



Kenneth D. Ellsworth, P.E.
Managing Member

Paul L. Bedford, AIA
Architect

Rodney L. Carey, L.S.
Land Surveyor

Kordian W. Wichtowski, R.A.
Architect

March 15, 2019

Ms. Katherine S. Wickwire, Chair
Town of Cortlandville Planning Board
The Raymond G. Thorpe Municipal Building
3577 Terrace Road
Cortland, New York 13045

RE: Cortland-Virgil Road Solar, LLC
Gallagher Road
Cortland, New York

Dear Ms. Wickwire:

As requested by the Cortland County Planning Board, we offer this letter as additional information regarding the above captioned project.

The project is proposed to be +/- 12.25 acres community solar project with +/- 0.73 acres of disturbance. The project will contain 7,328 each Hanwha 365 watt modules, 80 each Tabuchi 25 kW 3 phase inverters and preliminary estimates indicate that this site will produce +/- 3,744,608 kWh of electricity annually. The (80 each) Inverters will be connected to circuit breakers in (10 each) electrical panelboards, which will then be routed to (2 each) Pad-mounted Electrical Switchgear and Transformers, before interconnecting to the National Grid distribution system. There will be up to 2,000 linear feet of electrical cable in conduit buried to sufficient depths as required by the National Electric Code. The electricity generated by this project will be fed into the National Grid Distribution System as a Community Distributed Generation (CDG) project. Local residents, businesses, and municipalities in the Greater Cortland area who are National Grid ratepayers will have the option of subscribing to purchase a portion of the energy from this project to offset their electric usage, at a discount to the rates that they would otherwise purchase their electricity from National Grid.

The connection point for this project is on South Cortland-Virgil Road, please refer to the site plans for additional information as well as the attached interconnection drawings submitted to National Grid for more information. The details for the solar panels are shown on the site plans Drawing C200, the panel shown will have a maximum height of 7'. The posts to support the panels are also shown on this drawing. All post supports be driven or augered for this project.

A concern was raised regarding the "glare" from the solar panels impacting the surrounding properties. We have attached literature regarding the topic of glare and glint as it relates to solar panels. While this literature is focused on the impacts of solar systems near an Airport, the same conclusions can be made regarding impacts to surrounding properties. Please note that "light absorption, rather than reflection, is central to the function of solar PV panels". The proposed panels for this project are PV panels, therefore their intended function is to absorb light. Further, "modern PV panels reflect as little as two percent of incoming sunlight, about the same as water and less than soil or even wood shingles". There are homes located south of the proposed project, however these homes will not be affected as the panels for this project are rotating panels therefore are facing east-west. There is an approximately 500 feet wide tree line west of the panels and the topography east of

58 Exchange Street
Binghamton, New York 13901
Phone: 607.722.1100
Fax: 607.722.2515
E-mail: info@keyscomp.com
www.keyscomp.com

the panels is a higher elevation than the panels. Therefore, it is our opinion that there are no concerns with glare impacting adjacent properties.

Our office has contacted the Town of Cortlandville Highway Department regarding using the existing driveway entrance and were notified that they “most likely” will not require any permitting because of the change in use for the driveways, however they will review the information provided and notify our office if permitting will be required.

An Erosion and Sedimentation Control plan was prepared which addresses potential stormwater impacts from the project and demonstrates mitigation measures to prevent excess erosion. Please note that the current property is crop row with exposed soils and the final cover for the solar project will be a well maintained grass area. The improved cover from exposed earth to grass will significantly reduce the erosion runoff from the project site. Maintenance requirements are included on the Erosion and Sedimentation Plan for the project.

As discussed during the January 2019 Planning Board meeting, this project is located within an area identified as prime farmland. This matter was reviewed, and the Planning Board did not have any objections to the project’s location.

Please find attached a copy of the decommissioning plan for the project.

Please contact our office if you have any questions or comments.

Respectfully,

Keystone Associates
Architects, Engineers and Surveyors, LLC



Paul T. Woodward
Senior Designer

Enclosures

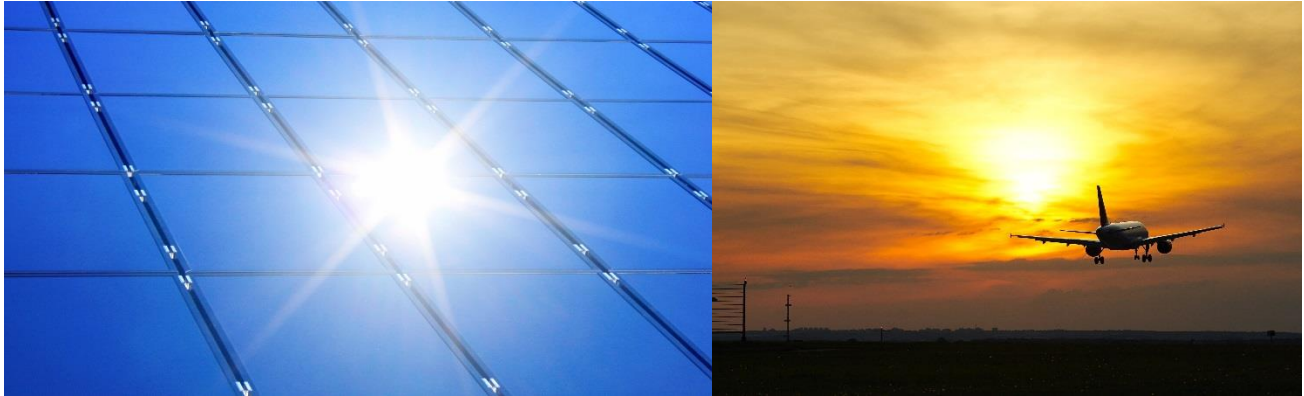
PTW:

P:\Projects\2018\2850\2850_24418\2850_24418_6 Cortland-Virgil\Correspondence\285024418_6_Cortland Virgil Project Narrative.docx

APPENDIX A

GLARE LITERATURE

Solar and Glare



I. Introduction

A common misconception about solar photovoltaic (PV) panels is that they inherently cause or create “too much” glare, posing a nuisance to neighbors and a safety risk for pilots. While in certain situations the glass surfaces of solar PV systems can produce glint (a momentary flash of bright light) and glare (a reflection of bright light for a longer duration), light absorption, rather than reflection, is central to the function of a solar PV panel - to absorb solar radiation and convert it to electricity. Solar PV panels are constructed of dark-colored (usually blue or black) materials and are covered with anti-reflective coatings. Modern PV panels reflect as little as two percent of incoming sunlight, about the same as water and less than soil or even wood shingles (SEIA/Sandia 2013). Some of the concern and misconception is likely due to the confusion between solar PV systems and concentrated solar power (CSP) systems. CSP systems typically use an array of mirrors to reflect sunlight to heat water or other fluids to create steam that turns an electric generator. These typically involve large ground-mounted reflectors, usually in remote desert locations, and are not installed in residential or commercial areas or near airports.

Solar PV system on the left compared to a parabolic trough CSP system on the right. Photo Copyright DOE/NREL/ORNL



II. PV on or near airports

Solar and Glare

As of June 2013, there were over 30 solar projects in operation at airports in 15 different states (Barrett 2013). Solar installations have been successfully located at or near US international airports in Boston, New York, San Francisco, and Denver, among others. Yet concerns over glint (a quick reflection) and glare (a longer reflection) often arise when a PV system is proposed on or near an airport. Pilots are familiar with both glint and glare as reflection is a common phenomenon, especially off of bodies of water or in the form of glare from the sun itself. However, issues can arise if the solar PV system were to cast glare into an air traffic control tower.¹

The Federal Aviation Administration (FAA) has been actively reviewing the impact of glare from solar panels to streamline an evaluation process that ensures safety while creating more opportunity for solar installations on or near airports. The FAA filed notice of its Interim Policy for review of solar energy systems on federally obligated airports (i.e. airports which receive federal funding) in October of 2013.² This policy requires that a sponsor of a federally obligated airport must request FAA review and approval to install solar on its "airport layout plan." Federally-obligated airports must also notify the FAA of its intent to construct any solar installation by filing FAA form 7460-1. The interim FAA policy also requires the use of the Solar Glare Hazard Analysis Tool for on-airport solar development.

III. FAA and the Solar Glare Hazard Analysis Tool

In order to understand and model glare in accordance with FAA standards, Sandia National Laboratories developed the Solar Glare Hazard Analysis Tool (SGHAT). Standardized safety metrics define what glare intensity will cause unwanted visual impacts to Air Traffic Control towers and airplane pilots. SGHAT can be used to evaluate the potential of a particular PV array to produce glare intensity, predicting when and where glare will occur from a prescribed PV array at user-defined observation points (i.e. from the Air Traffic Control Tower or from a series of points along an aircraft landing route) and be combined with Google maps for an easy user interface. In instances where glare may be a concern, the tool can prescribe minor adjustments to the tilt, direction, and location of the panels to alleviate any issues. SGHAT will predict annual energy production for the various adjusted positions (SEIA/Sandia PPT).

IV. Role for Local Governments

Local governments may wish to include airport guidance within their local zoning ordinances that address solar PV. The North Carolina Solar Center *Template Solar Energy Development Ordinance for North Carolina*³ includes a section on airports and recommends aviation notification steps for both on-airport solar projects and installations within 5 nautical miles of an airport. In addition to amendments to local zoning codes, local governments have the opportunity to conduct outreach to airports,

¹ <http://www.unionleader.com/article/20120830/NEWS02/708309966/0/newhampshire>

² <http://www.gpo.gov/fdsys/pkg/FR-2013-10-23/pdf/2013-24729.pdf>

³ http://ncsc.ncsu.edu/wp-content/uploads/Template-Solar-Ordinance_V1.0_12-18-13.pdf

Solar and Glare

organizations and local stakeholders about methods for predicting and managing glare impacts from solar panels near airports or other locations. Such outreach furthers the safety goals of the FAA and the solar energy development goals of municipalities and communities. Spreading awareness of the safety of PV systems along with FAA guidance and glare measurement tools will help foster informed communities and enable the deployment of safe and productive solar PV projects in locations where glint and glare may be of concern.

V. Useful Links

Sandia Solar Glare Mapping Tools: <https://share.sandia.gov/phlux>

V. Citations

Barrett, S., June 2013, Glare Factor: Solar Installations And Airports, *Solar Industry, Volume 6, Number 5*. http://www.solarindustrymag.com/issues/SI1306/FEAT_02_Glare_Factor.html.

Federal Register 2013, etc.: <http://www.gpo.gov/fdsys/pkg/FR-2013-10-23/pdf/2013-24729.pdf>

SEIA/Sandia Webinar on Solar PV and Glare:

<http://www.seia.org/sites/default/files/resources/Final%20ofAA%20Webinar%20Slides%20August%202013.pdf>

Authors: Caroline Palmer and Chad Laurent, Meister Consultants Group, Inc.

Meister Consultants Group, Inc. | 98 N. Washington St., Suite 302, Boston, MA 02114 | www.mcgroup.com

This fact sheet, produced by Meister Consultants Group, Inc., is supported by the following team of organizations: ICLEI-USA; International City/County Management Association (ICMA); Solar Electric Power Association (SEPA); Interstate Renewable Energy Council, Inc. (IREC); North Carolina Solar Center (NCSC); The Solar Foundation (TSF); American Planning Association (APA); and National Association of Regional Councils (NARC).

This material is based upon work supported by the U.S. Department of Energy under Award Number DE-EE0003525. This fact sheet was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe on privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

**APPENDIX B
DECOMMISSIONING PLAN**

Cortlandville Solar Projects - Decommissioning Plan

At the completion of the expected life of the Solar Energy Facility, the entire system shall be removed by the applicant or the subsequent owner. The Applicant' lease agreement with the landowner has a primary term of 20 years, followed by options for (3) five-year extensions. The lease agreement stipulates that at the conclusion of either the primary or renewal term, the premises shall be restored to its original condition, including the removal of the system mounting pads or other support structures and left in neat and clean order. The agreement allows for a removal term of up to 180 days for the Tenant to remove the system. The agreement also stipulates that if the tenant fails to remove the system prior to the expiration of the removal term, then the landlord shall have the right to remove the system to a public warehouse and restore the premises to its original condition at Tenant's reasonable cost.

The decommissioning process will be completed as follows:

- All items with resale value, including transformers and solar panels, will be removed from the site and sold for fair market value.
- All aluminum, steel, and other metal parts without resale value will be sold for scrap value
- All items with no resale or scrap value will be removed from the site, and recycled where applicable, otherwise disposed of in accordance with all local laws and regulations.

Note: It is widely believed that the resale value and scrap value alone will exceed the costs of system removal. Solar panels themselves, which carry a limited power warranty of >80% of their rated capacity after 25 years, may cover most, if not all, of the costs of decommissioning.

Based on NYSERDA's estimate of decommissioning costs for a 2 MW project (enclosed), each 2 MW-AC project in the Cortlandville Portfolio would carry the following budgetary costs for decommissioning:

Item	Estimated Cost
Remove Rack Wiring	\$ 2,459.00
Remove Panels	\$ 2,450.00
Dismantle Racks	\$ 12,350.00
Remove Electrical Equipment	\$ 1,850.00
Breakup and Remove Concrete Pads	\$ 1,500.00
Remove Racks	\$ 7,800.00
Remove Cable	\$ 6,500.00
Remove Ground Screws and Power Poles	\$ 13,850.00
Remove Fence	\$ 4,950.00
Grading	\$ 4,000.00
Seed Disturbed Area	\$ 250.00
Truck to Recycling Center	\$ 2,250.00
Total	\$ 60,209.00
Total after 20 years (2.5% inflation rate)	\$ 98,659.46

DECOMMISSIONING SOLAR PANEL SYSTEMS



This fact sheet provides information to local governments and landowners on decommissioning of large-scale solar panel systems.

