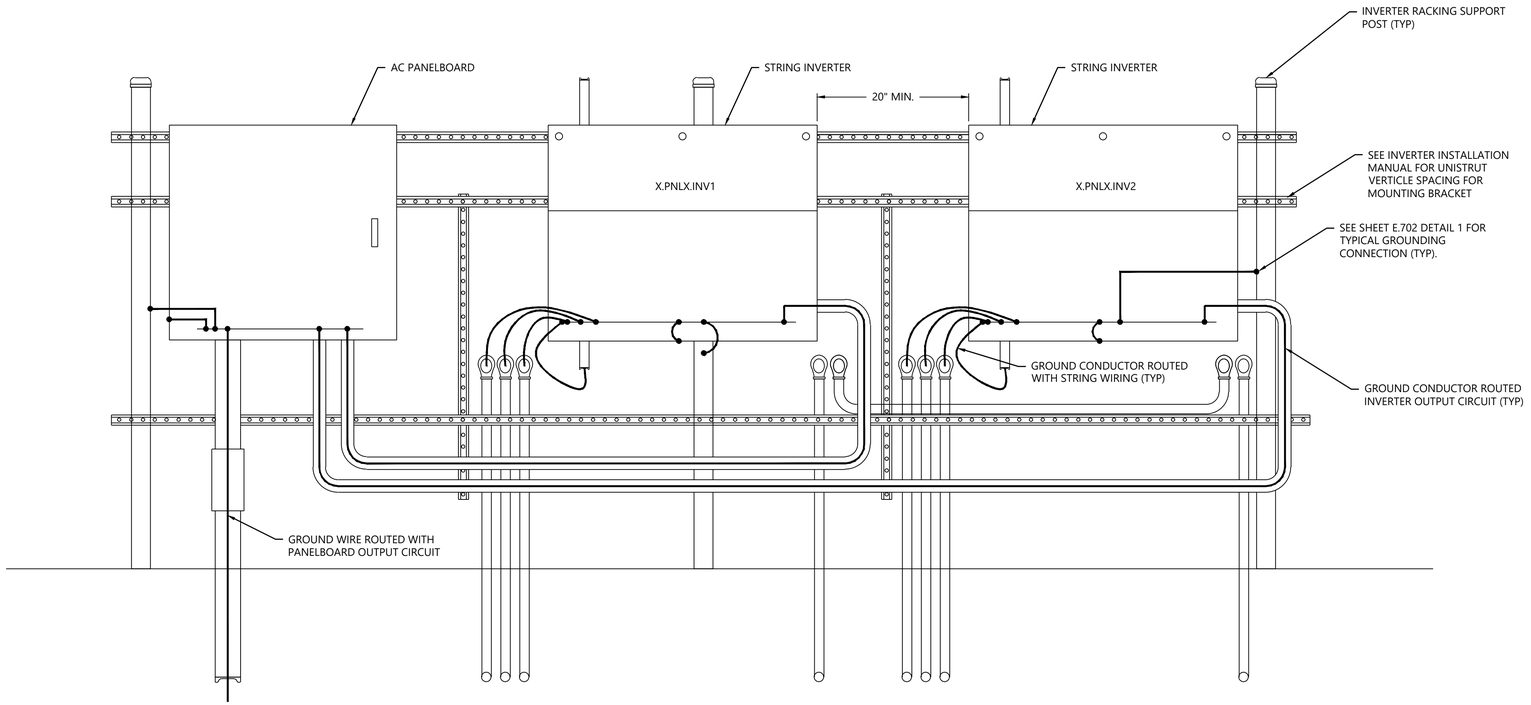
Grounding Diagram

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.700

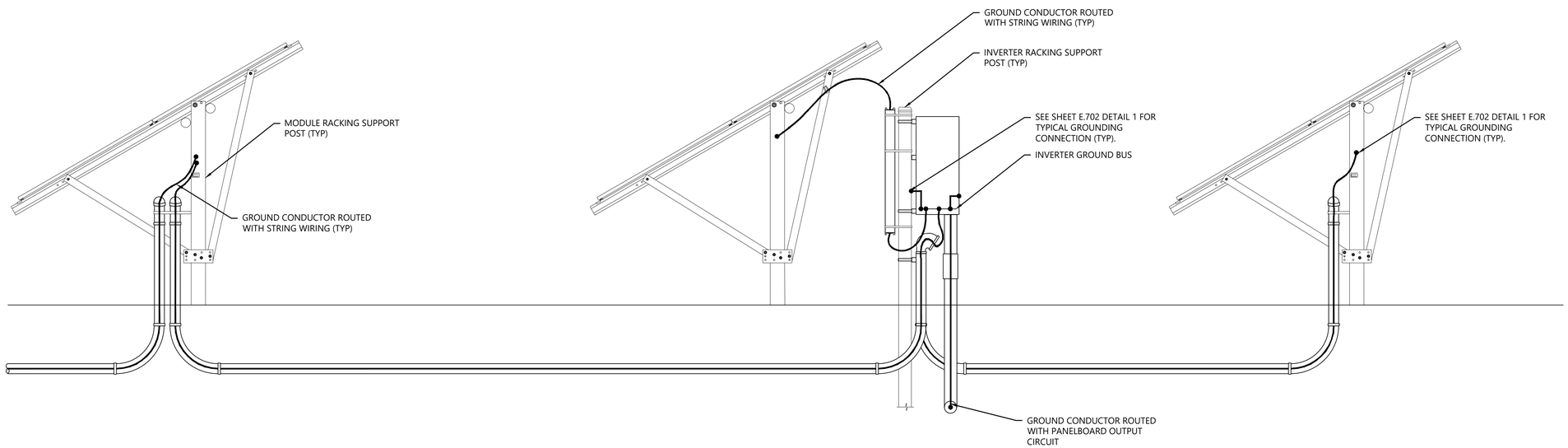
N:\0023366.00\Civil\Electric\d0023366.E.700 Grounding.dwg 6/7/2019 10:03 AM Marcus Wiesner



1 Typical Inverter and Panelboard Elevation
NTS

NOTES:

1. COORDINATE WITH MVAC SCHEDULES ON SHEET E.800, LVAC SCHEDULES ON SHEET E.810, AND DC SCHEDULES AND E.820 - E.822.
2. REFER TO SHEET E.300 FOR MVAC SITE PLAN.
3. REFER TO SHEET E.400 AND E.401 FOR LVAC AND DC SITE PLANS.
4. COORDINATE WITH ELECTRICAL EQUIPMENT MANUFACTURER SPECIFICATIONS FOR MORE DETAILS ON DEVICE GROUNDING.



