Weston & Sampson

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December 2, 2016

Mr. Syed H. Rahman, PE, Regional Material Management Engineer
NYS Department of Environmental Conservation
Division of Environmental Permits, Region 1
50 Circle Road
Stony Brook, NY 11790-3409

Re: **Town of Islip Blydenburgh Road Landfill Solar Project**
Engineering Report and Post Closure Operations and Maintenance Manual
Response to Comment Letter Dated October 18, 2016

Dear Mr. Rahman:

Weston & Sampson is in receipt of the New York State Department of Environmental Conservation (NYSDEC) comments contained within the letter dated October 18, 2016 for the above mentioned project. Copies of the pertinent revised documents are enclosed herewith. To facilitate NYSDEC's review, we have listed the original comments from the NYSDEC's October 18, 2016 review letter, followed by our responses in bold.

Current Conditions:
The current conditions of the landfill need to be analyzed and improved.

1. The north recharge basin capacity needs to be evaluated for a 25-year 24- hour storm to ensure that any run-off increase as a result of the change of the surface type (i.e., from grass area to a solar panel surface) is adequate. Additionally, please provide a schedule for improving and maintaining the sedimentation in the north basin to avoid overflow of water onto Blydenburgh Road during a major storm event.

   Per section 2.3.1 Stormwater Run-off Control Plan in the Engineer's Report:

   "The proposed PV system will not adversely affect the current stormwater characteristics including flow direction and volumes. Per NYSDEC regulations, the addition of the proposed PV development does not constitute addition of impervious cover. Without the addition of impervious cover to the existing site, NYSDEC stormwater management requirements include a SWPPP consisting of Erosion and Sediment Controls and submittal of a Notice of Intent (NOI). A full evaluation of how the site will be impacted from a stormwater perspective by the proposed PV development via updated storm water modeling is not required because the proposed design meets the following criteria:

   - **Solar panels are constructed on post/ballast (elevated off of the ground surface)**
   - **The panels are spaced apart so that rain water can flow off down gradient side of panel and reach the ground**
   - **The ground surface below the panels will be a well-established vegetative cover.**

   Given that the stipulations above are met for this project, there is no change in drainage between the pre- and post- development conditions and therefore no need for additional stormwater management controls beyond those currently in place."

   Since the drainage characteristics are not being changed as a result of the project, it is assumed that the existing stormwater infrastructure that was originally designed, approved, and installed is sufficient.

   The Town will maintain responsibility for improving and maintaining the sedimentation in the north basin. According to Town officials, they complete semi-annual inspections of the site, including the

sedimentation basin, which are reported to the NYSDEC. Town personnel address issues on an as-needed basis which could include repairs to the down-chutes, stilling basins, perimeter swales and periodic cleaning of the northeast recharge basin if necessary.

2. Currently, there are a number of trees at the top of the landfill. These need to be removed along with the root ball and unsuitable fill, and replaced with select fill as outlined in the landfill closure plan.

   The Islip Resource Recovery Agency will remove the trees, the root ball and unsuitable fill and replace with select fill per the existing landfill closure plan prior to the commencement of construction of the photovoltaic power system.

3. The site plan must reflect the current and proposed drainage conditions in the area of the proposed construction. Please provide the site plan in a larger scale (preferably at a one foot contours) within the construction area to clearly identify the existing drainage swales, berms, terraces, trees and subsurface piping that needs to be avoided.

   The site plans have been updated to show the drainage conditions in more detail. The diversion swales and down chutes are delineated and labeled to be consistent with the landfill cap as-builts to help clarify and supplement the survey. In addition, two site enlargement plans (Sheets C-4 and C-5) have been added to the drawing set included in Appendix A – Preliminary Design Drawing of the Engineer's Report.

4. The report states that majority of the top of the landfill surface is under 3.5 percent. 6 NYCRR Part 360-2.15(k)(1)(ii) requires slope of drainage swales to be at least four percent to allow proper drainage. The areas beneath the solar array must be graded to allow proper drainage.

   The scope of this project does not include significant modification to the grading or drainage system of the existing landfill. While the majority of the top of the landfill surface is under 3.5 percent, diversion swales were installed per the original approved design plans for the installation of the cap system. A detail has been added to the plans on sheet D-3 to allow for continued passage of stormwater through the swales, as currently exists, by installing a perforated pipe and stone with the diversion swales along the areas within the solar array. This approach will provide foundation for the ballasts while not impacting the existing stormwater management system.

Design Information:

5. Executive Summary – Please correct page ES-2 as the information contain pertains to a different facility.

   Executive Summary page ES-2 has been updated.

6. §2.1.1 Electrical Design – Please include provisions of explosion proof components near active gas collection wells or piping.

   We considered the existing landfill vents as sources of flammable vapor. Based on that consideration, a 10' diameter exclusion zone has been established around each vent. No PV related equipment will be located within this zone. As the electrical equipment is excluded from areas where gas may occur, the use of explosion proof electrical fittings and enclosures is not required.

7. § 2.2.2 Stress on Geomembrane - The report states that "potential damage to the Flexible Membrane Liner (FML) due to elongation and puncture cannot be evaluated since the properties of the FML and the grain size characteristics of the barrier protective and general fill materials are not known." The Town of Islip should have information on the type of material used for barrier protective

material and the FML in the capping certification report submitted to the Department. Although the risk of FML puncture due to additional stresses is assumed to be low, calculations must be submitted to substantiate such low risk.

The Town of Islip has provided information on the type of material used for barrier protective material and § 2.2.2 Stress on Geomembrane has been updated. Calculations for puncture analysis have been included in Appendix B – Geotechnical Report.

8. Geotechnical Calculations – Please provide calculations showing the stress on FML due to the proposed action.

Calculations showing the stress on the FML due to the proposed action were included in Appendix B – Geotechnical Report.

9. Soil Bearing Capacity - Please provide calculations for the bearing capacity of the soil cap to ensure that it can withhold the pressure exerted from the ballasts, as well as the equipment pads.

Calculations and a descriptive narrative showing the Soil Bearing Capacity of the soil cap are included in Appendix B – Geotechnical Report. In addition, § 2.2.7 Cap Soil Bearing Capacity has been added to the report.

10. § 2.2.3 Waste Compression - Please provide the complete geotechnical analyses on the waste compression. There has been extensive settlement on this landfill already. Provide detail settlement calculations based on the placement of ballasts and equipment pads, as well as the construction vehicles on the landfill surface.

Calculations and a descriptive narrative for waste compression are included in Appendix B – Geotechnical Report. Compression of the waste is analyzed similarly to cohesive soils and occurs over an extended time. Immediate settlement tends to occur in granular soils and such analysis is not appropriate for waste. Construction vehicle stresses on the landfill are temporary and contribution to long-term compression of the waste can be considered low. § 2.2.3 Waste Compression has also been updated accordingly.

11. § 2.2.4 Slope Stability Analysis - The slope stability analysis must be included with appropriate FML and soil cover. As mentioned previously, the Town of Islip should be able to provide information on the type of barrier protective material, as well as characteristics on the type of FML used.

We provided factor of safety values against sliding between the cover soils and the FML in our original geotechnical memorandum. The analyses considered a FML slope of 7.5 percent (matching the slope of the ground surface) and very conservative values for interface friction between the cover soil and the FML. The factor of safety values against sliding were calculated as 2.8 for saturated conditions and 3.8 for dry conditions. Given information now available for the cover soils and assumed engineering properties of the FML, our initial assumptions on characteristics and properties of the cover soils and FML were appropriate for the analyses and even somewhat conservative; however, the FML slope was revised from 7.5 to 8.5 percent to better reflect the slope of the ground surface in proposed construction areas. The factor of safety values against sliding were re-calculated as 2.5 for saturated conditions and 3.4 for dry conditions. In our opinion, our approach is appropriate to demonstrate adequate factor of safety values against sliding. § 2.2.4

Sliding Analysis has been updated in the Engineer's Report and the calculations are included in Appendix B – Geotechnical Report.

12. § 2.2.5 Access Roads - The report states that the current thickness of the soil cover along the access roads has sufficient cover to reduce the potential for damage to the FML, assuming a H-20 or lesser loading conditions. Please provide calculations to support this statement. Calculations must include the maximum ground stress imposed with loaded vehicles, and the bearing capacity of the material underneath.

Our original memo did not state the current thickness of the soil cover along the access roads is sufficient to reduce potential for damage to the FML. However, this section was revised to better clarify requirements that need to be met by the contractor prior to using construction vehicles on the landfill which include during construction, requirements for hand excavations and submittal of information regarding maximum tire stresses will be maintained and requirements for additional fill will be provided if necessary.

13. Vehicles on landfill - Please provide example vehicle models that will be used on the landfill footprint which will have the recommended 7 psi ground pressure on the geo-membrane and will not cause rutting on the soil cover. Please provide calculations of the maximum tire stresses as well as the total stress that will be imposed on the FML. In addition, please provide the maximum load in psi by axle for each vehicle for both loaded and unloaded conditions.

Types of construction vehicles the Contractor expects to use for the project are not known. We intend to require the Contractor to provide a submittal for each construction vehicle to be used on the landfill prior to use that includes type of vehicle, track/tire dimensions, and ground contact pressures. Our geotechnical memorandum recommends the Contractor confirm the cover soil thickness along access roads prior to construction. Weston & Sampson intends to review each submittal and assess the pressure on the liner for each vehicle, given information provided in the submittal and cover soil thicknesses provided by the Contractor. Submittals will only be approved provided stresses on the liner are calculated below 7 psi. We also intend to recommend additional fill thicknesses and material type along the road that would limit stresses to less than 7 psi, if applicable.

Providing a list of particular vehicles that are less likely to cause disturbance to the landfill surface is, in our opinion, not the best approach since disturbance often times results from the contractor's construction practices. Protection of the landfill surface from rutting/disturbance and any repair are the responsibility of the Contractor. However, we intend to include a statement in each submittal approval that recommends discontinuation of equipment that disturbs the landfill surface.

We have attached to this letter an example of a review that was conducted for other capped landfills in the construction phase. Equipment suitable for this project will be reviewed independently as the conditions are different.

14. Decommissioning - How will the solar arrays be decommissioned and removed, specifically the ballasts? Consider the load of the ballasts, and the maximum ground stress that the transportation of these materials will impose on the FML.

Similar to the prior comment, a contractor to preform decommissioning has not been selected and their means and methods will be their responsibility. The anticipated method would be to

disassemble as much of the existing installation in place as possible. The ballast tubs and larger equipment will be removed by similar track mounted equipment as was used during the initial installation. The contractor would be required to provide submittals on the equipment they propose to use and similar loading calculations will be performed to determine if it meets the specified requirements prior to any work onsite.

15. Wind Uplift Calculations - Please provide wind uplift calculations based on the proposed solar generation equipment to confirm that the solar panel ballast design is sufficient.

The manufacturer of the ballast system has provided loading calculations which include wind uplift calculations. The calculations have been included in the Engineer's Report as Appendix E – Loading Calculations.

Operations & Maintenance:

16. Please include the Department in the Contingency Response and Notification Procedure.

The NYSDEC has been included in the Contingency Response and Notification Procedure.

17. Please update the facility Post Closure O&M Manual to address a schedule of repairs to the down-chutes, stilling basins, perimeter swales and periodic cleaning of the northeast recharge basin.

The Town of Islip is responsible for conducting O&M on the site and updating the Post Closure O&M Manual for the entire site as a whole. It has been reported by the Town that they complete semi-annual inspections which are reported to the NYSDEC and that Town personnel addresses issues on an as-needed basis which could include repairs to the down-chutes, stilling basins, perimeter swales and periodic cleaning of the northeast recharge basin if necessary.

Additional Comments:

18. A copy of the agreement among the landfill owner, solar panel contractor or installer, and the solar panel operator to assure that the integrity of the cap is maintained throughout the construction and operation of the solar panels. In the event that the cap is compromised, the Department must be assured that the damage will be corrected in a timely manner. This information is not explicit in Appendix D (Town Lease Agreement).

The EPC Contract that will be executed with the contractor will include the following provisions:

2.15.9 Contractor shall exercise special care during its operations to avoid injury to landfill cap features, Including monitoring wells, gas vents and the cap itself, and shall perform all Work on or near the landfill cap in accordance with all applicable Permits, including the documents listed on Exhibit Q. When necessary, Contractor shall cooperate with representatives of public services companies in order to avoid damage to their structures.

2.15.10 Contractor shall ensure that the existing cap on the landfill that is part of the Site shall not be materially disturbed or penetrated by the Work. In the event that the cap is in some manner compromised or damaged, contractor shall notify site operator and system owner's engineer immediately. Repairs to the correct the damage shall be performed under supervision of owner's engineer and site operator.

19. All submittal must include an original Professional Engineer (PE), licensed to practice in the State of New York, stamp or statement of certification. Please be sure that the updated and revised report is sealed with an original PE stamp.

The updated revised report is sealed with an original PE stamp.

The updated report is attached. We trust that this letter, together with the attached revised report satisfies the October 18, 2016 comments of the New York State Department of Environmental Conservation. Please call me with any further questions at 518-463-4400 x 6504.

Sincerely,
WESTON & SAMPSON PE, LS, LA, PC

Joseph M. Zongol, PE
Project Manager

Cc: D. Myers, ACE
B. Hennessey, ACE
J. Heil, T/O Islip
M. Begum, NYSDEC
E. Lenio, NYSDEC
S. Wiehe, W&S
File

Attach: Engineer's Report and Post Closure O&M Manual
Example Equipment Review Form (Williamstown Landfill)

SUMMARY OF EQUIPMENT STRESSES ON FML AND CLAY IN ACCESS ROAD AND LANDFILL AREAS
WILLIAMSTOWN LANDFILL - WILLIAMSTOWN, MA

Assume:
Stage I:
Soil Cover above Clay on Landfill = 8 in.
No Access Road
Stage II
Soil Cover above FML on Landfill = 20 in. (based on test pits)
Soil Cover above FML on Access Road = 36 in.

CAT D6K Dozer

Ground Contact Pressure = 5.77 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 4.5 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 3.8 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 4.4 psi
OK to Operate on Access Road

Hitachi 135US

Ground Contact Pressure = 4.93 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 4.2 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 3.8 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 4.5 psi
OK to Operate on Access Road

John Deere 135g

Ground Contact Pressure = 5.36 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 4.5 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 2.7 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 4.6 psi
OK to Operate on Access Road

John Deere 230LC

Ground Contact Pressure = 5.13 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 4.5 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 4.1 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 4.8 psi
OK to Operate on Access Road

CAT313FL

Ground Contact Pressure = 4.87 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 4.1 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 3.7 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 4.4 psi
OK to Operate on Access Road

SUMMARY OF EQUIPMENT STRESSES ON FML AND CLAY IN ACCESS ROAD AND LANDFILL AREAS
WILLIAMSTOWN LANDFILL - WILLIAMSTOWN, MA

Assume:
Stage I:
Soil Cover above Clay on Landfill = 8 in.
No Access Road
Stage II
Soil Cover above FML on Landfill = 20 in. (based on test pits)
Soil Cover above FML on Access Road = 36 in.

Lull 1044 (assume at full loading capacity of 10,000 lbs)

Ground Contact Pressure = 63 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 23.8 psi
[redacted]

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 10.5 psi
[redacted]
Access Road: Estimated Stress on FML Due to Equipment and Soil = 6.9 psi
OK to Operate on Access Road

Dresser TD Dozer

Ground Contact Pressure = 3.95 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 3.9 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 3.5 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 4.4 psi
OK to Operate on Access Road

Dynapac Roller - 36,390 lbs (assume static mode only)

Ground Contact Pressure = 23.8 psi (under tires)
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 15.4 psi
[redacted]

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 7.9 psi
[redacted]
Access Road: Estimated Stress on FML Due to Equipment and Soil = 6.5 psi
(Assume one 12 in. lift of fill placed on landfill surface)
OK to Operate on Access Road

Kawasaki Mole

Ground Contact Pressure = 5.5 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 3.7 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 1.7 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 3.0 psi
OK to Operate on Access Road

John Deere 60D

Ground Contact Pressure = 4.4 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 3.4 psi
OK to Operate on Landfill Surface

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 2.8 psi
OK to Operate on Landfill Surface
Access Road: Estimated Stress on FML Due to Equipment and Soil = 3.7 psi
OK to Operate on Access Road

Oshkosh Concrete Truck (assume 7 CY of concrete)

Ground Contact Pressure = 42.6 psi
Stage I
Estimated Stress on Clay Due to Equipment and Soil = 18.3 psi
[redacted]

Stage II
Landfill Surface: Estimated Stess on FML Due to Equipment and Soil = 8.7 psi
[redacted]
Access Road: Estimated Stress on FML Due to Equipment and Soil = 6.3 psi
OK to Operate on Access Road

Weston & Sampson
1 Winners Circle, Suite 130, Albany, NY 12205
Tel: 518.463.4400

LETTER OF TRANSMITTAL

TO
NYSDEC Division of Environmental Permits, Region 1 50 Circle Road Stony Brook, NY 11790-3409

DATE	JOB NO.
December 2, 2016	2150683
ATTENTION	Mr. Syed Rahman, PE
RE	

Solar Array Installation at the
Blydenburgh Road Landfill
Engineer's Report and Post Closure O&M Manual

WE ARE SENDING YOU:

- ☐ Shop Drawing
- ☐ Attached
- ☐ Plans
- ☐ Samples
- ☐ Change Order
- ☐ Prints
- ☐ Copy of Letter
- ☐ Specifications
- ☑ Other
- ☐ Under Separate Cover Via: _____

COPIES	DATE	NO.	DESCRIPTION
1	Rev. November 2016	1	Revised Engineer's Report and Post Closure O&M Manual
1	December 2, 2016	1	Comment Response Letter

THESE ARE TRANSMITTED AS CHECKED BELOW:

- ☑ For Approval
- ☐ Approved as Submitted
- ☐ Resubmit Copies for Approval
- ☐ For Your Use
- ☐ Approved as Noted
- ☐ Submit Copies for Distribution
- ☐ For Review and Comment
- ☐ As Requested
- ☐ Return Corrected Prints
- ☐ FOR BIDS DUE
- ☐ Prints Returned After Loan to Us
- ☐ Returned for Corrections
- ☐ Other

REMARKS:

COPY TO:	SIGNED: Joseph M. Zongol

If enclosures are not as noted, kindly notify us at once.

Weston&Sampson.®
environmental/infrastructure consultants

301 Manchester Road, Suite 201A, Poughkeepsie, NY 12603
tel: 845-454-3344 fax: 845-454-0444

Engineer's Report and Post Closure O&M Manual

American Capital Energy: Solar Array Installation at the Blydenburgh Road Landfill

Blydenburgh Road
Hauppauge, New York

May 5, 2016
Rev. November 2016

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EXECUTIVE SUMMARY

Weston & Sampson, on behalf of American Capital Energy, Inc. (ACE) and the Town of Islip, NY, has prepared this application for approval to construct a solar photovoltaic array atop the Town-owned closed landfill. The following narrative provides an overview summary of the proposed project.

The Project

American Capital Energy (ACE) proposes to construct, operate and maintain a nominal 2,000 MW (DC) solar photovoltaic (PV) system on the existing Blydenburgh Road Landfill site, located in at 440 Blydenburgh Road in Hauppauge, a hamlet of Islip, New York as part of Long Island Power Authority's (LIPA) Feed-In-Tariff II Program. The 8.5-acre site is a portion of the 108-acres landfill property which is owned and operated by the Town of Islip – Resource Recovery Agency.

The Landfill

Per the Long Island Landfill Law, the landfill stopped receiving municipal solid waste (MSW) in 1990 and was capped in 1993 in general accordance with the NYSDEC approved closure plan. The existing landfill cap cross section from the ground surface downward consists of eighteen inches of compost/general backfill, twelve inches of general backfill, drainage net composite (geotextile/drainage net/geotextile), 60 mil textured HDPE cap, twelve inches gas venting layer (treated ash aggregate), and finally a second 3.8oz/square yard geotextile filter fabric which will be collectively referred to as the landfill cap herein. The landfill is grass covered and has a designed stormwater management system, and active gas collection system.

Solar Array

The post-closure use will include the placement and maintenance of approximately 6,308-315W photovoltaic (PV) modules, forty (40) 36 kW inverter and two (2) 28 kW inverters. The photovoltaic modules will be supported by a racking system, founded on concrete ballasts. The ballasts will have a low bearing pressure that will not damage or penetrate the landfill cap. The panels are to be connected by above ground cables and conduits to central inverters/transformer located in the central part of the array. All aboveground cable conduits will be rigid and supported by concrete blocks above grade. The project will be interconnected to LIPA's overhead distribution lines located on the east side of the landfill, near the Blydenburgh Road entrance to the property. The existing perimeter fence drainage and features will provide restricted access to the solar array.

Project Impacts

The Project is designed for minimal impact to the existing landfill cap. Minor modifications, described within the narrative, include installation of access roads, installation of surface mounted ballasts, and re-seeding vegetation with a shade tolerant seed mix. The Project will not alter drainage patterns or stormwater runoff. Potential construction impacts to the landfill cap have been identified and mitigated by design or specifications. Changes to stormwater runoff due to the Project are insignificant and no changes to the existing drainage system are expected. The Project is designed to not impact existing groundwater, surface water, soil gas monitoring equipment; and gas control equipment. The topography will not be altered by the Project, except for minor grading of the lower access road.

Post Closure Environmental Monitoring

The current gas collection, management and monitoring program will not be changed. The project will not cause adverse changes to human health and environmental risks. The current post-closure monitoring and maintenance plan will not be altered.

Regulatory Compliance

The project is in compliance with New York State Department of Environmental Conservation Solid Waste Management Regulations pertaining to Post-Closure Use of Landfills, 6NYCRR, Part 621. The conditions of the regulations include, in part, the facility must comply with current 6 NYCRR Part 360 Solid Waste Management Facilities Regulations. A Post-Closure Monitoring and Maintenance Plan was developed by Golder Associates, Inc., dated January 1996 (final revision January 2015) and the landfill was closed per the as-built plans entitled Blydenburgh Sanitary Landfill Closure Plan by Tully Construction, Inc. dated December, 1993.

Pursuant to the Solid Waste Management Facilities Regulations (6 NYCRR Part 360), a modification to the Closure Plan & Post-Closure Care Manual to the composting facility's existing Solid Waste Management Permit Engineer's Report is required when a post-closure use of a facility is being proposed. Installation of a solar array at the facility is included under this post-closure use requirement. This document will serve as a supplement and modification to the existing 1996 Engineer's Report (and future updates).

This supplemental Engineer's Report and Post Closure Operation & Maintenance Manual is for the proposed installation of a nominal 2,000 kW (DC) solar photovoltaic array at the facility. This document demonstrates that the proposed post-closure use of the facility is consistent with protecting public health, safety and the environment and that the solar array installation proposed as a post-closure use adheres to the site closure plan and characteristics and meets the requirements of the solid waste regulations, 6 NYCRR Part 360 and the conditions of the facility's 6 NYCRR, Part 621 permit.

Wetlands will not be impacted by the proposed project.

Financial assurance requirements for the landfill are currently and will continue to be met by the site Owner and Operator, the Town of Islip, New York.

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1.0 PROJECT OVERVIEW

1.1 Type of Permit Modification

6 NYCRR 621 – Permit Modification

1.2 SEQR Review

The Town of Islip served as lead agency for the SEQR review and determined this project to have No Impact.

1.3 Post-closure Use (6 NYCRR 621)

1.3.1 General Description

The project Developer, American Capital Energy (ACE), through a lease agreement with the Town of Islip proposes to construct, maintain and operate a utility scale solar photovoltaic (PV) system on the existing Blydenburgh Landfill site.

The site is located at 440 Blydenburgh Road in Hauppauge, a hamlet of the Town of Islip, New York and is comprised of portions of two parcels, totaling approximately 8.5 acres of the 108 acre property and has access via a curb cut off Blydenburgh Road and dirt road and cleared pathways. The remainder of the Blydenburgh Road Landfill property includes active clean fill landfilling operations (Phase I to the southeast and Phase II to the southwest), an office building and maintenance building. The perimeter of the property is enclosed with chain link fencing. Undeveloped woodlands and residences surround the landfill property in all directions.
The entirety of the site is developed (approximately 108 acres), including a stormwater collection and treatment facility in the northeast corner of the landfill property. The landfill stopped accepting MSW in 1990 and was capped in 1993 in accordance with the NYSDEC approved closure plan and cap design. There are several gas collection wells located throughout the top of the landfill from which the gas is collected and piped to a gas treatment and flare facility located at the north side of the property.

1.3.2 Current Post-closure Use

There are currently no NYSDEC approved post-closure uses on the Site at this time.

1.3.3 Proposed Post-closure Use

The Project includes the placement and maintenance of approximately 6,308-315W photovoltaic (PV) modules, forty (40) 36 kW inverters and two (2) 28 kW inverters, subject to change upon selection of final equipment. The photovoltaic modules will be supported by a racking system, founded on concrete ballasts. The concrete ballasts are non-penetrating and are to be installed above the sand drainage layer. The intent of the design is to cause as minimal disturbance to the existing landfill cap as possible. The PV panels and racking system will be raised off of the ground approximately 2 to 3 feet to promote growth of the existing grass ground cover and allow for maintenance/mowing of that ground cover. The panels will be inclined at approximately 20

degree angle facing south for optimal exposure and power generation. The system will be designed to produce up to 2.0 MW of power.

There will be one distinct array area. All panels are located on the facility's ground surface in areas with slopes of 10 percent or less, with the majority in areas under 3.5 percent. Equipment pads within the array area will support the required PV system electrical components and an additional equipment pad near the perimeter of the site will support the utility interconnection equipment.

The existing access road from the Blydenburgh Road entrance will be utilized for access to the site for maintenance. No additional access roads are planned at this time. A new access gate will be installed for added security at the site.

1.3.4 Effect of Changes

The Project is designed for minimal impact to the existing capping system. Specific details are described in more detail below:

Landfill Cap and Liner

The existing landfill cap cross section from the ground surface downward consists of eighteen inches of compost/general backfill, twelve inches of general backfill, drainage net composite (geotextile/drainage net/geotextile), 60 mil textured HDPE cap, twelve inches gas venting layer (treated ash aggregate), and finally a second 3.8oz/square yard geotextile filter fabric which will be collectively referred to as the landfill cap herein.

To protect the liner during construction, the contractor is required to adhere to strict quality control procedures regarding the use of low ground pressure equipment. Low ground pressure equipment exerts less than seven (7) pounds per square inch (psi) on the liner surface. Where low ground pressure equipment is not cost effective for construction, the contractor is required to install temporary access roads to achieve a three-foot vertical separation between vehicle traffic and the liner. This is necessary to reduce the contact pressure on the liner. The temporary access roads will be removed prior to construction completion.

In addition to the contact pressure on the liner, the design is intended to minimize excavations above the liner and to limit those necessary excavations to the topsoil layer (excavation's <12 inches) only. During all machine excavations, the contractor is required to coordinate oversight with the Engineer and to have a laborer ("spotter") present to identify the depth to liner prior to excavation.

Long term loading effects on the liner have been minimized by limiting the PV system loading to a maximum of 500 pounds per square foot (psf) or 3.5 psi.

Sand Drainage Layer

The sand drainage layer will not be impacted by the proposed PV system. The PV system design is intended to not disrupt current stormwater patterns and to not increase infiltration into the sand drainage layer; thereby there is no anticipated change to the hydraulic head above the landfill liner.

Topsoil/Landfill Surface
The proposed PV system has been designed for minimal disruption to the topsoil layer of the landfill. The topsoil will be disturbed locally where the ballasts are installed. A detail of the ballast construction can be found in the Preliminary Design Drawings attached as Appendix A. In addition to the ballasts, installation of the access road will result in replacement of topsoil with gravel to serve as an access road. The topography will not be altered by the Project, except for minor grading of the lower access road, and the conduit crossing beneath the access road. A supporting stormwater narrative demonstrating that stormwater discharges are not altered by the proposed construction is included in Section 2.3.

Vegetation
It is expected that the current vegetation may become distressed as a result of shading created by the PV panels. As a proactive measure, the area of PV development will be seeded with a shade tolerant mix in areas that are disturbed or damaged by the construction process.

Monitoring Equipment
The existing groundwater, surface water, and soil gas monitoring equipment are located outside of the landfill extents. Because the PV development area is located on the top of the landfill, the existing monitoring equipment will not be impacted by the proposed construction. Proposed utility routing and other supporting equipment located outside of the landfill extents will be placed or installed in a manner so as to not disrupt the existing monitoring equipment.

Landfill Gas Control Equipment
Exposed gas wells, valves and additional control equipment will not be disturbed as a result of the proposed PV development. A five-foot radius will be maintained around well heads and valves for inspection and maintenance. The PV system is designed to keep clear of the existing gas collection headers and lateral piping.

Stormwater
The proposed PV system will not impact the existing stormwater management system.

Operation and Maintenance
The landfill site has a Post Closure Monitoring & Maintenance Plan prepared by Golder Associates March 1996 and last revised January 2015. The proposed PV system installation is not anticipated to alter ongoing operation and maintenance (O&M) requirements presented in the plan. Ongoing monitoring and maintenance activities include mowing, environmental monitoring of the groundwater surface water, and soil gas; and monitoring and maintenance of the gas collection system. Mowing activities will remain in compliance with the current Post-Closure O&M plan. The proposed system will keep clear of existing environmental (groundwater, surface water, and soil gas) monitoring locations. The PV system layout will keep clear of existing well heads, valves, lateral collection piping, and headers located above the landfill cap. Within this report is an Operation & Maintenance Plan for the PV area that is to supplement the existing plan.

1.4 Closure Plan

The Capping of the landfill was documented by the as-built plans entitled Blydenburgh Sanitary Landfill Closure Plan by Malcolm Pirnie, Inc. dated December 1993.

1.5 Regulatory Compliance

1.5.1 Wetlands Protection

The proposed project does not impact any regulated wetland or wetland buffer areas.

1.5.2 Financial Assurance

Financial assurance requirements associated with post-closure maintenance and monitoring of the facility were addressed by the Town of Islip. No changes to these activities will result from installation of the solar arrays. Therefore, additional financial assurance is not required for this application. It should be noted that the Developer is undertaking maintenance of the solar arrays, and will conduct periodic weed trimming if necessary, and some erosion control inspections on behalf of the Town. The ultimate responsibility for all maintenance and monitoring will remain with the Town of Islip.

1.5.3 Other Permits

Solar array construction activities are expected to impact approximately 8.5 acres of land on the facility. This impacted includes areas designated for installation of solar panel array ballasts and access roads. Disturbance of land areas greater than one acre of land is regulated under the National Pollutant Discharge Elimination System, and filing of a Notice of Intent (NOI) is required for this project. The NOI filing requires that the contractor shall have in place a written Stormwater Pollution Prevention Plan (SWPPP) that details all of the erosion and sediment control measures that will be employed, including dust control during construction. A Construction General Permit requires operators to prepare a Stormwater Pollution Prevention Plan. These documents will be prepared prior to the start of construction activities.

Additional permitting is required by The Town of Islip also requires an electrical permit for the proposed PV project.

1.5.4 Enforcement Status

It is our understanding that there are no outstanding or unresolved enforcement actions related to the parcels/area the solar array is to be installed on at this time.