As local governments develop solar regulations and landowners negotiate land leases, it is important to understand the options for decommissioning solar panel systems and restoring project sites to their original status.

From a land use perspective, solar panel systems are generally considered large-scale when they constitute the primary use of the land, and can range from less than one acre in urban areas to 10 or more acres in rural areas. Depending on where they are sited, large-scale solar projects can have habitat, farmland, and aesthetic impacts. As a result, large-scale systems must often adhere to specific development standards.

Abandonment and decommissioning defined

Abandonment occurs when a solar array is inactive for a certain period of time.

- Abandonment requires that solar panel systems be removed after a specified period of time if they are no longer in use. Local governments establish timeframes for the removal of abandoned systems based on aesthetics, system size and complexity, and location. For example, the Town of Geneva, NY, defines a solar panel system as abandoned if construction has not started within 18 months of site plan approval, or if the completed system has been nonoperational for more than one year.¹
- Once a local government determines a solar panel system is abandoned, and has provided thirty (30) days prior written notice to the owner it can take enforcement actions, including imposing civil penalties/fines, and removing the system and imposing a lien on the property to recover associated costs.

Decommissioning is the process for removing an abandoned solar panel system and remediating the land.

- When describing requirements for decommissioning sites, it is possible to specifically require the removal of infrastructure, disposal of any components, and the stabilization and re-vegetation of the site.

What is a decommissioning plan?

Local governments may require to have a plan in place to remove solar panel systems at the end of their lifecycle, which is typically 20-40 years. A decommissioning plan outlines required steps to remove the system, dispose of or recycle its components, and restore the land to its original state. Plans may also include an estimated cost schedule and a form of decommissioning security (see Table 1).

What is the estimated cost of decommissioning?

Given the potential costs of decommissioning and land reclamation, it is reasonable for landowners and local governments to proactively consider system removal guarantees. A licensed professional engineer, preferably with solar development experience, can estimate decommissioning costs, which vary across the United States. Decommissioning costs will vary depending upon project size, location, and complexity. Table 1 provides an estimate of potential decommissioning costs for a ground-mounted 2-MW solar panel system. Figures are based on estimates from the Massachusetts solar market. Decommissioning costs for a New York solar installation may differ. Some materials from solar installations may be recycled, reused, or even sold resulting in no costs or compensation. Consider allowing a periodic reevaluation of decommissioning costs during the project's lifetime by a licensed professional engineer, as costs could decrease and the required payment should be reduced accordingly.

Table 1: Sample list of decommissioning tasks and estimated costs

Tasks	Estimated Cost (\$)
Remove Rack Wiring	\$2,459
Remove Panels	\$2,450
Dismantle Racks	\$12,350
Remove Electrical Equipment	\$1,850
Breakup and Remove Concrete Pads or Ballasts	\$1,500
Remove Racks	\$7,800
Remove Cable	\$6,500
Remove Ground Screws and Power Poles	\$13,850
Remove Fence	\$4,950
Grading	\$4,000
Seed Disturbed Areas	\$250
Truck to Recycling Center	\$2,250
Current Total	\$60,200
Total After 20 Years (2.5% inflation rate)	\$98,900

¹ Town of Geneva, N.Y. CODE § 130-4(D)(5) (2016):

How can decommissioning be ensured?

Landowners and local governments can ensure appropriate decommissioning and reclamation by using financial and regulatory mechanisms. However, these mechanisms come with tradeoffs. Including decommissioning costs in the upfront price of solar projects increases overall project costs, which could discourage solar development. As a result, solar developers are sometimes hesitant to provide or require financial surety for decommissioning costs.

It is also important to note that many local governments choose to require a financial mechanism for decommissioning. Although similar to telecommunications installations, there is no specific authority to do so as part of a land use approval for solar projects (see Table 2). Therefore, a local government should consult their municipal attorney when evaluating financial mechanisms.

The various financial and regulatory mechanisms to decommission projects are detailed below.

Table 2: Relevant Provisions of General City, Town, and Village Laws Relating to Municipal Authority to Require Conditions, Waivers, and Financial Mechanisms

Site Plan Review	General City Law	Town Law	Village
Conditions	27-a (4)	274-a (4)	7-725-a (4)
Waivers	27-a (5)	274-a (5)	7-725-a (5)
Performance bond or other security	27-a (7)	274-a (7)	7-725-a (7)
Subdivision	General City Law	Town Law	Village Law
Waivers	33 (7)	277 (7)	7-730 (7)
Performance bond or other security	33 (8)	277 (9)	7-730 (9)
Special	General City Law	Town Law	Village Law
Conditions	27-b (4)	274-b (4)	7-725-b (4)
Waivers	27-b (5)	274-b (5)	7-725-b (5)

Source: Referenced citations may be viewed using the NYS Laws of New York Online

Excerpts from these statutes are also contained within the “Guide to Planning and Zoning Laws of New York State,” New York State Division of Local Governments Services, June 2011: www.dos.ny.gov/lg/publications/Guide_to_planning_and_zoning_laws.pdf

Financial mechanisms

Decommissioning Provisions in Land-Lease Agreements.

If a decommission plan is required, public or private landowners should make sure a decommissioning clause is included in the land-lease agreement. This clause may depend on the decommissioning preferences of the landowner and the developer. The clause could require the solar project developer to remove all equipment and restore the land to its original condition after the end of the contract, or after generation drops below a certain level, or it could offer an option for the landowner to buy-out and continue to use the equipment to generate electricity. The decommissioning clause should also address abandonment and the possible failure of the developer to comply with

the decommissioning plan. This clause could allow for the landowner to pay for removal of the system or pass the costs to the developer.

Decommissioning Trusts or Escrow Accounts. Solar developers can establish a cash account or trust fund for decommissioning purposes. The developer makes a series of payments during the project’s lifecycle until the fund reaches the estimated cost of decommissioning. Landowners or third-party financial institutions can manage these accounts. Terms on individual payment amounts and frequency can be included in the land lease.

Removal or Surety Bonds. Solar developers can provide decommissioning security in the form of bonds to guarantee the availability of funds for system removal. The bond amount equals the decommissioning and reclamation costs for the entire system. The bond must remain valid until the decommissioning obligations have been met. Therefore, the bond must be renewed or replaced if necessary to account for any changes in the total decommissioning cost.

Letters of credit. A letter of credit is a document issued by a bank that assures landowners a payment up to a specified amount, given that certain conditions have been met. In the case that the project developer fails to remove the system, the landowner can claim the specified amount to cover decommissioning costs. A letter of credit should clearly state the conditions for payment, supporting documentation landowners must provide, and an expiration date. The document must be continuously renewed or replaced to remain effective until obligations under the decommissioning plan are met.²

Nonfinancial mechanisms

Local governments can establish nonfinancial decommissioning requirements as part of the law. Provisions for decommissioning large-scale solar panel systems are similar to those regulating telecommunications installations, such as cellular towers and antennas. The following options may be used separately or together.

- **Abandonment and Removal Clause.** Local governments can include in their zoning code an abandonment and removal clause for solar panel systems. These cases effectively become zoning enforcement matters where project owners can be mandated to remove the equipment via the imposition of civil penalties and fines, and/or by imposing a lien on the property to recover the associated costs. To be most effective, these regulations should be very specific about the length of time that constitutes abandonment. Establishing a timeframe for the removal of a solar panel system can be based on system aesthetics, size, location, and complexity. Local governments should include a high degree of specificity when defining “removal” to avoid ambiguity and potential conflicts.

² See a letter of credit submitted to the Vermont Public Service Board by NextSun Energy, LLC.

[http://psb.vermont.gov/sites/psb/files/docketsandprojects/Solar/Exhibit%20Petitioner%20JL-7%20\(Revised%20326.14\).pdf](http://psb.vermont.gov/sites/psb/files/docketsandprojects/Solar/Exhibit%20Petitioner%20JL-7%20(Revised%20326.14).pdf)

- **Special Permit Application.** A local government may also mandate through its zoning code that a decommissioning plan be submitted by the solar developer as part of a site plan or special permit application. Having such a plan in place allows the local government, in cases of noncompliance, to place a lien on the property to pay for the costs of removal and remediation.
- **Temporary Variance/Special Permit Process.** As an alternative to requiring a financial mechanism as part of a land use approval, local governments could employ a temporary variance/special permit process (effectively a re-licensing system). Under this system, the locality would issue a special permit or variance for the facility for a term of 20 or more years; once expired (and if not renewed), the site would no longer be in compliance with local zoning, and the locality could then use their regular zoning enforcement authority to require the removal of the facility.

What are some examples of abandonment and decommissioning provisions?

The New York State Model Solar Energy Law provides model language for abandonment and decommissioning provisions: www.cuny.edu/about/resources/sustainability/reports/NYS_Model_Solar_Energy_LawToolkit_FINAL_final.pdf

The following provide further examples that are intended to be illustrative and do not confer an endorsement of content:

- Town of Geneva, N.Y., § 130-4(D): ecode360.com/28823382
- Town of Olean, N.Y., § 10.25.5: www.cityofolean.org/council/minutes/ccmin2015-04-14.pdf

Is there a checklist for decommissioning plans?

The following items are often addressed in decommissioning plans requirements:³

- Defined conditions upon which decommissioning will be initiated (i.e., end of land lease, no operation for 12 months, prior written notice to facility owner, etc.).
- Removal of all nonutility owned equipment, conduit, structures, fencing, roads, and foundations.
- Restoration of property to condition prior to solar development.
- The timeframe for completion of decommissioning activities.
- Description of any agreement (e.g., lease) with landowner regarding decommissioning.
- The party responsible for decommissioning.
- Plans for updating the decommissioning plan.
- Before final electrical inspection, provide evidence that the decommissioning plan was recorded with the Register of Deeds.

Additional Resources

Template Solar Energy Development Ordinance for North Carolina (see Appendix G at pg. 21 for Sample Decommissioning Plan): nccleantech.ncsu.edu/wp-content/uploads/Template-Solar-Ordinance_V1.0_12-18-13.pdf

Land Use Planning for Solar: training.ny-sun.ny.gov/images/PDFs/Land_Use_Planning_for_Solar_Energy.pdf

Zoning Guide for Solar: training.ny-sun.ny.gov/images/PDFs/Zoning_for_Solar_Energy_Resource_Guide.pdf

Information on First Solar's recycling program for all of their modules: www.firstsolar.com/en/Technologies-and-Capabilities/Recycling-Services

PV Cycle: Europe's PV recycling program: www.pvcycle.org/

Solar Energy Industries Association (SEIA) information on solar panel recycling: www.seia.org/policy/environment/pv-recycling

Silicon Valley Toxics Coalition: svtc.org/

Silicon Valley Toxic Coalition Solar Scorecard: www.solarscorecard.com/2015/2015-SVTC-Solar-Scorecard.pdf

End-of-life PV: then what? - Recycling solar panels: www.renewableenergyfocus.com/view/3005/end-of-life-pv-then-what-recycling-solar-pv-panels/

NY-Sun, a dynamic public-private partnership, will drive growth in the solar industry and make solar technology more affordable for all New Yorkers. NY-Sun brings together and expands existing programs administered by the New York State Energy Research and Development Authority (NYSERDA), Long Island Power Authority (LIPA), PSEG Long Island, and the New York Power Authority (NYPA), to ensure a coordinated, well-supported solar energy expansion plan and a transition to a sustainable, self-sufficient solar industry.

³ North Carolina Solar Center, NC Sustainable Energy Center. December 2013. Template Solar Energy Development Ordinance for North Carolina. https://nccleantech.ncsu.edu/wp-content/uploads/Template-Solar-Ordinance_V1.0_12-18-13.pdf

APPENDIX C EQUIPMENT

Q.PLUS DUO L-G5.2 360-375

Q.ANTUM SOLAR MODULE

The new high-performance module **Q.PLUS DUO L-G5.2** is the ideal solution for commercial and utility applications thanks to a combination of its innovative cell technology **Q.ANTUM** and cutting edge cell interconnection. This 1500 V IEC/UL solar module with its 6 busbar cell design ensures superior yields with up to 375 Wp while having a very low LCOE.



LOW ELECTRICITY GENERATION COSTS

Higher yield per surface area, lower BOS costs, higher power classes, and an efficiency rate of up to 19.1%.



INNOVATIVE ALL-WEATHER TECHNOLOGY

Optimal yields, whatever the weather with excellent low-light and temperature behavior.



ENDURING HIGH PERFORMANCE

Long-term yield security with Anti LID Technology, Anti PID Technology¹, Hot-Spot Protect and Traceable Quality Tra.Q™.



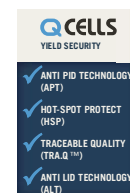
EXTREME WEATHER RATING

High-tech aluminum alloy frame, certified for high snow (5400 Pa) and wind loads (2400 Pa).



A RELIABLE INVESTMENT

Inclusive 12-year product warranty and 25-year linear performance warranty².