2 Typical Inverter, Panelboard, and Module Racking Detail
NTS

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ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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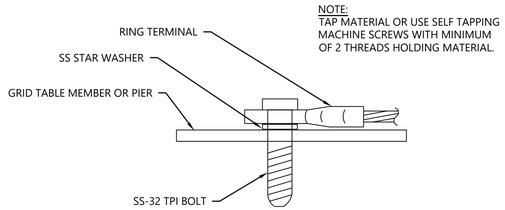
Voluntown Solar
New London County, CT

Grounding Details

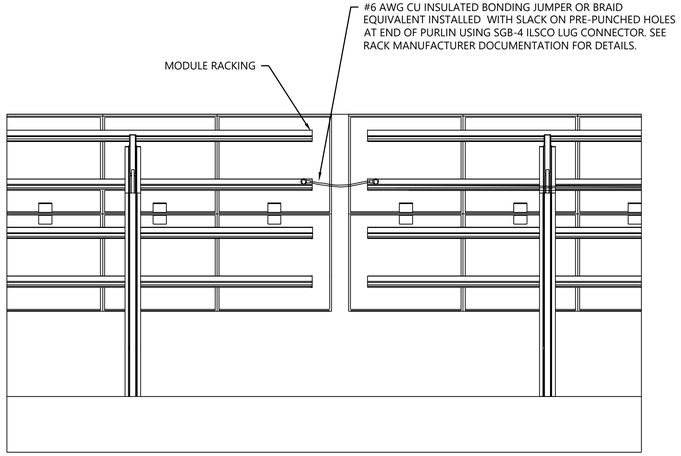
FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.701



1 Grounding Ring Terminal Detail
NTS



2 Adjacent Rack Grounding Detail
NTS

NOTES:
1. COORDINATE WITH MVAC SCHEDULES ON SHEET E.800, LVAC SCHEDULES ON SHEET E.810, AND DC SCHEDULES AND E.820 - E.822.
2. REFER TO SHEET E.300 FOR MVAC SITE PLAN.
3. REFER TO SHEET E.400 AND E.401 FOR LVAC AND DC SITE PLANS.
4. COORDINATE WITH ELECTRICAL EQUIPMENT MANUFACTURER SPECIFICATIONS FOR MORE DETAILS ON DEVICE GROUNDING.

Westwood

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12701 Whitewater Drive, Suite #300
Minnetonka, MN 55343
westwoodps.com
Westwood Professional Services, Inc.

PREPARED FOR:

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Voluntown Solar
New London County, CT

Grounding Details

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.702

MVAC WIRING SCHEDULE

CONDUCTOR LOCATION CODE	ORIGINATING EQUIPMENT	TERMINATING EQUIPMENT	RATED Vac (kV)	END OF CABLE Vac (kV)	Iac (A)	LENGTH (FT)	CONDUCTOR SIZE	CONDUCTOR MATERIAL	# OF PARALLEL CONDUCTORS	VOLTAGE DROP %	GROUND CONDUCTOR SIZE	GROUND CONDUCTOR MATERIAL	DRAWING REFERENCE	CONDUCTOR SPECIFICS	NOTES
OVHD00	METER.POLE.1	DISC.POLE.1	23	23.000	25.10	30		ACSR	1	0.0014	1#6 AWG	Copper	E.200	ACSR Turkey Overhead Conductor	
MV00	DISC.POLE.1	1.XFMR	23	22.999	25.10	140	3#1/0 AWG	AL	1	0.0050	1#6 AWG	Copper	E.200	25KV, 1/C, Trefoil, 100% Insulation, Type MV-90, Full CN	
OVHD00	METER.POLE.2	DISC.POLE.2	23	23.000	25.10	30		ACSR	1	0.0014	1#6 AWG	Copper	E.200	ACSR Turkey Overhead Conductor	
MV00	DISC.POLE.2	2.XFMR	23	22.996	25.10	430	3#1/0 AWG	AL	1	0.0154	1#6 AWG	Copper	E.200	25KV, 1/C, Trefoil, 100% Insulation, Type MV-90, Full CN	

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Voluntown Solar
New London County, CT

MVAC Schedule

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.800

LVAC WIRING SCHEDULE														
CONDUCTOR LOCATION CODE	ORIGINATING EQUIPMENT	TERMINATING EQUIPMENT	Rated Vac (kV)	End of Cable Vac (kV)	Iac (A)	LENGTH (FT)	CONDUCTOR SIZE	CONDUCTOR MATERIAL	# OF PARALLEL CONDUCTORS	VOLTAGE DROP %	GROUND CONDUCTOR SIZE	GROUND CONDUCTOR MATERIAL	DRAWING REFERENCE	CONDUCTOR SPECIFICS
LV01	1.SWG	1.PNL1	800	792.313	240.32	324	3#500 KCMIL	AL	1	0.9609	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV01	1.SWG	1.PNL2	800	794.187	240.32	245	3#500 KCMIL	AL	1	0.7266	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV01	1.SWG	1.PNL3	800	796.916	240.32	130	3#500 KCMIL	AL	1	0.3856	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	1.PNL1	1.PNL1.INV1	800	791.965	120.16	15	3#4/0 AWG	AL	1	0.0438	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	1.PNL1	1.PNL1.INV2	800	791.850	120.16	20	3#4/0 AWG	AL	1	0.0585	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	1.PNL2	1.PNL2.INV1	800	793.840	120.16	15	3#4/0 AWG	AL	1	0.0436	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	1.PNL2	1.PNL2.INV2	800	793.725	120.16	20	3#4/0 AWG	AL	1	0.0582	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	1.PNL3	1.PNL3.INV1	800	796.570	120.16	15	3#4/0 AWG	AL	1	0.0433	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	1.PNL3	1.PNL3.INV2	800	796.455	120.16	20	3#4/0 AWG	AL	1	0.0578	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C

LVAC WIRING SCHEDULE														
CONDUCTOR LOCATION CODE	ORIGINATING EQUIPMENT	TERMINATING EQUIPMENT	Rated Vac (kV)	End of Cable Vac (kV)	Iac (A)	LENGTH (FT)	CONDUCTOR SIZE	CONDUCTOR MATERIAL	# OF PARALLEL CONDUCTORS	VOLTAGE DROP %	GROUND CONDUCTOR SIZE	GROUND CONDUCTOR MATERIAL	DRAWING REFERENCE	CONDUCTOR SPECIFICS
LV01	2.SWG	2.PNL1	800	795.255	240.32	200	3#500 KCMIL	AL	1	0.5932	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV01	2.SWG	2.PNL2	800	796.678	240.32	140	3#500 KCMIL	AL	1	0.4152	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV01	2.SWG	2.PNL3	800	798.102	240.32	80	3#500 KCMIL	AL	1	0.2373	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	2.PNL1	2.PNL1.INV1	800	794.909	120.16	15	3#4/0 AWG	AL	1	0.0435	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	2.PNL1	2.PNL1.INV2	800	794.793	120.16	20	3#4/0 AWG	AL	1	0.0580	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	2.PNL2	2.PNL2.INV1	800	796.333	120.16	15	3#4/0 AWG	AL	1	0.0434	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	2.PNL2	2.PNL2.INV2	800	796.218	120.16	20	3#4/0 AWG	AL	1	0.0578	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	2.PNL3	2.PNL3.INV1	800	797.757	120.16	15	3#4/0 AWG	AL	1	0.0432	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C
LV00	2.PNL3	2.PNL3.INV2	800	797.642	120.16	20	3#4/0 AWG	AL	1	0.0576	1#4 AWG	CU	E.200	1000V, 1/C, XHHW-2 75°C