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2.0 DESIGN INFORMATION

2.1 Proposed Photovoltaic (PV) System Installation

2.1.1 Electrical Design

PV modules will be wired together in series to form a group of modules known as a string. Each string will include 19 modules. Multiple strings will be connected to string inverters located on equipment pads. Each inverter will convert the power produced by the modules from direct current (DC) to alternating current (AC). The output of multiple string inverters will be connected to 480V PV panelboards which combines the multiple inverter output circuits into a single system output circuit. In order to make the system output compatible with the utility interconnection circuit, transformers will increase the 480V output to 13,200 volts. The wiring and conduits on the facility will be run above ground, and the concrete pads will be installed on top of the existing ground surface.

The preliminary design assumes there will be forty (40) 36 kW and two (2) 28 kW string inverters, two (2) PV panelboards and two (2) pads mounted 1,250 kVA transformers mounted to equipment pads located near center of the array. Two smaller additional equipment pads will be located near the southeastern corner of the array area. These pads will support the PV system switchgear and metering enclosures. The switchgear will house the overcurrent protection and utility-required relays for the PV system and the metering enclosure will include the equipment needed to measure the system output. The output of the PV system will be conveyed from the PV metering equipment pad within the fenced array boundary through above ground and underground circuit conductors to the utility switchgear, which will be located at the southeastern perimeter of the facility as shown on the Proposed Development Plan in Appendix A.

The output from the solar array will be connected to the local utility grid at a Public Service Enterprise Group (PSEG) identified interconnection point. All electrical work will be designed per the most recent version of the New York State Building Code, which includes and incorporates the requirements of the National Electric Code (NEC). The electrical components will be sealed, where required by NEC. Prior to the start of construction, an electrical permit will be obtained from the local building official and the project will incorporate any additional electrical requirements stipulated.

2.1.2 Solar Generation Equipment

Energy produced by the solar array will be generated using fixed-tilt PV modules. The major plant equipment consists of PV modules, mounting system, inverters, and the interconnection switchgear. The following table summarizes the proposed major equipment specified for this project.

Table 1
Proposed Solar Generation Equipment

Equipment	Anticipated Provider, Model
Photovoltaic Modules	Canadian Solar CS6X-315P (315 W) (or equivalent)
Inverters	Solectria PVI 36TL (36 kW) and Solectria PVI 28TL (28 Kw) (or equivalent)

Table 1 Proposed Solar Generation Equipment	
Equipment	**Anticipated Provider, Model**
Data Acquisition System	Aurora, Deck Monitoring (or equivalent)
Transformer	ABB (or equivalent)
Switchgear	S&C, PowerCon (or equivalent)
Mounting System	Gamechange Pour-in-Place, 20 degree tilt (or equivalent) equivalent)

The equipment listed above is representative of the equipment that will be used to construct the project. Final equipment selection and configuration may vary based on utility interconnection requirements, availability and other factors at the time of construction. If selected components do change, the Developer will incorporate any changes in the set of record drawings that will be filed with the Final Certification Report. The Developer will seek NYSDEC approval for any significant changes prior the start of construction and/or installation.

2.1.3 Solar Equipment Mounting System

The ballasted mounting system is installed directly on the surface of the site. If additional stone is required for leveling purposes, it will be provided by a certified source. In order to prepare the facility for installation of the PV array, the following actions will be undertaken:

1. Soil erosion and sedimentation controls will be installed prior to the initiation of any construction activities. See the Erosion and Sediment Control Plan included in the Preliminary Design Drawings in Appendix A.
2. The existing road network will be upgraded as required to handle the anticipated construction vehicular traffic.
3. Any existing weed/grass surface will be mowed/cut as low as possible.
4. Minimal "shaping" of the surface will be performed to remove small bumps and irregularities present. In no cases will the existing cover soils be scraped away or modified to change the minimum cover soil requirement, and all material removed will be redistributed to other areas of the facility. Clean imported fill material, from a certified source, will be brought in and spread as necessary. The ultimate goal is to create a surface that is relatively level to accommodate the racking system.

The ballasted mounting system will be designed to allow the installation of PV arrays where durability, low ground pressure, and low maintenance are required, and no ground penetrations are allowed or preferred.

The mounting system will be constructed entirely of aluminum alloy and galvanized steel with stainless steel fastening hardware.

The ballast for the mounting system will consist of cast-in-place (also known as pour-in-place) concrete units that are located under the racking sections. The ballasts will be filled with freeze-thaw rated 4,000 psi concrete. A ballast diagram will be prepared for the array in which the weight of ballast for each array segment is calculated based on the local building code, snow load, and wind speed. The broad width ballasts allow the weight of the ballast to be distributed over a relatively large area, minimizing point loading on the underlying sand/debris fill.

2.1.4 Cable Conduits

All cable conduits located within the array will be constructed of Schedule 80 PVC or cable tray mounted above grade on above-grade supports. Cable conduits from the equipment pads to the edge of the facility will be a combination of above ground rigid conduit installed on small ballast blocks, aerial conductors mounted to new poles, or underground conduit. Where required by code, conduit will utilize gas-tight fittings on each end to prevent gas migration.

2.1.5 Decommissioning

It is anticipated that the solar project will remain at the facility for at least 20 years. PV modules in Japan have been documented to be operating reliably 50 years after installation. At the conclusion of the lease, the Developer will decommission the PV array. Decommissioning and site restoration will include dismantling and removal of all panels and supporting equipment, transformers, overhead cables, equipment pad foundations, and restoration of any temporary access roads. If a crushed stone base is required to supplement the existing, it will be left in place and will not be removed from the ground surface. The crushed stone layer will continue to reduce the potential for erosion and effectively manage storm water flow on the ground surface after decommissioning. To the extent possible, the site will be restored and reclaimed to the general condition that existed prior to the construction of the solar array. For this project, very few alterations of the existing ground surface is expected at the time of construction, as well as when the solar project is decommissioned.

2.1.6 Interconnection

The proposed interconnection will include a connection to an existing, overhead, three-phase Public Service Enterprise Group 13.2 kV feeder located near the east side of the Blydenburgh Landfill property (see Appendix A for the anticipated connection location).

The proposed interconnection would include the necessary equipment to export electricity generated on site to the local power grid. The proposed system includes a new utility pole installed by LIPA used to deliver power from the PV system to the utility interconnection point on the east side of Blydenburgh road outside of the leased space. From the last pole (closest to utility connection) the circuit will transition below grade to utility switchgear as required by PSEG.

2.1.7 PV System Construction

The Developer of this project will remain in an oversight role as the General Contractor throughout the construction of the project. As the General Contractor, the Developer will assign a full-time field project manager and other staff to direct on-site activities including various subcontractors. The Developer's Engineer will continue to provide engineering services to apply for necessary permits and complete the system design.

Prior to construction, a near surface methane scan will be performed to measure concentrations of methane that are venting vertically through the soil surface. In addition, the Contractor will be required to include gas monitoring as part of their Health and Safety Plan (HASP).

2.1.8 Site Security

The existing chain link fence and stormwater features around the perimeter of the solar array will provide site security. Access to the array will be provided through locked access gates as indicated on the plans included in Appendix A.

2.2 Geotechnical Evaluation

A geotechnical assessment was performed to determine the suitability of the landfill to support the proposed solar array. The complete Geotechnical Report is included in Appendix B and should be reviewed for all limitations and assumptions.

2.2.1 Geotechnical Assessment

The following analyses were performed assuming landfill cap soil thicknesses above the FML are as presented in the Closure Report and in the As-Built Plans. Calculations are provided on the Geotechnical Calculations sheet in Appendix B. Hand excavations should be performed in the solar PV and existing/proposed construction access road areas to assess actual thickness and composition of the cap soils over the FML. Our analyses should then be revised if the thicknesses of the cap soils differ from those presented in the Closure Report and in the As-Built Plans and if the estimated soil unit weights differ from those assumed below.

2.2.2 Direct Bearing Stress on the FML

Typically, geomembrane manufacturers recommend limiting stresses on the FML to less than 7 psi during and after construction. We evaluated stresses on the FML from the existing soil cover and the potential increase on the FML due to the ballasts and equipment pads.

The existing cover soil above the FML imparts approximately 239 psf (1.6 psi) of vertical stress on the FML assuming a compost/general backfill moist unit weight of 95.6 pcf the layer thicknesses provided on the Project Plans. As discussed above, we assume the approximately 6-inch thick topsoil (compost) layer will be removed below the equipment pads. The cover soil above the FML imparts approximately 191 psf (1.3 psi) with the topsoil layer removed. Our computations indicate that the maximum stress increase on the FML due to each ballast is approximately 168 psf (1.2 psi) and the net stress increase due to the equipment pad and fill is approximately 269 psf (1.9 psi). The resulting combined net stresses on the FML will be approximately 407 psf (2.8 psi) and 460 psf (3.2 psi) below the ballasts and equipment pad, respectively. These values are well below 7 psi and can be considered acceptable for the proposed construction.

We evaluated the risk of FML puncture in accordance with procedures presented in the 5th edition of Designing with Geosynthetics by Koerner. The evaluation considered an allowable puncture resistance of 90 pounds, a maximum stress on the FML of 7 psi, a maximum particle size of 1-inch, and an angular and relatively large puncturing object. The factor of safety against puncture was estimated as 20, which indicates the risk of puncture due to the proposed construction and vehicle traffic is very low. Calculations are provided in Appendix B – Geotechnical Report.

2.2.3 Waste Compression

Settlement the landfill has experienced since closure was not available; however, continued settlement of the waste mass is likely under self-weight and continuing decomposition of waste materials. Adding load at the top of the landfill could result in additional waste mass settlement.

Estimating landfill settlement requires estimating properties of the compressible waste mass and the magnitude and lateral extent of stress increase within the waste mass due to proposed

loads at the top of the landfill. For practical purposes, the soil and geosynthetic layers of the landfill cap can be assumed incompressible.

The load imposed by each individual ballast or equipment pad (structure) results in a discrete stress over the contact area of the structure. Stress attenuates and becomes more uniform with depth. For example, theoretically, there is no stress increase at the surface of the landfill cap outside of the contact areas of new structures. As depth below the structures increases, the area experiencing the stress below each structure increases laterally and the magnitude of the stress decreases. As depth increases, adjacent "stressed areas" begin to overlap, the stress felt by the ground lessens and becomes more uniform (a.k.a. stress attenuation).

We estimated stress attenuation with depth based on a conservative/simplified 2 vertical to 1 horizontal distribution pattern. In other words, the proposed structure bearing load is assumed to be distributed over an area that increases laterally in all directions by one foot for every two feet of depth below the structure bearing surface. Based on this pattern, the stressed areas begin to overlap when the depth below the bearing surface exceeds the spacing between the structures.

Our stress distribution analyses indicates the stress increase at the top of the waste is approximately 168 psf for the ballasts and approximately 269 psf for each equipment pad, conservatively assuming the waste is directly below the gas venting layer. The additional stress imposed on the waste by the ballasts is expected to be relatively uniform over the PV array footprint. Uniform loads over a large area are estimated as constant with depth; therefore, stress increase due to the ballasts will effectively remain constant at 168 psf through the waste. Measureable stress overlap will not occur between the equipment pads due to the proposed spacing; therefore, stresses will decrease with depth through the waste.

We estimated additional waste mass compression due to stresses imposed by the ballasts and the equipment pads. Published waste mass compression index values suggest a range of 0.15 to 0.30 is reasonable for this analysis. A waste height of 200 ft. was used for the analyses. Based on these parameters, the estimated range of waste mass compression is between 1.7 and 3.4-inches due to the ballasts and between approximately 0.56 and 1.1-inch for the equipment pads. According to information available from GSI, a typical 60-mil textured HDPE FMLs possesses a minimum average yield elongation of 12 percent. Additionally, our experience with similar projects indicates that landfill liners are typically designed assuming a maximum differential settlement below the liner of approximately 12-inches. The magnitude of estimated settlement due to the ballasts and equipment pads is well below these values and, in our opinion, will not result in measurable or adverse strain in the FML. Calculations are provided in Appendix B – Geotechnical Report.

2.2.4 Sliding Analyses

The potential impact of additional loads over the FML on sliding between the FML and cover soil should be considered. For our analyses we assumed the cohesion between the cover soils and the FML to be zero, which means the factor of safety against sliding failure is governed by an infinite slope analysis. The factor of safety against sliding is determined as the tangent of the interface friction angle divided by the tangent of the slope of the FML. The weight of the overlying soil is not a factor in this analysis.

The slope of the FML is assumed to be 8.5 percent matching the slope of the ground surface, which is an angle of approximately 4.3 degrees. According to soil information contained in the available laboratory and field reports and typical FML engineering properties available from GSI, the interface friction value between the cover soil and the FML can be conservatively estimated at greater than 16 degrees if the soil is dry and 12 degrees if the soil is saturated. The resulting range of safety factor against sliding is from 2.5 to 3.4. This compares well to a generally accepted minimum value of 1.5 and indicates the risk of sliding along the FML is low. Calculations are provided in Appendix B – Geotechnical Report.

2.2.5 Construction Access Roads

Ground stresses imposed by heavy construction vehicles can exceed 20 psi, assuming H-20 loading conditions. As previously mentioned, stresses on the FML should be limited 7 psi to reduce the potential for damage. According to information provided in the GSE Geomembrane Protection Design Manual, a cover thickness of at least 36-inches above the geomembrane (FML) is generally required along access roads where H-20 loading will be used to maintain stresses of less than 7 psi on the FML. The cover thickness along the existing access roads was not provided in the Closure Report or the As-Built Plans, although the As-Built Plans depict approximately 16-inches in thickness of aggregate base course and general backfill were used to construct the existing access road along the west slope.

The stresses imposed on the FML by construction equipment cannot be estimated without knowing the soil cover thickness above the FML and the equipment type and track/tire dimensions that will be used for the project. Hand excavations should be performed along the construction access road areas prior to construction to assess the soil cover thickness above the FML. Additionally, the Site Contractor should submit for each vehicle the track/tire stresses that will be imposed on the landfill during construction to the Engineer for review. Once this information is provided, the stresses imposed on the FML, minimum cover thickness required, and the need to place any additional fill soils to protect the FML can be assessed. Equipment should not operate on the landfill until approved by the Engineer.

2.2.6 Construction Considerations

The trees and shrubs on the landfill will require removal for construction of the solar PV system. The vegetation and root system should be removed and the cap soils repaired in accordance with NYSDEC requirements.

The ballast subgrades should be prepared according to the GameChange Racking, LLC recommendations and guidelines.

The equipment pad subgrades should be prepared by removing the surficial organic components of the compost/general backfill layer (topsoil) and replacing it with compacted crushed stone below the equipment pads and within 12 inches laterally of the pad perimeters. The crushed stone should be sloped at a maximum of 3H:1V above the landfill cap and should be separated from surrounding soils on all sides with a heavy, non-woven geotextile filter fabric.

2.2.7 Cap Soil Bearing Capacity

The ballasts and equipment pads are expected to impart stresses up to 513 psf and 340 psf on the landfill surface, respectively. The allowable bearing capacity of the cap soils needs to be evaluated to assess risk of shear failure due to the imposed stresses. We evaluated the allowable bearing capacity of the general backfill layer using a method developed by Terzaghi, the lowest unit weight value provided in the available field reports, an assumed internal friction value using available grain size testing reports, foundation dimensions provided to us, and a factor of safety value of 3. The Terzaghi method considers soil characteristics and the diameter/width of the foundations to evaluate bearing capacity. The calculated bearing capacity of similar soils will increase as the foundation diameter/width increases; therefore, the cap soil bearing capacity below the equipment pads (16 ft. width) will be theoretically greater than below ballasts (2.7 ft. diameter). Given that geotechnical explorations have not been completed at the landfill to confirm soil properties, we used a conservative approach and considered the bearing capacity of the cap soils below equipment pads will equal the bearing capacity below the ballasts. We calculated an allowable bearing capacity of the cap soils of approximately 925 psf for below ballasts and the equipment pads. The allowable bearing capacity of the cap soils is considerably greater than foundation stresses; therefore, the risk of bearing capacity (shear) failure is considered low.

The allowable bearing capacity assumes soil properties presented in the laboratory and field reports, the cap soils are not disturbed during foundation construction, and the subgrades are prepared according to the GameChange Racking, LLC recommendations and guidelines. Our analyses considered the inorganic general backfill layer only. The ballasts are typically installed directly on the organic topsoil and some settlement of this layer due to the imposed stresses should be anticipated. Calculations are provided in Appendix B – Geotechnical Report.

2.3 Stormwater Management

2.3.1 Stormwater Run-off Control Plan

The Site's existing surface supports significant vegetation consisting of grasses and small brush that is adequate to control storm water runoff and erosion. The site is crowned and the existing storm water flows via sheet flow in all directions to the perimeter of the site. The proposed PV system will not adversely affect the current stormwater characteristics including flow direction and volumes.

Per NYSDEC regulations, the addition of the proposed PV development does not constitute addition of impervious cover. Without the addition of impervious cover to the existing site, NYSDEC stormwater management requirements include a SWPPP consisting of Erosion and Sediment Controls and submittal of a Notice of Intent (NOI). A full evaluation of how the site will be impacted from a stormwater perspective by the proposed PV development via updated storm water modeling is not required because the proposed design meets the following criteria:

- Solar panels are constructed on post/ballast (elevated off of the ground surface)
- The panels are spaced apart so that rain water can flow off down gradient side of panel and reach the ground
- The ground surface below the panels will be a well-established vegetative cover

Given that the stipulations above are met for this project, there is no change in drainage between the pre- and post- development conditions and therefore no need for additional stormwater management controls beyond those currently in place.

2.3.2 Existing Conditions

The existing site is relatively flat covered with low-lying vegetation. Beneath the vegetation is a layer of compacted soil above geosynthetic layers. The soils are well-drained with no signs of groundwater table present.

Mid-slope storm water swales or storm water collectors are not installed or necessary on this site. The facility surface supports significant vegetation consisting of grasses and small brush that is adequate to control storm water runoff and erosion. Existing storm water flows via sheet flow to the perimeter of the site in all directions. The Site's topography is relatively flat allowing the typical rain event to infiltrate into the ground. Even under more intense storms a significant amount of the runoff is infiltrated into the ground prior to reaching existing stormwater infrastructure downstream.

2.3.3 Proposed Conditions

As noted above, within the 8.5 acre footprint for the proposed solar array development, the vegetation will remain as is with the ballasts for the solar arrays installed on top of the existing ground cover. In addition, concrete equipment pads to support equipment and surface mounted electrical conduits will be installed. The proposed work is expected to cause negligible changes to the storm water runoff regime of the facility.

The solar array will be constructed using a ballasted racking system. The solar panels are not considered impervious surface as they are elevated from the ground surface and the stormwater that runs off of the solar panels has a direct flow-path to the vegetation around and underneath the panels. Accordingly, the areas occupied by the solar panels take on the characteristics of the underlying surface from a stormwater modeling perspective (low-lying vegetation).

The solar panels are connected to each other and in contact with the ground by a metal frame system that is supported by the pour-in-place ballast blocks. The solar PV panels will not collect storm water as it will directly infiltrate into the vegetation from the panels. The existing surface of the facility is sloped (approximately <2%), stormwater will flow across the vegetation in addition to infiltrating into the existing soils of the ground cover. Since only minor grading may be necessary, it is anticipated the storm water will follow the same general drainage patterns as current existing conditions.

The drainage areas between pre- and post-conditions remained unchanged, as well as the curve numbers and times of concentrations. The ability of the existing facility and storm water receiving areas were assessed for anticipated storm water runoff as a result of PV development. No functional impact is anticipated from the proposed design. Based on the stormwater regulations, no changes to the storm water runoff controls are proposed.

2.3.4 Stormwater Erosion Control Plan

A review was performed to assess the potential of increased erosion during and after the array is constructed. A possible source of erosion could be the disturbance of the ground surface by low ground pressure equipment. Any rutting or exposure of the cover soils will be promptly filled,

covered and/or stabilized by the contractor. Conventional erosion and sediment control measures and procedures will be implemented as depicted on the design plans included in Appendix A.

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3.0 OPERATIONS & MAINTENANCE

3.1 PV System Operations & Maintenance

Unique among energy generation technologies, PV systems are almost entirely solid state; the only moving parts in the proposed system are the cooling fans in the inverter enclosures. Maintenance and repairs on the facilities can be done while the plant is not producing power in the early morning and early evening. Additionally, individual sections of the plant can be taken offline for any other needed repairs, with negligible impact on plant output.

This site-specific O&M Plan has been developed to ensure that the PV system operates in a safe and efficient manner. The O&M plan includes a detailed discussion of specific activities to be performed on a routine basis, including:

- Daily remote monitoring of the PV system performance using the data acquisition system (DAS);
- Semi-annual inspection and testing of the entire array, including solar panels, mounting system, string and output wiring, DAS and inverters;
- Annual inspection of transformers, switchgear, and other major components; and
- Periodic (as needed) weed and vegetation control.

The Developer's obligations for maintenance of the facility cover system will be the solar array area. The Town of Islip will continue to maintain the rest of the facility outside of the area around the array, and will continue to be responsible for all post- closure environmental monitoring.

3.2 Operations & Maintenance Schedule

Unless noted otherwise, the Developer has full responsibility for the O&M of the leased/licensed area and all equipment on it for the period stipulated in the agreement with the Town of Islip. Preventative maintenance will be carried out as necessary depending on the site conditions. In addition, the Developer shall coordinate all warranty-related equipment repairs and upgrades with OEM suppliers. A summary of typical Operation & Maintenance procedures is as follows:

3.2.1 Site/Groundwork

- Periodically trim weeds or control growth within the fenced landfill area
- Repair and maintain the ground surface within the fenced solar array area, including filling ruts, rodent holes, and other depressions within the fenced area
- Vegetation control shall be by use of nylon line trimmers, ride-on brush cutters, and self-propelled brush cutters to maintain optimal performance of PV system and reasonable aesthetics.
- Inspect, maintain, and repair fence/gate security for the entire fenced area and oil locks when necessary
- Maintain the access points as required for O&M services
- Comply with NYSDEC permit conditions related to site maintenance
- Bare spots will be seeded as required to prevent site erosion

3.2.2 System

- Provide Torque checks to the string connections in the combiner boxes
- Test all strings to ensure they are functioning as expected

- Utilize thermal imaging to detect loose connections or hot spots
- Spot check torque settings on all racking hardware
- Spot check torque settings on all solar panels
- Visually inspect all terminations for corrosion/tightness
- Visually inspect all enclosures for rust, corrosion, moisture, breaks in the seal
- Visually inspect the panels for cracks, discoloring, excess soiling
- Visually inspect string wiring
- Fasten any wires that have loosened due to wind vibration
- Clean solar panels with water as needed to remove dust, dirt, pollen, and other soiling substances that can inhibit the proper production of the module
- Ensure that there is no movement of the racking or ballast on the leased site
- Monitor the viability of the vegetative layer on the leased site
- Ensure that no erosion has taken place on the leased site
- Visually inspect all labels to ensure they are legible, and replace as warranted
- Visually inspect all outdoor raceways for damage, and replace as warranted

3.2.3 *Inverters*

- Clean air filters
- Check MOV surge protector
- Use thermal imaging as needed for loose connections and hot spots
- Touch up exterior paint where needed
- Inspect cooling fans
- Inspect weather stripping for all doors

3.2.4 *Data Acquisition System (DAS) & Weather Station*

- Visually inspect connections to all peripherals
- Clean weather station as appropriate
- Check wire management for loose wires due to wind vibrations
- Check calibration of pyranometer
- Visually inspect DAS box for moisture or discoloration
- Inspect connections within the DAS box

3.2.5 *Monitoring & Emergency Response*

- Perform daily system review, via remote monitoring, to measure proper performance of inverters and production of the modules
- Daily review of metered power vs. modeled power to ensure the system is performing according to expectations
- A software alarm shall notify maintenance personnel of abnormalities occurring within the array
- Clear minor alarms as needed within a reasonable period of time
- Respond to major alarms within 2 hours with remote troubleshooting protocol
- If unable to clear the alarm, have technical personnel on site within 48 hours
- Work with equipment manufacturers to provide technical support, software upgrades, and replacement equipment as required

3.2.6 Reporting

- Coordinate with the Town to provide required reporting (if/as required) related to the PV facility per the NYSDEC site operating permit
- Provide an annual status report to the Town regarding the operation of the PV facility and compliance with site lease requirements

3.3 Contingency Response and Notification Procedure

In the event of an emergency, including fire and explosion, at the site of the PV array, the following procedure described in the flow chart below shall be implemented.

Z:\NY-Poughkeepsie-Projects\ACE - American Capital Energy\Islip NY - Long Island\Islip - Blydenburgh\Permit Modification Report\20160426 Blydenburgh Engineer's Report.docx

CONTINGENCY RESPONSE AND NOTIFICATION PROCEDURE

Notification Flowchart

EMERGENCY OBSERVED

Town of Islip - RRA
401 Main Street
Islip, NY 11751
(631) - 224 - 5644

Suffolk County Police Dept
11787, 727 Veterans Memorial Hwy
Shirley, NY 11967
911 or (631) - 852 - 8400

Islip Fire Department
28 Monell Ave,
Islip, NY 11751
(631) - 581 - 5656

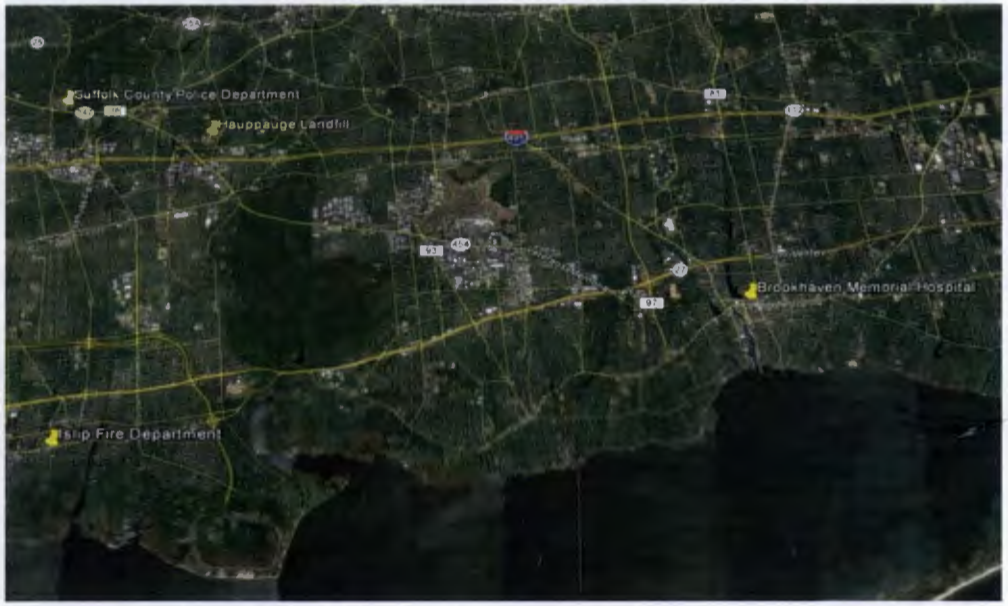
Weston & Sampson
5 Centennial Drive
Peabody, MA 01960
Steven Wiehe
(978) - 532 - 1900

NYS DEC
50 Circle Road
Stony Brook, NY 11790
Syed H. Rahman
(631) - 444 - 0231

American Capital Energy
360 Merrimack Street, Bldg 9, Entrance K ,Suite 202
Lawrence, MA 01843
Eric McLean
(978) - 221 - 2027

Golder Associates Inc.
305 Fellowship Road, Suite 200
Mt. Laurel, New Jersey 08054
(856) - 793 - 2005

Emergency Response Location Map



Nice map—

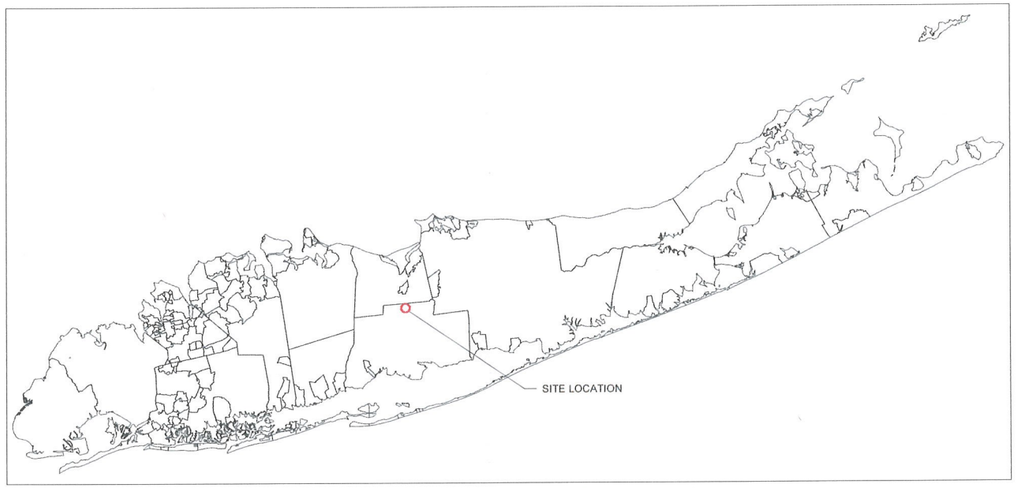
APPENDIX A

Preliminary Design Drawings

BLYDENBURGH LANDFILL

±1,980 kW (DC) SOLAR PHOTOVOLTAIC (PV) PROJECT

BLYDENBURGH ROAD
ISLIP, NEW YORK

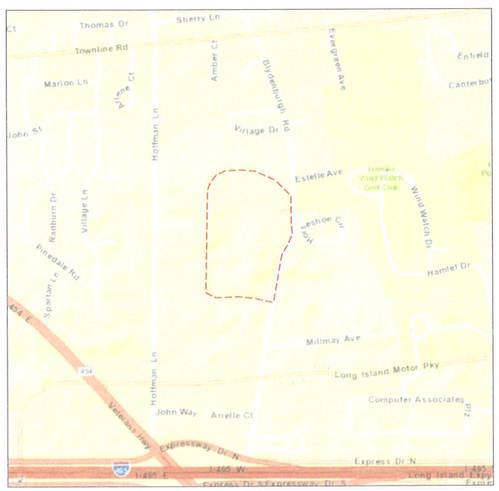


LONG ISLAND MUNICIPAL MAP
SCALE: N.T.S.