THE IDEAL SOLUTION FOR:



Rooftop arrays on commercial/industrial buildings



Ground-mounted solar power plants

Engineered in **Germany**

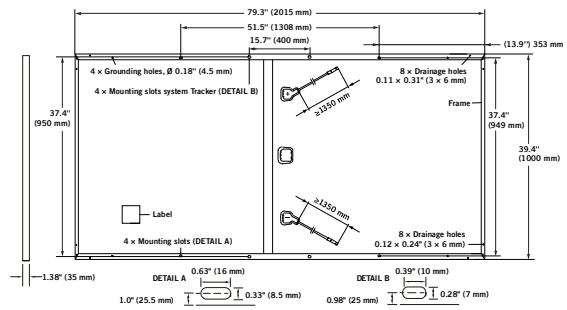
Q CELLS

¹ APT test conditions according to IEC/TS 62804-1:2015, method B (-1500V, 168h)

² See data sheet on rear for further information.

MECHANICAL SPECIFICATION

Format	79.3 in × 39.4 in × 1.38 in (including frame) (2015 mm × 1000 mm × 35 mm)
Weight	51.8 lbs (23.5 kg)
Front Cover	0.13 in (3.2 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Anodized aluminum
Cell	6 × 24 multicrystalline Q.ANTUM solar half-cells
Junction box	2.76-3.35 in × 1.97-2.76 in × 0.51-0.83 in (70-85 mm × 50-70 mm × 13-21 mm), Protection class IP67, with bypass diodes
Cable	4 mm ² Solar cable; (+) ≥ 53.1 in (1350 mm), (-) ≥ 53.1 in (1350 mm)
Connector	Multi-Contact MC4-EVO2, JMTHY PV-JM601A, IP68 or Renhe O5-8, IP67

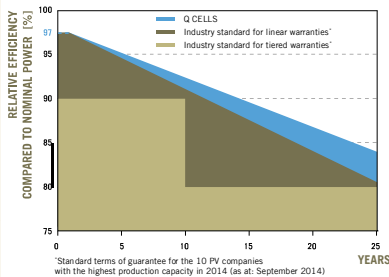


ELECTRICAL CHARACTERISTICS

POWER CLASS		360	365	370	375	
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC¹ (POWER TOLERANCE +5 W / -0 W)						
Minimum	Power at MPP¹	P_{MPP} [W]	360	365	370	375
	Short Circuit Current¹	I_{SC} [A]	9.87	9.92	9.96	10.01
	Open Circuit Voltage¹	V_{OC} [V]	46.80	47.03	47.26	47.49
	Current at MPP	I_{MPP} [A]	9.35	9.41	9.47	9.54
	Voltage at MPP	V_{MPP} [V]	38.52	38.79	39.05	39.32
	Efficiency¹	η [%]	≥ 18.1	≥ 18.3	≥ 18.6	≥ 18.8
MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT²						
Minimum	Power at MPP	P_{MPP} [W]	267.7	271.4	275.2	278.9
	Short Circuit Current	I_{SC} [A]	7.95	7.99	8.03	8.06
	Open Circuit Voltage	V_{OC} [V]	43.94	44.16	44.38	44.59
	Current at MPP	I_{MPP} [A]	7.35	7.40	7.46	7.51
	Voltage at MPP	V_{MPP} [V]	36.44	36.68	36.91	37.14

¹Measurement tolerances P_{MPP} ± 3%; I_{SC}, V_{OC} ± 5% at STC: 1000 W/m², 25 ± 2 °C, AM 1.5 G according to IEC 60904-3. ²800 W/m², NMOT, spectrum AM 1.5 G

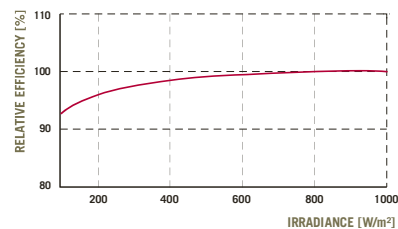
Q CELLS PERFORMANCE WARRANTY



At least 97% of nominal power during first year. Thereafter max. 0.54% degradation per year.
At least 92% of nominal power up to 10 years.
At least 84% of nominal power up to 25 years.

All data within measurement tolerances.
Full warranties in accordance with the warranty terms of the Q CELLS sales organization of your respective country.

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25 °C, 1000 W/m²).

TEMPERATURE COEFFICIENTS

Temperature Coefficient of I_{SC}	α	[%/K]	+0.04	Temperature Coefficient of V_{OC}	β	[%/K]	-0.29
Temperature Coefficient of P_{MPP}	γ	[%/K]	-0.39	Normal Operating Module Temperature	NMOT	[°F]	109 ± 5.4 (43 ± 3 °C)

PROPERTIES FOR SYSTEM DESIGN

Maximum System Voltage V_{SYS}	[V]	1500 (IEC) / 1500 (UL)	Safety Class	II
Maximum Series Fuse Rating	[A DC]	20	Fire Rating	C (IEC) / TYPE 1 (UL)
Max. Design Load, Push / Pull (UL)²	[lbs/ft²]	75 (3600 Pa) / 33 (1600 Pa)	Permitted module temperature on continuous duty	-40 °F up to +185 °F (-40 °C up to +85 °C)
Max. Test Load, Push / Pull (UL)²	[lbs/ft²]	113 (5400 Pa) / 50 (2400 Pa)	² see installation manual	

QUALIFICATIONS AND CERTIFICATES

UL 1703; CE-compliant;
IEC 61215:2016, IEC 61730:2016 application class A



PACKAGING INFORMATION

Number of Modules per Pallet	29
Number of Pallets per 53' Trailer	26
Number of Pallets per 40' High Cube Container	22
Pallet Dimensions (L × W × H)	81.9 in × 45.3 in × 46.7 in (2080 mm × 1150 mm × 1190 mm)
Pallet Weight	1635 lbs (742 kg)

NOTE: Installation instructions must be followed. See the installation and operating manual or contact our technical service department for further information on approved installation and use of this product.

Hanwha Q CELLS America Inc.

300 Spectrum Center Drive, Suite 1250, Irvine, CA 92618, USA | TEL +1 949 748 59 96 | EMAIL inquiry@us.q-cells.com | WEB www.q-cells.us

TABUCHI ELECTRIC

Three-phase 25kW Solar Inverter M25-6



6 MPPT Inverter

Designed for Distributed Solar

- ▶ Improved system performance
- ▶ 98.7% Maximum Efficiency
- ▶ 10-year Warranty (20-year option)
- ▶ Lower BOS costs - No need for combiner boxes
- ▶ Increased system reliability
- ▶ Optional Rapid Shutdown & Monitoring Systems

www.tabuchiaamerica.com



M25-6: Three-phase 25kW Solar Inverter (Model Number : TPD-250P6-US)

Input (DC)

Nominal Input power per string	4300 W (5200 W / output limited)
Max. input voltage	1000 V
Operation voltage range	200-1000 V
MPPT voltage range	200 V to 800 V
Nominal input voltage range	500 V to 800 V
Min. input voltage / starting voltage	200 V/200 V
Operating input current per string	10 A
Max. short circuit current per string	20 A
Number of MPP tracker inputs	6

Efficiency

Max. Efficiency	98.7%
CEC Efficiency	97.5%

Protection

Islanding Operation Detection: Active	Frequency shifting method
Islanding Operation Detection: Passive	Frequency change detective method

Output (AC: Grid connected)

Rated output power*	25000 W
Grid connection type	Three-phase, 4-wire type
Rated AC voltage	480 V (277 V WYE)
Rated power frequency	60 Hz
Rated output current	30 A
Power factor at rated output power	≥ 0.99

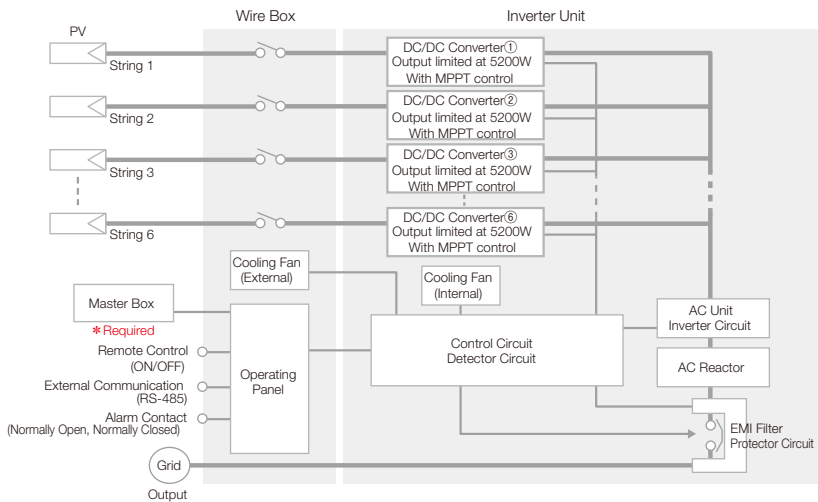
* When the Power factor is 100% during inverter operation.

General Data

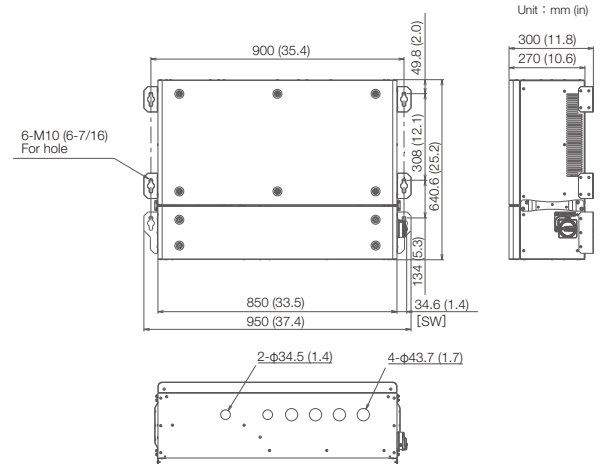
Dimensions W x H x D	950 x 640.6 x 300 mm (37.4 x 25.2 x 11.8 in)
Weight	69 kg (152.1 lb)
Operating temperature range	-20°C to +60°C (-4°F to +140°F) Rated output until +40°C (+104°F)
Internal consumption (night)	< 8 W
Cooling concept	Cooling Fan
Enclosure Rating	NEMA3
Controller/Interface	Master Box* (Required)/RS485
Certification	ETL(UL 1741/1699B, CSA C22.2 No. 107.1-01, IEEE 1547a, CEC) , FCC class A
Topology	Transformer-less

* Master Box is required to use three-phase 25 kW inverter.

Block Diagram



Dimensions



Some specifications or aspects of appearance may be changed without notice to improve the product.

NOTE: GOAB SHALL BE LOCATED IN LOCATION VISIBLE TO UTILITY AND ACCESSIBLE AT ALL TIMES - 24/7

SYSTEM INFORMATION:

XFMR #	MAIN SWITCHBOARD	Combiner Panel	INVERTER QTY	INVERTER MODEL	INVERTER NAMEPLATE KW	INVERTER MAX OUTPUT KW	PANEL TYPE	PANEL WATTS	NO. OF PANELS	NO. OF STRINGS PER ACP	NO. OF PANELS PER STRING	TILT	AZIMUTH	KWDC
A	MSB-A	ACPA-1	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	1080	60	18	20	180	361.8
		ACPA-2	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	882	49	18	20	180	295.47
		ACPA-3	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	900	50	18	20	180	301.5
		ACPA-4	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	900	50	18	20	180	301.5
		T#1 TOTALS	40		1000				3762					1260.27
B	MSB-B	ACPB-1	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	1152	64	18	20	180	385.92
		ACPB-2	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	1080	60	18	20	180	361.8
		ACPB-3	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	990	55	18	20	180	331.65
		ACPB-4	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	990	55	18	20	180	331.65
		T#2 TOTALS	40		1000				4212					1411.02
		SITE TOTALS	80		2000				7974					2671.29