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ecos ENERGY

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C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

New London County, CT

LVAC Schedule

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.810

DC Level 1: String Wire Collection to String Inverter: 1.PNL1.INV1

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	1.PNL1.INV1.STR1	1.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	437	1.0857	1.0857
2	1.PNL1.INV1.STR2	1.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	437	1.0857	1.0857
3	1.PNL1.INV1.STR3	1.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	348	0.8650	0.8650
4	1.PNL1.INV1.STR4	1.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	348	0.8650	0.8650
5	1.PNL1.INV1.STR5/6	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	260	0.8117	0.8117
6	1.PNL1.INV1.STR7/8	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	170	0.5316	0.5316
7	1.PNL1.INV1.STR9/10	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	413	1.2892	1.2892
8	1.PNL1.INV1.STR11/12	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	325	1.0154	1.0154
9	1.PNL1.INV1.STR13/14	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	238	0.7417	0.7417
10	1.PNL1.INV1.STR15/16	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	148	0.4616	0.4616
11	1.PNL1.INV1.STR17/18	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	379	1.1841	1.1841
12	1.PNL1.INV1.STR19/20	1.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	292	0.9104	0.9104
																			Average Voltage Drop %:	0.8896	0.8896

DC Level 1: String Wire Collection to String Inverter: 1.PNL1.INV2

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	1.PNL1.INV2.STR1	1.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	200	0.4972	0.4972
2	1.PNL1.INV2.STR2	1.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	200	0.4972	0.4972
3	1.PNL1.INV2.STR3	1.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	113	0.2816	0.2816
4	1.PNL1.INV2.STR4	1.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	113	0.2816	0.2816
5	1.PNL1.INV2.STR5/6	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	44	0.1369	0.1369
6	1.PNL1.INV2.STR7/8	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	384	1.1969	1.1969
7	1.PNL1.INV2.STR9/10	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	296	0.9231	0.9231
8	1.PNL1.INV2.STR11/12	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	206	0.6430	0.6430
9	1.PNL1.INV2.STR13/14	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	119	0.3724	0.3724
10	1.PNL1.INV2.STR15/16	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	28	0.0859	0.0859
11	1.PNL1.INV2.STR17/18	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	353	1.1014	1.1014
12	1.PNL1.INV2.STR19/20	1.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	264	0.8244	0.8244
																			Average Voltage Drop %:	0.6063	0.6063

DC Level 1: String Wire Collection to String Inverter: 1.PNL2.INV1

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	1.PNL2.INV1.STR1	1.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	196	0.4870	0.4870
2	1.PNL2.INV1.STR2	1.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	196	0.4870	0.4870
3	1.PNL2.INV1.STR3	1.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	108	0.2689	0.2689
4	1.PNL2.INV1.STR4	1.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	108	0.2689	0.2689
5	1.PNL2.INV1.STR5/6	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	364	1.1364	1.1364
6	1.PNL2.INV1.STR7/8	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	276	0.8626	0.8626
7	1.PNL2.INV1.STR9/10	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	187	0.5825	0.5825
8	1.PNL2.INV1.STR11/12	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	100	0.3119	0.3119
9	1.PNL2.INV1.STR13/14	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	378	1.1809	1.1809
10	1.PNL2.INV1.STR15/16	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	291	0.9072	0.9072
11	1.PNL2.INV1.STR17/18	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	201	0.6271	0.6271
12	1.PNL2.INV1.STR19/20	1.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	112	0.3501	0.3501
																			Average Voltage Drop %:	0.6715	0.6715

DC Level 1: String Wire Collection to String Inverter: 1.PNL2.INV2

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	1.PNL2.INV2.STR1	1.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	30	0.0736	0.0736
2	1.PNL2.INV2.STR2	1.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	30	0.0736	0.0736
3	1.PNL2.INV2.STR3	1.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	402	0.9995	0.9995
4	1.PNL2.INV2.STR4	1.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	402	0.9995	0.9995
5	1.PNL2.INV2.STR5/6	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	313	0.9772	0.9772
6	1.PNL2.INV2.STR7/8	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	224	0.7003	0.7003
7	1.PNL2.INV2.STR9/10	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	136	0.4234	0.4234
8	1.PNL2.INV2.STR11/12	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	46	0.1432	0.1432
9	1.PNL2.INV2.STR13/14	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	425	1.3274	1.3274
10	1.PNL2.INV2.STR15/16	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	338	1.0536	1.0536
11	1.PNL2.INV2.STR17/18	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	250	0.7799	0.7799
12	1.PNL2.INV2.STR19/20	1.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	161	0.5029	0.5029
																			Average Voltage Drop %:	0.6981	0.6981

NOTES:

1. DISTANCES SHOWN ARE APPROXIMATE FOR VOLTAGE DROP CALCULATION PURPOSES. CONTRACTOR SHALL FIELD-VERIFY LENGTH OF CONDUCTORS REQUIRED TO MAKE CONNECTIONS.
2. REFER TO DC SITE PLANS FOR CONDUIT AND WIRING ROUTING.
3. CABLES ARE SIZED PER NEC 690.8(B).
4. FUSES ARE SIZED USING Isc*1.25*1.25 PER NEC 690.9(B) & 220.5(B).
5. AMBIENT GROUND TEMPERATURE IS ASSUMED 27°C AT BURIAL DEPTH.
6. CONDUCTOR TEMPERATURE IS ASSUMED 85°C BASED ON SOFTWARE SIMULATION.
7. AMBIENT AIR TEMPERATURE IS ASSUMED X°C.