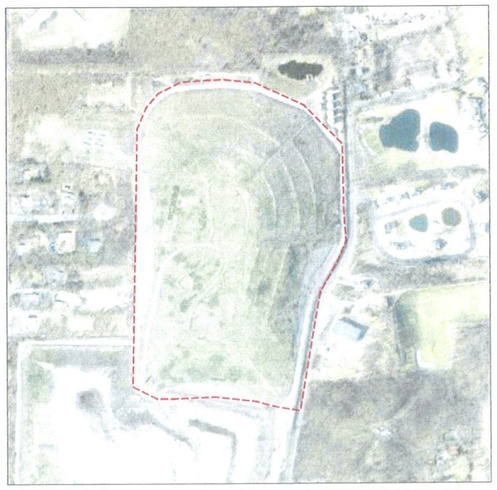
PROJECT DIRECTORY		
DEVELOPED BY: AMERICAN CAPITAL ENERGY, INC. 360 MARRIMACK STREET SUITE 202 LAWRENCE, MASSACHUSETTS 01843 CONTACT: CAMERON DOWD (978) 221-2046 ENGINEER: WESTON & SAMPSON ENGINEERS, INC. 301 MANCHESTER ROAD, SUITE 201A POUGHKEEPSIE, NEW YORK 12603 CONTACT: RICHARD MESSER, PE (845) 454-3344	HOST: TOWN OF BROOKHAVEN 1 INDEPENDENCE HILL FARMINGVILLE, NY 11738 CONTACT: PETER FOUNTAINE (631) 451-6455 CONTRACTOR: ELDOR CONTRACTING CORPORATION 30 CORPORATE DRIVE HOLTSVILLE, NY 11742 CONTACT: KEITH FELDMANN (631) 218-0010	UTILITY: PUBLIC SERVICE ENTERPRISE GROUP, INC. (PSEG) 175 E. OLD COUNTRY ROAD HICKSVILLE, NY 11801 CONTACT: STEPHEN CANTORE, CEM, DGCP (516) 545-4820 ELECTRICAL ENGINEER: TO BE DETERMINED

SOLAR PHOTOVOLTAIC (PV) SYSTEM DESCRIPTION		
SYSTEM SIZE	1,987 kW (DC)	1,496 kW (AC)
MODULE	(6,308) CANADIAN SOLAR CS6X-315P (315W)	
TILT ANGLE	20 DEGREES	
AZIMUTH	180 DEGREES (SOUTH)	
RACKING	(925) GAMECHANGE GC POUR-IN-PLACE BALLASTED RACKING ASSEMBLIES	
INVERTER(S)	(40) SOLECTRIA PVI-36TL AND (2) PVI-28TL	

DRAWING INDEX	
SHEET	SHEET TITLE
T-1	TITLE SHEET
G-1	NOTES, LEGENDS, AND EROSION CONTROL DETAILS
C-1	EXISTING CONDITIONS PLAN
C-2	EROSION AND SEDIMENT CONTROL PLAN
C-3	OVERALL PROPOSED DEVELOPMENT PLAN
C-4	PROPOSED DEVELOPMENT PLAN NORTH
C-5	PROPOSED DEVELOPMENT PLAN SOUTH
D-1	TYPICAL DETAILS I
D-2	TYPICAL DETAILS II
D-3	TYPICAL DETAILS III



SITE LOCATION MAP
SCALE: N.T.S.



SITE LOCATION MAP (AERIAL VIEW)
SCALE: 1"=400'

Project:
LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

BLYDENBURGH LANDFILL SOLAR PROJECT

AMERICAN CAPITAL ENERGY
360 Merrimack Street Suite 202
Lawrence, Massachusetts 01843
(978) 221-2000
www.americancapitalenergy.com

Weston&Sampson
301 Manchester Road, Suite 201A
Poughkeepsie New York, 12603
(845) 454-3344 (800) Sampson
www.westonandsampson.com

Revisions:

Rev	Date	Description

Seal:

JOB NO. 2150683

Date:	11.17.16
Scale:	AS SHOWN
Designed By:	RWG
Reviewed By:	DCH
Checked By:	RM
Approved By:	-

Drawing Title:
TITLE SHEET

Sheet Number:
T-1

LEGEND

- CONTOUR LINE (MINOR) — 341
- CONTOUR LINE (MAJOR) — 345
- SPOT ELEVATION (FLOOR ELEV.) (MISC. TEXT,NOTES) — 345.6
- FENCE (CHAIN LINK)
- FENCE (WOOD ETC.)
- GATES
- UTILITY POLE
- OVERHEAD UTILITIES — OH
- ELECTRIC/POWER — E
- LIGHT POLE
- SANITARY LINE — SS
- GAS — G
- GUIDE RAIL
- PAVEMENT (WALKS, CURBS, RET. WALLS)
- SURVEY BASELINE (TIES & TEXT)
- CONTROL MONUMENT
- IRON PIPE — IP
- BENCH MARK — BM 345.6
- PROPERTY LINE (EASEMENTS)
- VEGETATION LINE
- DECIDUOUS TREE — SPECIES, SIZE
- EVERGREEN TREE — SPECIES, SIZE
- SHRUB — 364 ARBORVITAE EL=178.34
- BUILDING OUTLINE (DOCKS, RAMPS PADS, STAIRS, ETC.)
- BOLLARD
- SIGNS
- FLAG POLE
- SOIL BORING HOLE — BORING B-123
- TEST PIT — TP-123
- STORM LINE — ST
- HYDRANT
- POST INDICATOR VALVE — PIV
- VALVE — WV
- WATER — W

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL CALL DIG SAFELY NEW YORK AT 811 OR (315) 437-7333 AT LEAST 72 HOURS, SATURDAYS, SUNDAYS, AND HOLIDAYS EXCLUDED, PRIOR TO EXCAVATING AT ANY LOCATION. A COPY OF THE DIGSAFE PROJECT REFERENCE NUMBER(S) SHALL BE GIVEN TO THE OWNER PRIOR TO EXCAVATION.
2. LOCATIONS OF EXISTING PIPES, CONDUITS, UTILITIES, FOUNDATIONS AND OTHER UNDERGROUND OBJECTS ARE NOT WARRANTED TO BE CORRECT AND THE CONTRACTOR SHALL HAVE NO CLAIM ON THAT ACCOUNT SHOULD THEY BE OTHER THAN SHOWN.
3. STONE WALLS, FENCES, CURBS, ETC. SHALL BE REMOVED AND REPLACED AS NECESSARY TO PERFORM THE WORK UNLESS OTHERWISE INDICATED, ALL SUCH WORK SHALL BE INCIDENTAL TO CONSTRUCTION OF THE PROJECT.
4. ALL AREAS DISTURBED BY THE CONTRACTOR BEYOND PAYMENT LIMITS SHALL BE RESTORED AT NO ADDITIONAL COST TO THE OWNER.
5. IF SURVEY CONTROL STAKING AND EROSION CONTROL MEASURES ARE REQUIRED. HAND DUG TEST HOLES WILL BE PERFORMED TO CONFIRM THE DEPTH TO THE GEOMEMBRANE LINER, PRIOR TO INSTALLATION. ALL TEST HOLES SHALL BE VERIFIED BY THE ON-SITE ENGINEER.

SPECIFICATIONS FOR WORK ON LANDFILL:

1. THE CONTRACTOR SHALL BE AWARE THAT WORK IS LOCATED ON A LANDFILL AND IS SUBJECT TO NEW YORK STATE'S SOLID WASTE MANAGEMENT FACILITIES REGULATIONS (6 NYCRR PART 360).
2. THE CONTRACTOR SHALL BE AWARE THAT THE WORK IS TO TAKE PLACE ABOVE A LANDFILL COVER SYSTEM, GENERALLY COMPRISED OF A VEGETATIVE SUPPORT LAYER, A SAND DRAINAGE LAYER, AND A LOW PERMEABILITY LINER LAYER/SOIL CAP. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO NOT DISRUPT THE LANDFILL CAP PROFILE OR TO DAMAGE THE LOW PERMEABILITY LINER/SOIL CAP, UNLESS AS INDICATED ON PLAN.
3. WORK SHALL BE COMPLETED IN GENERAL ACCORDANCE WITH THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION'S (NYSDEC) PERMIT APPROVAL.
4. THE CONTRACTOR SHALL HAVE A HEALTH AND SAFETY PLAN WHILE WORKING ON THE LANDFILL.

EQUIPMENT:

1. THE CONTRACTOR SHALL PROVIDE A LIST OF ALL EQUIPMENT PROPOSED TO BE WORKING ON THE LANDFILL. THE LIST SHALL INCLUDE THE EQUIPMENT WEIGHT, GROUND PRESSURE, AND ANY RESTRICTIONS THAT WILL BE IMPOSED ON THE VEHICLE (I.E. LIMITED TO TEMPORARY ACCESS ROADS, LIMITED TO CARRYING 1/2 LOADS, ETC.).
2. ALL EQUIPMENT IS SUBJECT TO REVIEW AND APPROVAL BY THE ENGINEER. AS A GENERAL RULE, EQUIPMENT SHALL ADHERE TO THE FOLLOWING REQUIREMENTS:

EQUIPMENT GROUND PRESSURE		MINIMUM LIFT THICKNESS	
KPa	psi	meter	inches
<70	<10	0.30	12
70-140	10-20	0.60	24
>140	>20	0.90	36

SOURCE: GEOMEMBRANE PROTECTION DESIGN MANUAL, GSE; DHANI NAREJO, PH.D. AND GREG CORCORAN, P.E., FIRST EDITION.

EXCAVATIONS:

1. THE CONTACTOR SHALL PROVIDE AN EXCAVATION PLAN DETAILING HOW THE CONTRACTOR WILL COMPLY WITH ALL PERTINENT PROVISIONS OF THE CONTRACT DOCUMENTS, INCLUDING SITE RESTRICTIONS, WORK PROTOCOLS, TEMPORARY ROADS, ON-SITE PARKING AND STORAGE AREAS.
2. EXCAVATIONS ON THE LANDFILL AREA SHALL BE PERFORMED WITH THE GUIDANCE OF A LABORER OR 'SPOTTER' AT ALL TIMES. THE LABORER SHALL IDENTIFY THE DEPTH OF THE LOW PERMEABILITY LINER AND NOTIFY THE OPERATOR SHOULD HE GET TOO CLOSE.
3. IT IS PREFERABLE TO USE A SMOOTH BUCKET EXCAVATOR IN LIEU OF BUCKET WITH TEETH.

SUGGESTED EROSION CONTROL CONSTRUCTION SCHEDULE:

1. INSTALL TEMPORARY CONSTRUCTION ENTRANCE AT APPROXIMATE LOCATION OF DRIVEWAY IF DRIVEWAY STONE HAS NOT YET BEEN PLACED.
2. INSTALL PROTECTIVE MEASURES AROUND TREES TO BE RETAINED WITHIN GRADING LIMITS.
3. INSTALL BRIGHTLY COLORED CONSTRUCTION FENCE ALONG ROAD TO LIMIT VEHICULAR ACCESS TO STONE DRIVEWAY OR CONSTRUCTION ACCESS DRIVE.
4. INSTALL INLET PROTECTION DEVICES AT CATCH BASINS DOWN SLOPE FROM THE SITE THAT ARE VULNERABLE TO SEDIMENT ACCUMULATIONS.
5. COMPLETE SITE CLEARING, STOCKPILE SAVED MATERIALS IN DESIGNATED AREAS.
6. INSTALL EROSION AND SEDIMENT CONTROL MEASURES IN LOCATIONS AROUND THE PERIMETER OF SITE WORK, STOCKPILE AREA AND ALONG THE CONTOUR OF ALL DISTURBED SLOPES AT A MINIMUM OF EVERY 50' OF HORIZONTAL DISTANCE OR AS SPECIFIED, MEASURED PERPENDICULAR TO THE SLOPE.
7. CONTRACTOR MUST ROUTINELY INSPECT AND MAINTAIN EROSION CONTROL DEVICES AND BEST MANAGEMENT PRACTICES (BMP'S). DOCUMENT WEEKLY INSPECTIONS IN SEPARATE CONTRACTOR'S LOG.
8. THE CONTRACTOR SHALL INITIATE STABILIZATION OF ANY BARE SOIL AREAS, AS SOON AS POSSIBLE, BUT IN NO CASE MORE THAN 14 DAYS AFTER INITIAL DISTURBANCE OF THE RESPECTIVE AREAS OF THE SITE. THE CONTRACTOR SHALL RETAIN SITE RECORDS OF THE EARTHWORK AND STABILIZATION WORK PERFORMED. EXCEPTIONS TO THIS POLICY CAN BE GRANTED UNDER NORMAL CONDITIONS IN THE FOLLOWING INSTANCES:
   A. WHERE THE INITIATION OF STABILIZATION MEASURES BY THE 14TH DAY AFTER CONSTRUCTION ACTIVITY TEMPORARILY OR PERMANENTLY CEASED IS PRECLUDED BY SNOW COVER OR FROZEN GROUND CONDITIONS. STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS PRACTICABLE.
   B. WHERE CONSTRUCTION ACTIVITY ON A PORTION OF THE SITE IS TEMPORARILY CEASED, AND EARTH-DISTURBING ACTIVITIES WILL BE RESUMED WITHIN TWENTY-ONE (21) DAYS, TEMPORARY STABILIZATION MEASURES NEED NOT BE INITIATED ON THAT PORTION OF THE SITE IF REQUESTED IN WRITING AND APPROVED BY THE ENGINEER.
9. ALL EROSION CONTROL MEASURES SHALL REMAIN IN PLACE UNTIL FINAL STABILIZATION IS ATTAINED. REMOVAL OF ANY EROSION CONTROL MEASURES MUST FIRST BE APPROVED BY THE ENGINEER AND/OR THE JURISDICTION HAVING AUTHORITY.
10. WHEN WEATHER CONDITIONS PROHIBIT SEED GERMINATION, DISTURBED GROUND SHOULD BE MULCHED WITH STRAW OR FIBER MULCH AND RECEIVE A BINDER/TACK APPLICATION OR EQUIVALENT.
11. THE SCHEDULE DESCRIPTIONS ABOVE ARE SUGGESTIONS PROVIDED TO ASSIST THE CONTRACTOR(S) IN DEVELOPING THEIR STORM WATER POLLUTION PREVENTION PLAN (SWPPP) SCHEDULE SPECIFIC TO THIS PROJECT. THE ACTUAL SCHEDULING AND IMPLEMENTATION OF THE SWPPP AND MAINTENANCE OF REQUIRED WATER QUALITY IS THE RESPONSIBILITY OF THE CONTRACTOR(S). THE EROSION AND SEDIMENT CONTROL PLAN AND DEVICES SHOWN ARE CONSIDERED TO COMPRISE THE MAJORITY OF EFFORTS NEEDED, BUT NOT NECESSARILY ALL THAT WILL BE REQUIRED. WEATHER, SITE AND UNFORESEEN CONDITIONS CAN DICTATE THAT GREATER EFFORTS WILL BE NECESSARY. IN THE CASE OF PROJECTS THAT DISTURB MORE THAN 1 ACRE OF LAND, THE OWNER, OR OWNER'S REPRESENTATIVE, WILL DEVELOP THE SWPPP WITH SUBMITTED CONTRIBUTIONS FROM THE ASSIGNED CONTRACTORS PERFORMING PROJECT SITE WORK. THESE CONTRIBUTIONS WILL CONSIST OF AN EROSION AND CONTROL SCHEDULE (AS SPECIFIED IN THE PROJECT MANUAL), SHORT NARRATIVE OF ANTICIPATED EROSION CONTROL ACTIVITIES, INSPECTION REPORTS AND LOGS AND SIGNED CERTIFICATION STATEMENTS AND PRE-CONSTRUCTION PHOTOGRAPHS AS SPECIFIED. THIS COMPETENT PERSON SHALL BE EITHER A LICENSED ENGINEER, LANDSCAPE ARCHITECT OR CERTIFIED EROSION CONTROL SPECIALIST.

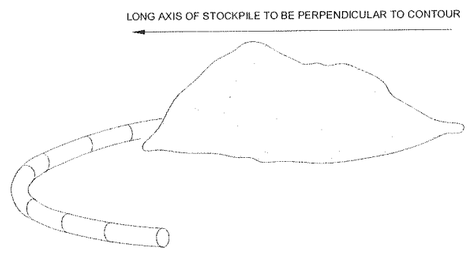
GENERAL MAINTENANCE PLAN:

1. ALL EROSION AND SEDIMENT CONTROL PRACTICES WILL BE CHECKED FOR STABILITY AND OPERATION FOLLOWING EVERY RUNOFF PRODUCING RAINFALL, BUT IN NO CASE LESS THAN ONCE EVERY WEEK. IN ACCORDANCE WITH THE SWPPP AND NYSDEC SPDES GENERAL PERMIT No. GP-0-15-002. ANY NEEDED REPAIRS WILL BE MADE IMMEDIATELY TO MAINTAIN ALL PRACTICES AS DESIGNED.
2. SEDIMENT WILL BE REMOVED FROM BEHIND EROSION AND SEDIMENT CONTROL MEASURES WHEN IT BECOMES 6" DEEP AT THE MEASURE OR WHEN ACCUMULATIONS HAVE ADVERSELY AFFECTED IT'S FUNCTION. EROSION AND SEDIMENT CONTROL MEASURES WILL BE REPAIRED BY REMOVING SILT AND SEDIMENTS AND THEN TAMPING LOOSE SOIL ALONG BASE, REPLACING DAMAGED MEASURES OR AS NECESSARY TO MAINTAIN A BARRIER.
3. SEDIMENT WILL BE REMOVED AND FILTER DEVICES CLEANED OR REPLACED AT CATCH BASINS WHEN THE SEDIMENT POOL NO LONGER DRAINS FREELY. SEDIMENT ACCUMULATIONS WITHIN DRAINAGE STRUCTURES AND PIPING SHALL BE CLEANED OUT AT THE PROJECT COMPLETION AND AS ORDERED BY ENGINEER WHEN DETERMINED THAT PRE-COMPLETION INSTALLATIONS NO LONGER FUNCTION PROPERLY DUE TO SEDIMENT OR DEBRIS. EVENTUAL SYSTEM CLEANING IS NOT AN EXCUSE TO NOT IMPLEMENT APPROPRIATE CONTROLS UPSTREAM. THE ENGINEER SHALL BE THE FINAL JUDGE REGARDING WHETHER THE PIPING SYSTEM REQUIRES CLEANING. THE CONTRACTOR CAN MINIMIZE THE NECESSITY OF EXTENSIVE SILT AND SEDIMENT ACCUMULATION REMOVALS BY EFFECTIVE IMPLEMENTATION OF THE SWPPP.
4. ALL DISTURBED AREAS WILL BE FERTILIZED, SEEDED AND MULCHED ACCORDING TO LANDSCAPE RESTORATION SPECIFICATIONS TO MAINTAIN VIGOROUS, DENSE VEGETATION. REPAIR ANY ERODED SLOPES, REAPPLY TOPSOIL, RESEED AND STABILIZE REPAIR AREA AS REQUIRED FOR PERMANENT OR TEMPORARY MEANS. REPAIR SOIL AREAS DAMAGED BY EROSION OR CONSTRUCTION EQUIPMENT.
5. IMMEDIATELY REPAIR ANY DAMAGE CAUSED BY CONSTRUCTION EQUIPMENT, MAINTENANCE OR OTHER ACTIVITY TO ANY EROSION CONTROL MEASURE, OR BEST MANAGEMENT PRACTICE OR DEVICE.
6. THE PRIME CONTRACTOR(S) ARE RESPONSIBLE FOR THE PERFORMANCE AND COMPLIANCE OF THEIR SUB-CONTRACTOR'S ACTIVITIES RELATING TO THE SWPPP. THEY SHALL MAKE FREQUENT INSPECTIONS OF THEIR WORK AND COORDINATE APPROPRIATE INSTALLATION AND MAINTENANCE OF EROSION CONTROL AND WATER QUALITY DEVICES.
7. EMPLOY POLLUTION PREVENTION MEASURES TO CONTROL LITTER, CONSTRUCTION CHEMICALS, SEDIMENT AND CONSTRUCTION DEBRIS INCLUDING, BUT NOT LIMITED, TO THE FOLLOWING: SALVAGE AND REUSE OF MATERIALS, MINIMIZING PACKAGING WASTE, RECYCLING, PROPER DISPOSAL AT FREQUENT INTERVALS IN ACCORDANCE WITH PREVAILING LAWS, ONSITE INSTRUCTION REGARDING APPROPRIATE SEPARATION/HANDLING/RECYCLING, PERIODIC DEBRIS REMOVAL AT DRAINAGE STRUCTURES (GRATES AND SUMPS)/SEDIMENT TRAPS/ FOREBAY AND OTHER BMP'S, PROPER MAINTENANCE OF SEDIMENT/ EROSION CONTROL SYSTEMS, ROUTINE AND EVENT RELATED INSPECTIONS OF DRAINAGE AND BMP SYSTEMS PER PERMIT REQUIREMENTS, PROVIDE APPROPRIATE SANITARY FACILITIES FOR ONSITE PERSONNEL, PICK UP TRASH AND DEBRIS FREQUENTLY AND USE WATER MIST, CALCIUM CHLORIDE OR OTHER LEGAL MEANS TO LIMIT THE SPREAD OF DUST AND SOIL PARTICLES.

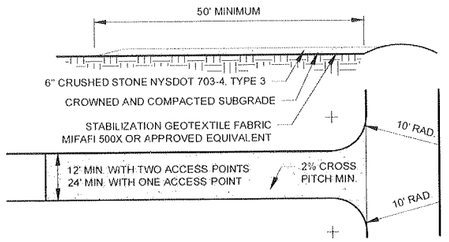
PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

SWPPP
(STORMWATER POLLUTION PREVENTION PLAN)

- ☑ • HAS BEEN DETERMINED TO BE REQUIRED BASED ON SCOPE OF PROJECT CONSISTING OF EROSION AND SEDIMENT CONTROL PLANS. SWPPP REQUIRES DOCUMENTS FROM CONSTRUCTION TEAM.
- ☐ • HAS BEEN DETERMINED NOT TO BE REQUIRED BASED ON SCOPE OF PROJECT.
- • REFER TO REQUIREMENTS LISTED ON THIS SHEET AND SPECIFICATION SECTION 01580 ENCLOSED IN THE SWPPP. IF SCOPE OF PROJECT CHANGES, THE REQUIREMENT FOR A SWPPP AND NYSDEC PERMITTING MAY REQUIRE RE-EVALUATION.



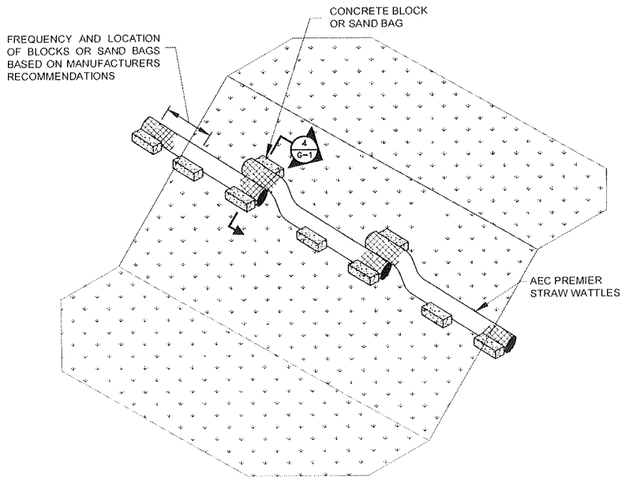
1 TEMPORARY STOCKPILE DETAIL
SCALE: N.T.S.



NOTES:

1. STABILIZATION FABRIC SHALL BE PLACED OVER THE ENTIRE ENTRANCE AREA PRIOR TO PLACING OF STONE. OVERLAP FABRIC PER MANUFACTURER'S SPECIFICATIONS.
2. ALL SURFACE WATER FLOWING OR DIVERTED TOWARDS THE CONSTRUCTION ENTRANCE SHALL BE PIPED BENEATH THE ENTRANCE ROAD.
3. WHEN EQUIPMENT WASHING IS REQUIRED IT SHALL BE DONE ON A SEPARATE AREA ADJACENT TO THE ENTRANCE ROAD AND STABILIZED WITH STONE. EQUIPMENT WASHING WILL BE REQUIRED IF ROAD RECEIVES SIGNIFICANT SOILS OR DEBRIS ACCORDING TO JUDGMENT BY OWNER OR OWNER'S REPRESENTATIVE.
4. KEEP ROADS CLEAR OF STONES, MUD, AND OTHER CONSTRUCTION DEBRIS. CLEAN PAVEMENT AS ACCUMULATIONS WARRANT AND AS ORDERED BY ENGINEER.
5. REMOVE SILT ACCUMULATIONS ROUTINELY AND DISPOSE OF PROPERLY SUCH THAT WATER QUALITY IS NOT IMPAIRED. DO NOT INTRODUCE SILT INTO DRAINAGE SYSTEM OR TOPSOIL/RESTORATION AREAS.

2 STABILIZED CONSTRUCTION ENTRANCE PAD DETAIL
SCALE: N.T.S.



3 SLOPE DETAIL
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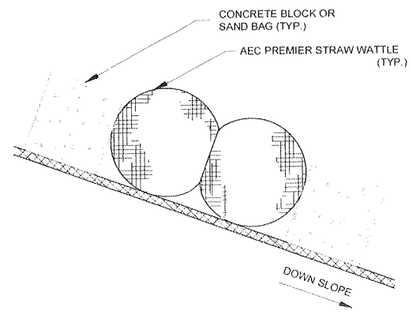

4 CONCRETE BLOCK DETAIL SECTION (ON CAP)
SCALE: N.T.S.

Project
LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

BLYDENBURG LANDFILL SOLAR PROJECT

American Capital Energy
360 Merrimack Street Suite 202
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Revisions

Rev	Date	Description

Seal:

JOB NO. 2150683

Date:
Scale:
Designed By:
Reviewed By:
Checked By:
Approved By:

Drawing Title:
NOTES, LEGENDS, AND EROSION CONTROL DETAILS

Sheet Number:
G-1

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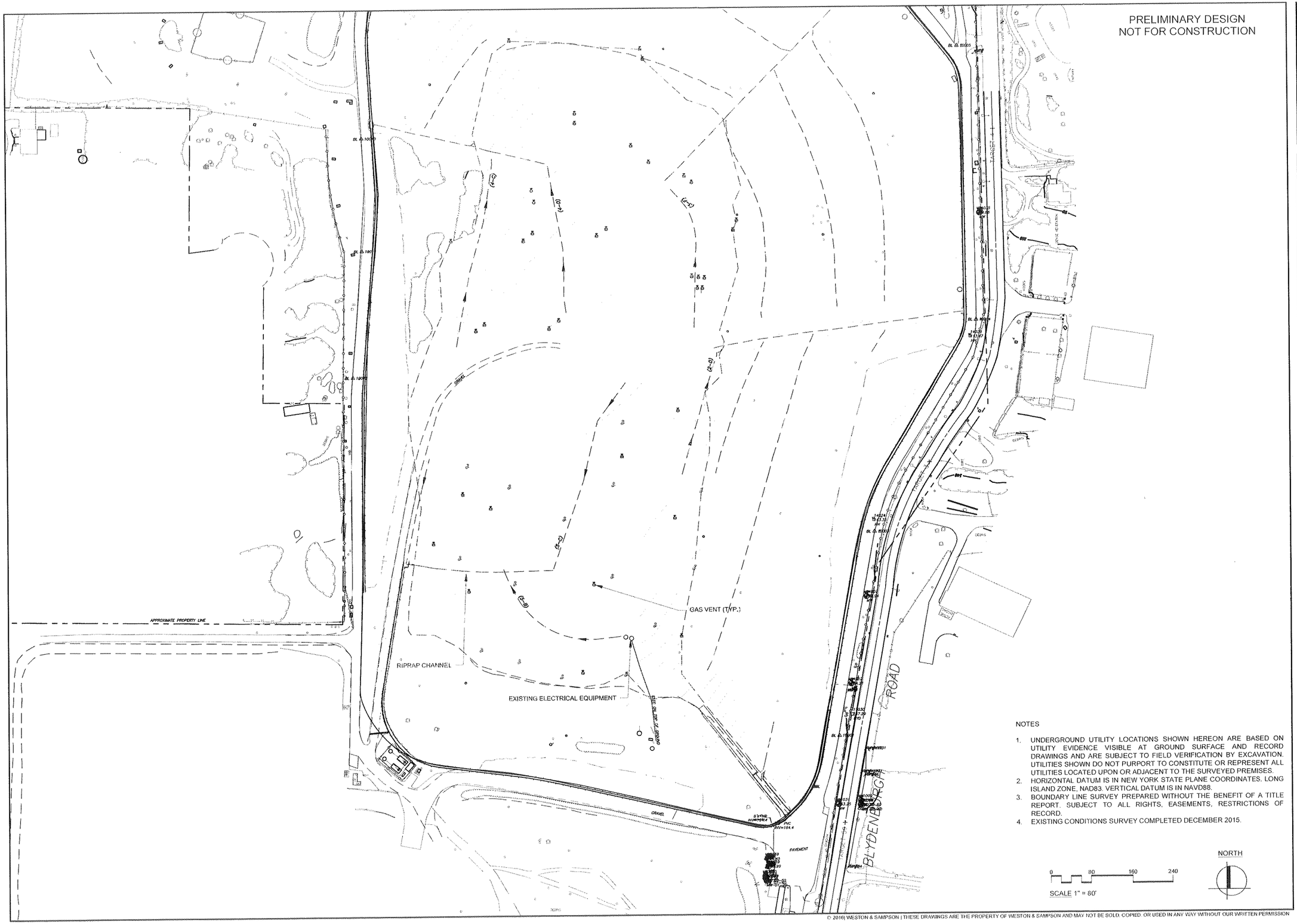
PRELIMINARY DESIGN
NOT FOR CONSTRUCTION



NOTES

1. UNDERGROUND UTILITY LOCATIONS SHOWN HEREON ARE BASED ON UTILITY EVIDENCE VISIBLE AT GROUND SURFACE AND RECORD DRAWINGS AND ARE SUBJECT TO FIELD VERIFICATION BY EXCAVATION. UTILITIES SHOWN DO NOT PURPORT TO CONSTITUTE OR REPRESENT ALL UTILITIES LOCATED UPON OR ADJACENT TO THE SURVEYED PREMISES.
2. HORIZONTAL DATUM IS IN NEW YORK STATE PLANE COORDINATES, LONG ISLAND ZONE, NAD83. VERTICAL DATUM IS IN NAVD88.
3. BOUNDARY LINE SURVEY PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT, SUBJECT TO ALL RIGHTS, EASEMENTS, RESTRICTIONS OF RECORD.
4. EXISTING CONDITIONS SURVEY COMPLETED DECEMBER 2015.