REV	DATE	DESCRIPTION	REVISION	ISSUED FOR REVIEW	DATE	BY



Stephen A. Bray
PROFESSIONAL ENGINEER

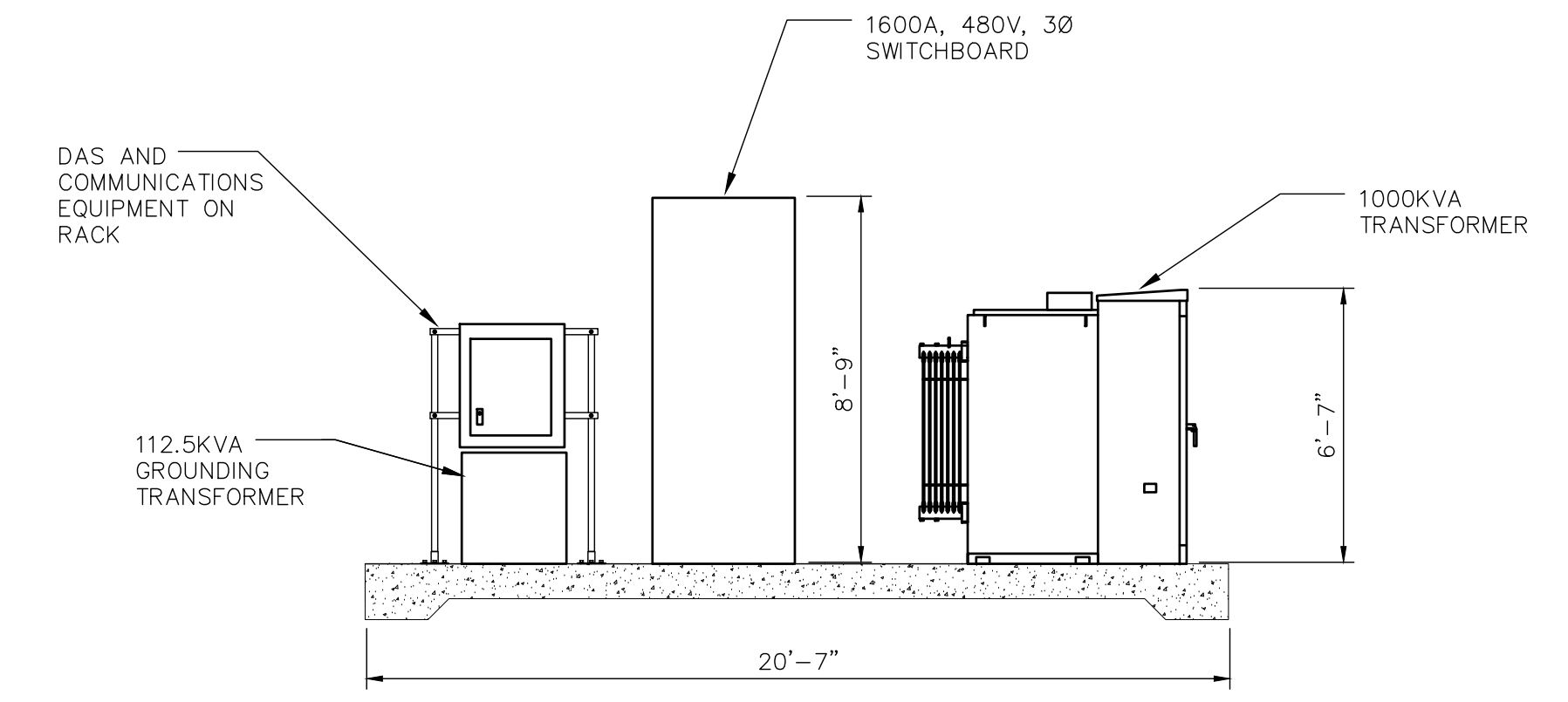
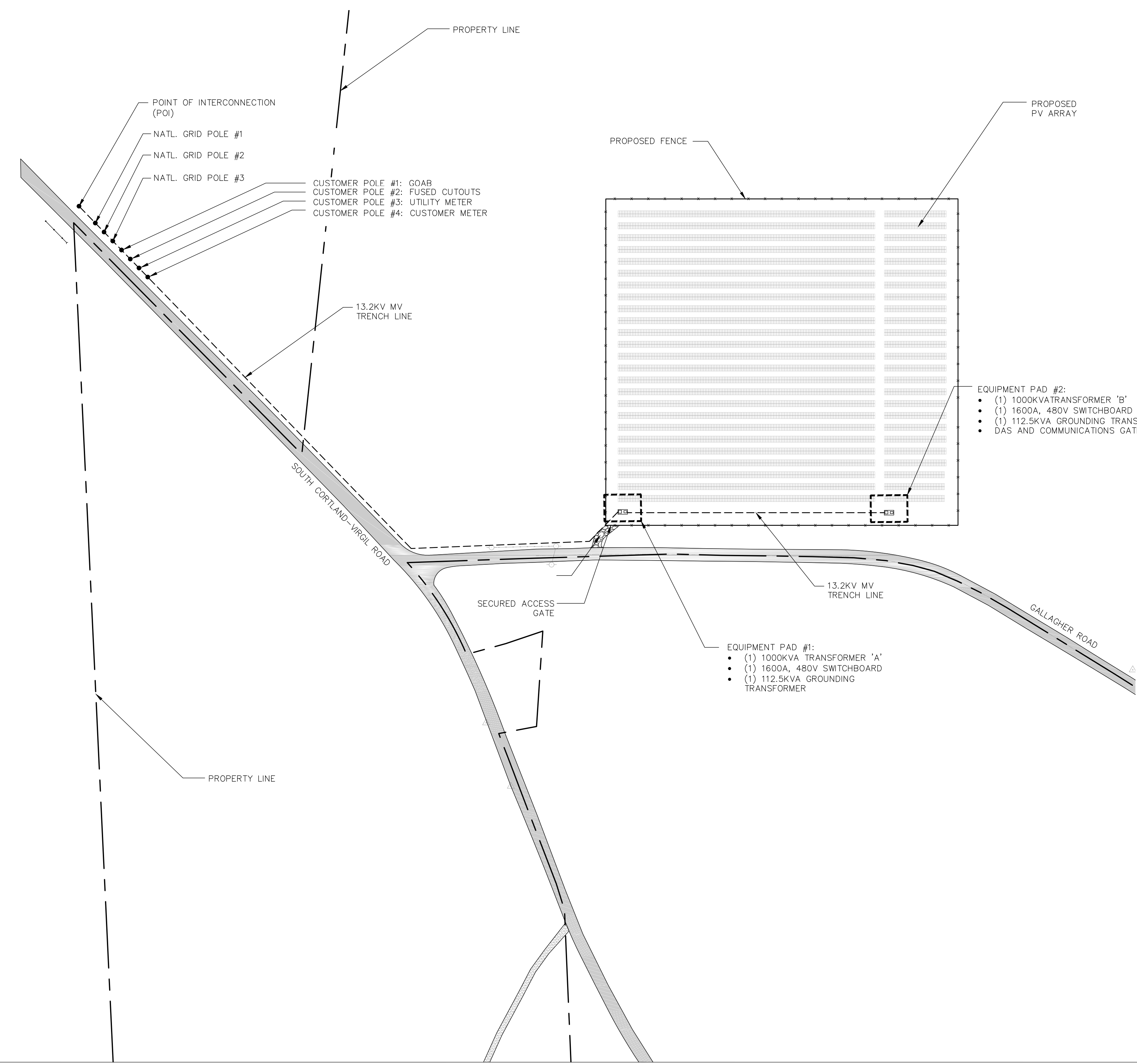
NY LICENSE: 086064 1/23/2019

NY COMMUNITY SOLAR
- GUTCHESSE LUMBER SCM SOLAR
- 1.992 MWAC/2.67 MWDC GROUND MOUNT PHOTOVOLTAIC SYSTEM
1027 GALLAGHER RD.
CORTLAND, NY 13045

KMB PROJECT #:
732.0507.010
DRAWING TITLE:
PHOTOVOLTAIC SITE PLAN SHEET 1

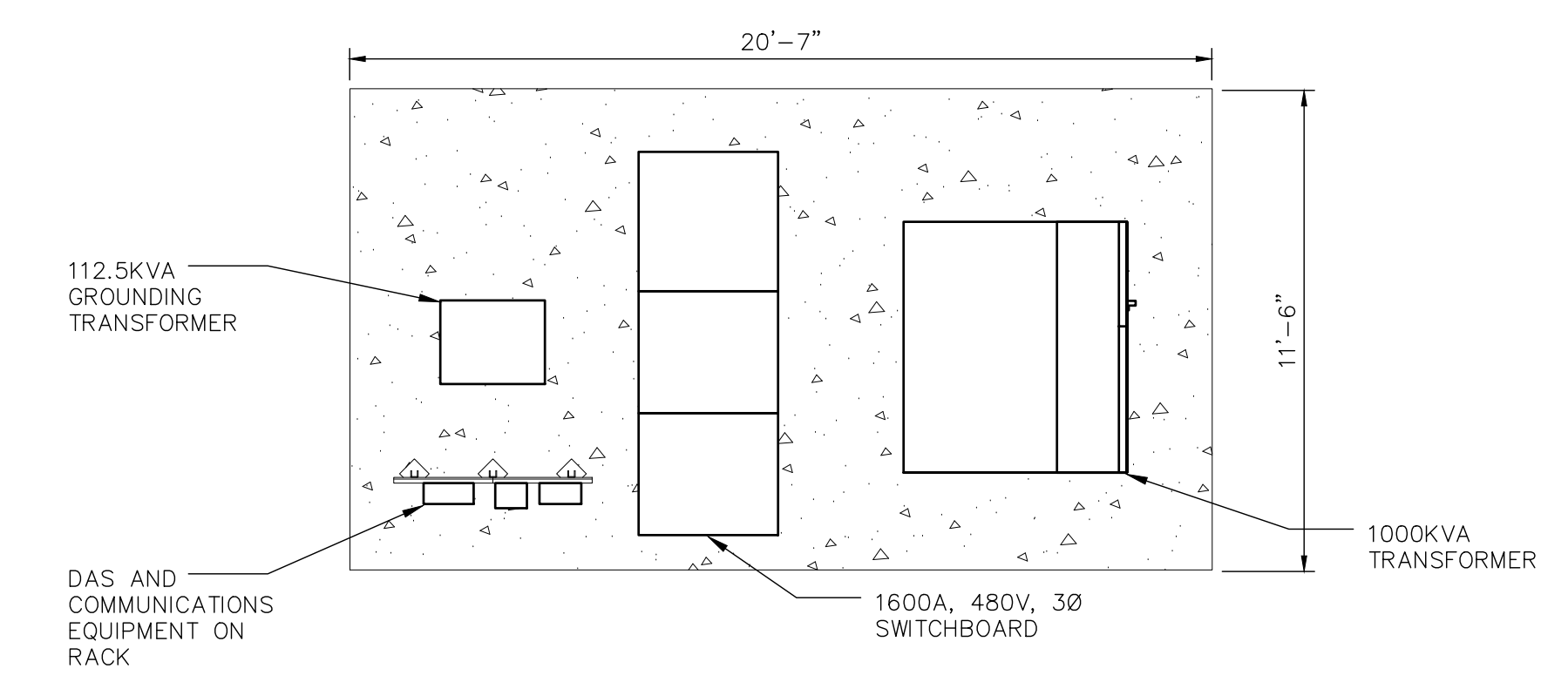
DRAWING SCALE:
NONE
DRAWN BY: JD
CHECKED BY: MLWJR
DATE: 12.14.18

PV-100



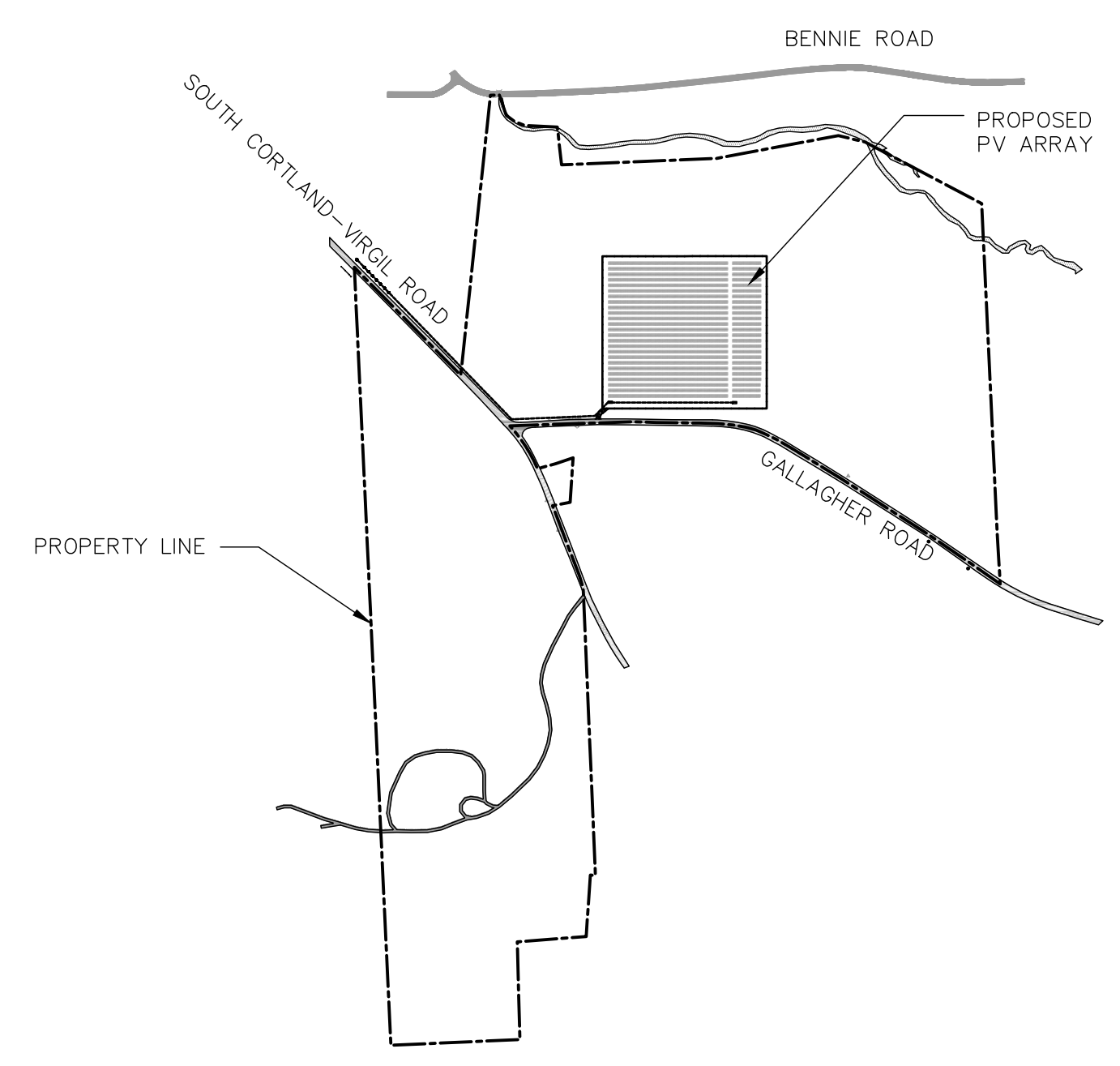
2 EQUIPMENT PAD ELEVATION - TYPICAL OF 2.