CALCULATIONS:

1. FORMULA USED FOR VOLTAGE DROP CALCULATION:

   $$VD = \frac{2 * K * Imp * D}{N * 1000}$$

   WHERE:

   VD = VOLTAGE DROP

   K = TEMPERATURE CORRECTED WIRE RESISTANCE

   Imp = MAXIMUM POWER POINT CURRENT

   D = ONE WAY LENGTH OF CIRCUIT SEGMENT (FT)

   N = NUMBER OF PARALLEL CONDUCTORS

2. FORMULA USED FOR WIRE RESISTANCE CALCULATION:

   $K = R1 * [1 + \alpha * (T2 - 75°C)$

   WHERE

   K = TEMPERATURE CORRECTED WIRE RESISTANCE

   R1 = WIRE RESISTANCE (NEC TABLE 8, OHM/KFT)

   T2 = CABLE TEMPERATURE (°C)

   WHERE

   α = 0.00323 FOR COPPER

   α = 0.00330 FOR ALUMINUM

3. MAXIMUM STRING VOLTAGE CALCULATION (PER NEC 690.7):

   $Vmax = Vmod * N * [1 + (25°C - TL) * (\beta/100)]$

   WHERE

   Vmax = MAXIMUM STRING VOLTAGE (V)

   Vmod = MODULE OPEN CIRCUIT VOLTAGE AT STC (V)

   N = NUMBER OF MODULES PER STRING

   TL = MINIMUM EXPECTED SITE TEMPERATURE (°C)

   β = TEMPERATURE COEFFICIENT OF Voc (%/°C)

4. WEIGHTED VOLTAGE DROP CALCULATION:

   $$Vt = \sum_{i=0}^{n}(Xi * VDi) \;/\; \sum_{i=0}^{n}(Xi)$$

   WHERE

   Vt = TOTAL WEIGHTED VOLTAGE DROP (V)

   X = NUMBER OF STRINGS PER CIRCUIT

   VD = VOLTAGE DROP (V)

   n = TOTAL NUMBER OF CIRCUITS IN SUMMATION

   i = EACH CIRCUIT CONNECTED TO COMMON POINT

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Westwood Professional Services, Inc.

PREPARED FOR:

ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

New London County, CT

DC Schedules

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.820

DC Level 1: String Wire Collection to String Inverter: 1.PNL3.INV1

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	1.PNL3.INV1.STR1	1.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	83	0.2055	0.2055
2	1.PNL3.INV1.STR2	1.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	83	0.2055	0.2055
3	1.PNL3.INV1.STR3	1.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	322	0.8016	0.8016
4	1.PNL3.INV1.STR4	1.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	322	0.8016	0.8016
5	1.PNL3.INV1.STR5/6	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	234	0.7289	0.7289
6	1.PNL3.INV1.STR7/8	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	145	0.4520	0.4520
7	1.PNL3.INV1.STR9/10	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	59	0.1846	0.1846
8	1.PNL3.INV1.STR11/12	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	299	0.9327	0.9327
9	1.PNL3.INV1.STR13/14	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	210	0.6557	0.6557
10	1.PNL3.INV1.STR15/16	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	122	0.3820	0.3820
11	1.PNL3.INV1.STR17/18	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	36	0.1114	0.1114
12	1.PNL3.INV1.STR19/20	1.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	293	0.9136	0.9136
																			Average Voltage Drop %:	0.5368	0.5368

DC Level 1: String Wire Collection to String Inverter: 1.PNL3.INV2

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	1.PNL3.INV2.STR1	1.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	208	0.5175	0.5175
2	1.PNL3.INV2.STR2	1.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	208	0.5175	0.5175
3	1.PNL3.INV2.STR3	1.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	119	0.2968	0.2968
4	1.PNL3.INV2.STR4	1.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	119	0.2968	0.2968
5	1.PNL3.INV2.STR5/6	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	29	0.0891	0.0891
6	1.PNL3.INV2.STR7/8	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	320	0.9995	0.9995
7	1.PNL3.INV2.STR9/10	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	232	0.7226	0.7226
8	1.PNL3.INV2.STR11/12	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	144	0.4488	0.4488
9	1.PNL3.INV2.STR13/14	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	51	0.1592	0.1592
10	1.PNL3.INV2.STR15/16	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	255	0.7958	0.7958
11	1.PNL3.INV2.STR17/18	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	167	0.5220	0.5220
12	1.PNL3.INV2.STR19/20	1.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	74	0.2324	0.2324
																			Average Voltage Drop %:	0.4784	0.4784

DC Level 1: String Wire Collection to String Inverter: 2.PNL1.INV1

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	2.PNL1.INV1.STR1	2.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	99	0.2461	0.2461
2	2.PNL1.INV1.STR2	2.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	99	0.2461	0.2461
3	2.PNL1.INV1.STR3	2.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	188	0.4668	0.4668
4	2.PNL1.INV1.STR4	2.PNL1.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	188	0.4668	0.4668
5	2.PNL1.INV1.STR5/6	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	275	0.8594	0.8594
6	2.PNL1.INV1.STR7/8	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	125	0.3915	0.3915
7	2.PNL1.INV1.STR9/10	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	38	0.1178	0.1178
8	2.PNL1.INV1.STR11/12	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	38	0.1178	0.1178
9	2.PNL1.INV1.STR13/14	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	124	0.3883	0.3883
10	2.PNL1.INV1.STR15/16	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	213	0.6653	0.6653
11	2.PNL1.INV1.STR17/18	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	302	0.9422	0.9422
12	2.PNL1.INV1.STR19/20	2.PNL1.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	291	0.9072	0.9072
																			Average Voltage Drop %:	0.5102	0.5102

DC Level 1: String Wire Collection to String Inverter: 2.PNL1.INV2

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	2.PNL1.INV2.STR1	2.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	295	0.7331	0.7331
2	2.PNL1.INV2.STR2	2.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	295	0.7331	0.7331
3	2.PNL1.INV2.STR3	2.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	207	0.5149	0.5149
4	2.PNL1.INV2.STR4	2.PNL1.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	207	0.5149	0.5149
5	2.PNL1.INV2.STR5/6	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	118	0.3692	0.3692
6	2.PNL1.INV2.STR7/8	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	31	0.0955	0.0955
7	2.PNL1.INV2.STR9/10	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	32	0.0987	0.0987
8	2.PNL1.INV2.STR11/12	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	117	0.3661	0.3661
9	2.PNL1.INV2.STR13/14	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	207	0.6462	0.6462
10	2.PNL1.INV2.STR15/16	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	143	0.4456	0.4456
11	2.PNL1.INV2.STR17/18	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	231	0.7194	0.7194
12	2.PNL1.INV2.STR19/20	2.PNL1.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	319	0.9963	0.9963
																			Average Voltage Drop %:	0.4985	0.4985

NOTES:

1. DISTANCES SHOWN ARE APPROXIMATE FOR VOLTAGE DROP CALCULATION PURPOSES. CONTRACTOR SHALL FIELD-VERIFY LENGTH OF CONDUCTORS REQUIRED TO MAKE CONNECTIONS.
2. REFER TO DC SITE PLANS FOR CONDUIT AND WIRING ROUTING.
3. CABLES ARE SIZED PER NEC 690.8(B).
4. FUSES ARE SIZED USING Isc*1.25*1.25 PER NEC 690.9(B) & 220.5(B).
5. AMBIENT GROUND TEMPERATURE IS ASSUMED 27°C AT BURIAL DEPTH.
6. CONDUCTOR TEMPERATURE IS ASSUMED 85°C BASED ON SOFTWARE SIMULATION.
7. AMBIENT AIR TEMPERATURE IS ASSUMED X°C.