NORTH

0 80 160 240

SCALE 1" = 80'

Project

LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

BLYDENBURGH LANDFILL SOLAR PROJECT

AMERICAN CAPITAL ENERGY
360 Merrimack Street Suite 202
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Revisions

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Seal:

JOB NO. 2150683

Date:	11.17.16
Scale:	AS SHOWN
Designed By:	RWG
Reviewed By:	DCH
Checked By:	RM
Approved By:	-

Drawing Title:

EXISTING CONDITIONS PLAN

Sheet Number:

C-1

PRELIMINARY DESIGN
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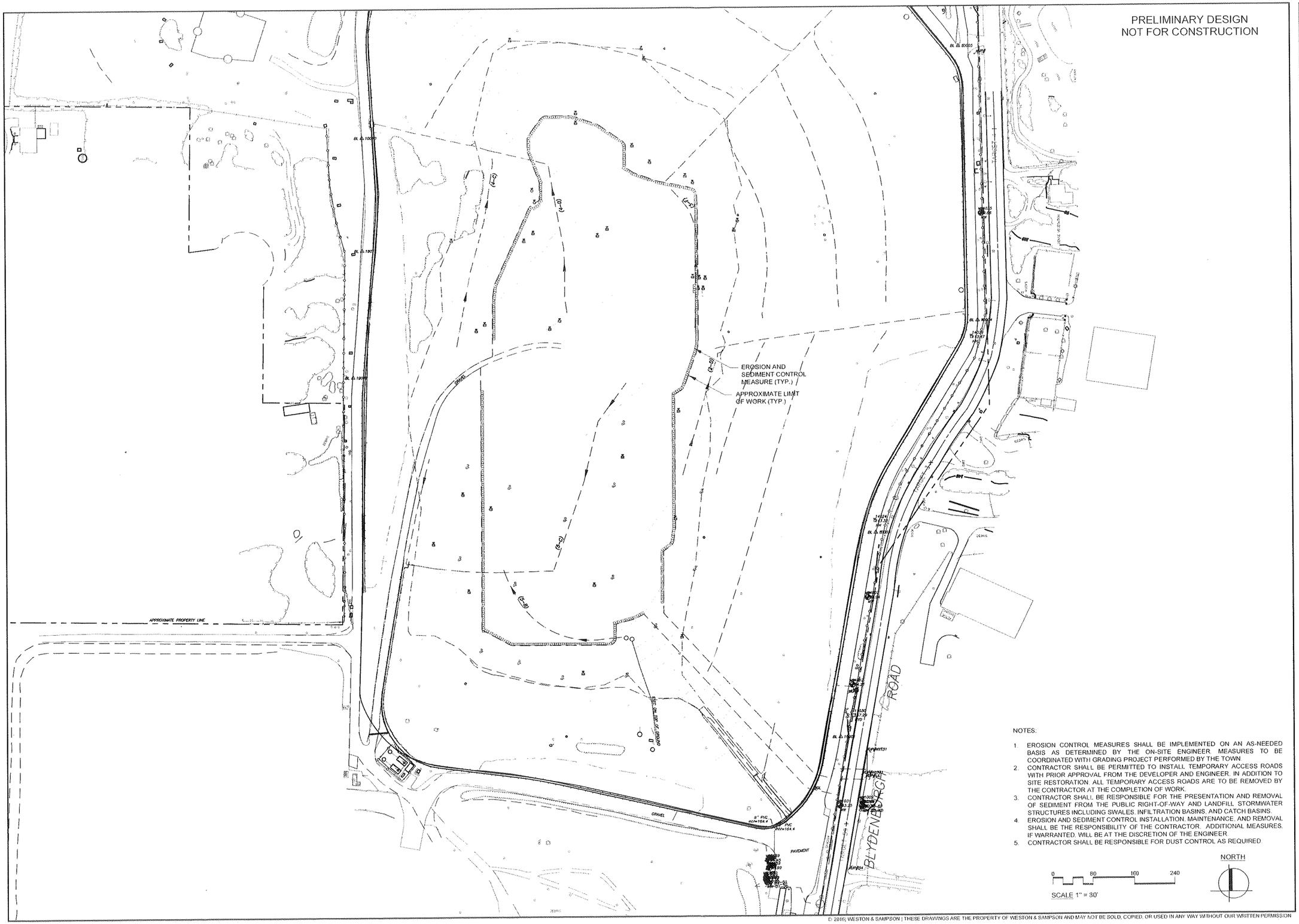

NOTES:

1. EROSION CONTROL MEASURES SHALL BE IMPLEMENTED ON AN AS-NEEDED BASIS AS DETERMINED BY THE ON-SITE ENGINEER. MEASURES TO BE COORDINATED WITH GRADING PROJECT PERFORMED BY THE TOWN.
2. CONTRACTOR SHALL BE PERMITTED TO INSTALL TEMPORARY ACCESS ROADS WITH PRIOR APPROVAL FROM THE DEVELOPER AND ENGINEER. IN ADDITION TO SITE RESTORATION, ALL TEMPORARY ACCESS ROADS ARE TO BE REMOVED BY THE CONTRACTOR AT THE COMPLETION OF WORK.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR THE PRESENTATION AND REMOVAL OF SEDIMENT FROM THE PUBLIC RIGHT-OF-WAY AND LANDFILL STORMWATER STRUCTURES INCLUDING SWALES, INFILTRATION BASINS, AND CATCH BASINS.
4. EROSION AND SEDIMENT CONTROL INSTALLATION, MAINTENANCE, AND REMOVAL SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ADDITIONAL MEASURES, IF WARRANTED, WILL BE AT THE DISCRETION OF THE ENGINEER.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR DUST CONTROL AS REQUIRED.

NORTH

0 80 160 240

SCALE 1" = 30'

Project

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Drawing Title.

EROSION & SEDIMENT CONTROL PLAN

Sheet Number:

C-2

PRELIMINARY DESIGN
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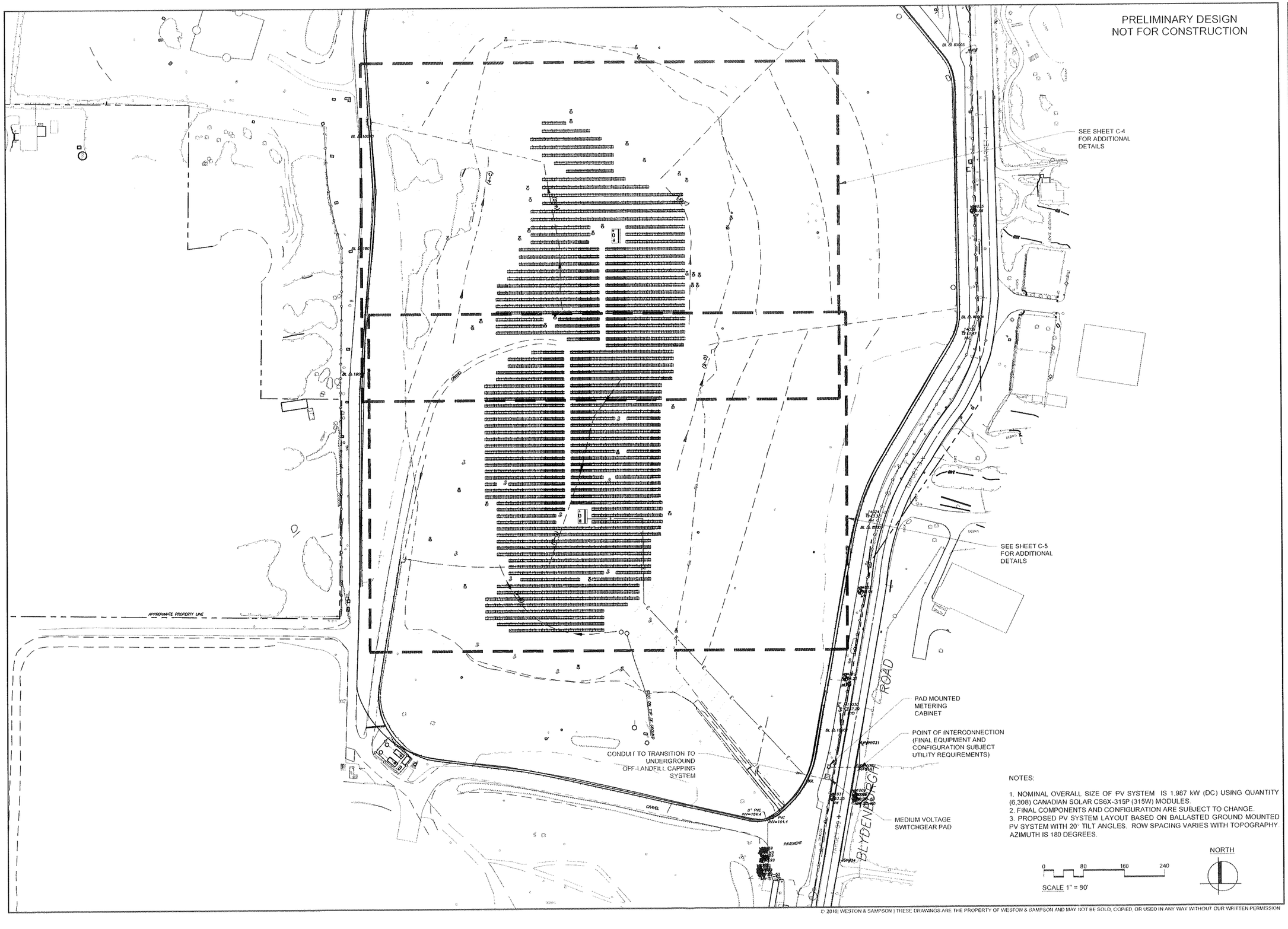

NOTES:

1. NOMINAL OVERALL SIZE OF PV SYSTEM IS 1,987 kW (DC) USING QUANTITY (6,308) CANADIAN SOLAR CS6X-315P (315W) MODULES.
2. FINAL COMPONENTS AND CONFIGURATION ARE SUBJECT TO CHANGE.
3. PROPOSED PV SYSTEM LAYOUT BASED ON BALLASTED GROUND MOUNTED PV SYSTEM WITH 20° TILT ANGLES. ROW SPACING VARIES WITH TOPOGRAPHY AZIMUTH IS 180 DEGREES.

NORTH

0 80 160 240

SCALE 1" = 80'

Project

LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

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OVERALL PROPOSED DEVELOPMENT PLAN

Sheet Number:

C-3

PRELIMINARY DESIGN
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PROVIDE PERFORATED PIPE DRAIN AT DIVERSION SWALES WITHIN FOOTPRINT OF SOLAR ARRAY AREA (TYP.) SEE SHEET D-3 FOR ADDITIONAL DETAILS

GAS VENT EQUIPMENT FREE ZONE (5-FT. RADIUS)

EQUIPMENT PAD (TYP.)

±13-FT. ACCESS PATH

SOLAR PV ARRAY (BALLASTED)

(4-C)

(4-D)

(4-C)

(2-D)

GRAVEL

NOTES:

1. NOMINAL OVERALL SIZE OF PV SYSTEM IS 1,987 kW (DC) USING QUANTITY (6,308) CANADIAN SOLAR CS6X-315P (315W) MODULES.
2. FINAL COMPONENTS AND CONFIGURATION ARE SUBJECT TO CHANGE.
3. PROPOSED PV SYSTEM LAYOUT BASED ON BALLASTED GROUND MOUNTED PV SYSTEM WITH 20° TILT ANGLES. ROW SPACING VARIES WITH TOPOGRAPHY. AZIMUTH IS 180 DEGREES.

NORTH

0 30 60 90

SCALE 1" = 30'

Project:

LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

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PROPOSED DEVELOPMENT PLAN NORTH

Sheet Number:

C-4

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

NOTES:

1. NOMINAL OVERALL SIZE OF PV SYSTEM IS 1,987 kW (DC) USING QUANTITY (6,308) CANADIAN SOLAR CS6X-315P (315W) MODULES.
2. FINAL COMPONENTS AND CONFIGURATION ARE SUBJECT TO CHANGE.
3. PROPOSED PV SYSTEM LAYOUT BASED ON BALLASTED GROUND MOUNTED PV SYSTEM WITH 20° TILT ANGLES. ROW SPACING VARIES WITH TOPOGRAPHY. AZIMUTH IS 180 DEGREES.

NORTH

0 30 60 90

SCALE 1" = 30'

Project

LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

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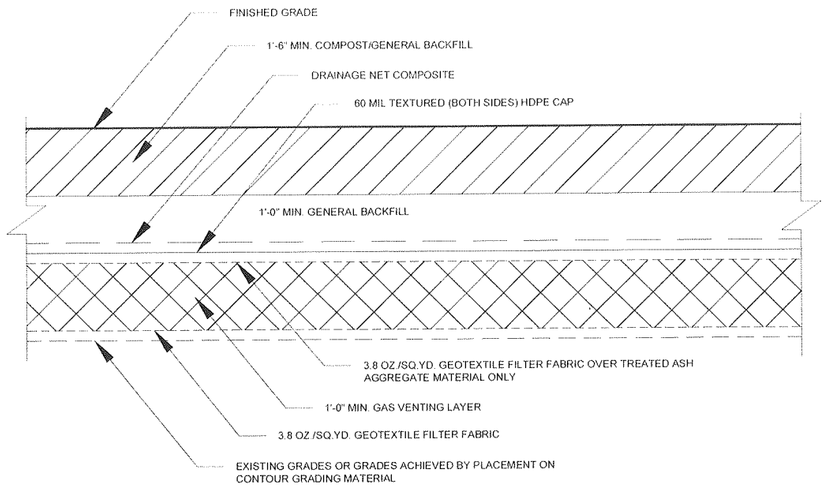
Drawing Title

PROPOSED DEVELOPMENT PLAN SOUTH

Sheet Number:

C-5

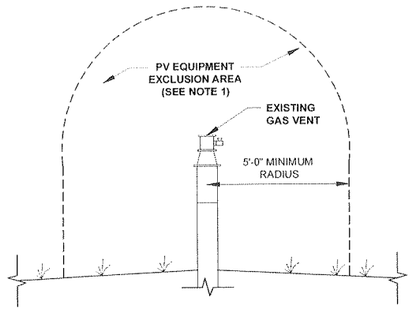


NOTES:

1. TEST PITS OF THE FINAL COVER SYSTEM WILL BE PERFORMED BY THE CONTRACTOR AND OBSERVED BY THE ENGINEER OF RECORD, TO VERIFY ACTUAL CROSS SECTION DIMENSIONS AND LAYERS.
2. CONSTRUCTION EQUIPMENT MUST RECEIVE PERMISSION FROM THE ENGINEER OF RECORD PRIOR TO DRIVING ON THE LANDFILL. SEE RELATED REQUIREMENTS ON SHEET G-1.

1 TYPICAL CAP DETAIL

SCALE: N.T.S.



NOTES:

1. NO EQUIPMENT ASSOCIATED WITH THE PV SYSTEM SHALL BE LOCATED WITHIN A 5' EXCLUSION AREA RADIUS OF PASSIVE GAS VENTS.
2. THE CONTRACTOR IS RESPONSIBLE TO PROTECT THE EXISTING GAS VENTS FROM DAMAGE FROM CONSTRUCTION VEHICLES. ANY DAMAGE TO EXISTING GAS VENTS SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER AND REPAIRED AT NO COST TO THE OWNER/DEVELOPER.

2 GAS VENT WITH EQUIPMENT FREE AREA DETAIL

SCALE: N.T.S.

PRELIMINARY DESIGN
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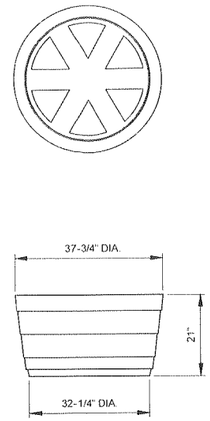
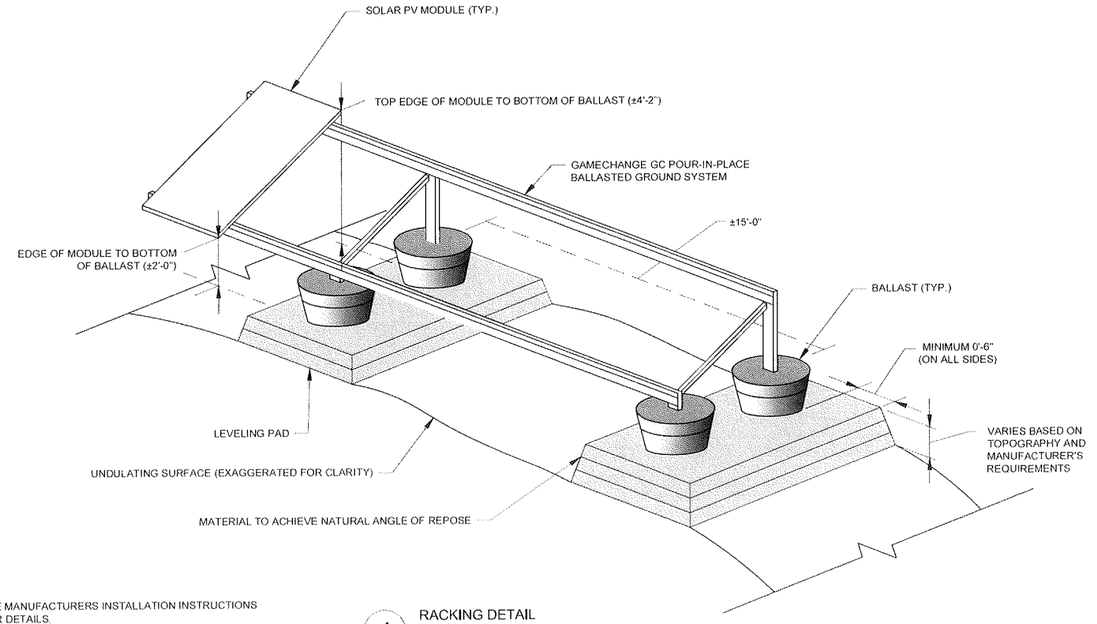


NOTES:

1. SEE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR DETAILS.
2. FINAL COMPONENTS AND CONFIGURATION SUBJECT TO CHANGE BASED ON BUILDING CODES.

3 TYPICAL BALLAST DETAIL

SCALE: N.T.S.

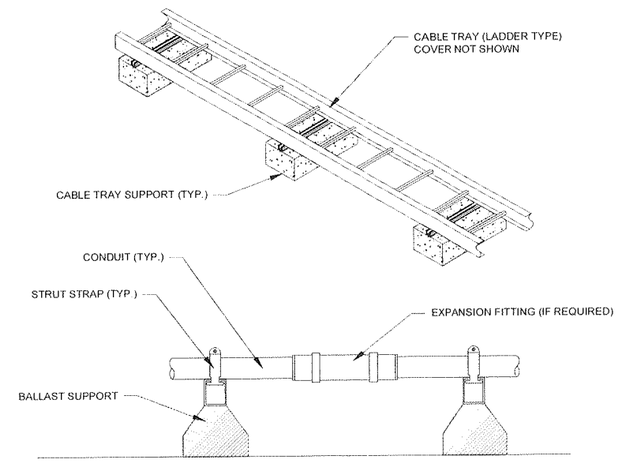


NOTES:

1. SEE MANUFACTURERS INSTALLATION INSTRUCTIONS FOR DETAILS.
2. BALLAST PREPARATION TO INCLUDE CONTRACTOR TO INSTALL WOVEN GEOTEXTILE FABRIC, AND ADD STONE UNTIL THE DESIRED HEIGHT. CONTRACTOR TO NOTIFY ENGINEER PRIOR TO COMMENCEMENT OF WORK.

4 RACKING DETAIL

SCALE: N.T.S.



NOTES:

1. ALL CABLE TRAY/CONDUIT RELATED HARDWARE TO BE GALVANIZED.
2. CABLE TRAY/CONDUIT SUPPORTS SHALL BE SPACED PER THE NEC.
3. EXPANSION AND SPLICE FITTINGS SHALL BE INSTALLED PER THE NEC AND MANUFACTURERS SPECIFICATIONS.
4. CABLE TRAY/CONDUIT TYPE AND DIMENSIONS SHALL BE BASED ON FINAL CONDUIT AND WIRE PLAN.
5. CRUSHED STONE TO BE ADDED BENEATH CABLE TRAY/CONDUIT SUPPORTS AS NEEDED TO LEVEL CONDUIT.
6. CABLE TRAY/CONDUIT AND SUPPORTS SHALL NOT BE INSTALLED SUCH THAT STORMWATER FLOW AND COLLECTION SHALL BE IMPACTED.

5 TYPICAL ABOVE-GROUND CABLE TRAY AND CONDUIT DETAIL

SCALE: N.T.S.

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TYPICAL DETAILS I

Sheet Number:

D-1

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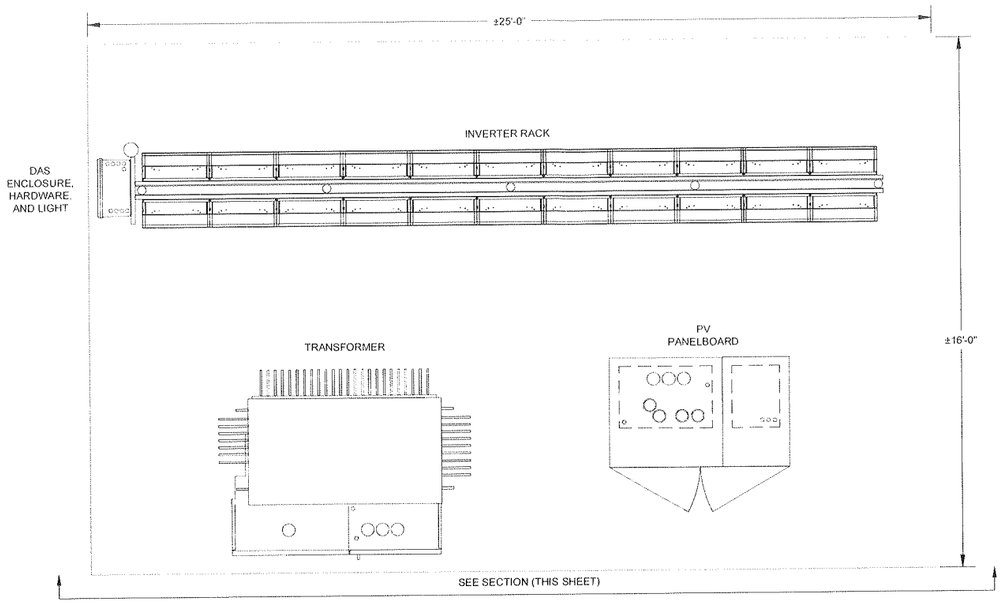
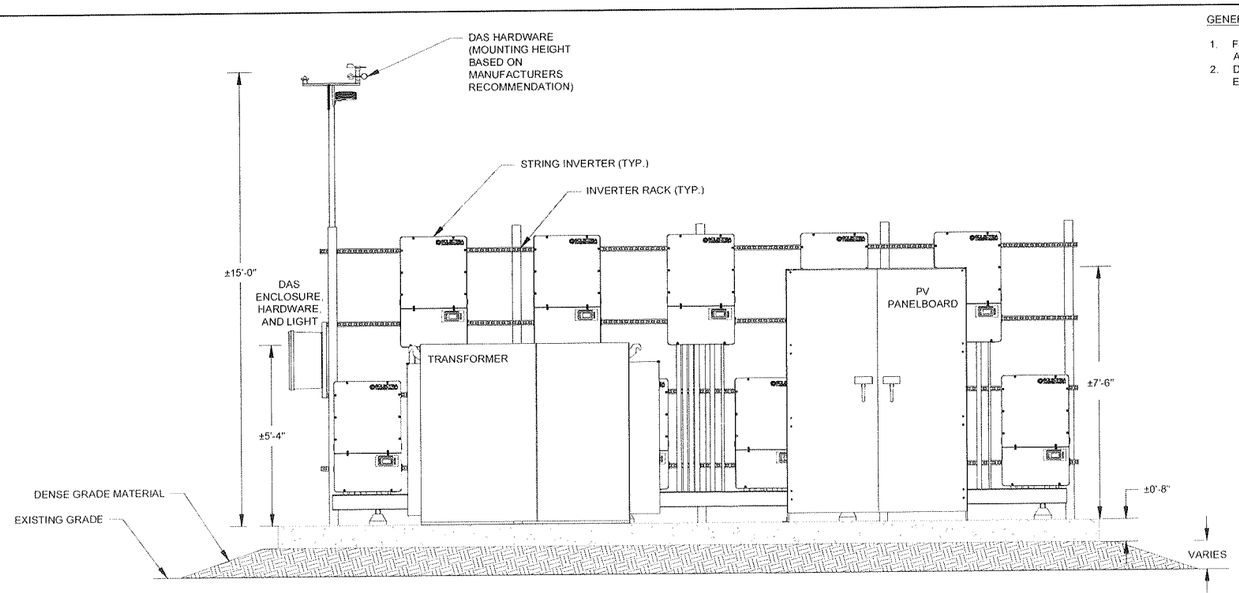


6 TYPICAL EQUIPMENT PAD LAYOUT

SCALE: N.T.S.



7 TYPICAL EQUIPMENT PAD CROSS SECTION

SCALE: N.T.S.

GENERAL NOTES:

1. FINAL COMPONENTS AND CONFIGURATION SUBJECT TO CHANGE. PAD DIMENSIONS AND REINFORCEMENT TO BE DESIGNED AS PART OF THE BUILDING PERMIT SUBMITTAL.
2. DENSE GRADE MATERIAL TO LEVEL THE PAD. CONDUIT TO REMAIN ABOVE THE EXISTING GRADE AT ALL TIMES

Project
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TYPICAL DETAILS II

Sheet Number:
D-2

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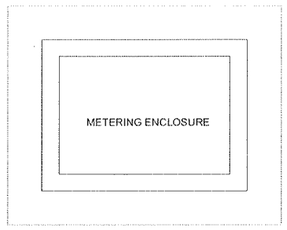
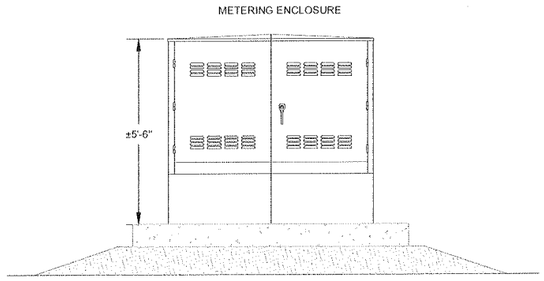
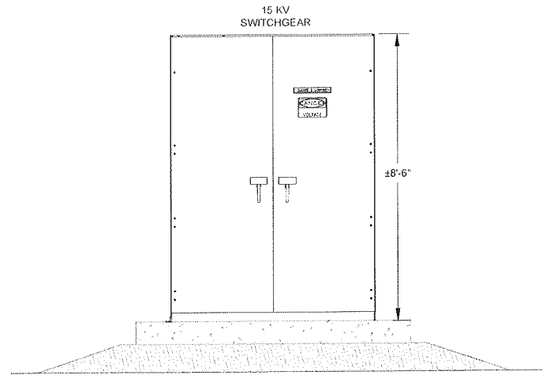


METERING ENCLOSURE
PLAN VIEW

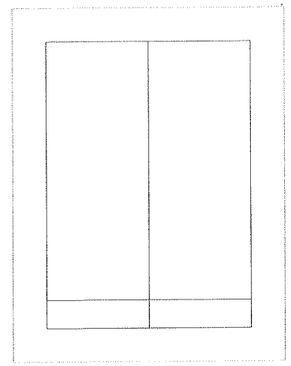


METERING ENCLOSURE
ELEVATION VIEW

8 TYPICAL PAD MOUNTED METERING ENCLOSURE DETAIL
SCALE: N.T.S.

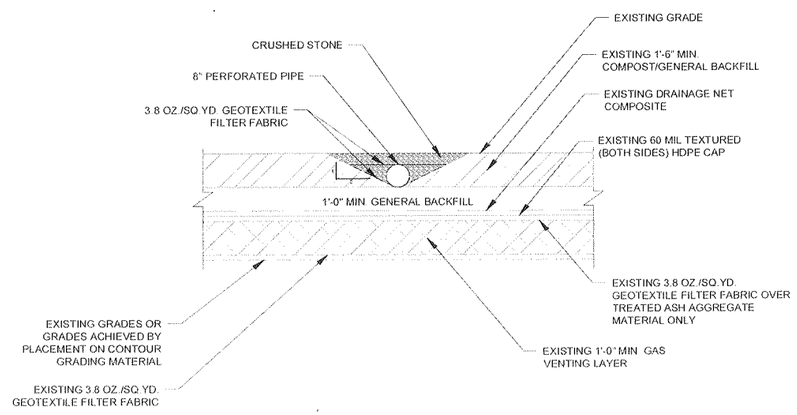


MV SWITCHGEAR
ELEVATION VIEW



MV SWITCHGEAR
PLAN VIEW

9 TYPICAL PAD MOUNTED SWITCHGEAR DETAIL
SCALE: N.T.S.



10 TYPICAL DIVERSION SWALE DETAIL
SCALE: N.T.S.

GENERAL NOTES:

1. FINAL COMPONENTS AND CONFIGURATION SUBJECT TO CHANGE. PAD DIMENSIONS AND REINFORCEMENT TO BE DESIGNED AS PART OF THE BUILDING PERMIT SUBMITTAL.
2. DENSE GRADE MATERIAL TO LEVEL THE PAD. CONDUIT TO REMAIN ABOVE THE EXISTING GRADE AT ALL TIMES.

Project:
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Drawing Title:
TYPICAL DETAILS IIi

Sheet Number:
D-3

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APPENDIX B

Geotechnical Report

Weston&Sampson®

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MEMORANDUM

TO:	Mr. Eric McLean, PE, American Capital Energy, Inc.
FROM:	Thomas J. Strike, PE, Weston & Sampson Engineers, Inc.
CC:	Steve Wiehe, PG, Weston & Sampson Engineers, Inc.
DATE:	May 4, 2016 – Revised November 30, 2016
SUBJECT:	Geotechnical Assessment for Solar PV System Blydenburgh MSW Landfill Blydenburgh, NY
PROJECT NO.	2150683

Weston & Sampson Engineers, Inc. (Weston & Sampson) is pleased to present this memorandum discussing our geotechnical assessment and construction considerations for the proposed solar photovoltaic (PV) system on the Blydenburg Municipal Solid Waste (MSW) Landfill at 600 Blydenburgh Road in Blydenburgh, New York.

The purpose of our assessment was to evaluate potential impacts on the existing landfill cap due to construction of the proposed PV array project. Primary concerns for PV array construction on landfills generally include the potential for adverse impacts to the low permeable liner of the landfill cap due to increased stresses imparted by the PV array foundations, including temporary stresses from construction equipment traffic. Potential adverse impacts include puncture, deflection, and elongation of the liner and sliding between the liner and overlying cover soil due to the added weight of the PV array foundations and ancillary structures and site development. This memorandum documents our assessment of these issues.

LANDFILL HISTORY AND EXISTING CONDITIONS

According to information contained in a Post Closure Monitoring and Maintenance Plan Report (Closure Report) prepared by Golder Associates last revised in January 2015, the 62 acre landfill received municipal solid waste between approximately 1960 and 1990. The Islip Resource Recovery Authority (IRRA) informed us the maximum height of the waste is approximately 200 ft.

Construction and demolition debris was accepted in 1992 as waste grading material prior to closure. The composition, thickness, and placement and compaction procedures of this layer were not available for review.

Closure of the landfill was completed in December 1993. The landfill cover system from the ground surface down to the construction and demolition debris layer is comprised of approximately 1.5 feet of compost/general backfill and 1-foot of general backfill over a drainage

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net composite and a 60-mil textured HDPE flexible membrane liner (FML). Information contained in the Closure Report suggests the compost material is approximately 6-inches thick. The gas venting layer below the FML and directly above the construction and debris layer is approximately 1-foot thick with geotextile filter fabric on the top and bottom of the layer. In some areas, rolite-stabilized incinerator ash (thickness not provided) was used for the gas venting layer. Trees, shrubs, and other ground cover species were planted in select areas across the landfill after placement of the compost/general backfill layer.

We have not performed geotechnical investigations at the site to verify thicknesses of the cap soils above or below the FML.

Information on the characteristics, composition, and compaction of the general backfill layer were contained in laboratory and field test reports provided to us from IRRA. Laboratory tests completed on the general backfill prior to construction included grain size and modified proctor analyses. Results of the tests indicate the general backfill is generally comprised of poorly graded sand with a maximum particle size of 1-inch and maximum density values ranging between 103.7 and 126.0 pounds per cubic foot (pcf). Results of nuclear density compaction testing performed during construction on the general backfill indicate this material was compacted to densities ranging between approximately 95.6 and 120.0 pcf.