SCALE: 1/4" = 1'-0"



3 EQUIPMENT PAD DETAIL - TYPICAL OF 2.

SCALE: 1/4" = 1'-0"



4 PROPERTY LINE KEY PLAN

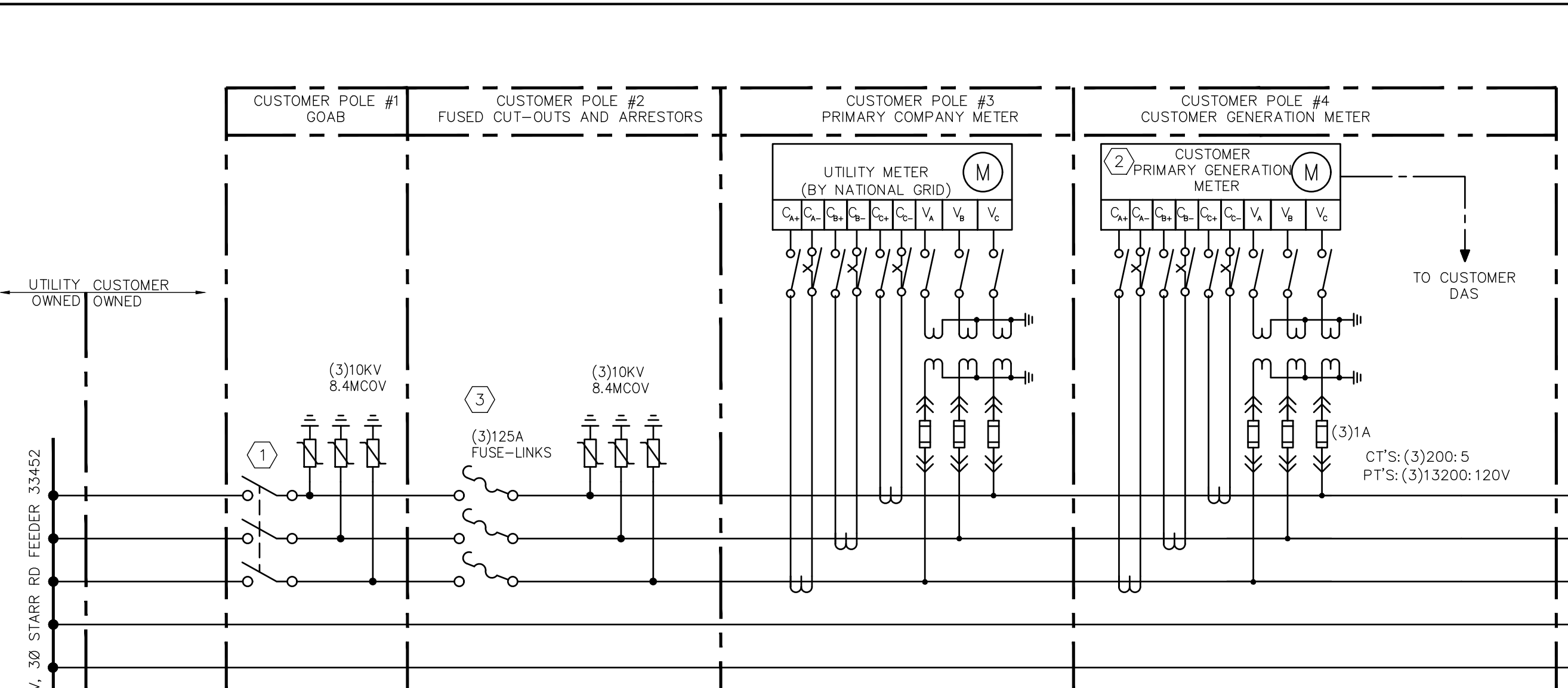
SCALE: NTS

1 SYSTEM LAYOUT

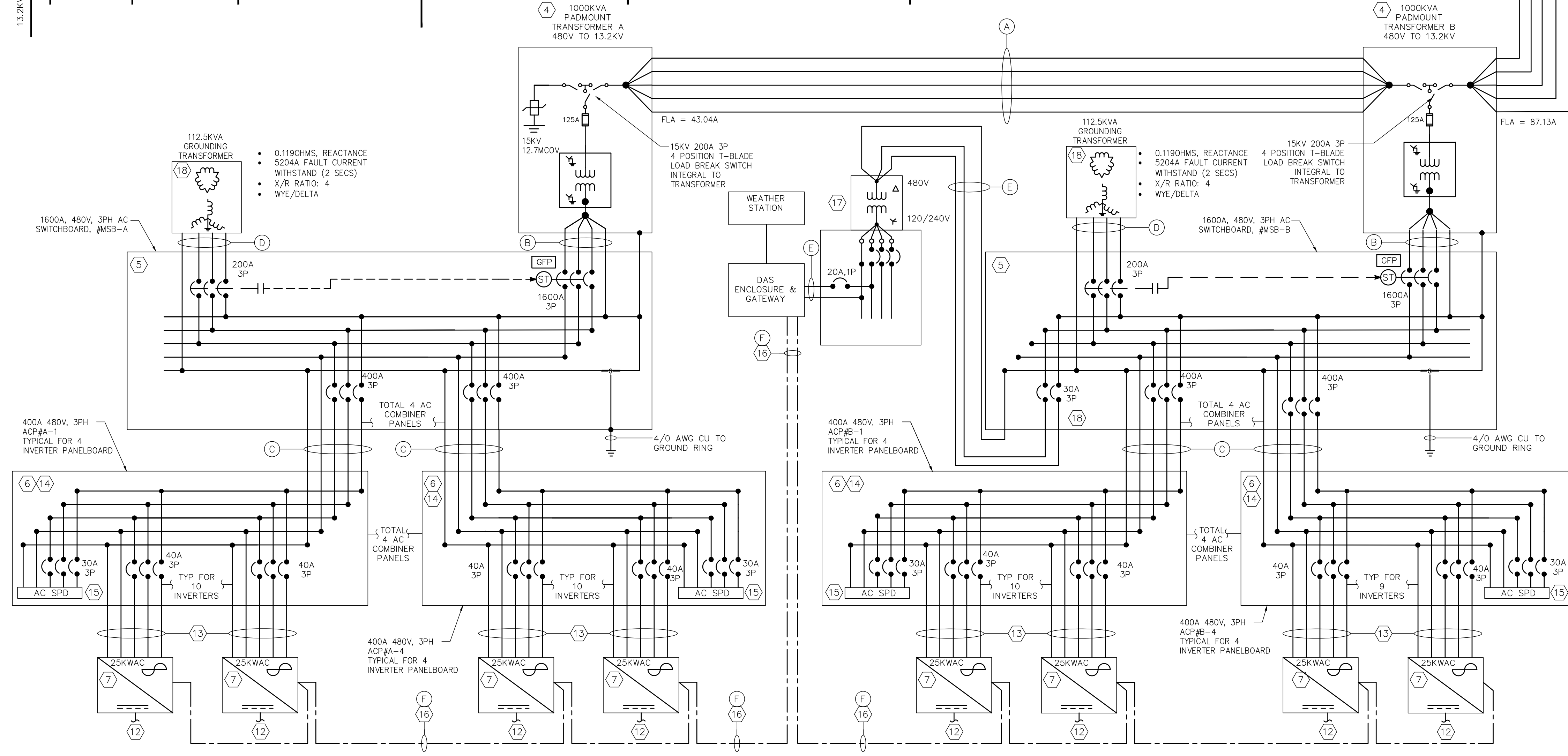
SCALE: 1/128" = 1'-0"

OWNERSHIP OF DOCUMENTS: THIS DOCUMENT AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS IN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF KMB DESIGN GROUP, LLC AND ARE NOT TO BE USED, IN WHOLE OR IN PART, FOR OTHER PROJECTS WITHOUT THE WRITTEN AUTHORIZATION OF KMB DESIGN GROUP, LLC. IT IS UNLAWFUL FOR ANY PERSON TO AMEND ANY ASPECT OF THESE DRAWINGS UNLESS THEY HAVE THE APPROVAL OF THE LICENSED PROFESSIONAL IN WRITING.

OWNERSHIP OF DOCUMENTS: THIS DOCUMENT AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF KMB DESIGN GROUP, LLC AND ARE NOT TO BE USED, IN WHOLE OR IN PART, FOR OTHER PROJECTS WITHOUT THE WRITTEN AUTHORIZATION OF KMB DESIGN GROUP, LLC. IT IS UNLAWFUL FOR ANY PERSON TO AMEND ANY ASPECT OF THESE DRAWINGS UNLESS THEY HAVE THE APPROVAL OF THE LICENSED PROFESSIONAL IN WRITING.



SYSTEM INFORMATION:														
XFMR #	MAIN SWITCHBOARD	Combiner Panel	INVERTER QTY	INVERTER MODEL	INVERTER NAMEPLATE KW	INVERTER MAX OUPUT KW	PANEL TYPE	PANEL WATTS	NO. OF PANELS	NO. OF STRINGS PER ACP	NO. OF PANELS PER STRING	TILT	AZIMUTH	KWDC
A	MSB-A	ACPA-1	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	1080	60	18	20	180	361.8
		ACPA-2	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	882	49	18	20	180	295.47
		ACPA-3	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	900	50	18	20	180	301.5
		ACPA-4	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	900	50	18	20	180	301.5
		T#1 TOTALS	40		1000				3762					1260.27
B	MSB-B	ACPB-1	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	1152	64	18	20	180	385.92
		ACPB-2	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	1080	60	18	20	180	361.8
		ACPB-3	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	990	55	18	20	180	331.65
		ACPB-4	10	Tabuchi 25KW	25	24	Hanwha Q Cell 335	335	990	55	18	20	180	331.65
		T#2 TOTALS	40		1000				4212					1411.02
		SITE TOTALS	80		2000				7974					2671.29



EQUIPMENT SPECIFICATIONS			
MODULE SPECIFICATIONS			
Hanwha Q Cell 335			
MAX POWER OUTPUT (WATTS)	335		
MAX VOLTAGE (VOLTS)	37.33		
MAX CURRENT (AMPS)	8.97		
OPEN CIRCUIT VOLTAGE (VOLTS)	46.81		
SHORT CIRCUIT CURRENT (AMPS)	9.54		
INVERTER SPECIFICATIONS			
Tabuchi 25KW			
RATED OUTPUT (KW)	24.0		
AC RATED OUTPUT (VOLTS)	480		
AC RATED CURRENT (AMPS)	30.00		
POWER FACTOR	>0.99		
PEAK EFFICIENCY EFF%	98.5%		

AC WIRE AND CONDUIT SCHEDULE:			
CONDUIT ID	MINIMUM VOLTAGE	WIRE SIZE & TYPE	MINIMUM CONDUIT
A	13.2KV	(3) #2AL MV-105, 15KV 100% EPR INSULATED MV CABLE + (1) #6 AL THWN-2 GRND	(2) 2-1/2"
B	480V	6 SETS OF: (4) 400 KCMIL AL THWN-2 + 300 KCMIL GND	(6) 4"
C	480V	2 SETS OF: (4) 250 KCMIL AL THWN-2 + #1 AWG GND	(2) 2-1/2"
D	480V	(4) 3/0AWG CU THWN-2 + 6AWG GROUND	2"
E	120V & 480V	(2) #12 THWN-2 + 12AWG GROUND	#REF!
F	-	RS-485 MODBUS COMMUNICATIONS CABLE	(1) 1"

AC WIRE AND CONDUIT SCHEDULE			
CONDUIT ID	MINIMUM VOLTAGE	WIRE SIZE & TYPE	MINIMUM CONDUIT
A	13.2KV	(3) #2AL MV-105, 15KV 100% EPR INSULATED MV CABLE + (1) #6 AL THWN-2 GRND	(2) 2-1/2"
B	480V	6 SETS OF: (4) 400 KCMIL AL THWN-2 + 300 KCMIL GND	(6) 4"
C	480V	2 SETS OF: (4) 250 KCMIL AL THWN-2 + #1 AWG GND	(2) 2-1/2"
D	480V	(4) 3/0AWG CU THWN-2 + 6AWG GROUND	2"
E	120V & 480V	(2) #12 THWN-2 + 12AWG GROUND	#REF!
F	-	RS-485 MODBUS COMMUNICATIONS CABLE	(1) 1"

AC COMBINER PANEL INVERTER ALLOCATION			
PANELBOARD ACP#	# of 24KW INVERTERS	SWITCHBOARD MSB	
ACPA-1	10	MSB-A	
ACPA-2	10		
ACPA-3	10		
ACPA-4	10		
ACPB-1	10	MSB-B	
ACPB-2	10		
ACPB-3	10		
ACPB-4	10		

GENERAL NOTES:

- THE INSTALLATION CONTRACTOR WILL BE RESPONSIBLE FOR MAINTAINING THE INTEGRITY OF THE NEMA 4 ENCLOSURES. ALL CONDUIT MUST ENTER THE COMBINER BOXES AND BE PROPERLY GASKETED.
- ELECTRICAL CONTRACTOR SHALL IDENTIFY SOURCE WIRING WITH MARKING TAPE OR OTHER APPROVED METHOD. POSITIVE SHALL BE MARKED RED AND NEGATIVE MARKED BLACK. CONDUCTORS 4 AWG AND LARGER SHALL BE IDENTIFIED AT ALL TERMINATIONS. AS PER NEC 200.6 (A)(6) A SINGLE CONDUCTOR, SUNLIGHT RESISTANT, PROVIDE COMPRESSION LUGS AT BUS TERMINATIONS.
- ALL DC CONDUCTORS SHALL BE 1000VDC MIN. RATED PV WIRE. IN NO INSTANCE SHALL WHITE WIRE BE USED FOR DC SOURCE CIRCUIT WIRING.
- ALL EQUIPMENT AND PANELS SHALL BE MARKED IN ACCORDANCE WITH ARTICLE 690 OF THE NEC. SEE PV-403 FOR SIGNAGE REQUIREMENTS.