CALCULATIONS:

1. FORMULA USED FOR VOLTAGE DROP CALCULATION:

   $$VD = \frac{2 * K * Imp * D}{N * 1000}$$

   WHERE:

   VD = VOLTAGE DROP

   K = TEMPERATURE CORRECTED WIRE RESISTANCE

   Imp = MAXIMUM POWER POINT CURRENT

   D = ONE WAY LENGTH OF CIRCUIT SEGMENT (FT)

   N = NUMBER OF PARALLEL CONDUCTORS

2. FORMULA USED FOR WIRE RESISTANCE CALCULATION:

   $K = R1 * [1 + \alpha * (T2 - 75°C)$

   WHERE

   K = TEMPERATURE CORRECTED WIRE RESISTANCE

   R1 = WIRE RESISTANCE (NEC TABLE 8, OHM/KFT)

   T2 = CABLE TEMPERATURE (°C)

   WHERE

   α = 0.00323 FOR COPPER

   α = 0.00330 FOR ALUMINUM

3. MAXIMUM STRING VOLTAGE CALCULATION (PER NEC 690.7):

   $Vmax = Vmod * N * [1 +(25°C-TL)*(\beta/100)]$

   WHERE

   Vmax = MAXIMUM STRING VOLTAGE (V)

   Vmod = MODULE OPEN CIRCUIT VOLTAGE AT STC (V)

   N = NUMBER OF MODULES PER STRING

   TL = MINIMUM EXPECTED SITE TEMPERATURE (°C)

   β = TEMPERATURE COEFFICIENT OF Voc (%/°C)

4. WEIGHTED VOLTAGE DROP CALCULATION:

   $$Vt = \sum_{i=0}^{n}(Xi * VDi) \;/\; \sum_{i=0}^{n}(Xi)$$

   WHERE

   Vt = TOTAL WEIGHTED VOLTAGE DROP (V)

   X = NUMBER OF STRINGS PER CIRCUIT

   VD = VOLTAGE DROP (V)

   n = TOTAL NUMBER OF CIRCUITS IN SUMMATION

   i = EACH CIRCUIT CONNECTED TO COMMON POINT

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Westwood Professional Services, Inc.

PREPARED FOR:

ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

New London County, CT

DC Schedules

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.821

DC Level 1: String Wire Collection to String Inverter: 2.PNL2.INV1

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	2.PNL2.INV1.STR1	2.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	390	0.9690	0.9690
2	2.PNL2.INV1.STR2	2.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	390	0.9690	0.9690
3	2.PNL2.INV1.STR3	2.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	302	0.7509	0.7509
4	2.PNL2.INV1.STR4	2.PNL2.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	302	0.7509	0.7509
5	2.PNL2.INV1.STR5/6	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	212	0.6621	0.6621
6	2.PNL2.INV1.STR7/8	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	124	0.3883	0.3883
7	2.PNL2.INV1.STR9/10	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	468	1.4611	1.4611
8	2.PNL2.INV1.STR11/12	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	380	1.1873	1.1873
9	2.PNL2.INV1.STR13/14	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	293	0.9136	0.9136
10	2.PNL2.INV1.STR15/16	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	204	0.6366	0.6366
11	2.PNL2.INV1.STR17/18	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	116	0.3629	0.3629
12	2.PNL2.INV1.STR19/20	2.PNL2.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	30	0.0923	0.0923
																			Average Voltage Drop %:	0.7424	0.7424

DC Level 1: String Wire Collection to String Inverter: 2.PNL2.INV2

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	2.PNL2.INV2.STR1	2.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	39	0.0964	0.0964
2	2.PNL2.INV2.STR2	2.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	39	0.0964	0.0964
3	2.PNL2.INV2.STR3	2.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	40	0.0989	0.0989
4	2.PNL2.INV2.STR4	2.PNL2.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	40	0.0989	0.0989
5	2.PNL2.INV2.STR5/6	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	28	0.0859	0.0859
6	2.PNL2.INV2.STR7/8	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	119	0.3724	0.3724
7	2.PNL2.INV2.STR9/10	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	208	0.6494	0.6494
8	2.PNL2.INV2.STR11/12	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	295	0.9199	0.9199
9	2.PNL2.INV2.STR13/14	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	51	0.1592	0.1592
10	2.PNL2.INV2.STR15/16	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	137	0.4265	0.4265
11	2.PNL2.INV2.STR17/18	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	224	0.7003	0.7003
12	2.PNL2.INV2.STR19/20	2.PNL2.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	313	0.9772	0.9772
																			Average Voltage Drop %:	0.4486	0.4486

DC Level 1: String Wire Collection to String Inverter: 2.PNL3.INV1

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	2.PNL3.INV1.STR1	2.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	150	0.3729	0.3729
2	2.PNL3.INV1.STR2	2.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	150	0.3729	0.3729
3	2.PNL3.INV1.STR3	2.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	65	0.1623	0.1623
4	2.PNL3.INV1.STR4	2.PNL3.INV1	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	65	0.1623	0.1623
5	2.PNL3.INV1.STR5/6	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	130	0.4043	0.4043
6	2.PNL3.INV1.STR7/8	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	40	0.1241	0.1241
7	2.PNL3.INV1.STR9/10	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	43	0.1337	0.1337
8	2.PNL3.INV1.STR11/12	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	130	0.4043	0.4043
9	2.PNL3.INV1.STR13/14	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	217	0.6780	0.6780
10	2.PNL3.INV1.STR15/16	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	306	0.9549	0.9549
11	2.PNL3.INV1.STR17/18	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	23	0.0732	0.0732
12	2.PNL3.INV1.STR19/20	2.PNL3.INV1	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	112	0.3501	0.3501
																			Average Voltage Drop %:	0.3658	0.3658