Laboratory test information on the 60-mil textured HDPE FML was not available for review. However, typical engineering properties of 60-mil textured HDPE FMLs available from the Geosynthetic Institute (GSI) include an average minimum puncture resistance of 90 pounds and a minimum average yield elongation of 12 percent.

Information on the characteristics, composition, and compaction of the gas venting layer were not available for review. Additionally, the composition and placement procedures of the waste were not available for review.

A gravel road located along the west slope of the landfill provides access to the top of the landfill. Several other access roads are located on top of the landfill. The thickness of soil cover over the FML along the access roads was not available for review; however, according to August 1992 As-Built Plans prepared by Malcolm Pirnie, Inc., approximately 16-inches in thickness of aggregate base course and general backfill were used to construct the access road along the west slope.

Project Plans indicate that the ground surface elevations on the landfill cap and within the proposed PV array area range between approximately El. 245 ft. and El. 260 ft. (NAVD88 datum). The ground surface is generally sloped at less than 8.5 percent.

PROPOSED CONSTRUCTION

According to the Project Plans, the proposed project will include construction of an approximately 2 MW PV array system on the cap of the Blydenburgh Landfill. Elements of the array include ballast supported solar modules, concrete equipment pads, and other site

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improvements. Construction access roads were not shown on the Plans. Proposed elevations were not provided on the plans, but it is assumed that proposed ground surface elevations will essentially match existing grades.

The proposed array foundations will be cast-in-place concrete ballasts using the 1 UP Pour-In-Place Round Tub Assembly manufactured by GameChange Racking LLC (GameChange). The tubs are expendable concrete forms made from plastic. The tubs supporting the legs of the racking system have a bottom diameter of approximately 32.25-inches and center to center spacing between the front and rear tubs of approximately 40.5-inches.

The tubs are placed directly on the ground without removing the upper vegetative soil layer. GameChange indicates the racking system is sufficiently adjustable to accommodate ballast movement resulting from leaving the vegetative layer in place (i.e. settlement due to compression of the topsoil and heave caused by freezing and expansion). The racking system legs are placed into the tubs and the tubs are filled with concrete. Concrete heights in the tubs vary between approximately 19 and 21-inches. Gravel fill can be placed, if necessary, to fill locally low areas below the tubs.

According to our review of a November 17, 2016 Calculation Package prepared by GameChange for this project, the the maximum stress imposed on the subgrade soils by the ballasts will be approximately 513 pounds per square foot (psf) (including snow and wind loads).

Three equipment pads will be constructed on the landfill and will each measure up to approximately 16 ft. wide by 25 ft. long by 1 ft. thick. The pads will support switchgear, inverter rack, PV panel board, transformer, and metering equipment. The pads will be constructed on approximately 18-inches of compacted fill, which is assumed to consist of ¾-inch crushed stone. It is assumed organic topsoil (compost layer) will be removed before placing the fill. Equipment loads up to 13,362 pounds are expected on the pads. The net stress increase imposed by the loaded equipment pads and compacted fill will be about 340 psf at the bottom of the compacted fill layer.

The stresses from the ballasts and equipment pads will be distributed through the cover soils to the FML, continuing through the underlying gas venting and construction and demolition debris soils and into the waste.

It is assumed that the existing access roads will be used to provide access and support for heavy construction vehicles during construction. The type of construction equipment and the ground contact stresses imposed by the tires/tracks were not known at the time of this memorandum.

GEOTECHNICAL ASSESSMENT

The following analyses were performed assuming landfill cap soil thicknesses above the FML are as presented in the Closure Report and in the As-Built Plans, general backfill composition and characteristics included in the available laboratory and field test reports, and typical FML engineering properties available from GSI. Calculations are provided on the attached

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Geotechnical Calculations sheet. Hand excavations should be performed in the solar PV and existing/proposed construction access road areas to assess actual thickness and composition of the cap soils over the FML. Our analyses should then be revised if the thicknesses of the cap soils differ from those presented in the Closure Report and in the As-Built Plans.

Direct Bearing Stress on the FML

Typically, geomembrane manufacturers recommend limiting stresses on the FML to less than 7 psi during and after construction. We evaluated stresses on the FML from the existing soil cover and the potential increase on the FML due to the ballasts and equipment pads.

The existing cover soil above the FML imparts approximately 239 psf (1.6 psi) of vertical stress on the FML assuming a compost/general backfill moist unit weight of 95.6 pcf the layer thicknesses provided on the Project Plans. As discussed above, we assume the approximately 6-inch thick topsoil (compost) layer will be removed below the equipment pads. The cover soil above the FML imparts approximately 191 psf (1.3 psi) with the topsoil layer removed. Our computations indicate that the maximum stress increase on the FML due to each ballast is approximately 168 psf (1.2 psi) and the net stress increase due to the equipment pad and fill is approximately 269 psf (1.9 psi). The resulting combined net stresses on the FML will be approximately 407 psf (2.8 psi) and 460 psf (3.2 psi) below the ballasts and equipment pad, respectively. These values are well below 7 psi and can be considered acceptable for the proposed construction.

We evaluated the risk of FML puncture in accordance with procedures presented in the 5th edition of Designing with Geosynthetics by Koerner. The evaluation considered an allowable puncture resistance of 90 pounds, a maximum stress on the FML of 7 psi, a maximum particle size of 1-inch, and an angular and relatively large puncturing object. The factor of safety against puncture was estimated as 20, which indicates the risk of puncture due to the proposed construction and vehicle traffic is very low.

Cap Soil Bearing Capacity

The ballasts and equipment pads are expected to impart stresses up to 513 psf and 340 psf on the landfill surface, respectively. The allowable bearing capacity of the cap soils needs to be evaluated to assess risk of shear failure due to the imposed stresses. We evaluated the allowable bearing capacity of the general backfill layer using a method developed by Terzaghi, the lowest unit weight value provided in the available field reports, an assumed internal friction value using available grain size testing reports, foundation dimensions provided to us, and a factor of safety value of 3. The Terzaghi method considers soil characteristics and the diameter/width of the foundations to evaluate bearing capacity. The calculated bearing capacity of similar soils will increase as the foundation diameter/width increases; therefore, the cap soil bearing capacity below the equipment pads (16 ft. width) will be theoretically greater than below ballasts (2.7 ft. diameter). Given that geotechnical explorations have not been completed at the landfill to confirm soil properties, we used a conservative approach and considered the bearing capacity of the cap soils below equipment pads will equal the bearing capacity below the ballasts. We calculated an allowable bearing capacity of the cap soils of approximately 925 psf for below

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ballasts and the equipment pads. The allowable bearing capacity of the cap soils is considerably greater than foundation stresses; therefore, the risk of bearing capacity (shear) failure is considered low.

The allowable bearing capacity assumes soil properties presented in the laboratory and field reports, the cap soils are not disturbed during foundation construction, and the subgrades are prepared according to the GameChange Racking, LLC recommendations and guidelines. Our analyses considered the inorganic general backfill layer only. The ballasts are typically installed directly on the organic topsoil and some settlement of this layer due to the imposed stresses should be anticipated.

Waste Compression

Settlement the landfill has experienced since closure was not available; however, continued settlement of the waste mass is likely under self-weight and continuing decomposition of waste materials. Adding load at the top of the landfill could result in additional waste mass settlement.

Estimating landfill settlement requires estimating properties of the compressible waste mass and the magnitude and lateral extent of stress increase within the waste mass due to proposed loads at the top of the landfill. For practical purposes, the soil and geosynthetic layers of the landfill cap can be assumed incompressible.

The load imposed by each individual ballast or equipment pad (structure) results in a discrete stress over the contact area of the structure. Stress attenuates and becomes more uniform with depth. For example, theoretically, there is no stress increase at the surface of the landfill cap outside of the contact areas of new structures. As depth below the structures increases, the area experiencing the stress below each structure increases laterally and the magnitude of the stress decreases. As depth increases, adjacent "stressed areas" begin to overlap, the stress felt by the ground lessens and becomes more uniform (a.k.a. stress attenuation).

We estimated stress attenuation with depth based on a conservative/simplified 2 vertical to 1 horizontal distribution pattern. In other words, the proposed structure bearing load is assumed to be distributed over an area that increases laterally in all directions by one foot for every two feet of depth below the structure bearing surface. Based on this pattern, the stressed areas begin to overlap when the depth below the bearing surface exceeds the spacing between the structures.

Our stress distribution analyses indicates the stress increase at the top of the waste is approximately 168 psf for the ballasts and approximately 269 psf for each equipment pad, conservatively assuming the waste is directly below the gas venting layer. The additional stress imposed on the waste by the ballasts is expected to be relatively uniform over the PV array footprint. Uniform loads over a large area are estimated as constant with depth; therefore, stress increase due to the ballasts will effectively remain constant at 168 psf through the waste. Measureable stress overlap will not occur between the equipment pads due to the proposed spacing; therefore, stresses will decrease with depth through the waste.

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We estimated additional waste mass compression due to stresses imposed by the ballasts and the equipment pads. Published waste mass compression index values suggest a range of 0.15 to 0.30 is reasonable for this analysis. A waste height of 200 ft. was used for the analyses. Based on these parameters, the estimated range of waste mass compression is between 1.7 and 3.4-inches due to the ballasts and between approximately 0.56 and 1.1-inch for the equipment pads. According to information available from GSI, a typical 60-mil textured HDPE FMLs possesses a minimum average yield elongation of 12 percent. Additionally, our experience with similar projects indicate that landfill liners are typically designed assuming a maximum differential settlement below the liner of approximately 12-inches. The magnitude of estimated settlement due to the ballasts and equipment pads is well below these values and, in our opinion, will not result in measurable or adverse strain in the FML.

Sliding Analyses

The potential impact of additional loads over the FML on sliding between the FML and cover soil should be considered. For our analyses we assumed the cohesion between the cover soils and the FML to be zero, which means the factor of safety against sliding failure is governed by an infinite slope analysis. The factor of safety against sliding is determined as the tangent of the interface friction angle divided by the tangent of the slope of the FML. The weight of the overlying soil is not a factor in this analysis.

The slope of the FML is assumed to be 8.5 percent matching the slope of the ground surface, which is an angle of approximately 4.3 degrees. According to soil information contained in the available laboratory and field reports and typical FML engineering properties available from GSI, the interface friction value between the cover soil and the FML can be conservatively estimated at greater than 16 degrees if the soil is dry and 12 degrees if the soil is saturated. The resulting range of safety factor against sliding is from 2.5 to 3.4. This compares well to a generally accepted minimum value of 1.5 and indicates the risk of sliding along the FML is low.

Construction Access Roads

Ground stresses imposed by heavy construction vehicles can exceed 20 psi, assuming H-20 loading conditions. As previously mentioned, stresses on the FML should be limited 7 psi to reduce the potential for damage. According to information provided in the GSE Geomembrane Protection Design Manual, a cover thickness of at least 36-inches above the geomembrane (FML) is generally required along access roads where H-20 loading will be used to maintain stresses of less than 7 psi on the FML. The cover thickness along the existing access roads was not provided in the Closure Report or the As-Built Plans, although the As-Built Plans depict approximately 16-inches in thickness of aggregate base course and general backfill were used to construct the existing access road along the west slope.

The stresses imposed on the FML by construction equipment cannot be estimated without knowing the soil cover thickness above the FML and the equipment type and track/tire dimensions that will be used for the project. Hand excavations should be performed along the construction access road areas prior to construction to assess the soil cover thickness above the FML. Additionally, the Site Contractor should submit for each vehicle the track/tire stresses that

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will be imposed on the landfill during construction to the Engineer for review. Once this information is provided, the stresses imposed on the FML, minimum cover thickness required, and the need to place any additional fill soils to protect the FML can be assessed. Equipment should not operate on the landfill until approved by the Engineer.

CONSTRUCTION CONSIDERATIONS

The trees and shrubs on the landfill will require removal for construction of the solar PV system. The vegetation and root system should be removed and the cap soils repaired in accordance with NYSDEC requirements.

The ballast subgrades should be prepared according to the GameChange Racking, LLC recommendations and guidelines.

The equipment pad subgrades should be prepared by removing the surficial organic components of the compost/general backfill layer (topsoil) and replacing it with compacted crushed stone below the equipment pads and within 12 inches laterally of the pad perimeters. The crushed stone should be sloped at a maximum of 3H:1V above the landfill cap and should be separated from surrounding soils on all sides with a heavy, non-woven geotextile filter fabric.

Please call if you have any questions.

Attachment: Geotechnical Calculations

O:\American Capital Energy\New York\LIPA\Blydenburg\Geotechnical\Memo\MEMO - Blydenburg Landfill - Geotechnical Recommendations_11.30.16.doc

BLYDENBURGH LANDFILL SOLAR - GEOTECHNICAL CALCULATIONS (Stress on FML)

Ballast Assumed Information:

Round Tub Ballasts
Front and Rear Dia. = 2.7 ft. each; Assume rectangular foundation at 2.6 ft. x 4.5 ft.
Max. Total Stress Imposed by Combined Ballast on the Landfill Surface = 513 psf = q_0 (From GameChange)
Depth from bottom of ballast to FML = 2.5 ft. = z (From As-Built Plans)

Equipment Assumed Information:

Size = 1ft. thick x 16 ft. wide x 25 ft. long
Max. Equipment Load on Pads = 13,362 lbs
Pad Stress = 183 psf
Fill below pad (after removing topsoil) = 18 in. thick layer of 3/4 in. crushed stone
stone unit weight = 140 pcf (assumed)
Stress Increase due new fill below pad = 157 psf
Total Stress Increase from Pad and Fill at 6 in. below Landfill Surface = 340 psf = q_0

Estimate Stress Increase on FML Due to Ballast and Soil

Use the 2:1 Stress Increase Method

$$\Delta q = \frac{q_0 \times B \times L}{(B + z)x(L + Z)}$$

B = pad width = 2.6 ft.
L = pad length = 4.5 ft.
z = depth to FML = 2.5 ft.
q_0 = stress from ballast at ground surface = 513 psf

$$\Delta q_{ballast} = \frac{513\ psf \times 2.6\ ft. \times 4.5\ ft.}{(2.6\ ft. + 2.5\ ft.) \times (4.5\ ft. + 2.5\ ft.)}$$

Δq = 168 psf = 1.2 psi **(estimated stress increase on FML due to ballast)**
q_{liner} = 168 psf + 239 psf = 407 psf = 2.8 psi **(estimated stress on FML due to ballast and soil)**

Stress increase due to ballast will effectively be constant with depth through the waste due to stress overlap of adjacent ballast foundations. Conservatively assume stress increase on FML due to ballast = stress increase on waste (assume waste is directly below FML).

Estimate Stress Increase on FML Due to Equipment Pad and Fill

Use the 2:1 Stress Increase Method

$$\Delta q = \frac{q_0 \times B \times L}{(B + z)x(L + Z)}$$

B = pad width = 16 ft.
L = pad length = 25 ft.
z = depth from bottom of pad to FML = 3.5 ft.
q_0 = stress from pad at ground surface = 183 psf

Stress Increase From Pad:

$$\Delta q_{pad} = \frac{183\ psf \times 16\ ft. \times 25\ ft.}{(16\ ft. + 3.5\ ft.) \times (25\ ft. + 3.5\ ft.)}$$

Δq_{pad} = 132 psf = 0.92 psi

Stress Increase From Fill:

$$\Delta q_{fill} = \frac{157\ psf \times 24\ ft. \times 33\ ft.}{(24\ ft. + 2\ ft.) \times (33\ ft. + 2\ ft.)}$$

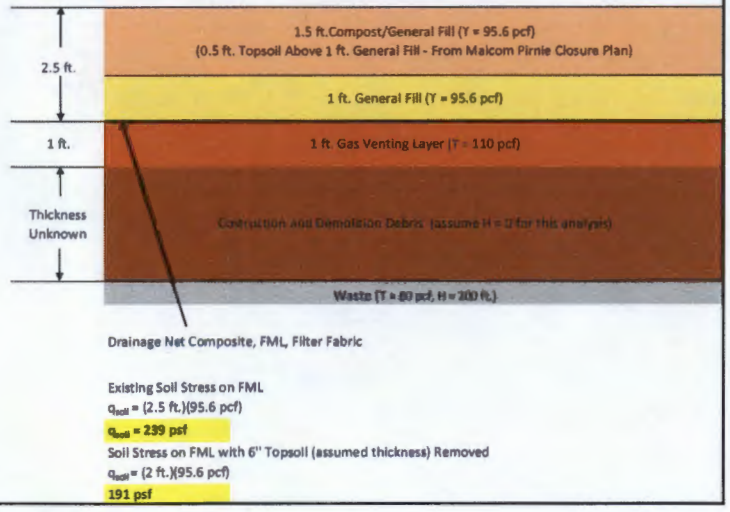
B = width of fill below pad = 24 ft.
L = length of fill below pad = 33 ft.
z = depth from bottom of fill to FML = 2 ft.

Δq_{fill} = 137 psf = 0.95 psi

Δq = Δq_{pad} + Δq_{fill} = 269 psf = 1.9 psi **(estimated stress increase on FML due to pad and new fill)**
q_{liner} = 269 psf + 191 psf = 460 psf = 3.2 psi **(estmated stress on FML due to pad, new fill, and cap soils)**

TYPICAL LANDFILL CAP DETAIL

(From As- Built Plans Prepared by Malcom Pirnie, Inc.)



Existing Soil Stress on FML
q_{soil} = (2.5 ft.)(95.6 pcf)
q_{soil} = 239 psf
Soil Stress on FML with 6" Topsoil (assumed thickness) Removed
q_{soil} = (2 ft.)(95.6 pcf)
191 psf

BLYDENBURGH LANDFILL SOLAR - GEOTECHNICAL CALCULATIONS (Waste Compression)

Compression of Waste due to Foundation Construction

Compression of waste can be estimated by using the consolidation equation and parameters as follows:

$$S = \frac{C_c \times H_w}{1 + e_o} \log \frac{q_o + \Delta q_{av}}{q_o}$$ (From DAS 3rd Edition)

Assume C_c (Waste Compression Index)= 0.15 and 0.30 (generally accepted published values for MSW)
Assume H_w (Height of Waste) = 200 ft. (From Islip)
Assume e_o (waste initial void ratio) = 0.8
Assume Primary Compression of Waste
q_o = Existing Stress at Middle of Waste = 8334.6 psf

Δq_{av} = average stress increase in waste due to ballast or pad = $1/6(\Delta q_{pad,t} + 4\Delta q_{pad,m} + \Delta q_{pad,b})$ (From DAS 3rd Edition)

For Ballast
Δq_{av} = 168 psf (constant with depth)

For Equipment Pad
Δq_{av} = 1/6(269 psf + 4x12 psf + 4 psf) = 53.5 psf

Estimate Compression of 200 ft. thick Waste Layer - Ballast

For C_c = 0.15

$$S = \frac{0.15 \times 200 \text{ ft.}}{1 + 0.8} \log \frac{8334.6 \text{ psf} + 168 \text{ psf}}{8334.6 \text{ psf}}$$

S = 1.7 in.

For C_c = 0.30

$$S = \frac{0.30 \times 200 \text{ ft.}}{1 + 0.8} \log \frac{8334.6 \text{ psf} + 168 \text{ psf}}{8334.6 \text{ psf}}$$

S = 3.4 in.

Estimate Compression of 200 ft. thick Waste Layer - Equipment Pad

For C_c = 0.15

$$S = \frac{0.15 \times 200 \text{ ft.}}{1 + 0.8} \log \frac{8334.6 \text{ psf} + 53.5 \text{ psf}}{8334.6 \text{ psf}}$$

S = 0.56 in.

For C_c = 0.30

$$S = \frac{0.30 \times 200 \text{ ft.}}{1 + 0.8} \log \frac{8334.6 \text{ psf} + 53.5 \text{ psf}}{8334.6 \text{ psf}}$$

S = 1.1 in.

Estimate Stress Increase in Waste Due to Equipment Pad and Fill

Assume stress increase on top of waste = **269 psf = q_{top}**
Use the 2:1 Stress Increase Method
Waste thickness = 40 ft. (from GPR Survey by others)
Use an area of 24 ft. x 33 ft.

Stress Increase Middle of Waste:

$$\Delta q_{mid} = \frac{269 \text{ psf} \times 24 \text{ ft.} \times 32 \text{ ft.}}{(24 \text{ ft.} + 100 \text{ ft.}) \times (32 \text{ ft.} + 100 \text{ ft.})}$$

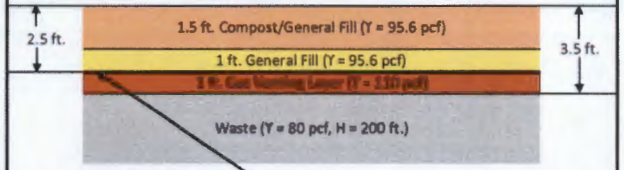
Δq_{mid} = 12 psf

Stress Increase Bottom of Waste

$$\Delta q_{bot} = \frac{269 \text{ psf} \times 24 \text{ ft.} \times 32 \text{ ft.}}{(24 \text{ ft.} + 200 \text{ ft.}) \times (32 \text{ ft.} + 200 \text{ ft.})}$$

Δq_{bot} = 4 psf

TYPICAL LANDFILL CAP DETAIL
(From As- Built Plans Prepared by Malcom Pirnie, Inc.)



Drainage Net Geocomposite, FML, and Filter Fabric
Assume Waste Directly Below Gas Venting Layer
q_{top} = (3.5 ft.)(95.6 pcf)
q_{top} = 334.6 psf
q_{mid} = 334.6 psf + (100 ft.)(80 pcf)
q_{mid} = 8334.6 psf
q_{bot} = 8334.6 psf + (100 ft.)(80pcf)
q_{bot} = 16334.6 psf

BLYDENBURGH LANDFILL SOLAR - GEOTECHNICAL CALCULATIONS (Puncture and Sliding)

Geomembrane (VFPEL) Puncture Analysis

From Information Provided in Grain Size Test Result Documents: maximum particle size in General Backfill = 1 inch
From Geosynthetic Institute: minimum average puncture resistance for a 60 mil HDPE textured FML = 90 pounds

Assume FML is in direct contact with surrounding soil (conservative approach)

Factor of Safety against Puncture:

$$FS_{punc.} = \frac{F_{allow.}}{F_{actual}} \qquad F_{allow} = 90 \text{ pounds}$$

$F_{actual} = pd^2S_1S_2S_3$ (Designing with Geosynthetics 5th Edition - Koerner - eq. 2.30)

Where

p = pressure exerted on geotextile (psi) - assume 7 psi	From Table 2.13 (Koerner)
d = average diameter of puncturing object (in.) - assume 1 in.	for anular and relatively large puncturing objects (conservative)
S_1 = protusion factor of the puncturing object	$S_1 = 0.9$
S_2 = scale factor to adjust for actual shape of puncturing object	$S_2 = 0.8$
S_3 = shape factor to adjust for actual shape of puncturing object	$S_3 = 0.9$

$F_{actual} = (7 \text{ psi})(1 \text{ in})^2(0.9)(0.8)(0.9) = 4.5$ pounds

$$FS_{punc.} = \frac{90 \text{ pounds}}{4.5 \text{ pounds}} = 20$$ Acceptable

Sliding Analyses - Cap Soils and FML

Use the Infinite Slope Theory:

$$FS = \frac{\tan \mu}{\tan \beta}$$

Where,
μ = Friction Factor Between General Backfill and FML = 16 degrees (dry) and 12 degrees (saturated)
β = Slope Angle = 4.8 degrees (8.5 percent slope)

Dry Conditions:

$$FS = \frac{\tan 16}{\tan 4.8} = 3.4$$

Saturated Conditions

$$FS = \frac{\tan 12}{\tan 4.8} = 2.5$$

Bearing capacity Spreadsheet

Project: Blydenburgh Landfill
Footing: 2.7 ft. wide ballast

By: TJS
Date: 11/22/2016

footing width (B) =	2.70	feet
footing embed (D) =	0.0	
Groundwater depth =	0	

Overburden Soil Properties

soil type=		
effective gamma1=	95.6	pcf

Bearing Soil Properties

Water depth below footing =	50.0	
soil type =		
gamma2 =	115	
effective gamma2 =	115.0	pcf
effective phi =	30.0	degrees
effective c =	0.0	psf

Bearing Capcity Factors (Vesic)

Nc	Nq	Nγ
30.1	18.4	22.4

	Strip	Square	Circular
Ultimate Bearing Capacity (psf) =	3478	2782	2782
Factor of Safety =		3	
Allowable Bearing Capacity (psf) =	**1159**	**927**	**927**

Assume calculated bearing capacity of soils below equipment is equal to that of the ballasts (conservative approach)
Ballast is a 2.7 ft. diameter circular foundation (from ACE)
Largest equipment pad is proposed at 16 ft. x 25 ft. and will be supported on 18-inches of crushed stone.
Stress imposed by ballast = 513 psf < 1,076 psf = Acceptable
Stress imposed by pad/stone = 340 psf < 1,076 psf = Acceptable

APPENDIX C

Solar Array Equipment

CanadianSolar

MAX POWER
CS6X-305|310|315P

High quality and reliability in all Canadian Solar modules is ensured by 14 years' experience in module manufacturing, well-engineered module design, stringent BOM quality testing, an automated manufacturing process and 100% EL testing.

KEY FEATURES

- Excellent module efficiency up to 16.42%
- Outstanding low irradiance performance > 96.0%
- +5Wp — Positive power tolerance up to 5 W
- No. 1 PTC — High PTC rating up to 91.97%
- IP67 — IP67 junction box for long-term weather endurance
- Heavy snow load up to 5400 Pa wind load up to 2400 Pa
- Salt mist and blown sand resistance, for seaside and desert environments

25 years — **insurance-backed warranty**
non-cancellable, immediate warranty insurance
linear power output warranty

10 years — **product warranty on materials and workmanship**

MANAGEMENT SYSTEM CERTIFICATES*

ISO 9001: 2008 / Quality management system
ISO/TS 16949: 2009 / The automotive industry quality management system
ISO 14001: 2004 / Standards for environmental management system
OHSAS 18001: 2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: VDE / MCS / CE / SII / CEC AU / CQC / INMETRO
UL 1703 / IEC 61215 performance: CEC listed (US)
UL 1703: CSA / IEC 61701 ED2: VDE / IEC 60068-2-68: SGS
PV CYCLE (EU) / UNI 9177 Reaction to Fire: Class 1

* As there are different certification requirements in different markets, please contact your local Canadian Solar sales representative for the specific certificates applicable to the products in the region in which the products are to be used.

CANADIAN SOLAR INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. As a leading manufacturer of solar modules and PV project developer with about 9 GW of premium quality modules deployed around the world since 2001, Canadian Solar Inc. (NASDAQ: CSIQ) is one of the most bankable solar companies worldwide.

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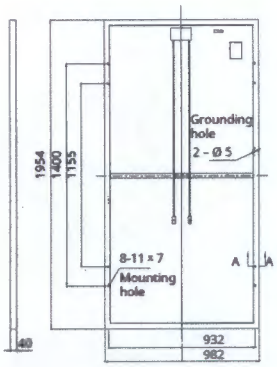
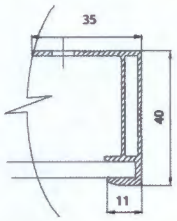
MODULE / ENGINEERING DRAWING (mm)

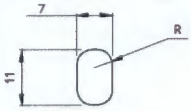
Rear View



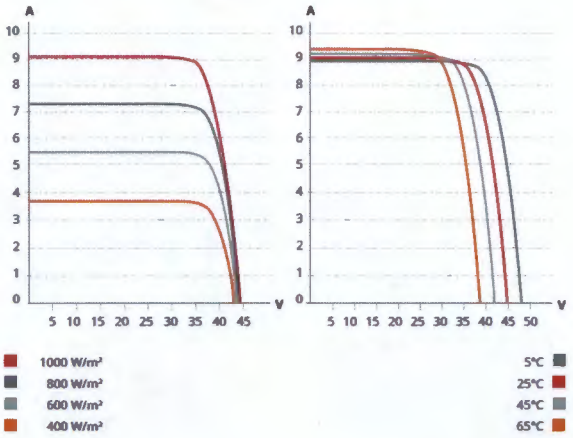
Frame Cross Section A-A



Mounting Hole



CS6X-310P / I-V CURVES



ELECTRICAL DATA / STC*

Electrical Data CS6X	305P	310P	315P
Nominal Max. Power (Pmax)	305 W	310 W	315 W
Opt. Operating Voltage (Vmp)	36.3 V	36.4 V	36.6 V
Opt. Operating Current (Imp)	8.41 A	8.52 A	8.61 A
Open Circuit Voltage (Voc)	44.8 V	44.9 V	45.1 V
Short Circuit Current (Isc)	8.97 A	9.08 A	9.18 A
Module Efficiency	15.90%	16.16%	16.42 %
Operating Temperature	-40°C ~ +85°C		
Max. System Voltage	1000 V (IEC) or 1000 V (UL)		
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC 61730)		
Max. Series Fuse Rating	15 A		
Application Classification	Class A		
Power Tolerance	0 ~ + 5 W		

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25°C.

ELECTRICAL DATA / NOCT*

Electrical Data CS6X	305P	310P	315P
Nominal Max. Power (Pmax)	221 W	225 W	228 W
Opt. Operating Voltage (Vmp)	33.1 V	33.2 V	33.4 V
Opt. Operating Current (Imp)	6.68 A	6.77 A	6.84 A
Open Circuit Voltage (Voc)	41.2 V	41.3 V	41.5 V
Short Circuit Current (Isc)	7.27 A	7.36 A	7.44 A

* Under Nominal Operating Cell Temperature (NOCT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

PERFORMANCE AT LOW IRRADIANCE

Industry leading performance at low irradiation, +96.0 % module efficiency from an irradiance of 1000 W/m² to 200 W/m² (AM 1.5, 25°C).

The specification and key features described in this Datasheet may deviate slightly and are not guaranteed. Due to on-going innovation, research and product enhancement, Canadian Solar Inc. reserves the right to make any adjustment to the information described herein at any time without notice. Please always obtain the most recent version of the datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein.

Caution: For professional use only. The installation and handling of PV modules requires professional skills and should only be performed by qualified professionals. Please read the safety and installation instructions before using the modules.