LINETYPE LEGEND:

--- EXISTING TO REMAIN
 - - - NEW
 - - - NEW RS485 COMMUNICATIONS

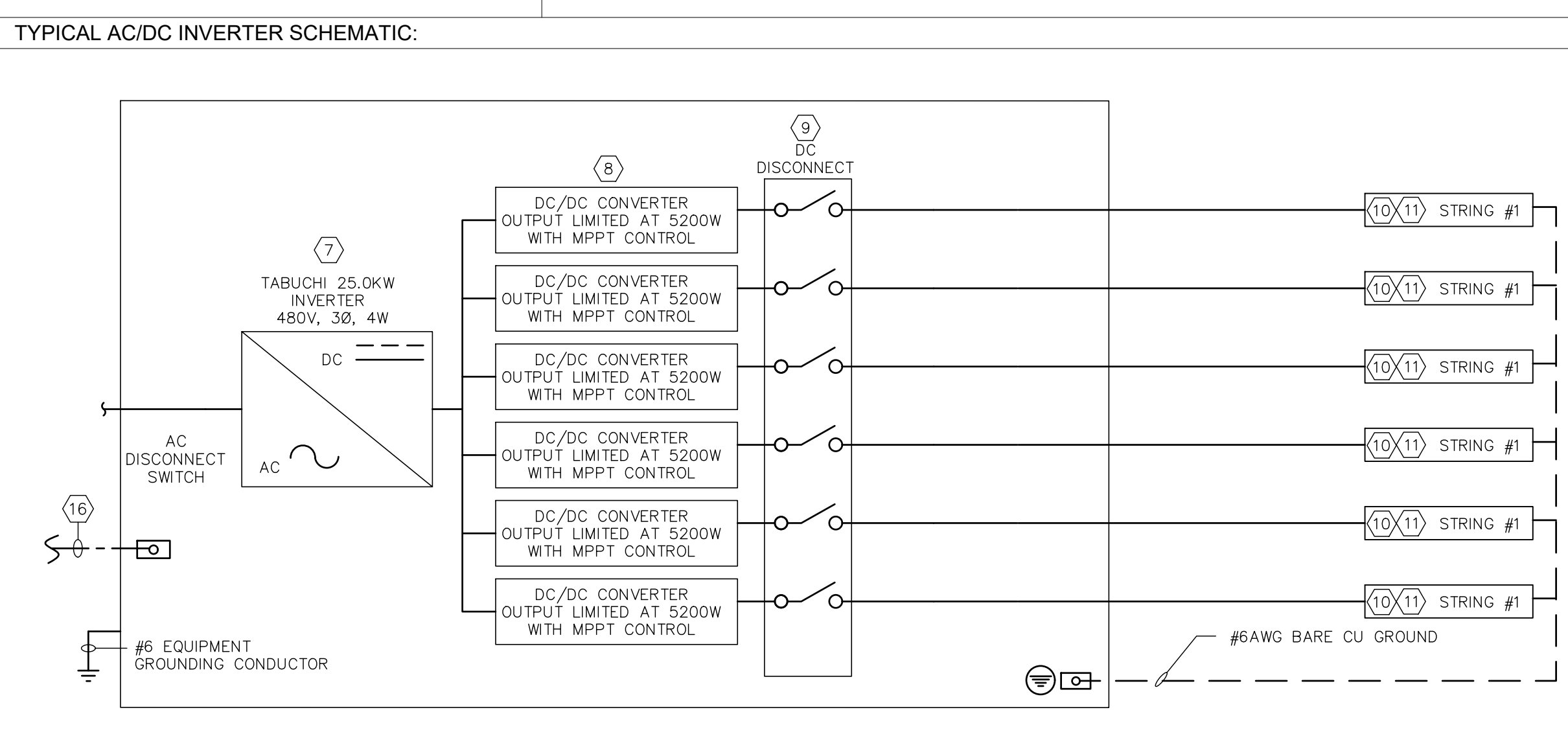
(N) NEW
 (E) EXISTING

KEY NOTES:

- 15KV, 600A, POLE MOUNTED GANG-OPERATED AIR-BREAK SWITCH, SWITCH SHALL BE PROVIDED WITH VISIBLE BREAK, LOCKABLE OPERATING HANDLE AND BE ACCESSIBLE TO UTILITY 24/7. 10KV STATION CLASS 8.4MCOV ARRESTORS SHALL BE INSTALLED ON POLE AT GOAB LOCATION
- NEW 15KV CUSTOMER POLE MOUNTED METERING CLUSTER. METERING SHALL BE SUPPLIED WITH METERING CLASS PT AND CT RATIOS AS INDICATED. METER SHALL BE INTERCONNECTED WITH CUSTOMERS DAS GATEWAY.
- NEW 15KV 125A FUSE LINKS INSTALLED IN POLE MOUNTED CUTOUTS. FUSE-LINKS SHALL SERVE TO PROVIDE PROTECTION FOR UNDERGROUND CONDUCTORS FROM CUSTOMER POLE TO TRANSFORMERS. 15KV STATION CLASS 12.7MCOV ARRESTORS SHALL BE INSTALLED ON POLE AT CUTOUT LOCATION
- PAD MOUNTED GENERATOR STEP UP TRANSFORMER (GSU), SIZE AS INDICATED. TRANSFORMER SHALL HAVE DESIGN IMPEDANCE OF 5.75% Z. HV: 7603/13200V GRND-WYE; LV: 277/480V GRND-WYE WITH SOLIDLY GROUND NEUTRAL. TRANSFORMER SHALL BE PROVIDED WITH 200A LOOP FEED BUSHINGS. (1) TRANSFORMER SHALL BE PROVIDED WITH 10KV, 8.4MCOV ELBOW MOUNTED SURGE ARRESTORS
- NEW 1600A, 277/480V, 3Ø, 4W, HEAVY DUTY, NEMA 3R PV AC MAIN SOLAR SWITCHGEAR. SWITCHGEAR SHALL BE PROVIDED WITH BRANCH BREAKERS AS INDICATED. WHERE POSSIBLE, BRANCH BREAKERS SHALL BE INSTALLED WITH SPACE BETWEEN ADJACENT BREAKERS TO ALLOW FOR AIR CIRCULATION BETWEEN BREAKERS.
- NEW 400A, 277/480V, 3Ø, 4W, MLO, HEAVY DUTY, NEMA 3R, PV AC COMBINER PANELBOARD WITH 40A 3P BREAKERS FOR INTERCONNECTION OF PV INVERTERS. BREAKERS SHALL BE LABELED AS PV DISCONNECTS.
- NEW TABUCHI 25.0KW INVERTER, 25KW 480V, 3Ø, 4W PV INVERTER. SEE TYPICAL AC/DC INVERTER SCHEMATIC ON THIS SHEET.
- DC/DC CONVERTER OUTPUT LIMITED AT 5200W WITH MPPT CONTROL

TYPICAL AC/DC INVERTER SCHEMATIC:

- DC DISCONNECT SWITCH, SUPPLIED INTEGRAL WITH THE INVERTER CABINET, 1000 VDC.
- HANWHA 335W SOLAR PANELS WIRING IN SERIES. EACH MODULE INCLUDES 1 #10 AWG OUTDOOR RATED QUICK CONNECTS FOR MODULE INTERCONNECTION. DO NOT REMOVE THE QUICK CONNECTS, OTHERWISE THE MODULE WARRANTY AND THE UL LISTING MAY BE INVALIDATED. QUICK CONNECTS SHALL COMPLY WITH NEC 690.33(C).
- INDIVIDUAL MODULES SHALL BE BONDED TO THE RACKING SYSTEM USING APPROVED RACKING GROUNDING LUG.
- REFER TO SYSTEM INFORMATION TABLE AND DC WIRING SCHEDULE ON SHEET PV-201 FOR INVERTER DC MODULE/STRING QUANTITIES AND CONDUCTOR SIZES.
- REFER TO INVERTER AC WIRING SCHEDULE ON SHEET PV-201 FOR INVERTER AC CONDUCTOR AND CONDUIT SIZES.
- SEE INVERTER TO PANELBOARD SCHEDULE ON THIS SHEET FOR ADDITIONAL INFORMATION ON ALLOCATION OF INVERTER TO PANELBOARDS.
- PROVIDE 277/480V, 3Ø TYPE 1 SURGE PROTECTIVE DEVICE. DEVICE SHALL BE WIRED TO LOAD SIDE OF 50A, 3P BREAKER WITH MANUFACTURER PROVIDED LEADS.
- NEW RS-485 WIRE MODBUS COMMUNICATION CABLE DAISY CHAINED BETWEEN INVERTERS. WEATHERSTATION AND MAIN DAS GATEWAY. CONFIRM CABLE CONFIGURATION WITH DAS PROVIDER AND SOLAREDEGE PRIOR TO INSTALLATION.
- PROVIDE NEW 5KVA MINI POWER-ZONE PACKAGED POWER SUPPLY. SQUARE-D MODEL #MPZ5540F OR APPROVED EQUAL. POWER SUPPLY SHALL BE SUPPLIED WITH 5KVA ENCAPSULATED TRANSFORMER AND INTEGRATED 120/240V, 1Ø LOAD CENTER IN NEMA 3R ENCLOSURE.
- PROVIDE NEW "ZIG-ZAG" WYE-GRND:DELTA GROUNDING TRANSFORMER. TRANSFORMER SHALL BE PROVIDED IN NEMA 3R ENCLOSURE AND ITS CIRCUIT BREAKER SHALL BE PROVIDED WITH AUXILIARY CONTACTS TO FACILITATE SHUNT TRIP OF THE 400A ACP FEEDERS UPON OPENING OF THE GROUNDING TRANSFORMER BREAKER.



KMB DESIGN GROUP
 1800 ROUTE 14 SUITE 209
 WALL KILLIP
 07730-5633
 FOR ALL QUESTIONS PLEASE CONTACT
 ALLISON D. KIRSHALL, PROJECT MANAGER

Stephen A. Bray
 PROFESSIONAL ENGINEER

NY LICENSE: 086084 1/23/2019

NY COMMUNITY SOLAR
 - GUTCHESS LUMBER SCM SOLAR
 1.992 MWAC/2.67 MWDC GROUND MOUNT PHOTOVOLTAIC SYSTEM
 1027 GALLAGHER RD.
 CORTLAND, NY 13045

DRAWING NO: **732.0507.010**
 DRAWING TITLE: **PHOTOVOLTAIC 3-LINE SHEET 1**
 DRAWING SCALE: NONE
 DRAWN BY: [] CHECKED BY: [] DATE: 12.14.18
 DWG NO.: **PV-200**

OWNERSHIP OF DOCUMENTS: THIS DOCUMENT AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF KMB DESIGN GROUP, LLC AND ARE NOT TO BE USED, IN WHOLE OR IN PART, FOR OTHER PROJECTS WITHOUT THE WRITTEN AUTHORIZATION OF KMB DESIGN GROUP, LLC. IT IS UNLAWFUL FOR ANY PERSON TO AMEND ANY ASPECT OF THESE DRAWINGS UNLESS THEY HAVE THE APPROVAL OF THE LICENSED PROFESSIONAL IN WRITING.