DC Level 1: String Wire Collection to String Inverter: 2.PNL3.INV2

COMBINER BOX INPUT	FROM	TO	MODULE	MODULES PER STRING	STRINGS PER CIRCUIT	Pmp (W)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	MAX. CIRCUIT CURRENT (A)	FUSE SIZE AT COMBINER (A)	CABLE TYPE	CONDUCTOR MATERIAL	CONDUCTOR SIZE	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR MATERIAL	GROUND CONDUCTOR SIZE	TOTAL ONE WAY DISTANCE (FT)	LINE VOLTAGE DROP (%)	TOTAL DC VOLTAGE DROP (%)
1	2.PNL3.INV2.STR1	2.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	209	0.5200	0.5200
2	2.PNL3.INV2.STR2	2.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	209	0.5200	0.5200
3	2.PNL3.INV2.STR3	2.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	298	0.7407	0.7407
4	2.PNL3.INV2.STR4	2.PNL3.INV2	LG LG400N2W-V5 400W	25	1	10000	1232.5	1015	10.47	9.86	13	20	1000V/2000V PV WIRE	CU	10 AWG	1	CU	6 AWG	298	0.7407	0.7407
5	2.PNL3.INV2.STR5/6	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	46	0.1432	0.1432
6	2.PNL3.INV2.STR7/8	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	136	0.4234	0.4234
7	2.PNL3.INV2.STR9/10	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	225	0.7035	0.7035
8	2.PNL3.INV2.STR11/12	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	313	0.9772	0.9772
9	2.PNL3.INV2.STR13/14	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	70	0.2196	0.2196
10	2.PNL3.INV2.STR15/16	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	159	0.4966	0.4966
11	2.PNL3.INV2.STR17/18	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	248	0.7735	0.7735
12	2.PNL3.INV2.STR19/20	2.PNL3.INV2	LG LG400N2W-V5 400W	25	2	20000	1232.5	1015	20.94	19.72	26	35	1000V/2000V PV WIRE	CU	8 AWG	1	CU	6 AWG	337	1.0504	1.0504
																			Average Voltage Drop %:	0.6048	0.6048

NOTES:

1. DISTANCES SHOWN ARE APPROXIMATE FOR VOLTAGE DROP CALCULATION PURPOSES. CONTRACTOR SHALL FIELD-VERIFY LENGTH OF CONDUCTORS REQUIRED TO MAKE CONNECTIONS.
2. REFER TO DC SITE PLANS FOR CONDUIT AND WIRING ROUTING.
3. CABLES ARE SIZED PER NEC 690.8(B).
4. FUSES ARE SIZED USING Isc*1.25*1.25 PER NEC 690.9(B) & 220.5(B).
5. AMBIENT GROUND TEMPERATURE IS ASSUMED 27°C AT BURIAL DEPTH.
6. CONDUCTOR TEMPERATURE IS ASSUMED 85°C BASED ON SOFTWARE SIMULATION.
7. AMBIENT AIR TEMPERATURE IS ASSUMED X°C.

CALCULATIONS:

1. FORMULA USED FOR VOLTAGE DROP CALCULATION:

   $$VD = \frac{2 * K * Imp * D}{N * 1000}$$

   WHERE:

   VD = VOLTAGE DROP

   K = TEMPERATURE CORRECTED WIRE RESISTANCE

   Imp = MAXIMUM POWER POINT CURRENT

   D = ONE WAY LENGTH OF CIRCUIT SEGMENT (FT)

   N = NUMBER OF PARALLEL CONDUCTORS

2. FORMULA USED FOR WIRE RESISTANCE CALCULATION:

   $K = R1 * [1 + \alpha * (T2 - 75°C)$

   WHERE

   K = TEMPERATURE CORRECTED WIRE RESISTANCE

   R1 = WIRE RESISTANCE (NEC TABLE 8, OHM/KFT)

   T2 = CABLE TEMPERATURE (°C)

   WHERE

   α = 0.00323 FOR COPPER

   α = 0.00330 FOR ALUMINUM

3. MAXIMUM STRING VOLTAGE CALCULATION (PER NEC 690.7):

   $Vmax = Vmod * N * [1 + (25°C - TL) * (\beta/100)]$

   WHERE

   Vmax = MAXIMUM STRING VOLTAGE (V)

   Vmod = MODULE OPEN CIRCUIT VOLTAGE AT STC (V)

   N = NUMBER OF MODULES PER STRING

   TL = MINIMUM EXPECTED SITE TEMPERATURE (°C)

   β = TEMPERATURE COEFFICIENT OF Voc (%/°C)

4. WEIGHTED VOLTAGE DROP CALCULATION:

   $$Vt = \sum_{i=0}^{n}(Xi * VDi) \;/\; \sum_{i=0}^{n}(Xi)$$

   WHERE

   Vt = TOTAL WEIGHTED VOLTAGE DROP (V)

   X = NUMBER OF STRINGS PER CIRCUIT

   VD = VOLTAGE DROP (V)

   n = TOTAL NUMBER OF CIRCUITS IN SUMMATION

   i = EACH CIRCUIT CONNECTED TO COMMON POINT

Westwood

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Westwood Professional Services, Inc.

PREPARED FOR:

ecos ENERGY

REVISIONS:

#	DATE	COMMENT
A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar

New London County, CT

DC Schedules

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.822

FOR REFERENCE ONLY. EQUIPMENT DESIGNED BY
OTHERS AND REVIEWED FOR CONFORMANCE WITH THE
ELECTRICAL ENGINEERING DESIGN FOR THE PROJECT

LG NeON® 2

LG400N2W-V5

72

400W

The LG NeON® 2 is LG's best selling solar module, and is one of the most powerful and versatile modules on the market today. Featuring LG's Cello Technology, the LG NeON® 2 increases power output. New updates include an extended performance warranty from 86% to 89.6% to give customers higher performance and reliability.

In progress

Made in USA From Imported Parts

Features

Enhanced Performance Warranty

LG NeON® 2 has an enhanced performance warranty. After 25 years, LG NeON® 2 is guaranteed to perform at minimum 89.6% of initial performance.

Enhanced Product Warranty

LG has extended the warranty of the NeON® 2 to 25 years, which is among the top of industry standards.

Better Performance on a Sunny Day

LG NeON® 2 now performs better on sunny days, thanks to its improved temperature coefficient.

BOS (Balance Of System) Saving

LG NeON® 2 can reduce the total number of strings due to its high module efficiency resulting in a more cost effective and efficient solar power system.

About LG Electronics

LG Electronics is a global leader in electronic products in the clean energy markets by offering solar PV panels and energy storage systems. The company first embarked on a solar energy source research program in 1985, supported by LG Group's vast experience in the semi-conductor, LCD, chemistry and materials industries. In 2010, LG Solar successfully released its first Mono(X® series to the market, which is now available in 32 countries. The NeON® (previous. Mono(X® NeON), NeON®2, NeON®2 Bifacial won the "Intersolar AWARD" in 2013, 2015 and 2016, which demonstrates LG's leadership and innovation in the solar industry.