MODULE / MECHANICAL DATA

Specification	Data
Cell Type	Poly-crystalline, 6 inch
Cell Arrangement	72 (6 × 12)
Dimensions	1954×982×40 mm (76.93×38.7×1.57 in)
Weight	22 kg (48.5 lbs)
Front Cover	3.2 mm tempered glass
Frame Material	Anodized aluminium alloy
J-BOX	IP67, 3 diodes
Cable	4 mm² (IEC) or 4 mm² & 12 AWG 1000V (UL), 1150 mm (45.3 in)
Connectors	MC4 or MC4 comparable
Stand. Packaging	24 pcs, 608 kg (quantity & weight per pallet)
Module Pieces per Container	528 pcs (40' HQ)

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.43% / °C
Temperature Coefficient (Voc)	-0.34% / °C
Temperature Coefficient (Isc)	0.065% / °C
Nominal Operating Cell Temperature	45±2°C

PARTNER SECTION

Pour-in-Place™ Ballasted Ground System

- Patent pending protected system with self-leveling technology: 68% faster install than precast
- Substantial labor savings by eliminating moving and shimming heavy precast blocks
- Integrated grounding and wire management
- Gen4 Pour-in-Place™ Ballasted Ground System with round forms shipping in Q4 2015 - less concrete, faster install, steeper slopes
- Available in both 1 and 2 panels up in portrait
- 20 year warranty - Made in USA
- ETL / UL 2703 Tested
- Independent assessment by Black & Veatch
- Wind tunnel tested by industry leader CPP

cpp CERMAK PETERKA PETERSEN

Intertek

System Information

Features:
Self-leveling technology: 68% faster install than precast
Up to 4ft. high ground clearance to allow for snow slide and vegetation growth
Substantial adjustability allows for slopes up to 15%
Gen4 Pour-in-Place™ Ballasted Ground System with Round Forms Shipping in Q4 2015 - Less Concrete, Faster Install, Steeper Slopes
Up to 25% less concrete due to optimized ballast distribution
Available in both 1 and 2 panels up in portrait
Slots enables additional vertical adjustability, up to total of 10"
No gravel beds or other expensive ground preparations required - save up to $.05/watt
Integrated grounding with star washers or teethed module clamps included - both approved under ETL/UL 2703
5 to 35° tilt with multiple inter-row spacing options
51% overall lower cost than competitors
Unique design innovations protected under patent pending
Made in the U.S.A.

Installation:
Fastest install of any ballasted ground system
Just place leave-behind Pour-in-Place™ forms, place rail supports, bolt on and level rails, pour concrete, mount panels
Panels mount rapidly from above using top mount clamps or from below using panel mounting holes
Five men install 1454 panels with racks and ballast per week: 15 men install 1.31 MW per week
Self-leveling technology enables 10" total vertical adjustability including use of slots
Rapid install using concrete truck to fill Pour-in-Place™ forms around supports, or for weight sensitive landfill caps or narrow row spacing using pump or tracked bobcats with gravity feed buckets
3 trucks per MW typical
Bundles typically 3100lbs. maximum for easy offloading
Full turnkey services provided by certified installers program

Testing & Certifications:
Wind tunnel tested by industry leader CPP & rated for 150mph wind speed
Independent assessment by Black & Veatch
Rated up to 90 psf snow load
ETL/UL 2703 tested
ETL/UL 467 GameChange teethed panel mounting clamps included for top mount installations
Meets IBC and ASME standards for structural loading
Warranty 20 years
Minimum order size 750 KW

Technical Data

Material:
Rail support structure components: G90+ galvanized steel
Panel mounting rails: 6005 aluminum, or G90+ galvanized steel
Recycled HMWPE forms
Stiffening Strips: 304 stainless steel
3/8" Magnacoat bolts and serrated flange nuts
Panel mounting hardware:
Top mount: panel mounting clips: stainless steel teethed clips
¼-20 x 1.5" to 2.5" T bolts, ¼-20 serrated flange nuts: stainless steel
Bottom mount: ¼-20 x 3/4" T bolts, ¼-20 serrated flange nuts, star washers: stainless steel
Use 4000 psi concrete, freeze thaw rated where applicable

Calculations:
100% code compliant designs for any locality
Structural PE, stamped drawings and calculations
Individual system structural calculations
Individual system design calculations based on regional load values
Design loads according to IBC 2006 or 2009

Grounding:
Integrated grounding with star washers or teethed module clamps included - both approved under ETL/UL 2703
Jumpers provided for aluminum rail thermal expansion breaks
Grounding must be done by electrician at row ends

Place supports, attach rails, then level rail supports quickly prior to pouring concrete

Available with galvanized purlins with large wire management tray

Slots combined with rail support self-leveling technology enable up to 10" vertical adjustability

Gen4 Pour-in-Place™ Ballasted System with round forms shipping Q4 2015: less concrete, faster install, steeper slope

Pouring bucket on bobcat for concrete pouring of Pour-in-Place™ forms on sensitive landfill caps

Standard concrete pump truck has long range and fills up to 1.5MW of Pour-in-Place™ forms per week

DECK Monitoring

Solar Monitoring Solutions

FEATURES:

Revenue Grade System Monitoring – Utility grade, verifiable data for billing, reporting to agencies, SREC reporting, and analytics.

Web, Kiosk, and Plasma Display Integration – Highly customizable and visually interactive web view and optional Kiosk integration. Perfect for integration into websites, store lobbies, and large screen displays.

Advanced Performance Monitoring – Our powerful data center allows users to view detailed analysis of system performance. Interactive graphs bring the power to troubleshoot and benchmark systems to the user's fingertips. Our high end data gateway can record a multitude of information including: generation, load, irradiance, volts, amps, cell temperature, weather data, and wind direction / speed.

Demand Monitoring – Our demand monitoring package allows you to accurately monitor your facility's energy usage in fifteen minute intervals. The package is fully integrated with the standard flash view including detailed graphing capabilities. This information facilitates energy conservation by identifying high energy use periods.

System Administration – Our powerful administration panel allows contractors to quickly get an overview of the performance of all their systems at once (and system owners of their individual systems). Advanced notification options allow you to be notified instantly of errors, alerts and track system performance remotely.

KEY BENEFITS:

Customizable - Easily configurable for customer choice of colors, project information and kiosk integration.

Integrated Pricing - The purchasing and installation process is simplified and streamlined. Our basic package includes flash views and contractor admin panels at no extra charge.

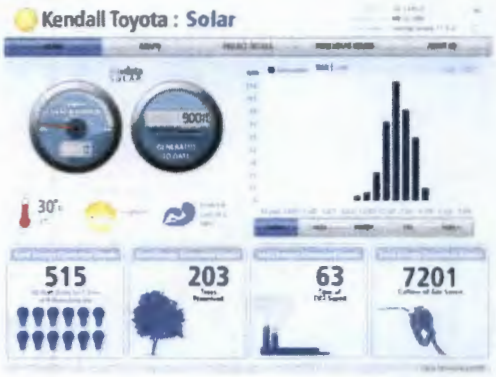
Power and Beauty – The standard DECK system is a combination of powerful commercial grade features and a stunning user interface. Perfect for public kiosks, web pages, and in-facility displays.

Customer Service - Custom alarms ensure installers instantly know about any performance issue. Keep connected to your customer base.

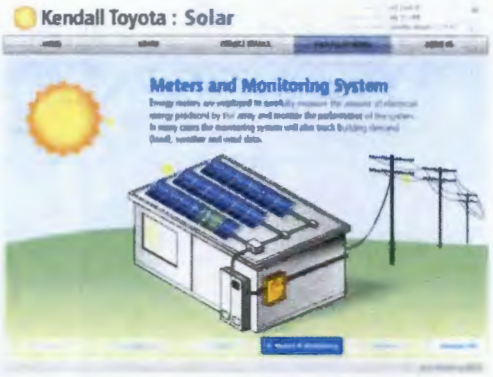
DECK Monitoring
1 East Broadway, Eugene, OR 97401
www.deckmonitoring.com
Sales Office: 541.343.1233
Corporate Office: 541.343.0110

DECK Monitoring

Solar Monitoring Solutions



Dashboard - Energy meters display current generation, historical data, weather data, and equivalencies.



Educational Information - Visitors to your website or facility can learn about how your solar system works.

Custom Pages - Each deployment comes standard with custom pages, describing your specific installation and system details.

Administration Panel - Keep track of your valued customers! System owner and contractor access to view multiple systems, alarms, downloadable historical data, advanced performance visualizations, and case notes for each project.

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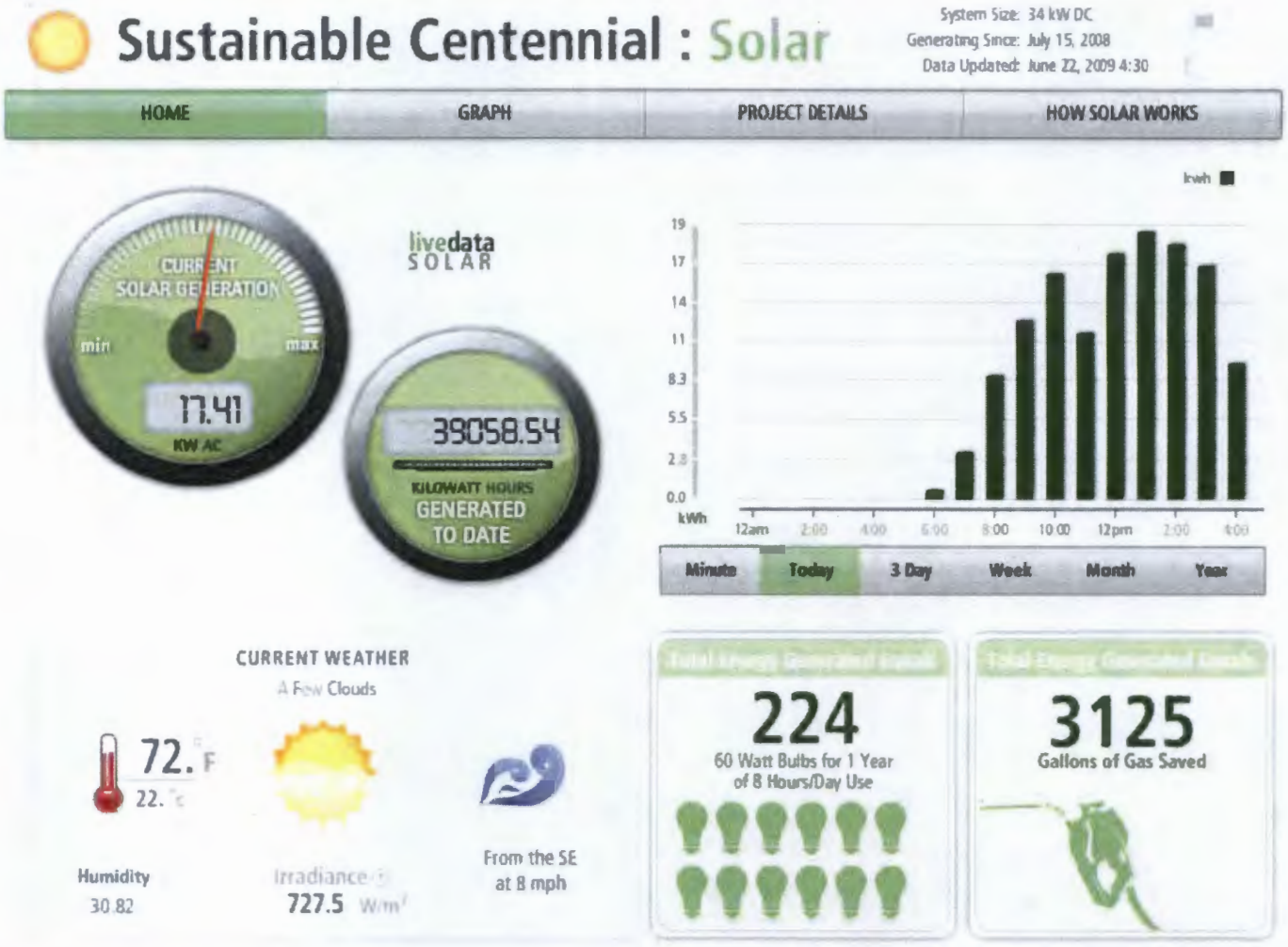
DECK Monitoring

Public Dashboard



KEY MODULES:

Energy Meters - Display current solar generation as well as kilowatt hours generated to date.

Historical Graph - Display historical graphs of solar generation. Views include detailed daily views, 3 day, weekly, monthly, and yearly graphing options.

Weather Module - Display current weather conditions (including irradiance) on site using a compatible DECK weather station, or via the national government weather feed.

Equivalencies - Display the equivalent energy which would have been generated or used by other sources. Options include Gasoline, Lightbulbs, Trees, CO_2, and SREC Credits.

Customization Options - Choose your choice of colors, equivalencies, and customizable project details pages. Customization options come standard with our core packages.

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DECK Monitoring

Public Dashboard

CUSTOM PAGES:

Company Pages: Our standard package includes a custom page specific to your installation, which includes photos and text of your choice. Use this page to highlight the green efforts of your company.

Multiple Installation Integration: Do you have multiple systems which you would like to integrate into one dashboard? We can easily combine multiple systems into one public display, including graphs which break apart each installations' production (or each inverters' production).

Information specific to your installation

Incorporate multiple installations into one dashboard

EDUCATIONAL FEATURES:

How Solar Works page: Every dashboard comes standard with a How Solar Works tab. This tab explains the basics of the solar systems components.

Educational Dashboard Option: A highly interactive display which incorporates educational information and is optimized for kiosk or wall mounted touch screen use. Users can see the flow of energy from the sun, through the solar panels, the inverters, the meters, and finally out to the grid. Handy tool tips at each point explain the basics of solar production, and real time data gives users feedback on current conditions. A green equivalency slider offers an easy method to switch between equivalencies - including REC credits!

Interactive educational dashboards and displays

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DECK Monitoring

Admin Panel

KEY CAPABILITIES:

Provide Enhanced Support and Troubleshooting - The integrator or contractor benefits by being able to keep track of all their valued customers in one place, quickly, and efficiently. Alarms and notices can alert the integrator to potential system problems and outages instantly, and troubleshooting features can save time for both contractor and customer.

Maximize System Performance - Be immediately alerted of system performance issues which might go undetected and cause expensive system downtime.

Agency Reporting and Data Download Center- Provide automatic transfer of data to utilities in order to receive incentive payments. Certified as a PDP and PMRS in the state of California. The Data Download Center allows users to download data to their desktop at any time in an easy to use format.

DC String and Subarray Monitoring - Detailed performance data and visualization down to the string level. View underreporting arrays and strings and identify issues with system performance.

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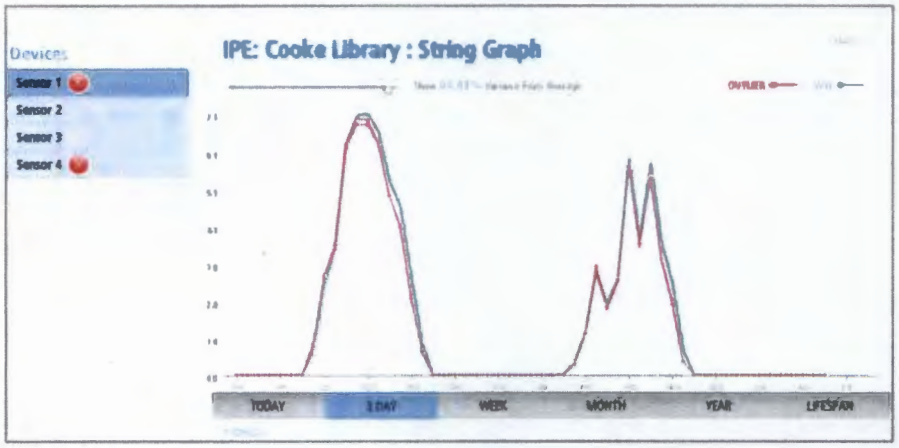
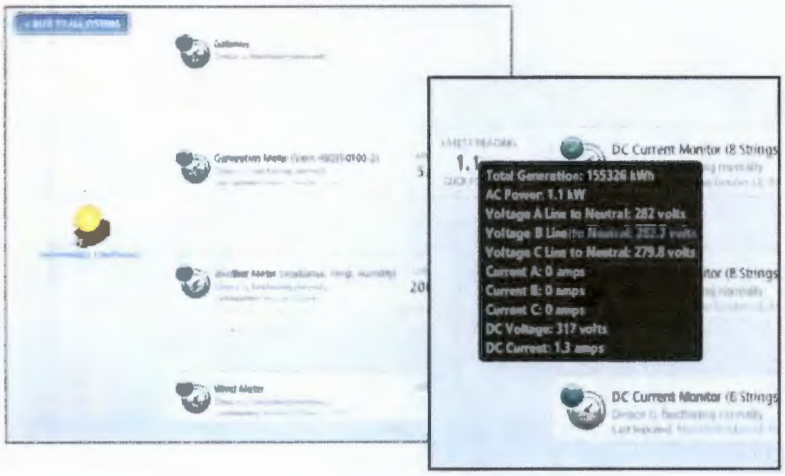
Admin Panel



DC String and Subarray Monitoring - Detailed performance data and visualization down to the string level. View underreporting arrays and strings and identify issues with system performance.

Alarms and Notes - Create custom alarms to notify you or a member of your team in case of performance issues or fault codes from inverters. Take advantage of our hierarchical alarm system to reduce information overload for team members. Make notes specific to systems or alarms. Record who was notified of which alarms, what actions were taken and when those actions were taken. Access a running log of history on any particular system or system alarm.



Inverter and Device Data - Instant access to performance data directly from the inverter. DECK Monitoring is compatible with most commonly used commercial inverters. In addition our system views give the user instant visibility to each device which is reporting to the system.

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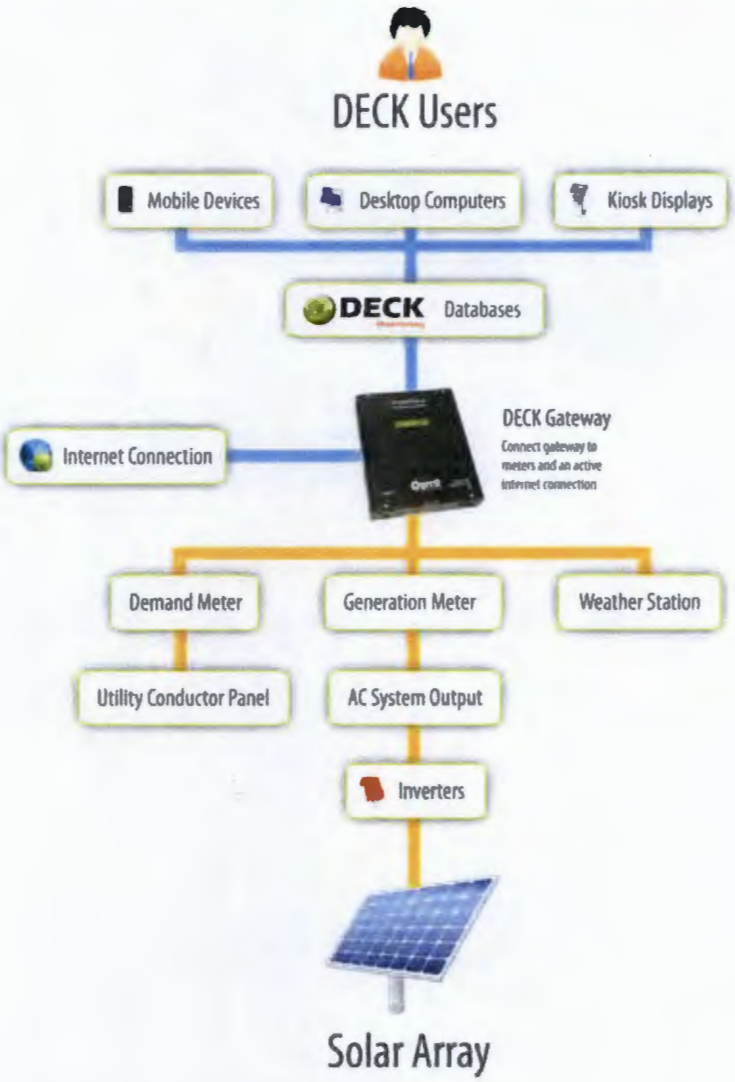
DECK Monitoring

Hardware and Deployment

DECK HARDWARE:

Components: The standard DECK Monitoring solution is comprised of a data gateway which is mounted on site. This data gateway communicates with supplied meters and data gathering hardware which connects via Modbus, Pulse, or wireless signals. Typically the included CT Meter is used to measure system generation after the inverter on the AC side.

Revenue Grade and Extendable: Our hardware componénts were selected for future expandability, high resolution data and low failure rates. Our system components can be incorporated into other third party systems down the road. In the future, if you would like to add demand monitoring capabilities, integrate with other EMS systems, add another array, weather station, string monitoring solutions or countless other components, you can use the same hardware and you will not have to replace the core components of the system.



KEY HARDWARE CAPABILILITIES:

Choice of meters

Demand (load) metering options

Plug and play with third party components

Expandable platform

Wireless (cellular) connectivity options

String monitoring options

String combiner box integration

Data backup stored onsite in hardware

Revenue grade data

Inverter communication capabilities

EASY INSTALLATION:

The DECK Monitoring platform is designed around plug and play connectivity, and proven communication standards. Mount the gateway to the wall in the facility, connect the internet to the gateway, and install our CT meters to get up and running. We offer a choice of CT meters for our customers including split core Veris CT meters and Shark Electro Industries CT meters.

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DECK Monitoring

Hardware and Deployment

STEP 1: GET QUOTE

We can provide you with our standard price sheet, making it easy to price your system on your own. If you have any questions about our solutions or how to price them, contact our sales team and we will generate a custom quote for you or your client.

STEP 2: PLACE ORDER

Place an order with us directly, or with one of our distribution partners. You will be given the same quality service and equipment either way.

STEP 3: SITE SURVEY FORM

As soon as you place an order we will send you a link to our online site survey form. The site survey form will give us the necessary information to customize the hardware and software for your specific project. If there is any other needed information, we will contact you directly.

STEP 4: SHIPMENT

We will pre-configure your hardware and software so it is ready to install, and then drop ship your equipment to your specified shipping address. Standard solutions may ship within two to three weeks. Custom solutions may take longer depending on wait times for hardware.

STEP 5: Installation

When your team receives the equipment onsite, the software will already be deployed. At this point once the hardware is connected and configured, the installation will be complete.

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POWERCON CORPORATION

5kV &15Kv METAL-CLAD SWITCHGEAR
BROCHURE #PC042

ELECTRONIC VERSION CREATED: 6/30/96

Powercon Corporation
P.O. Box 477
1551 Florida Avenue
Severn, Maryland 21144
Baltimore: 410-551-6500
Washington: 301-621-7400
Fax: 410-551-8451
email: info@powerconcorp.com

METAL-CLAD VACUUM SWITCHGEAR

This bulletin describes Metal-Clad Switchgear - one of Powercon's Switchgear product lines.

This advanced switchgear line is completely factory built, wired and assembled. Each cubicle may contain the circuit breaker, bus bars, primary and secondary disconnecting devices, instrument transformers, instruments and relays, secondary wiring and other necessary corn The switchgear is designed so that additional circuit breaker or auxiliary cubicles may be added in the future.

The Circuit Breaker

- Vacuum interrupters with stored energy operating mechanism
- Primary disconnecting devices
- Auxiliary switches
- Ground contacts
- Control wiring
- Interlocks

In addition to the standard equipment described, custom engineered switchgear is offered to meet individual purchaser needs.

With a highly skilled professional engineering manufacturing team, an organizational entity has been developed to provide the material and services our customers require. The engineering staff - application product design - development - manufacturing - has achieved the extensive system experience and knowledge required in the application, manufacture, delivery, and service of Power Systems Switchgear.

This product is the result of seasoned technical efforts combined with the well versed, skilled competent, veteran work force exerting their combined efforts to provide the best in service and equipment.

Our membership in NEMA, ANSI and IEEE keep us up to date on the ever changing standards so that we meet today's exacting demands.

An all inclusive *METAL-CLAD* equipment designed, built and tested to the applicable industry standards shown in Table 1.

PORCELAIN (the near ultimate in insulation) for all live part supports including the circuit breaker itself, is available.

Compartmented cable, bus, fuses, voltage and auxiliary transformers.

An interlock system to:

- Prevent breaker closing except in "connect", "test", or "disconnect" position.
- Interference for prevention of any but proper breaker to be inserted in cell.
- Spring discharge prior to removal from cell.

(For Guide Specifications - See Publication PC-029)

Table 1 - Applicable Industry Standards

American National Standards Institute (ANSI) **70 East 40th Street** **New York, New York 10017**		**National Electrical Manufacturers Association (NEMA)** **2101 L Street N.W., Suite 300** **Washington, D.C. 20037**	
Standard No	Description	Standard No.	Description
C37.04	CA High-Voltage Circuit Breaker Rating Structure	**SG-2**	High Voltage Fuses
C37.06	Preferred Ratings of AC High-Voltage Circuit Breakers		
C37.09	Test Procedures for AC High-Voltage Circuit Breakers	**SG-4**	Power Circuit Breakers
C37.010	Application Guide for AC High-Voltage Circuit Breakers		
C37.11	AC High-Voltage Circuit Breakers Control Requirements	**SG-5**	Power Switchgear Assemblies
C37.20.2	Switchgear Assemblies and Metal-Enclosed Bus		
C37.100	Definitions of Power Switchgear		

HORIZONTAL DRAWOUT

15kV 500MVA Indoor Line-Up

Preferred Ratings for Indoor Oilless Circuit Breakers

Table 2 - ANSI C37.06 - 1987

Rated Max. Voltage (1) kV, rms	Rated Voltage Range Factor K (2)	Rated Continuous Current at 60Hz (3) Amperes, rms	Rated Short-Circuit Current (at Rated maximum kV) (4) (5) (6) (9) kA, rms	Rated Interruption Time (7) Cycles	Rated Max. Voltage Divided by K kV, rms	Max. Symmetrical Interrupting Capability and Rated Short-Time Current (4) (5) (8) kA, rms	Closing and Latching Capability 2.7K times Rated Short-Circuit Current, (4) kA, Crest
4.76	1.36	1200	8.8	5	3.5	12	32
4.76	1.24	1200,2000	29	5	3.85	36	97
4.76	1.19	1200,2000, 3000	41	5	4.0	49	132
8.25	1.25	1200,2000	33	5	6.6	41	111
15.0	1.30	1200,2000	18	5	11-5	23	62
15.0	1.30	1200,2000	28	5	11.5	36	97
15.0	1.30	1200,2000, 3000	37	5	11.5	413	130
38.0	1.65	1200,2000, 3000	21	5	23.0	35	95
38.0	1.0	1200,3000	40	5	38.0	40	108

For service conditions, definitions, and interpretations of ratings, tests, and qualifying terms, see ANSI/IEEE C37.04-1979, ANSI/IEEE C37.09-1979, and ANSI/IEEE C37.100-1981.

Current values have been rounded off to the nearest kilo-ampere (kA) except that two significant figures are used for values below 1OkA.

(1)The voltage rating is based on ANSI C84.1-1982, where applicable, and is the maximum voltage for which the breaker is designed and the upper limit for operation.

(2)The rated voltage range factor, K, is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical current interrupting capabilities vary in inverse proportion to the opening voltage.

(3)The 25-Hz continuous current ratings in amperes are given herewith following the respective 60Hz rating: 600-700; 1200-1400; 2000-2250; 3000-3500.

(4) Related Required Capabilities The following related required capabilities are associated

with the short circuit current rating of the circuit breaker.

(a) Minimum symmetrical interrupting capability (kA. mm) of the circuit breaker is equal to K times rated short circuit current.

(b) 3-second short time current carrying capability (kA, rms) of the circuit breaker is equal to K times rated Short-Circuit current.

(c) Closing and latching capability (kA, rms) of the circuit breaker is equal to 1.6 K times rated Short-Circuit current. If expressed in peak amperes, the value is equal to 2.7 K times rated short circuit current.

(d) 3-Second short-time current carrying capability and closing and latching capability are independent of operating voltage up to and including rated maximum voltage.

(5) To obtain the required symmetrical current interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used:

Required symmetrical current interrupting capability=
rated short circuit current X $\frac{\text{(rated maximum voltage)}}{\text{(operating voltage)}}$

For operating voltages below 1/K times rated maximum voltage. the required symmetrical current interrupting capabilities of the circuit breaker shall be equal to K times rated short circuit current.

(6) With the limitation stated in 5.10 of ANSI/IEEE C37.04-1979. all values apply for poly-phase and line-to-line faults. For single phase-to-ground faults, the specific conditions stated in 5.10.23 of ANSI/IEEE C37.04-1979 apply.

(7) The ratings in this column are on a 60-Hz basis and are the maximum time interval to be expected during a breaker opening operating between the instant of energizing the trip circuit and interrupting of ht main circuit on the primary arcing contacts under certain specified conditions. The values may be exceeded under certain conditions as specified in 5.7 of ANSI/IEEE C37.04-1979,

(8) Current values in this minimum are not to be exceeded even for operating voltages below I/K times rated minimum voltage. For voltages between rated maximum voltage and 1/K times rated maximum voltage, follow (5) above.

(9) Rated permissible tripping delay time (Y) = 2 seconds.

METAL-CLAD SWITCHGEAR HORIZONTAL DRAWOUT

See Guide Specifications - See Publication PC-029

It Consists Of:

- Framework of welded steel
- Sheet steel enclosure, including a hinged front door, which may be used as an instrument panel
- Compartment and inter-unit barriers
- Three-phase insulated bus and connections
- Porcelain bus supports available
- Stationary primary disconnecting devices
- Stationary secondary disconnecting devices
- Circuit breaker racking-in device
- Circuit breaker interlocking device
- Instruments and relays
- Control wiring
- terminal blocks
- Instrument transformers
- Provision for connecting main cable
- Guide rail on floor of structure
- Wiring channels
- Control cut-outs

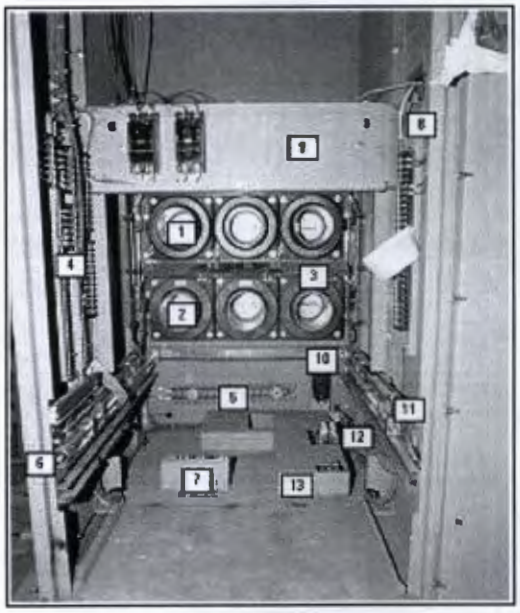
The breaker, bus, potential transformers, current transformers and cables all have their own compartments. And, each function is isolated by rugged partitions.

Powercon metal-clad provides the value of a superior insulation system at vital points, and greater structural strength from a rugged all-welded steel frame.

Relays and instrumentation are mounted on the front door so that the breaker can be removed or inserted without damaging a relay.

Guide rails are provided so that the breaker will roll into proper position in the cubicle. The mechanism assures perfect alignment when the breaker is racked into its operating position.

Porcelain - The Ultimate In Insulation



LOWER BREAKER COMPARTMENT CONSTRUCTION
FRONT VIEW - DOORS, SHUTTERS AND SHUTTER ISOLATION BARRIERS REMOVED

UPPER COMPARTMENT SIMILAR IN CONSTRUCTION WHEN REQUIRED

1. Upper Primary Disconnects
2. Lower Primary Disconnects
3. Current Transformers
4. Secondary Terminal Blocks
5. Heaters
6. Racking Mechanism
7. Interference Plate
8. Lower Wireway
9. Device Panel
10. Secondary Stationary Coupler
11. Rollout Rails
12. Breaker Ground Shoe
13. Stationary Auxiliary Switch

NOTE: This construction for GE Breaker - functionally similar construction for Westinghouse and Siemens ALL 3 ARE UL LISTED BY POWERCON

WITH A *SUPER STRUCTURE*

FRONT VIEW -- BREAKERS REMOVED

1. Auto Shutters
2. Breaker Auxiliary Switch
3. Breaker Rails
4. Metal Partition
5. Relay Doors
6. Ground Shoe

METAL-CLAD SWITCHGEAR WITH A

The Vital Link to Dependable Power

THE CONDUCTORS

All bus systems are designed with either copper or aluminum conductors. The Aluminum bus system weighs less than the electrically equivalent copper bus system Both copper and aluminum conductors are plated to improve joint contact and to reduce corrosion.