DC WIRING SCHEDULE				
INVERTER #	STRING HOME RUN WIRE SIZE AND TYPE	EQUIPMENT GROUND SIZE	MODULES PER STRING	NUMBER OF STRINGS
INVA-1	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-2	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-3	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-4	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-5	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-6	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-7	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-8	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-9	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA-10	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA2-1	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA2-2	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA2-3	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA2-4	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVA2-5	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA2-6	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA2-7	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA2-8	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA2-9	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-1	#10 AWG 1KV PV WIRE	#10 AWG	19	5
INVA3-2	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-3	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-4	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-5	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-6	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-7	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-8	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-9	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA3-10	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA4-1	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVA4-2	#10 AWG 1KV PV WIRE	#10 AWG	19	5
INVA4-3	#10 AWG 1KV PV WIRE	#10 AWG	20	5
INVA4-4	#10 AWG 1KV PV WIRE	#10 AWG	21	5
INVA4-5	#10 AWG 1KV PV WIRE	#10 AWG	22	5
INVA4-6	#10 AWG 1KV PV WIRE	#10 AWG	23	5
INVA4-7	#10 AWG 1KV PV WIRE	#10 AWG	24	5
INVA4-8	#10 AWG 1KV PV WIRE	#10 AWG	25	5
INVA4-9	#10 AWG 1KV PV WIRE	#10 AWG	26	5
INVA4-10	#10 AWG 1KV PV WIRE	#10 AWG	27	5
INVB1-1	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-2	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-3	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-4	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-5	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-6	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-7	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-8	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-9	#10 AWG 1KV PV WIRE	#10 AWG	18	6
INVB1-10	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB1-11	#10 AWG 1KV PV WIRE	#10 AWG	19	5
INVB2-1	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-2	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-3	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-4	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-5	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-6	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-7	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-8	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-9	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-10	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB2-11	#10 AWG 1KV PV WIRE	#10 AWG	19	5
INVB3-1	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-2	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-3	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-4	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-5	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-6	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-7	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-8	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-9	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-10	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB3-11	#10 AWG 1KV PV WIRE	#10 AWG	18	5
INVB4-1	#10 AWG 1KV PV WIRE	#10 AWG	19	5
INVB4-2	#10 AWG 1KV PV WIRE	#10 AWG	20	5
INVB4-3	#10 AWG 1KV PV WIRE	#10 AWG	21	5
INVB4-4	#10 AWG 1KV PV WIRE	#10 AWG	22	5
INVB4-5	#10 AWG 1KV PV WIRE	#10 AWG	23	5
INVB4-6	#10 AWG 1KV PV WIRE	#10 AWG	24	5
INVB4-7	#10 AWG 1KV PV WIRE	#10 AWG	25	5
INVB4-8	#10 AWG 1KV PV WIRE	#10 AWG	26	5
INVB4-9	#10 AWG 1KV PV WIRE	#10 AWG	27	5
INVB4-10	#10 AWG 1KV PV WIRE	#10 AWG	28	5
INVB4-11	#10 AWG 1KV PV WIRE	#10 AWG	29	5

INVERTER AC WIRE SCHEDULE			
INVERTER #	MINIMUM VOLTAGE	CONDUCTOR SIZE & TYPE	MINIMUM CONDUIT (WHERE REQUIRED)
INVA-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA2-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA3-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA4-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA4-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA4-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA4-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA4-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVA4-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB1-11	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB2-11	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB3-11	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-1	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-2	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-3	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-4	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-5	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-6	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-7	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-8	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-9	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(1) 3/4"
INVB4-10	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(3) 3/4"
INVB4-11	480V 3PH	(4) #8 AWG CU THWN-2 + #10 AWG GND	(3) 3/4"



Stephen A. Bray
PROFESSIONAL ENGINEER

NY LICENSE: 086084 1/23/2019

NY COMMUNITY SOLAR
- GUTCHESS LUMBER SCM SOLAR
1.992 MWAC/2.67 MWDC GROUND MOUNT PHOTOVOLTAIC SYSTEM
1027 GALLAGHER RD.
CORTLAND, NY 13045

PROJECT NO: **732.0507.010**

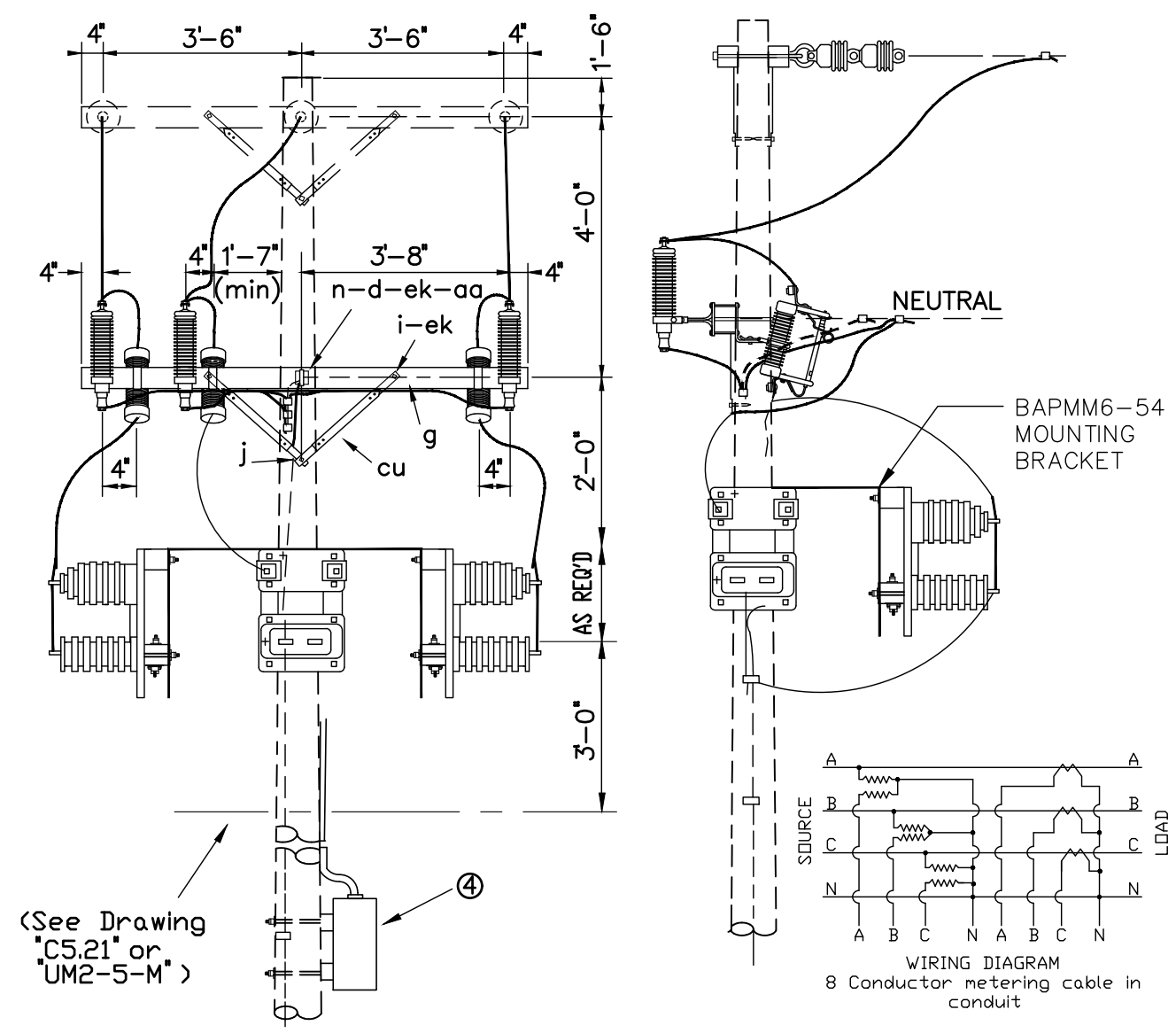
DRAWING TITLE:
**PHOTOVOLTAIC
3-LINE
SHEET 2**

DRAWING SCALE:
NONE

DRAWN BY:	CHECKED BY:	DATE:
TR	MLWJR	12.14.18

PV-201

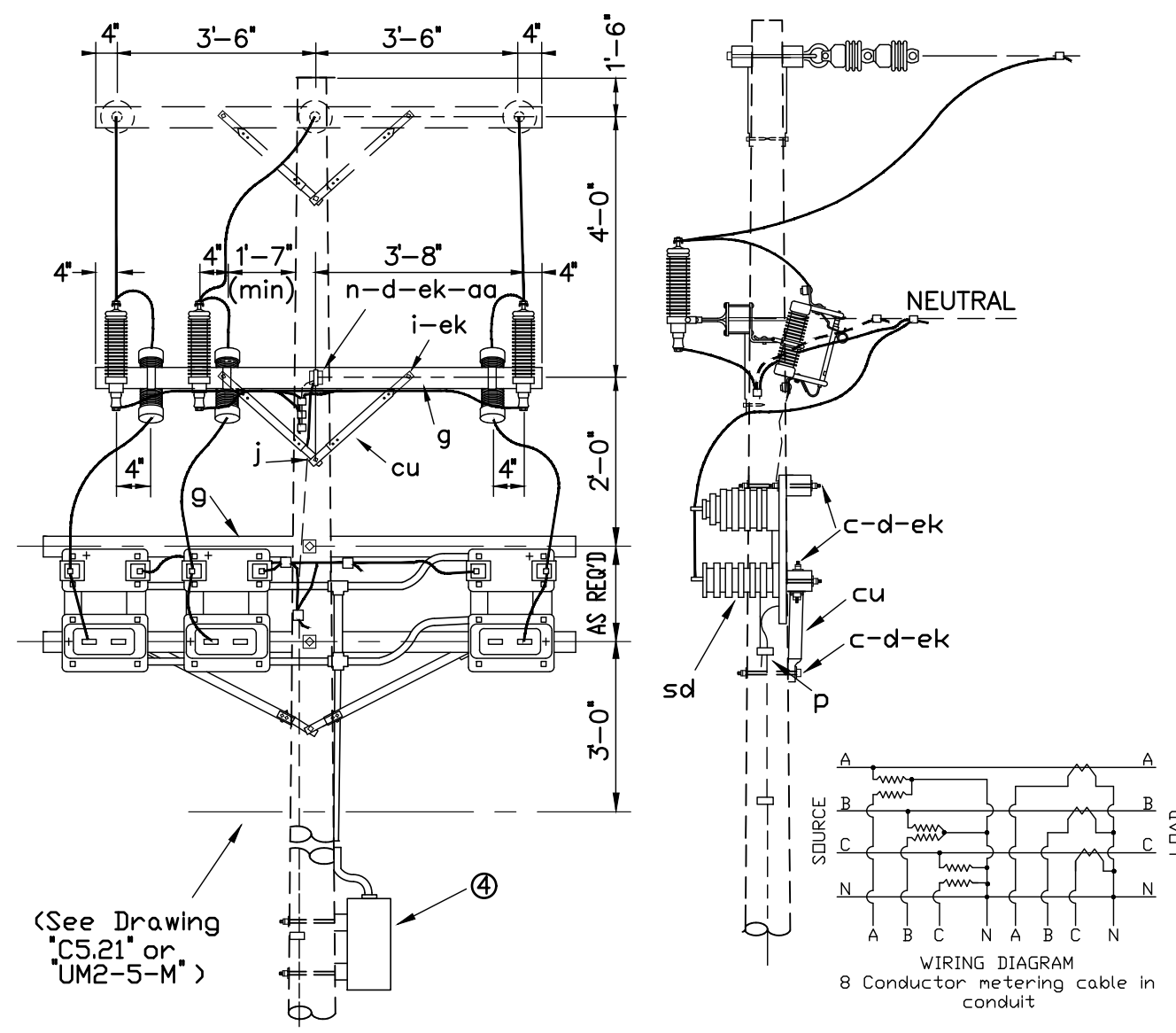
OWNERSHIP OF DOCUMENTS: THIS DOCUMENT AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF KMB DESIGN GROUP, LLC AND ARE NOT TO BE USED, IN WHOLE OR IN PART, FOR OTHER PROJECTS WITHOUT THE WRITTEN AUTHORIZATION OF KMB DESIGN GROUP, LLC. IT IS UNLAWFUL FOR ANY PERSON TO AMEND ANY ASPECT OF THESE DRAWINGS UNLESS THEY HAVE THE APPROVAL OF THE LICENSED PROFESSIONAL IN WRITING.



ITEM QTY	MATERIAL	ITEM QTY	MATERIAL
c 5	Bolt, machine, 5/8" x req'd length	ae 3	Arrester, surge (9 kV)
c 26	Bolt, machine, 1/2" x req'd length	af 3	Cutout, dist. open (15 kV)
d 33	Washer, 2 1/4" square	cu 2	Brace, 28"
d 2	Washer, round, 1 3/8" dia.	cu 1	Brace, wood, 60" span
g 1	Crossarm, 3 5/8" x 4 5/8" x 8-0"	④	Meter box, meter on test block
g 2	Crossarm, 3 5/8" x 4 5/8" x 10-0"	sd 3	Transformer, current
i 2	Bolt, carriage, 3/8" x 4 1/2"	se 3	Transformer, potential
j 1	Screw, lag, 1/2" x 4"	ek 34	Locknuts
n 1	Bolt, double arming, 5/8" x req'd length	* 6	Mounting brackets
p	Connectors, as required	aa 1	Nut, eye, 5/8"
aa 1	Nut, eye, 5/8"	av	Jumper, primary, bare, as required
av	Jumper, primary, bare, as required		

*Specify this item to be furnished by the transformer manufacturer.