LG Life's Good

LG NeON® 2

Made in USA From Imported Parts

LG400N2W-V5

General Data

Cell Properties (Material / Type)	Monocrystalline / N-type
Cell Maker	LG
Cell Configuration	72 Cells (6 x 12)
Number of Busbars	12EA
Module Dimensions (L x W x H)	2,024mm x 1,024mm x 40 mm
Weight	20.3 kg
Glass(Material)	Tempered Glass with AR Coating
Backsheet(Color)	White
Frame(Material)	Anodized Aluminium
Junction Box(Protection Degree)	IP 68
Cables(Length)	1,200 mm x 2EA
Connector(Type / Maker)	MC 4 / MC

Certifications and Warranty

Certifications	IEC 61215-1/-1-1/2016, IEC 61730-1/2:2016, UL 1703
	ISO 9001, ISO 14001, ISO 50001
	OHSAS 18001, PV CYCLE
Salt Mist Corrosion Test	IEC 61701 : 2012 Severity 6
Ammonia Corrosion Test	IEC 62716 : 2013
Module Fire Performance	Type 1 (UL 1703)
Fire Rating	Class C (UL 790, ULC/ORD C 1703)
Solar Module Product Warranty	25 Years
Solar Module Output Warranty	Linear Warranty*

* 1) First year : 98% 2) After 1st year : 0.35% annual degradation 3) 89.6% for 25 years

Temperature Characteristics

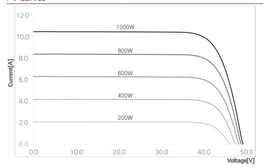
NMOT*	[°C]	42 ± 3
Pmax	[%/°C]	-0.36
Voc	[%/°C]	-0.26
Isc	[%/°C]	0.02

* NMOT (Nominal Module Operating Temperature): Irradiance 800 W/m², Ambient temperature 20 °C, Wind speed 1 m/s, Spectrum AM 1.5

Electrical Properties (NMOT)

Model		LG400N2W-V5
Maximum Power (Pmax)	[W]	300
MPP Voltage (Vmpp)	[V]	38.0
MPP Current (Impp)	[A]	7.88
Open Circuit Voltage (Voc)	[V]	46.5
Short Circuit Current (Isc)	[A]	8.40

I-V Curves



Electrical Properties (STC*)

Model		LG400N2W-V5
Maximum Power (Pmax)	[W]	400
MPP Voltage (Vmpp)	[V]	40.6
MPP Current (Impp)	[A]	9.86
Open Circuit Voltage (Voc, ±5%)	[V]	49.3
Short Circuit Current (Isc, ±5%)	[A]	10.47
Module Efficiency	[%]	19.3
Power Tolerance	[%]	0 ~ +3

* STC (Standard Test Condition): Irradiance 1000 W/m², Cell temperature 25 °C, AM 1.5

Operating Conditions

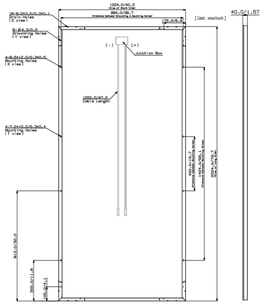
Operating Temperature	[°C]	-40 ~ +90
Maximum System Voltage	[V]	1,500(UL), 1000(IEC)
Maximum Series Fuse Rating	[A]	20
Mechanical Test Load (Front)	[Pa / psf]	5,400 / 113
Mechanical Test Load (Rear)	[Pa / psf]	3,000 / 63

* Test Load = Design load X Safety Factor (1.5)

Packaging Configuration

Number of Modules per Pallet	[EA]	25
Number of Modules per 40ft HQ Container	[EA]	550
Packaging Box Dimensions (L x W x H)	[mm]	2,080 x 1,120 x 1,226
Packaging Box Gross Weight	[kg]	551

Dimensions (mm / inch)



LG Electronics Inc.
Solar Business Division
2000 Millbrook Drive
Lincolnshire, IL 60069
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Product specifications are subject to change without notice.
LG400N2W-V5_US_Ver01

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PREPARED FOR:

ecos ENERGY

REVISIONS:

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A	05/06/2019	50% SUBMITTAL
B	05/30/2019	90% SUBMITTAL
C	06/07/2019	ISSUED FOR CONSTRUCTION
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Voluntown Solar
New London County, CT

Specification Sheet - Module

FOR CONSTRUCTION

DATE: 06/07/2019

SHEET: E.900

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SOLAR INVERTERS

ABB string inverters
PVS-166/175-TL-US

The PVS-166/175-TL-US is ABB's innovative three-phase string inverter, delivering a solution to enhance and optimize solar power generation for ground mounted utility scale applications.

— PVS-166/175-TL-US three-phase string inverter

Highest power in class
This new high-power string inverter, within the 1500 Vdc segment, delivers up to 185 kVA at 800 Vac. This not only maximizes the ROI for ground mounted utility-scale applications but also reduces Balance of System costs (i.e. AC side cabling) for small to large scale, free field ground mounted PV installations.

Design flexibility
The inverter comes equipped with 24 inputs and 12 MPPT, the highest available in the market, enabling maximum PV plant design flexibility and increasing yields also in case of complex installations.

Installer friendly design
Quick and easy installation, thanks to plug and play connectors, as the existing PV module's mounting systems can be used to install the inverters, thus saving time and cost on site preparation.
The fuse and combiner free design eliminates the need for external components, such as separate DC combiner boxes, thanks to the integrated DC disconnect and AC wiring compartment.
The Advanced Cooling Concept preserves the lifetime of the system and minimizes O&M costs thanks to internal heavy-duty cooling fans. These can be easily removed during scheduled maintenance cycles whilst the power module can be easily replaced without removing the wiring box.

Advanced communication for O&M
Standard wireless access from any mobile device makes the configuration of inverter and plant easier and faster. An improved user experience thanks to a built-in User Interface (UI) enables access to advanced inverter configuration settings.
The Installer for Solar Inverters mobile app and configuration wizard enable a quick multi-inverter installation and commissioning reducing the time spent on site.

Fast system integration
Industry standard Modbus (RTU/TCP)/SUNSPEC protocol enables fast system integration.
Two Ethernet ports enable fast and future-proof communication for PV plants.

Protect your assets
Monitoring your assets is made easy, as every inverter is capable to connect to ABB cloud platform and thanks to the state-of-the-art cybersecurity and Arc Fault Detection option, your assets and profitability are secure in the long term.