Selection of conductor material, whether it be aluminum or copper is most important. The correct temper and conductivity is extremely critical and is specified by the Engineering Group to be held within exacting tolerances.

THE INSULATION SYSTEM

The insulation system is of equal importance. It is nominally designed to withstand 40,OOOA (or more) asymmetrical short circuit but is dependent upon Customer requirements. It is designed and manufactured to ANSI standards and has an ANSI Class 105 degree C temperature limit.

Powercon's bus insulation system is a family of carefully selected and applied materials that have resulted from many years of experience. Detailed laboratory and field-proof testing, as well as in-service experience have confirmed the critical engineering considerations necessary to insure a reliable insulation system. Such factors include but are not limited to:

- *Dielectric strength and moisture absorption under 100% humidity and cycling conditions.*
- *Insulation power factor considerations under varying conditions.*
- *Flame retardance.*
- *Mechanical and thermal strength - shock characteristics under normal operating conditions, fault conditions, and possible shipment problems.*
- *Dimensional and electrical creep under normal operating conditions.*

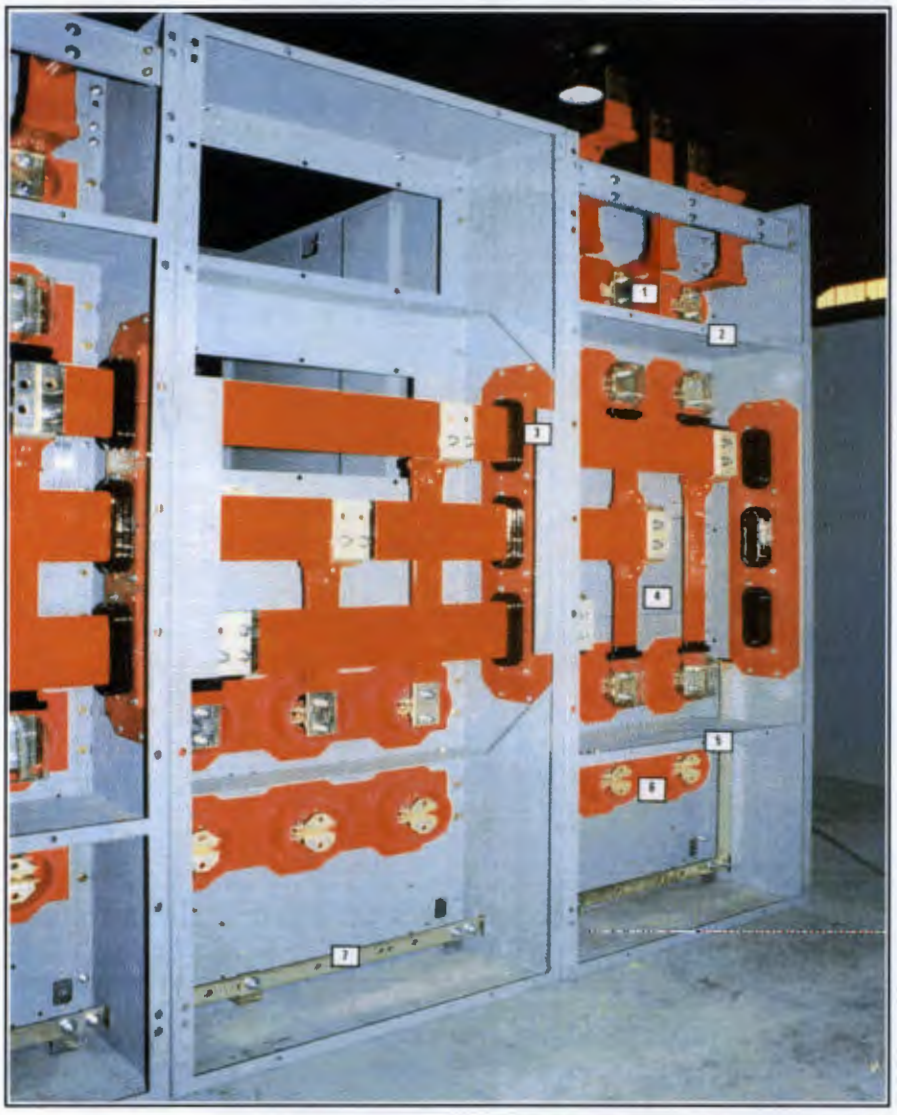
SAFETY AND RELIABILITY

Safety in power distribution is of the utmost importance. In order to achieve a high degree of safety, the bus is completely metal-enclosed with all live parts isolated and fully insulated. The enclosure is tied into the switchgear ground bus.

Reliability is achieved through a coordinated engineering and manufacturing design, achieving a minimum of maintenance, excellent accessibility for inspection, and the selection of materials monitored by a superior quality control program.

REAR VIEW WITH CABLE COMPARTMENT & BARRIERS REMOVED

1. Upper Load Primary Disconnects
2. Barrier
3. Porcelain Bus Thru Bushings
4. Bus Compartment
5. Barrier
6. Lower Load Primary Disconnects
7. Ground Bus



QUALITY FEATURES

LIKE A DIAMOND.....

IT IS THE HIDDEN FACETS WHICH MAKE POWERCON SWITCHES AND SWITCHGEAR OUTSTANDING AND SUPERIOR!

ENGINEERING

HIGHLY QUALIFIED EXPERIENCED
- APPLICATION
- DESIGN
- DEVELOPMENT
- MANUFACTURING
- TESTING

POWERCON'S TOP MANAGEMENT ARE REGISTERED PROFESSIONAL ENGINEERS

FACILITIES

200,000 SO. FT. WITH SOME OF THE MOST MODERN & SOPHISTICATED MACHINERY IN THE INDUSTRY.
AUTOMATIC MACHINERY FOR:
- BUS MANUFACTURING
- WIRING, CUT TO LENGTH, MARKED AND LUGGED
- CNC SHEET METAL
- WELDING
- MACHINE CENTERS
- ETC.

COMPUTERIZED DOCUMENTATION

POWERCON UTILIZES SOPHISTICATED AND UNIQUE COMPUTER CAPABILITIES TO ASSIST THE ENGINEERING AND MANUFACTURING OF SWITCHGEAR. DOWNLOADING FROM ENGINEERING TO MANUFACTURING PRODUCES A HIGH QUALITY PRODUCT.

LABORATORY

AN ELECTRICAL-MECHANICAL LAB TO VERIFY DESIGNS AND CONFORMITY TO PROJECT REQUIREMENTS AND MONITOR VARIOUS COMPONENTS OF PRODUCTION.

THE LEADER IN VALUE - SECOND TO NONE

ASSURED QUALITY CONTROL

A QUALITY CONTROL SYSTEM TO PROVIDE SWITCHGEAR FEATURES-

- •SAFETY
- •PERFORMANCE
- •CONFORMANCE
- •RELIABILITY
- •DURABILITY
- •SERVICEABILITY
- •REQUIRED FEATURES

ALONG WITH U.L. CERTIFICATION

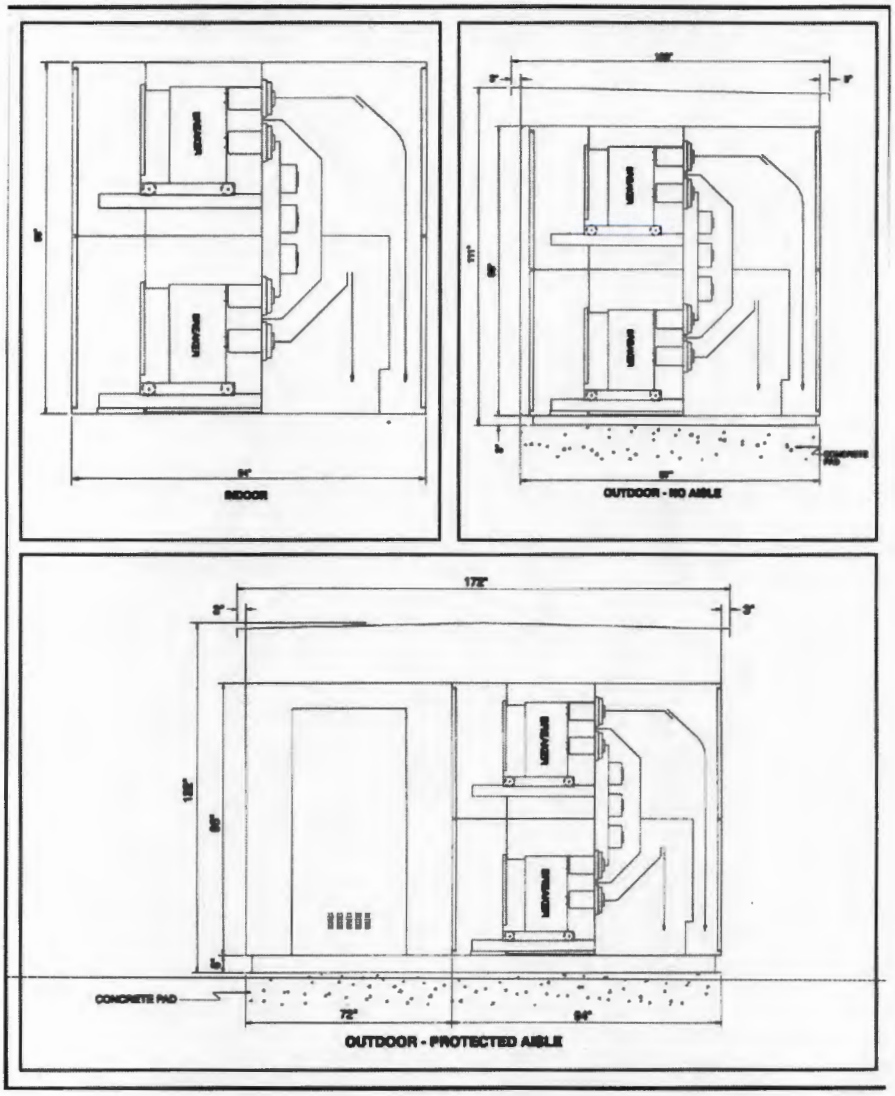
SERVICE ENGINEERING

FIELD SERVICE ENGINEERS AND SPECIALISTS, EACH WITH MORE THAN 10 YEARS OF SWITCHGEAR EXPERTISE HAVE MASTERED THE DEMANDING SKILLS FOR THE PROPER INSTALLATION, MAINTENANCE AND EMERGENCY REPAIRS OF SWITCHGEAR PRODUCTS. THESE COMPETENT SEASONED VETERANS ARE FACTORY TRAINED AND BACKED UP WITH THE PROBLEM SOLVING EXPERTS OF POWERCON. OUR FULL RESOURCES ARE IMMEDIATELY AVAILABLE WITH A DEEP SUPPORT STRUCTURE.

EXPERIENCE & GROWTH

35 YEARS OF CONTINUOUS GROWTH FROM AN 8 MAN OPERATION TO OUR PRESENT 350 PERSON ENGINEERING AND MANUFACTURING TEAM - TO PROVIDE YOU WITH THE EXPERIENCE UNEQUALED IN THE INDUSTRY.

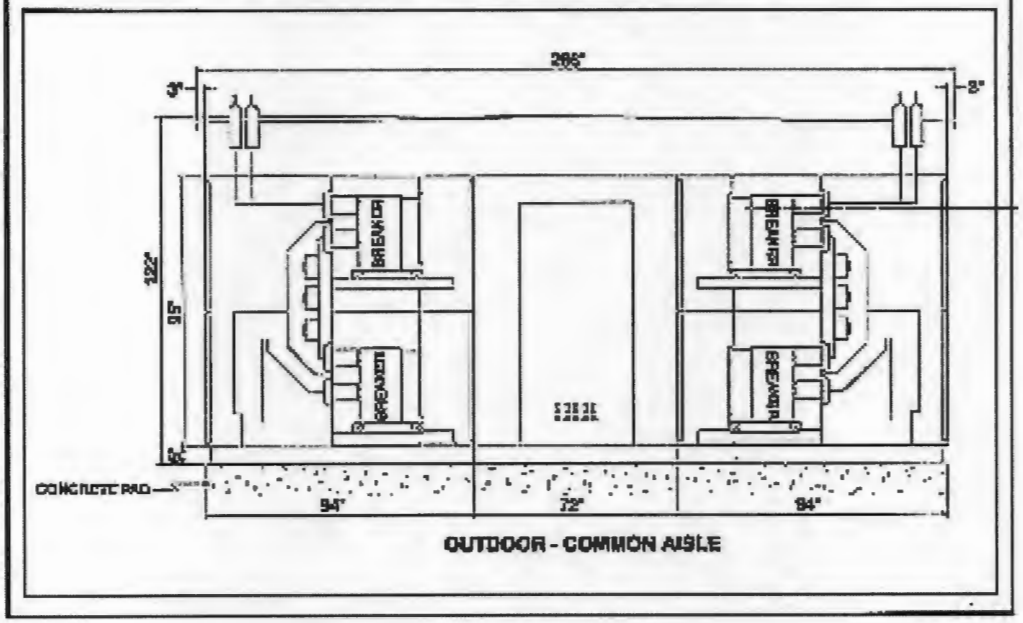
METAL-CLAD SWITCHGEAR



TYPICAL SECTION DIMENSIONS

Breaker Rating	Current Rating (Amps)	Breaker Weight	INDOOR Height	INDOOR Depth	INDOOR Bascon Vertical Section (Less Breakers) Width	INDOOR Bascon Vertical Section (Less Breakers) Weight	INDOOR Auxiliary Vertical Section Width	INDOOR Auxiliary Vertical Section Weight	OUTDOOR*** Height	OUTDOOR*** Depth	OUTDOOR*** Equipment Vertical Section (Less Breakers) Width	OUTDOOR*** Equipment Vertical Section (Less Breakers) Weight	OUTDOOR*** Auxiliary Vertical Section Width	OUTDOOR*** Auxiliary Vertical Section Weight	OUTDOOR*** For Enclosure ABVE, Add To Each Vertical Section Depth	OUTDOOR*** For Enclosure ABVE, Add To Each Vertical Section Weight	INDOOR & OUTDOOR Radiant Weight (PT-CPT)	INDOOR & OUTDOOR Required Clearance Front Aisle Min.	INDOOR & OUTDOOR Required Clearance Rear Aisle Min.
4.16-250	1600	600	95	94"	36	3700	36	3700	111 or 112 ins. Below	181 176 or 262 ins. below	36	3600	36	3600	75	1500	550	60"*	25
	2000	600																	
4.16-250	1200	550																	
	2000	600																	
	3000	700																	
72-500	1200	550																	
	2000	600																	
38.5-500	1200	550																	
	2000	600																	
38.5-150	1200	550																	
	2000	600																	
38.5-1200	1200	600																	
	2000	600																	
	3000	700																	

* (An optional 82" depth is available for some applications if limited to one breaker per vertical section.)
** (36" minimum front aisle space available for indoor.)
*** (For common aisle construction, add 1500 pounds to weight of 2 indoor vertical sections.)



OUTDOOR - COMMON AISLE

CONSTRUCTION

13.2kV Metal-Clad Switchgear for Large Oxygen Plant

13.2kV Metal-Clad for Wastewater Treatment Plant

Outdoor Non-Walkin 4160V Metal-Clad Switchgear for Service Large Hospital

FLEXIBILITY

The flexibility of Powercon switchgear is demonstrated with photos of the indoor equipment shown on the left. The upper photo shows transformer feeders supplying large induction motors and synchronous motors along with various plant feeds and ties to plant generation.

The other indoor equipment is supplied by two utility lines with bus tie to distribute power to various processes in the system.

Other applications include capacitor, arc furnace, reclosing, generator controls, etc.

WEATHERPROOFED EQUIPMENT

The versatility of packaging Powercon Switchgear is demonstrated. The additional features include:

- *Doors, side sheets and frames sealed with long-lasting gaskets.*
- *All parts treated for rust resistance, painted prior to assembly to protect the metal against rust and corrosion, even between overlapping points.*
- *Bottom of the entire unit undercoated.*
- *Front and rear doors hinged and louvered. Louvers include a filter.*
- *Interiors equipped with lights, heaters, and convenience outlets.*
- *Structures strong enough to be pier mounted.*

Non-Walk-in

In weather-tight steel enclosure units, the complete control panel - with instruments, relays, switches, etc. - is at the front of the unit for easy access. The panel is directly above the breaker, providing the same amount of space, in the same position, as indoor equipment. The control device panel is hinged to swing aisle easily and allow access to the rear of the panel.

The design puts the device panel up front and reduces the space required for an outdoor installation. Foundations can be smaller, reducing installation costs.

TAILORED TO FIT YOUR REQUIREMENTS

Protected Aisle

The protected aisle metal-clad switchgear is assembled together as a complete unit at the factory.

Your maintenance crew works indoors while servicing. With outdoor protected aisle housings, you can plan your year-round maintenance schedule with confidence.

The reinforced steel floor is at the same level as the floor of the metal-clad enclosures to Permit breaker removal and servicing without a use of a transfer truck.

Common Aisle

For common aisle switchgear, as for protected aisle, the basic switchgear units and compartments are similar to those used for conventional outdoor equipment, except the individual weatherproof doors are omitted and hinged access doors are provided in the front of each breaker compartment.

Panic lockable doors at each end of the protected aisle keep unauthorized persons out. However, the inside opening latch is designed to permit door opening at all times when actuated from inside the protected aisle housing, even if the door is padlocked on the outside.

Climatized

Protected aisle switchgear is also available with insulated enclosures call Power Control Complexes, shown being unloaded. Here the walls, roof, floors as required are insulated for the environment of the installation. Air conditioners, heaters, pressurizers, communication and fire suppression systems can be added along with personal conveniences such as kitchens, bathrooms, etc.

13.2kV Walk-In for Utility Service

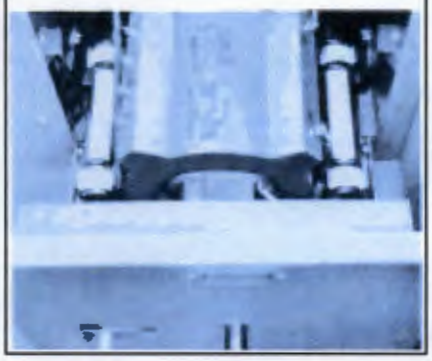
Climatized 13.8kV Metal-Clad for Petrochemical Plant

Interior Switchgear of Climatized Unit

ADDITIONAL FEATURES

Drawout Potential Transformers
Featuring:

•Porcelain through bushings for PT leads above 5kV.
•Phosphor bronze primary contacts spring loaded
•Porcelain live part contact supports above 5kV
•Shutters to block access to live parts when PT's are drawn out.
•When fully withdrawn:
- *•PT windings are grounded*
- *•PT secondaries are open*



Wiring

Color coded vulkene SIS control wiring provides ease of inspection and field maintenance. **All** wire is 14 AWG type SIS, 41 strand, tinned copper. Un-insulated ring lugs are provided for all CT circuits and spade lugs for all other circuits. Other options are available upon request. All secondary wiring in high voltage compartments is run in conduit, wire trough or armored wire except for the short lengths necessary to connect to instrument transformer secondaries. Wiring outside high voltage compartments is bundled, secured and terminate in molded terminal blocks. Hinge wiring is terminated in terminal blocks. Control wiring troughs are provided for interconnecting wiring between circuit.

Control Power Transformers

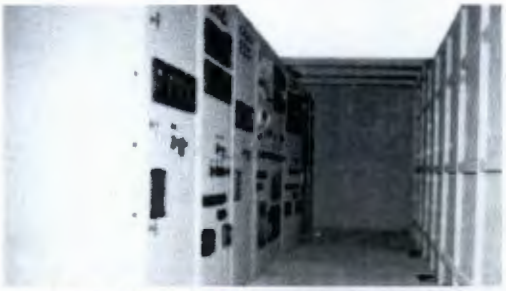
Control Power Transformers up to 75 kVA 3-phase at 15 kV are available in metal-clad construction. Transformers are epoxy or oil and have BIL levels equivalent to the switchgear rating. Transformers rated 15kVA single-phase and below are mounted on drawout carriage with their fuses. Above 15kVA the fuses are drawout and the transformers are stationary. Interlocking is provided as specified.

ADDITIONAL FEATURES

Quality Assurance

Powercon's Assembly Methodology allows its Quality Control & Inspectors to review all portions of the product prior to bolting on covers or obscuring critical parts.

Metal-Clad Switchgear Assembly Line



Outdoor Walk-in Metal-Clad During Final Assembly

Drawings and Instruction Books

Drawings are prepared in accordance with the applicable standards.
Drawings included are:

A) Dimensional plan, elevation and section views.
B) Plans showing location and details of channels, cell and anchor bolts furnished by customer and termination of the power control cables.
C) Schematic or elementary wiring diagram.
D) Detail control wiring diagram (These diagrams generally follow the approval drawings.)
E) Bill of materials, which provide a listing of all devices that are furnished with the equipment.

Instruction books are provided to cover operating and maintenance instructions for each piece of equipment required. The number of instruction books are limited to a maximum of three (3) without charge). Consult Powercon factory for additional books.

World Wide Service.....

Powercon Field Service Engineering

Powercon's 24-hour-a-day field service is provided through factory Field Service Engineers. Our Field Service Engineers are highly skilled SWITCHGEAR experts extremely proficient in providing the highest quality service for switchgear and its components.

Powercon is prepared to provide you with:

- *Emergency Service*
- *Repair and Maintenance Services for Existing* or *Obsolete Equipment*
- *Installation Supervision of New Equipment Advice and instruction of Preventive Maintenance Procedures*
- *Coordination Check of New Equipment*
- *In Warranty Service*
- *Other Required Installation and Engineering Services*

Power Service Engineering is based at the manufacturing facility in Severn, Maryland, only 6 miles from the Baltimore-Washington International Airport.

Our Service Engineering group is in close liaison with other Powercon engineers who create the application, and the mechanical and electrical design of each switchgear equipment. Powercon also maintains detailed records of every part and component manufactured and/or purchased for each project. They have immediate access to the purchasing staff for suppliers service.

Responsibility

Powercon is responsible for the complete product and all services that it provides.

Powercon purchases, assembles, and provides components from other suppliers. In those rare instances when supplier component problems occur Powercon will handle and solve these problems. All warranties on such components will be handled by Powercon direct with the original supplier. Any and all repairs are the responsibility of Powercon.

POWERCON'S POWER LAB & QUALITY ASSURANCE PROGRAMS PROVIDE OUTSTANDING PERFORMANCE

Documented Quality Assurance

The control of quality is a top management function and responsibility. Power has established a high quality tradition over many years. Constant vigilance and careful workmanship combine to create rigid requirements for quality.

The Quality Control Procedures used by Powercon have been in use since its inception- There have been additions during the intervening years as more information and data was collected and the need arose to be more inclusive. The Quality Control Procedures are fully documented and emanate with the initial engineering designs.

Because final quality must be assured, every complete equipment is tested at the factory for conformity to rigid standards verifying the mechanical and electrical specifications.

Powercon Corporation
P.O. Box 477
1551 Florida Ave.
Severn, Maryland 21144
410-551-6500 (Balt)

The following are some of the tests made on Powercon metal-clad switchgear.

- final master-breaker fixture alignment of all mating and matching points, including drawout mechanism; bushing matching; auxiliary contact mating; grounding shoe contact to assure correct operation to accommodate interchangeability of breaker units.
- .auxiliary wiring check to assure correctness and continuity. This includes primary current injection - primary voltage application - control power to actually operate and synthesize the entire control and protective system.
- all relays and devices given complete secondary power check by test consoles.
- high potential tests of primary and secondary circuitry in accordance with ANSI standards.
- final inspection.

SOLECTRIA
A YASKAWA COMPANY

3-PH TRANSFORMERLESS
STRING INVERTERS

PVI 14TL
PVI 20TL
PVI 23TL
PVI 28TL
PVI 36TL

FEATURES

- 600 or 1000 VDC
- Best-in-class efficiency
- Touch-safe fuses
- Dual & wide MPP tracking zones
- Modbus communications
- User-interactive LCD
- Integrated DC fused string combiner
- DC arc-fault protection
- PVI 36TL - HECO and Rule 21 compliant

OPTIONS

- Web-based monitoring
- Shade cover
- DC/AC disconnect covers
- Roof mount array bracket
- DC combiners bypass

3-PH TRANSFORMERLESS STRING INVERTERS

Solectria's PVI 14TL, PVI 20TL, PVI 23TL, PVI 28TL, and PVI 36TL are compact, transformerless three-phase inverters with a dual MPP tracker. These inverters come standard with AC and DC disconnects, user-interactive LCD, and an 8-position string combiner. Its small, lightweight design makes for quick and easy installation and maintenance. These inverters include an enhanced DSP control, comprehensive protection functions, and advanced thermal design enabling highest reliability and uptime. They also come with a standard 10 year warranty with options for 15 and 20 years. Options include web-based monitoring, shade cover, DC/AC disconnect covers, DC combiners bypass, and roof mount array bracket.

Built for the real world

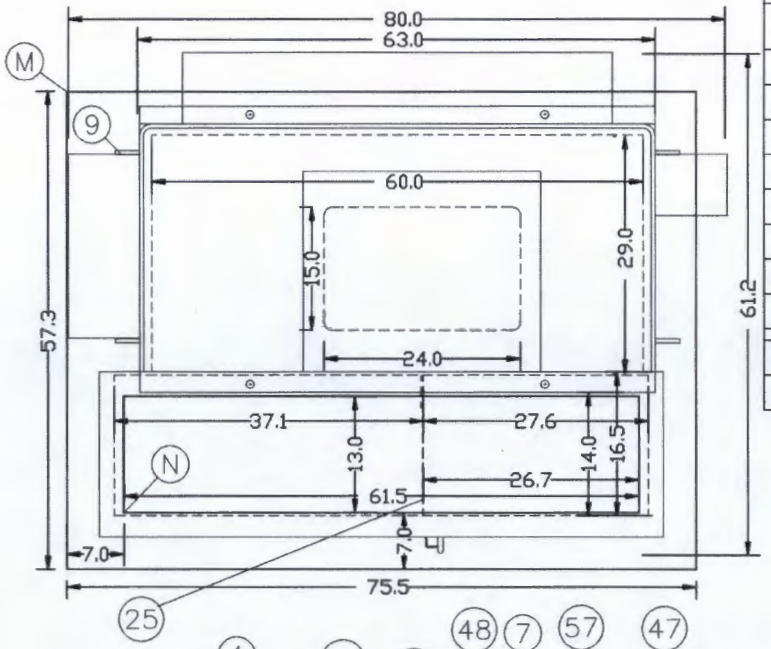
SPECIFICATIONS	PVI 14TL	PVI 20TL	PVI 23TL	PVI 28TL	PVI 36TL
DC Input					
Absolute Maximum Open Circuit Voltage	600 VDC			1000 VDC	
Operating Voltage Range (MPPT)	180-580 VDC	260-580 VDC	300-900 VDC		200-950 VDC
Max Power Input Voltage Range (MPPT)	300-540 VDC	300-550 VDC	480-800 VDC	500-800 VDC	540-800 VDC
MPP Trackers	2 with 4-fused inputs per tracker				
Maximum Operating Input Current	25 A per MPPT (50 A)	35 A per MPPT (70 A)	25 A per MPPT (50 A)	29 A per MPPT (58 A)	35 A per MPPT (70 A)
Maximum Short Circuit Current	45 A per MPPT (90 A)	45.5 A per MPPT (91 A)	41 A per MPPT (82 A)	48 A per MPPT (96 A)	50 A per MPPT (100 A)
Maximum PV Power (per MPPT)	9.5 kW	13.5 kW	15.5 kW	19 kW	27 kW
Strike Voltage	300 V		330 V		330 V
AC Output					
Nominal Output Voltage	208 VAC, 3-Ph		480 VAC/277VAC, 3-Ph		480 VAC, 3-Ph
AC Voltage Range (Standard)	-12%/+10%				
Continuous Output Power	14 kW	20 kW	23 kW	28 kW	36 kW
Apparent Output Power	14 kVA	20 kVA	23 kVA	28 kVA	36 kVA
Reactive Output Power (PF=0.8)	8.4 kVAR	12 kVAR	13.8 kVAR	16.8 kVAR	21.6 kVAR
Maximum Output Current	39 A	25.5 A	27.7 A	33.7 A	43.5 A
Maximum Backfeed Current	0 A				
Nominal Output Frequency	60 Hz				
Output Frequency Range	59.3-60.5 Hz (adjustable 55-65 Hz)				57-63 Hz
Power Factor	Unity, >0.99 (±0.8 adjustable)	Unity, >0.99 (±0.9 adjustable)		Unity, >0.99 (±0.8 adjustable)	
Fault Current Contribution (1 Cycle RMS)	70.4 A	43.3 A	69.6 A		73.2 A
Total Harmonic Distortion (THD) @ Rated Load	< 3%				
Grid Connection Type	3ø+/N/GND				
Efficiency					
Peak Efficiency	96.9%	97.4%	98.6%	98.4%	
CEC Efficiency	96.0%	97.0%		98.0%	
Tare Loss	4 W		2 W		
Integrated String Combiner					
8 Fused Positions (4 positions per MPPT)	15 A (fuse by-pass available)				15 A (15-30 A compatible)
Temperature					
Ambient Temperature Range	-13°F to +140°F (-25°C to +60°C) Derating occurs over +50°C		-13°F to +140°F (-25°C to +60°C) Derating occurs over +45°C		
Storage Temperature Range	-22°F to +158°F (-30°C to +70°C)				-40°F to +158°F (-40°C to +70°C)
Relative Humidity (non-condensing)	0-95%				
Operating Altitude	13,123 ft/4,000 m (derating from 6,562 ft/2000 m)				
Data Monitoring					
Optional SolrenView Web-based Monitoring	Integrated				
Optional Revenue Grade Monitoring	External				
External Communication Interface	RS-485 Modbus RTU				
Testing & Certifications					
Safety Listings & Certifications	UL 1741/IEEE 1547, CSA C22.2#107.1, FCC part 15 B				
Testing Agency	ETL			CSA	
Warranty					
Standard	10 year				
Optional	15, 20 year; extended service agreement				
Enclosure					
dBA (Decibel) Rating	< 50 dBA @ 3 m				
AC/DC Disconnect	Standard, fully-integrated				
Dimensions (H x W x D)	41.6 in. x 21.4 in. x 8.5 in. (1057 mm x 544 mm x 216 mm)		39.4 in. x 23.6 in. x 9.1 in. (1001 mm x 600 mm x 232 mm)		
Weight	141 lbs (64 kg)	132 lbs (60 kg)	104 lbs (47.2 kg)		121 lbs (55kg)
Enclosure Rating	Type 4				Type 4X
Enclosure Finish	Polyester powder coated aluminum				