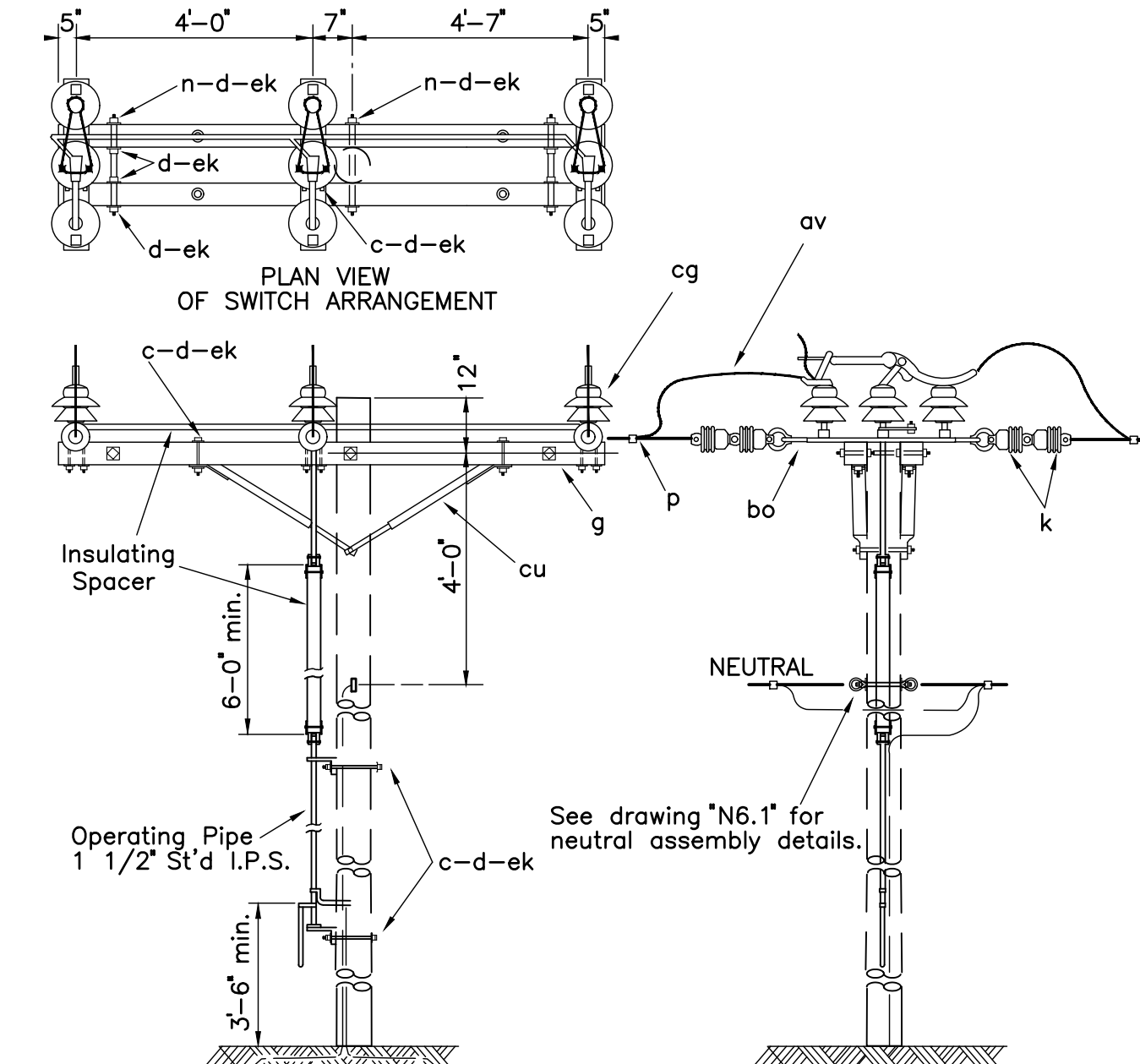
UTILITY METERING POLE DETAILS ARE SHOWN FOR DIAGRAMMATIC PURPOSES ONLY. FINAL DESIGN DETAILS TO BE COORDINATED WITH UTILITY SPECIFICATIONS



ITEM QTY	MATERIAL	ITEM QTY	MATERIAL
c 5	Bolt, machine, 5/8" x req'd length	ae 3	Arrester, surge (9 kV)
c 26	Bolt, machine, 1/2" x req'd length	af 3	Cutout, dist. open (15 kV)
d 33	Washer, 2 1/4" square	cu 2	Brace, 28"
d 2	Washer, round, 1 3/8" dia.	cu 1	Brace, wood, 60" span
g 1	Crossarm, 3 5/8" x 4 5/8" x 8-0"	④	Meter box, meter on test block
g 2	Crossarm, 3 5/8" x 4 5/8" x 10-0"	sd 3	Transformer, current
i 2	Bolt, carriage, 3/8" x 4 1/2"	se 3	Transformer, potential
j 1	Screw, lag, 1/2" x 4"	ek 34	Locknuts
n 1	Bolt, double arming, 5/8" x req'd length	* 6	Mounting brackets
p	Connectors, as required	aa 1	Nut, eye, 5/8"
aa 1	Nut, eye, 5/8"	av	Jumper, primary, bare, as required
av	Jumper, primary, bare, as required		

*Specify this item to be furnished by the transformer manufacturer.

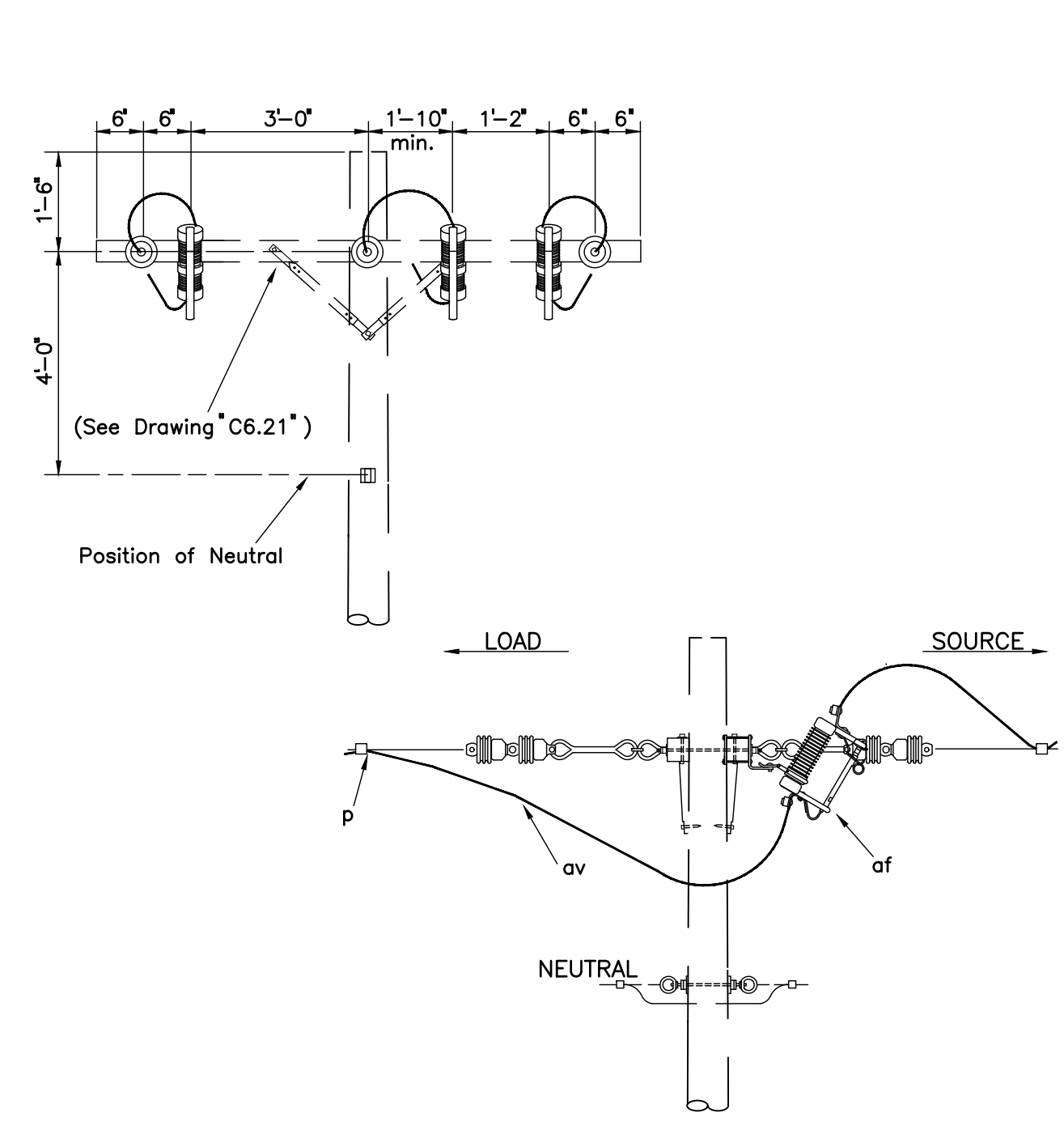
CUSTOMER METERING POLE DETAILS ARE SHOWN FOR DIAGRAMMATIC PURPOSES ONLY. FINAL DESIGN DETAILS TO BE COORDINATED WITH UTILITY SPECIFICATIONS



NOTES: See Dwg. "H4.1" (Preferred) or "H3.1" for required grounding assembly. RUS accepted pre-assembled, group operated, airbreak switches may be used. Install according to manufacturer's instructions.

ITEM QTY	MATERIAL	ITEM QTY	MATERIAL
c 4	Bolt, machine, 1/2" x req'd length	aa 2	Nut, eye, 5/8"
c 15	Bolt, machine, 5/8" x req'd length	av	Jumpers, as required
d 4	Washer, round, 1 3/8"	bo 6	Shackle, anchor
d 25	Washer, square, 2 1/4"	cg 1	Switch, airbreak, group operated
d 2	Washer, square, 3"		15 kV, w/ operating mechanism
g 2	Crossarm, 3 5/8" x 4 5/8" x 10-0"	cu 2	Brace, wood, 60" span
k 12	Insulator, suspension, 4 1/4"	ek 33	Locknuts
n 4	Bolt, double arm, 5/8" x req'd length		
p	Connectors, as required		

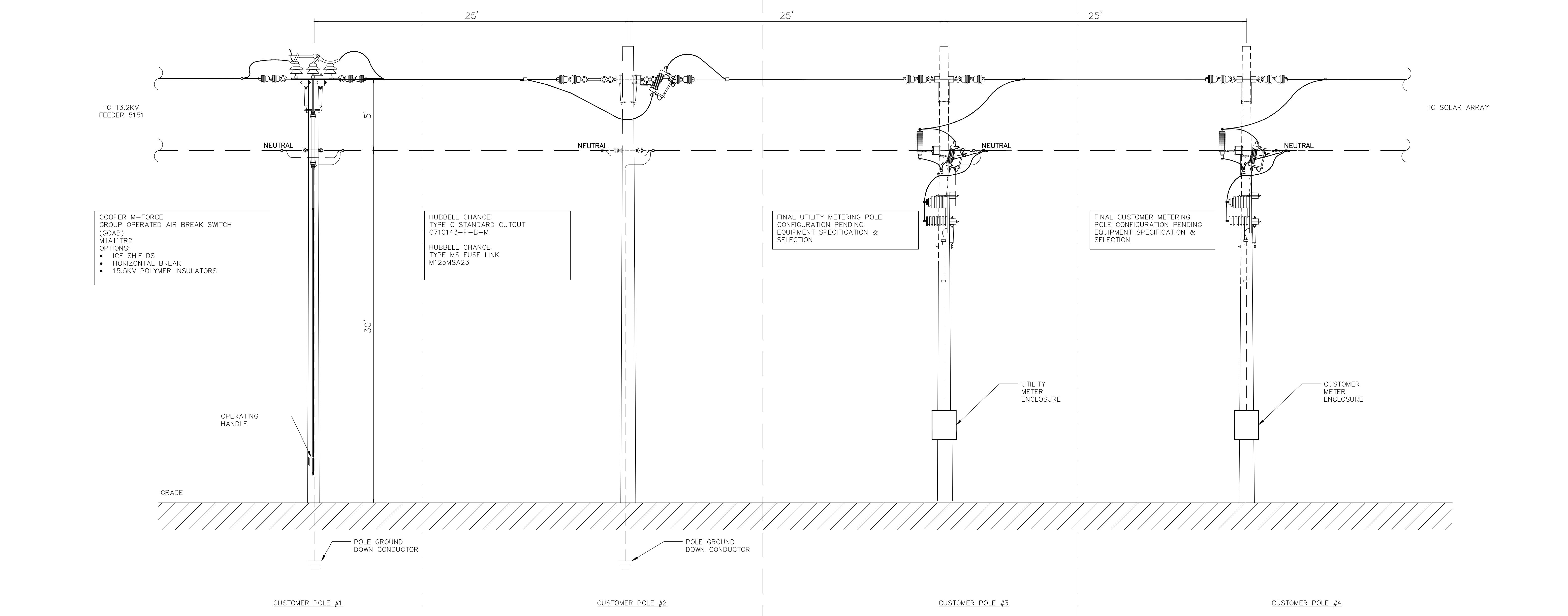
3 GROUP OPERATE AIRBREAK SWITCH - THREE PHASE



NOTES: 1. Specify fuse size or solid blade. 2. Mount cutouts so that blades face climbing face of pole.

ITEM QTY	MATERIAL
p 6	Connector, compression type
af 3	Cutout, distribution open (15 kV)
av	Jumpers, as req'd

4 GROUP OPERATE AIRBREAK SWITCH - THREE PHASE



5 GROUP OPERATE AIRBREAK SWITCH - THREE PHASE
6 FUSED CUTOUTS - THREE PHASE
7 UTILITY METERING POLE - THREE PHASE
8 CUSTOMER METERING POLE - THREE PHASE

REV	DATE	REVISION DESCRIPTION	BY	CHKD
A	01.22.18	ISSUED FOR REVIEW	ML	AK

KMB DESIGN GROUP
kmbdg.com
1800 ROUTE 24 SUITE 209
WALL KETTER
7370 980-5433
FOR ALL QUESTIONS, PLEASE CONTACT
ALISON D. KIRKALL, PROJECT MANAGER

Stephen A. Bray
PROFESSIONAL ENGINEER

NY LICENSE: 086084 1/23/2018

NY COMMUNITY SOLAR
-GUTCHESS LUMBER SCM SOLAR
1.992 MWAC/2.67 MWDC GROUND MOUNT PHOTOVOLTAIC SYSTEM
1027 GALLAGHER RD.
CORTLAND, NY 13045

KMB PROJECT NO: **732.0507.010**

DRAWING TITLE

DRAWING SCALE

DRAWN BY: _____ CHECKED BY: _____ DATE: 12.14.18

DWG NO.