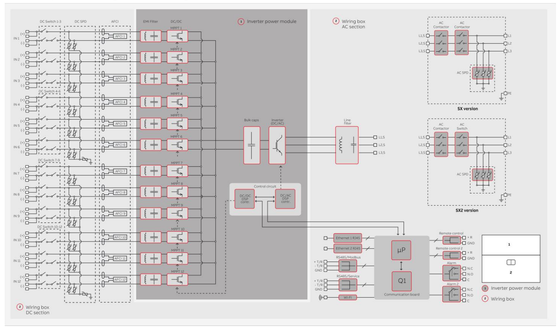
Highlights
- Up to 185 kW power rating, highest in class
- All-in-one combiner and fuse free design
- Separate power module and wiring compartment for fast swap and replacement
- 12 MPPT and wide input voltage range for maximum energy yield
- WLAN interface for commissioning and configuration
- Remote monitoring and firmware upgrade via ABB cloud platform (logger free)
- Free of charge standard access to Aurora Vision® cloud

ABB string inverters
PVS-166/175-TL-US
166.5 to 185 kW

Technical data and types

Type code	PVS-166-TL US	PVS-175-TL US
Input side		
Absolute maximum DC input voltage ($V_{max,abs}$)	1500 V	
Start-up DC input voltage (V_{start})	750 V (650…1000 V)	
Operating DC input voltage range (V_{dcmin}…V_{dcmax})	0.7 x V_{start}…1500 V (min 600 V)	
Rated DC input voltage (V_{dc})	1150 V	
Rated DC input power (P_{dc})	169 000 W @ 40°C	188 000 W @ 30°C (177 kW @ 40°C)
Number of independent MPPT	12	
MPPT input DC voltage range ($V_{MPPTmin}$…$V_{MPPTmax}$) at P_{acr}	850…1350 V	
Maximum DC input current for each MPPT (I_{dcmax} / $I_{MPPTmax}$)	22 A	
Maximum input short circuit current for each MPPT (I_{SCmax})	30 A	
Number of DC input pairs for each MPPT	2 DC Inputs per MPPT	
DC connection type	PV quick fit connector [1]	
Input protection		
DC Series Arc Fault Circuit Interrupter	Type I acc. to UL 16998 [2] with single-MPPT sensing capability	
Reverse polarity protection	Yes, from limited current source	
Input over voltage protection for each MPPT - replaceable surge arrester	Type 2 with monitoring	
Photovoltaic array isolation control (Insulation Resistance, R-iso)	Yes (pre start-up R-iso measurement)	
Residual Current Monitoring Unit (leakage current protection)	Yes (dynamic GFDI)	
DC Load Breaking Disconnect Switch (rating for each MPPT)	30A/1500 V	
Fuse rating	N/A, No fuses required	
String current monitoring	MPPT-level current sense	
Output side		
AC Grid connection type	Three phase 3W+PE	
Rated AC power (P_{ac} @cosϕ=1)	166 500 W @ 40°C	175 000 W @ 40°C
Maximum AC output power (P_{acmax} @cosϕ=1)	166 500 W @ 30°C	185 000 W @ 30°C
Maximum apparent power (S_{max})	166 500 VA	185 000 VA
Rated AC grid voltage ($V_{ac,r}$)	800 V	
AC voltage range	552…960 [3]	
Maximum AC output current ($I_{ac,max}$)	134 A	
Rated output frequency (f_r)	50 Hz / 60 Hz	
Output frequency range (f_{min}…f_{max})	45…55 Hz / 55…65 Hz [3]	
Nominal power factor and adjustable range	> 0.995, 0…1 inductive/capacitive with maximum S_{max}	
Total current harmonic distortion	< 3%	
Max DC current injection (% of in)	< 0.5%*In	
AC wire range	4x1x2/0 AWG to 4x1x400 kcmil, Cu/Al [4]	
AC plate	Opening for Trade size 3 conduit	
AC connection type	Copper Busbar for ring terminal lug connections with M10 stud type terminal block (bolts included)	
Output protection		
Anti-islanding protection	Meets UL1741 / IEEE1547 requirements	
Output overvoltage protection - replaceable surge protection device	Type 2 with monitoring	
Operating performance		
Maximum efficiency (η_{max})	98.6 %	
Weighted CEC efficiency (η_{CEC})	98.4 %	
Communication		
Embedded communication interfaces	Dual port Ethernet, WLAN [5], RS-485	
User interface	4 LEDs, Web User Interface, Mobile APP	
Communication protocol	Modbus RTU/TCP (SunSpec compliant)	
Commissioning tool	Web User Interface, Mobile APP	
Monitoring	Plant Portfolio Manager, Plant Viewer	

ABB PVS-166/175-TL-US string inverter block diagram



Technical data and types

Type code	PVS-166-TL US	PVS-175-TL US
FW update	Remote inverter FW upgrade via Ethernet/WLAN interface locally/remotely	
Parameter upgrade	Remote inverter parameter upgrade via Ethernet/WLAN according to SunSpec Modbus protocol	
Environmental		
Operating ambient temperature range	-13…+140°F (-25…+60°C) with derating above 104°F (40°C)	
Relative humidity	0…100% condensing	
Sound pressure level, typical	<65 dB(A)@ 1m	
Maximum operating altitude without derating	2000 m / 6560 ft	
Physical		
Environmental protection rating	Cert. to UL 50E Type 4X – meets or exceeds NEMA 4X	
Cooling	Forced air cooling with variable speed cooling fan	
Dimension (H x W x D)	34.2x42.7x16.5 in (867 x 1086 x 419 mm) / -SX model 34.2x42.7x18 in (867 x 1086 x 458 mm) / -SX2 model	
Weight	~76.5kg / 168 lbs for power module ~76.8kg / 169 lbs for wiring box Overall max.153 kg / 338 lbs	
Mounting system	Bracket (included, vertical mounting only)	
Safety		
Isolation level	Transformer-less (floating array)	
Marking (Pending)	$_{c}$TUV$_{us}$	
Safety and EMC standard (Pending)	UL1741, IEEE1547, IEEE1547.1, CSA-C22.2 No. 107.1-01, UL1998, UL 1699B, FCC 47 CFR Part 15B Class A Limits	
Grid standard (Pending)	UL 1741 SA, IEEE1547, IEEE 1547a, Rule 21, Rule 14 (HI)	
Available products variants		
Inverter power module	PVS-166-TL-POWER MODULE	PVS-175-TL-POWER MODULE
24 quick fit connector pairs (2 each mppt) + DC switches + SPD Type 2 Pluggable Cartridges (DC & AC)	WB-SX-PVS-166-TL-US	WB-SX-PVS-175-TL-US
24 quick fit connector pairs (2 each mppt) + DC switches + AC disconnection switch + SPD Type 2 Pluggable Cartridges (DC & AC)	WB-SX2-PVS-166-TL-US	WB-SX2-PVS-175-TL-US
Optional available		
DC link recharge circuit	Night time operation with restart capability	
Anti-PID [6]	Based on night time polarization of the array	

1) Multicontact MC4-Evo2. Cable couplers may accept up to 10mm² (AWG8)
2) Performance in line with the relevant requirements of the Draft IEC 63027 standard
3) The AC voltage and frequency range may vary depending on specific country grid standard
4) Aluminum cable requires bi-metallic compression lug or bi-metallic adapter
5) as per IEEE 802.11 b/g/n standard, 2.4 GHz
6) Cannot operate simultaneously when installed in conjunction with the DC link recharge circuit

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Voluntown Solar
New London County, CT

Specification Sheet - Inverter

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