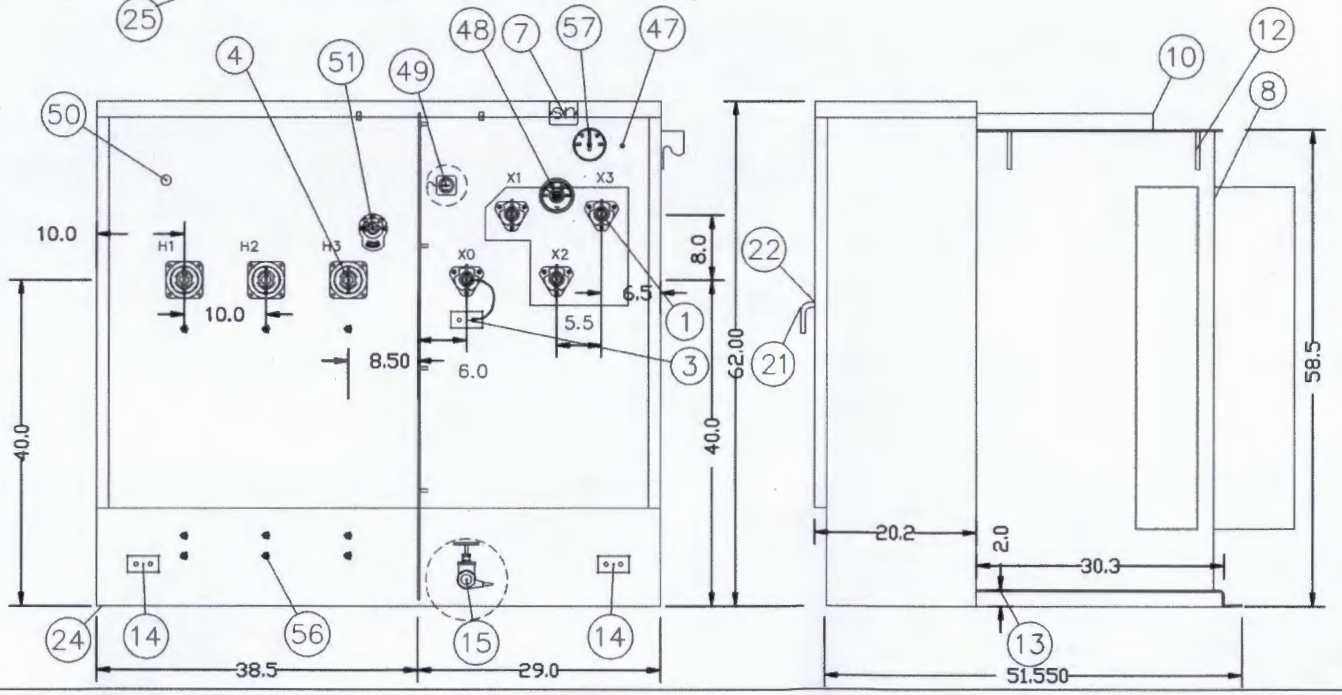
	DESCRIPTION
1	LV BUSHING & 6-HOLE SPADE
3	2 HOLE HORIZ NEMA GRD PAD
4	HV PORC 95BIL W/2H G-SPADE
7	NP ON DOOR, SERIAL ON TANK
8	TANK
9	COOLING RADIATORS
10	HANDHOLE & SECURITY COVER
12	LIFTING LUGS
13	JACKING PROVISIONS
14	2 HOLE HORIZ NEMA GRD PAD
15	1 IN DRAIN VALVE AND SAMPLER
21	PADLOCKABLE DOOR HANDLE
22	3 PT LATCH PENTA SEC BOLT
24	12 IN REMOVABLE SILL
25	METAL LV-HV BARRIER
47	PRESSURE RELIEF VALVE
48	DIAL THERM W/MAX POINTER
49	2" MAG LLG
50	OIL LEVEL PLUG
51	TAP CHANGER HANDLE
56	PROVISIONS FOR LTG ARR
57	PRES VAC GAUGE

	SPECIAL NOTES
A	
B	
C	
D	
E	

CAT NO	9393435478052		
DWG BY:	WM	DATE:	03/06/09
APP BY:	CB	CC.	745

M	SUGGEST PAD SIZE	75.5 X	57.3
N	SUGGEST HOLE SIZE	61.5 X	13.0





DWG NO. 0073-170230-894

SUNBELT Transformer®

CUSTOMER :	
SPEC. INQ NO-SPEC	DATED
KVA 1000.0 BIL 95 TAPS SPECIAL	
HIGH VOLTAGE 14400	
LOW VOLTAGE 480Y/277	
APPROX. CORE AND COIL WEIGHT	3592
APPROX. TANK AND ACCESS. WEIGHT	1872
GAL. OF OIL 330; APPROX. WEIGHT	2476
APPROX. TOTAL WEIGHT	7940

REV.	DATE	DESCRIPTION	BY / APP
A	2/21/11	CHG LOGO	WM

ID 3WMD8015 | 0073-170230-894

APPENDIX D

Town Lease Agreement

3/23/16 – Execution Version

RENEWABLE ENERGY LEASE AGREEMENT

BETWEEN

ISLIP RESOURCE RECOVERY AGENCY

AND

ACE – BLYDENBURGH SOLAR, LLC

Premises: 440 Blydenburgh Road, Hauppauge, NY

Date: March ____, 2016

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EXHIBITS
Exhibit A -- Description of Premises
Exhibit B -- Quarterly Operating Payment Estimate
Exhibit C -- Approved Site Plan
Exhibit D -- Form of Surety Bond
Exhibit E -- Liens and Encumbrances
Exhibit F – Agency Requirements
Exhibit G -- Form of Memorandum of Lease
Exhibit H -- Renewable Energy Facility Electric Interconnection Easement
Exhibit I—Parent Guarantee

RENEWABLE ENERGY LEASE AGREEMENT

THIS RENEWABLE ENERGY LEASE AGREEMENT ("Agreement"), made as of March ____, 2016, by and between the **ISLIP RESOURCE RECOVERY AGENCY**, a public authority organized pursuant to New York Public Authorities Law Title 13-C, §2046 et seq., with its principal offices at 401 Main Street, New York 11751 (hereinafter referred to as the "Agency") and **ACE – Blydenburgh Solar, LLC,** with its principal offices at 360 Merrimack Street, Building 9, Entrance K, Suite 202, Lawrence, MA (hereinafter referred to as "Lessee"). Agency and Lessee shall hereinafter also be referred to as a "Party" or collectively, the "Parties."

WITNESSETH

NOW, THEREFORE, in consideration of the mutual agreements and respective promises herein contained and made by the Parties hereto, the Parties hereby agree, effective as the last date of execution below (the "Effective Date" of this Agreement) unless otherwise stated, as follows:

Section 1. Definitions

Agency: means the Islip Resource Recovery Agency.

Affiliate: means any partnership, corporation or other entity which controls, is controlled by, or is under common control with Lessee or Lessee's parent.

American Arbitration Association: means the organization selected to administer arbitration between the Parties regarding Restoration Cost estimates.

Approved Site Plan: is the site plan depicting the Improvements' location on the Premises and the specifications, to be constructed and installed by Lessee, all according to the requirements cited in Section 7.01.

Benefits: shall have the meaning set forth in Section 16.01.

Business Day: means any day except a Saturday, a Sunday, or any day in which commercial banks are required or authorized to close in New York.

Calendar Quarter: means each three month period during the Calendar Year, i.e., January 1-March 31, April 1-June 30, July 1-September 30, and October 1-December 31.

Calendar Year: means January 1 through December 31.

Change in Law means:

(a) (i) a change after the Effective Date in any federal, state, county, town or other local law, ordinance, code, rule, regulation or other legislation, or in the interpretation thereof; or (ii) the imposition of any material conditions on the issuance or renewal of any official permit, license or approval after the Contract Date, which in the case of either (i) or (ii), establishes requirements which make the operating, maintenance or capital costs of the Renewable Energy System more, or less, burdensome than those on the Effective Date;

(b) the order or judgment, after the Effective Date, of a federal, state or local court, administrative agency or governmental body having jurisdiction over the Renewable Energy System or the Landfill, if it is not also the result of the willful or negligent action or inaction of the party relying thereon; provided, however, that neither the contesting in good faith of any such order or judgment, nor the failure so to contest shall constitute or be construed as a willful or negligent action or inaction of such party; or

(c) the suspension, termination, interruption, denial or failure of renewal, after the Commencement Date, by any administrative agency or governmental body of any permit, license, consent, authorization or approval essential to the operation of the Renewable Energy System or the Landfill, except any license for the technology required to operate the Renewable Energy System; provided, however, that such acts or events shall not be the result of the willful or negligent action or inaction of the party relying thereon and that neither the contesting in good faith of any such suspension, termination, interruption, denial or failure of renewal, nor the failure to so contest shall constitute or be construed as a willful or negligent action or inaction of such party.

Change in Law shall not include the following:

(a) a change in the nature or severity of the actions typically taken by a governmental authority to enforce compliance with any federal, state, county, town or other local law, ordinance, code, rule, regulation or other legislation in effect on the Effective Date; or

(b) acts, events and circumstances with respect to permitting risk to the extent associated with a decision to undertake further development of the Renewable Energy System or the Landfill, or modify the existing Renewable Energy System or Landfill.

Closure Obligations: shall mean any and all activities and obligations undertaken by the Agency as required by Laws, consent agreement or other obligation relating to the operation, maintenance or environmental remediation of the properties as operating landfills, closed landfills or active or inactive hazardous or non-hazardous waste disposal sites, or required pursuant to any applicable law or regulation of the New York State Department of Environmental Conservation, United States Environmental Protection Agency, or any other governmental agency having jurisdiction over the Property, including any modification to the closure plan and post-closure care manual to be obtained by Lessee.

Commencement Date: means the date on which Lessee has received the fully executed "Contract for the Purchase and Sale of Renewable Energy, Renewable Energy Certificates and Capacity" with the Long Island Lighting Co. dba LIPA ("LIPA"), and all permits and approvals necessary for the uses permitted under Section 2.02(b) (regarding the Renewable Energy System). Promptly after the Commencement Date, Agency and Lessee shall execute a written confirmation of the Commencement Date in the form provided by Agency. Lessee shall notify Agency of the LIPA agreement effective date promptly after receiving the agreement. In the event the Commencement Date does not occur on or before one (1) year after the effective date of the LIPA agreement, or in the event LIPA fails to approve of the transaction contemplated herein upon terms and conditions reasonably satisfactory to Lessee, Lessee shall have the right to terminate this Agreement upon ten (10) days written notice to Agency and thereafter, this Agreement shall be terminated. Except for those obligations herein which are intended to survive the termination of this Agreement, neither party shall have any obligations to the other party after such termination.

Condemnor: means an entity which has authority to take private property.

County: means the County of Suffolk, New York.

Day: means a period of twenty-four (24) consecutive hours beginning at 00:00 hours EPT on any calendar Day and ending at 24:00 hours EPT on the same calendar Day.

Easements: mean those areas defined pursuant to Section 7.08.

Effective Date: means the last date of execution of this Agreement.

Environmental Attributes: mean any and all current or future credits, benefits, emissions reductions, environmental air quality credits, emissions reduction credits, renewable energy credits, offsets and allowances, attributable to the Renewable Energy System, or otherwise attributable to the generation, purchase, sale or sue of energy from or by the Renewable Energy System, however entitled or named, resulting from the avoidance, reduction, displacement or offset of the emission of any gas, chemical or other substance, including any of the same arising out of legislation or regulation concerned with oxides of nitrogen, sulfur or carbon, with particulate matter, soot or mercury. Convention on Climate Change (UNFCCC) or the Kyoto Protocol to the UNFCCC or crediting "early action" emissions reduction, or Laws or regulations involving or administered by the Clean Air Markets Division of the Environmental Protection Agency (or successor agency), or any state or federal entity given jurisdiction over a program involving transferability of Environmental Attributes, and any Green Tag Reporting rights to such Environmental Attributes.

Expiration Date: shall have the meaning set forth at Section 4.

Force Majeure: means any act or event that delays or prevents a Party from timely performing all or a portion of its obligations under this Agreement or from complying with all or a portion of the conditions under this Agreement if such act or event, despite the exercise of reasonable efforts, cannot be avoided by and is beyond the reasonable control of and without the fault or negligence of the Party relying thereon as justification for such delay, nonperformance, or noncompliance and may include without limitation: an act of God or the elements such as heavy rains, lightning, hurricanes, tornadoes, or ice storms; explosion; fire; volcanic eruption; flood; epidemic; landslide; mudslide; sabotage; terrorism; earthquake; or other cataclysmic events; an act of public enemy; war; blockade; civil insurrection; riot; civil disturbance; full or partial reduction in the electric output of the Renewable Energy System caused by systematic weather patterns that alter irradiation rates; Renewable Energy System emergencies; the inability of any warranty provider for the Renewable Energy System to fulfill its warranty due to bankruptcy or other end of going concern event; or any restraint or restriction imposed by applicable Law or any directive from a Governmental Authority, (including the failure to grant or the repeal, rescinding, non-renewal or the like of any permit or Law, to the extent the affected Party exercised diligent and reasonable efforts to obtain or maintain such permit or the applicability of such Law). It is expressly understood and agreed that the following shall not constitute Force Majeure Events:

(a) any Change in Law with respect to federal, state or local income taxes or sales taxes of any kind, or with respect to new federal, state or local taxes enacted to replace the foregoing;

(b) any Change in Law with respect to taxes, special assessments or special ad valorem levies of any kind (for purposes of this exclusion, the terms "tax," "special assessment" and "special ad valorem levy" are defined in Section 102 of New York Real Property Tax Law);

(c) adverse changes in the financial ability of any party to this Agreement to perform its obligations hereunder;

(d) the consequences of errors of design, construction, start-up, operation or maintenance on the part of the Lessee, or any of Lessee's employees, agents, contractors, subcontractors, suppliers or affiliates;

(e) the failure of the Lessee to secure or maintain patents or licenses in connection with the technology necessary to design, operate or maintain the Renewable Energy System, except to the extent such failure is caused by the acts or events first described as "Force Majeure" events, above;

(f) the failure of any supplier to deliver to the Lessee, any necessary materials, equipment or parts for the operation of the Renewable Energy System, provided that alternate suppliers shall be available to deliver any such materials, equipment or parts reasonably consistent with the specifications and schedule, except to the extent such failure is caused by the acts or events first described as "Force Majeure" events, above;

(g) the lack of fitness for use, or the failure to comply with specifications or design of any materials, equipment or parts constituting part of the Renewable Energy System, provided that such lack or failure shall not have been the result of the occurrence of a Change in Law;

(h) any commercial or economic frustration of purpose, or impracticability of technology to perform, except to the extent such failure is caused by the acts or events first described as "Force Majeure" events, above;

(i) the failure of the Lessee to obtain or maintain an electricity purchase agreement;

(j) any act, event or circumstance that would not have occurred if the affected party had complied with its obligations under this Agreement;

(k) changes, for any reason, in the price received by the Lessee for energy generated at the Renewable Energy System, the cost of the utility services purchased by the Lessee or the Agency, interest rates, inflation rates, wage rates, insurance costs, commodity prices, currency values, exchange rates and other general economic conditions;

(l) any legal proceeding brought against the Lessee and not the Agency, or against the Agency and not the Lessee, except to the extent any such legal proceeding constitutes a Change in Law hereunder;

(m) an increase or decrease in the number of employees employed by the Lessee or the Agency due to a strike or labor dispute;

(n) union or labor work rules, requirements or demands which have the effect of increasing or decreasing the cost to the Lessee or the Agency of performing under this Agreement except to the extent such increase or decrease results from a Change in Law;

(o) Change in Law occurring outside of the United States.

Governmental Authorities: means the Town, the County, State of New York, the Federal Government and/or any political subdivision, agency, department, commission, board, bureau or instrumentality of any of the foregoing, now existing or hereafter created, having jurisdiction over the Premises or any portion thereof, except not the Agency.

Green Tag Reporting Rights: mean the right of a purchaser of renewable energy to report ownership of accumulated "green tags" in compliance with and to the extent permitted by applicable Law and include, without limitation, rights under Section 1605(b) of the Energy Policy Act of 1992, and any present or future federal, State or local certification program or emissions trading program.

Hazardous Materials: includes, without limitation, any "hazardous substance", "hazardous material", "toxic substance" "solid waste" or similar term as defined in any applicable Law

pertaining in whole or part to the protection of the environment, natural resources or human health.

Improvements: means the Renewable Energy System and Transmission Facilities, collectively.

IDA: shall have the meaning in Section 16.01.

Incentive Programs: shall mean as set forth in Section 16.01.

Landfill: shall mean the landfill owned and operated by the Agency and located upon the Property, a portion of which is within the Premises.

Laws: mean all applicable laws, statutes, regulations, ordinances, directives, and requirements of all federal, State, County and Town departments, bureaus, boards, agencies, offices, commissions, and other subdivisions thereof, or of any other governmental, public or quasi-public authority, but not those of the Agency.

Lender: means any lender providing senior or subordinated construction, interim or long-term debt or equity financing or refinancing for or in connection with the development, construction, purchase, installation or operation of the Renewable Energy System, whether that financing or refinancing takes the form of private debt, public debt or any other form (including debt financing or refinancing provided to a member or other direct or indirect owner of Lessee), including any equity and tax investor directly or indirectly providing financing or refinancing for the Renewable Energy System or purchasing equity ownership interests of Lessee and/or its affiliates, and any trustee or agent acting on their behalf, and any Person providing interest rate protection agreements to hedge any of the foregoing obligations.

Monetary Default: shall have the meaning set forth at Section 26.03(1).

Non-Monetary Default: shall have the meaning set forth at Section 26.03.

Notice of Termination: shall have the meaning set forth at Section 26.04.

Nuisances: shall have the meaning set forth at Section 11.

Obligor: shall have the meaning set forth at Section 23.01.

Operations Date: means the date on which electricity is generated, delivered and sold (excluding startup and testing of the Renewable Energy System) from the Renewable Energy System or any portion thereof or used by Lessee.

Parties: means the Agency and Lessee, collectively.

Party: means either the Agency or Lessee.

Person: means any individual, trustee, corporation, general partnership, limited partnership, limited liability company, limited liability limited partnership, joint stock company, trust, unincorporated organization, bank, business association, firm, joint venture or Governmental Authority.

PILOT: means the payment in lieu of tax agreement dated a date to be determined by and between the Lessee and the IDA.

Premises: is a portion of the Property, and shall have the meaning set forth at Section 3.01, and as further described on Exhibit A.

Property: means Agency property which is the subject of this Agreement, described in Section 3.01.

Purchase Request: means as set forth in Section 15.01.

Quarterly Operating Payments: shall have the meaning set forth at Section 5.01.

Registered Lender: shall have the meaning set forth at Section 23.02(c).

Renewable Energy Estate: shall mean each and all of the assets of which the Renewable Energy System is comprised, including solar energy panels, mounting systems, tracking devices, inverters, integrators and other related equipment and components installed on the Premises, electric lines and conduits required to connect such equipment to the utility's distribution system, protective and associated equipment, improvements, metering devices, and other tangible and intangible assets, permits, property rights and contract rights reasonably necessary to construct, operate, and maintain the Renewable Energy System, but shall not include the landfill infrastructure, equipment, fixtures or property of the Agency.

Renewable Energy Incentives: means (i) any federal, State, or local tax credits associated with the construction, ownership, or production of electricity from the Renewable Energy System (including credits under Sections 38 and 45K of the Internal Revenue Code of 1986, as amended); (ii) any investment tax credits and any other tax credits associated with the Renewable Energy System (including credits under Sections 38 and 48 of the Internal Revenue Code of 1986, as amended); (iii) any State, federal or private cash payments or grants relating in any way to the Renewable Energy System or the output thereof; (iv) State, federal or private grants or other benefits related to the Renewable Energy System or the output thereof, and (v) any other form of incentive that is not an Environmental Attribute that is available with respect to the Renewable Energy System.

Renewable Energy System: shall have the meaning set forth at Section 2.02(b).

Resolution: means Resolution dated February 9, 2016, of the Agency Board.

Restoration: shall mean as set forth in Section 15.01.

Restoration Costs: shall mean as set forth in Section 15.04.

Solar Energy Facilities: means individual units or arrays of solar energy collection cells, panels, mirrors, lenses and related facilities necessary to harness sunlight for photovoltaic energy generation, including without limitation, existing and/or future technologies used or useful in connection with the generation of electricity from sunlight, and associated support structure, braces, wiring, plumbing, and related equipment.

Term: shall have the meaning set forth at Section 4.01.

Termination Date: means the date specified in the Notice of Termination upon which the Agreement shall expire in the event Lessee fails to cure a Default.

Town: means the Town of Islip, N.Y.

Transmission Facilities: means any of the following improvements on the Property: underground and/or overhead distribution, collection and transmission underground and/or overhead control, communications and radio relay systems and telecommunications equipment; energy storage facilities; interconnection and/or switching facilities, circuit breakers, transformers; cables, wires, fiber, conduit, footings, foundations, towers, poles, crossarms, guy lines and anchors, and any related or associated improvements, fixtures, facilities, appliances, machinery and equipment.

Section 2. Lease; Purpose

Section 2.01 The Parties hereto acknowledge that the Agency is a public benefit corporation and is entering into and executing this Agreement by virtue of the authority of the Agency Board Resolution for the use, purpose and intent expressed in the Resolution, that the Resolution is incorporated herein by reference, and further that Lessee has examined the Resolution and is fully aware of the intended purpose thereof.

Section 2.02 In accordance with applicable Laws, the Agency hereby leases to Lessee for the Term, the Premises for the following purposes:

(a) Conducting studies of solar energy, soils and other meteorological and geotechnical data;

(b) Constructing, reconstructing, erecting, installing, improving, replacing, relocating and removing from time to time, and maintaining, using, monitoring and operating, existing, additional or new (i) Solar Energy Facilities, (ii) electrical transmission and distribution facilities, including without limitation, overhead and underground transmission, distribution or collector lines, circuit breakers, meters, conduit, footings, towers, poles, crossarms, guy lines, anchors, cabling and wires, (iii) overhead and underground control, communications and radio relay systems, (iv) substations, interconnection and/or switching facilities and electric transformers and transformer pads, (v) energy storage facilities, (vi) meteorological towers and solar energy measurement equipment, (vii) control buildings, control boxes and computer monitoring hardware, (viii) utility installation, (ix) safety protection facilities, (x) maintenance yards, (xi) roads and erosion control facilities, (xii) signs and fences, and (xiii) other improvements, fixtures, facilities, machinery and equipment associated or connected with the generation, conversion, storage, switching, metering, step-up, step-down, transmission, distribution, conducting, wheeling, sale or other use or conveyance of electricity (all of the foregoing, including the Renewable Energy System, collectively the Solar Energy Facilities); other improvements, fixtures, facilities, machinery and equipment associated or connected with the generation, conversion, storage, switching, metering, step-up, step-down, transmission, distribution, conducting, wheeling, sale or other use or conveyance of electricity (all of the foregoing, including the Solar Energy Facilities, all subject to any necessary permits required for such construction or other activity, provided that the Agency may prohibit any activity that may threaten or interfere with the implementation of any Closure Obligations of the Agency with respect to the subject Property (collectively a "Renewable Energy System");

(c) Removing, trimming, pruning, topping or otherwise controlling the growth of any tree, shrub, plant or other vegetation; dismantling, demolishing, and removing any improvement, structure, embankment, impediment, berm, wall, fence or other object, on or that intrudes (or upon maturity could intrude) into the Premises that could obstruct, interfere with or impair the Renewable Energy System or the use of the Premises intended by Lessee hereunder, the Parties acknowledging and agreeing that Lessee shall acquire necessary permits and provide notice to Agency prior to such activity, and further agreeing that the Agency may prohibit any activity that may threaten or interfere with the implementation of any Closure Obligations of the Agency with respect to the subject Property;

(d) Vehicular and pedestrian access, ingress and egress to, from and over the Property, for purposes permitted under this Agreement; or, for promotional or marketing purposes located on the Premises, which, without limiting the generality of the foregoing, shall entitle Lessee to use and improve any existing and future roads

and access routes from time to time located on or providing access to the Property, except such improvement shall comply with all Closure Obligations, and Lessee shall provide the Agency with not less than 5 days' notice of any paving, grading or other work involving the use of heavy equipment, or work that may impact the internal flow of traffic at the Landfill;

(e) After providing not less than five days' notice of proposed scope of work to Agency, extracting soil samples, perform geotechnical tests, and conduct such other tests, studies, inspections and analysis of or on the Premises as Lessee deems necessary, useful or appropriate, provided that that the Agency may prohibit any activity that may threaten or interfere with the implementation of any Closure Obligations of the Agency with respect to the subject Property; and

(f) After providing not less than five days' notice of proposed scope of work to Agency, undertaking any other lawful activities directly related to the purposes of this Agreement, whether accomplished by Lessee or a third party authorized by Lessee, that Lessee determines are necessary, helpful, appropriate or convenient in connection with, incidental to or to accomplish any of the foregoing purposes.

Section 2.03 Without limiting the provisions of Section 2.02, the Agency acknowledges and agrees that the activities contemplated by this Agreement may be accomplished by Lessee or one or more third parties authorized by Lessee, subject to (i) any such third party/subcontractor agreeing to the relevant terms and conditions set forth in this Agreement, and (ii) such third party/subcontractor shall not be debarred from public work by the New York State Department of Labor or other agency of competent jurisdiction. Lessee shall give prior notice to Agency of the identity of all third parties authorized to enter the Premises by Lessee.

Section 2.04 Notwithstanding Lessee's right to use the Premises under the terms of this Agreement, the Agency, its agents, employees, professional engineers, consultants and contractors retains its rights to enter upon the Premises at any time, to inspect the Landfill and related infrastructure or areas, and to repair erosion, gas collection vents/wells, Landfill cap and cover, and related activities solely to fulfill any Closure Obligations of the Agency with respect to the subject Property, which entry shall not interfere with or be inconsistent with Lessee's use. Agency shall make reasonable efforts to provide prior notice to Lessee of its entry made under this Section 2.04.

Section 2.05. Notwithstanding Lessee's right to enter and use the Premises under Section 2.02, Lessee may begin construction of the Solar Energy Facilities on the Premises only after it provides to the Agency commercially reasonable evidence of full construction financing for the Solar Energy Facilities, which evidence may be a letter of commitment from the lender, or similar documentation.

Section 3. Property Description

Section 3.01 The Property is that real property identified as County Tax Map Numbers 0500-016.00-02.00-003.100 and 0500-016.00-02.00-004.000, located at 440 Blydenburgh Road, Hauppauge, NY 11751, and the "Premises" is a portion of the Property, more specifically identified as the "Lease Parcel" on the survey attached hereto as "Exhibit A-1", together with all buildings, structures, improvements, additions, and permanent installations constructed and installed or to be constructed and installed therein, thereon, or there under during the term of this Agreement.

Section 3.02 Lessee accepts the Premises without any representation or warranty by the Agency as to the use or occupancy which may be made thereof under any existing or future law, rule, regulation, or ordinance and Agency shall not be liable for any latent or patent defect thereon, other than those Agency representations, warranties, and liabilities stated in Section 17.01 (regarding Hazardous Materials, and the Landfill). Lessee will not do, or permit to be done, any action or thing which is contrary to any legal or insurable requirement. Lessee expressly acknowledges the nature and history of the Property as a landfill used for the purpose of disposal of solid wastes, and has inspected the Property and reviewed its regulatory history in the files of the New York State Department of Environmental Conservation and makes this agreement in full knowledge thereof.

Section 4. Term The term of this Agreement ("Term") shall begin on the Commencement Date and shall remain in effect until the later to occur of a) the twenty-first (21st) anniversary of the Operations Date, or (b) the date which is three (3) months following the expiration of Lessee's power purchase agreement with LIPA (either termination the "Expiration Date") subject to earlier termination as set forth hereinafter; provided, however, that if such date does not fall on a Business Day then this Agreement shall end on the next Business Day. Two additional five (5) year extensions may be exercised upon the mutual consent of all parties subject to the respective Board approvals.

Section 5. Payments to Agency

Section 5.01 Commencing with the Operations Date, Lessee shall make quarterly payments to the Agency (the "Quarterly Operating Payments"). A schedule setting forth the amount of the Quarterly Operating Payments shall be agreed upon, in writing, prior to the issuance of the building permit ("Quarterly Operating Payment Estimate") attached hereto as Exhibit B and incorporated herein by this reference. The parties acknowledge and agree that the Quarterly Operating Payments Estimate is based upon an estimate of the size of the Renewable Energy System which, once completed, may be smaller or larger than the estimated size as set forth in Exhibit B. Once the size of the Renewable Energy System is determined, and prior to the issuance of the building permit, the parties shall execute an amendment to this Agreement to specify the

Quarterly Operating Payments payable by Lessee under this Agreement. Quarterly Operating Payments shall be paid in arrears sixty (60) Days after the end of each Calendar Quarter during the Term unless such Day falls on a weekend or holiday in which case it shall be due on the next business Day. If the Operations Date is not the first Day of a Calendar Quarter, the Quarterly Operating Payment for the portion of the first Calendar Quarter shall be prorated on a per diem basis. The Agency agrees to waive any Quarterly Operating Payments due for the final three (3) month period of said Term during which the Lessee is decommissioning the Renewable Energy System.

Section 5.02 If applicable, Lessee shall make a one-time payment to the Agency, in an amount mutually agreed to, in writing, which amount shall in no event exceed actual expenses incurred by the Agency for the installation/relocation of security cameras, which in the opinion of the Agency is necessary to accommodate installation of the Renewable Energy System while at the same time maintaining the Agency's and public's continued safe use of the Agency's premises.

Section 5.03 Nothing contained in the foregoing shall affect the survival of the obligation of Lessee as set forth in the Sections of this Agreement covering the survival of Lessee's obligations.

Section 5.04 Lessee shall pay all Quarterly Operating Payments without set-off, abatement, deductions, defense or claims, except as specifically set forth herein, to the Agency at the Agency's address set forth herein or at such other place as the Agency may designate in writing in lawful currency of the United States of America. All remittances shall be made payable to "Islip Resource Recovery Agency."

Section 6. Late Charges

Section 6.01 If Lessee should fail to pay any amount required to be paid by Lessee under this Agreement within fifteen (15) Days of the due date for such payment to the Agency, including without limitation, any payment of fees or any payment of utility or other charges, or if any such amount is found to be due as the result of an audit, then, in such event, the Agency may impose (by statement, bill or otherwise) a late charge with respect to each such unpaid amount, in the amount of 1% of any part of the invoiced amount which has become past due for each thirty (30) Day period the subject payment is late. Such penalty shall accrue on the unpaid balance until said unpaid balance is liquidated.

Section 6.02 Each late charge shall be payable immediately upon demand made at any time therefore by the Agency. No acceptance by the Agency of payment of any unpaid amount or of any unpaid late charge amount shall be deemed a waiver of the right of the Agency of payment of any late charge or late charges payable under the provisions of this Section with respect to such unpaid amount. Each late charge shall be and become additional fees, recoverable by the Agency in the same manner and with like remedies as if it were originally a part of the fees payable

hereunder. Nothing in this Section is intended to, or shall be deemed to, affect, alter, modify or diminish in any way (i) any rights of the Agency under this Agreement, including without limitation the Agency's rights set forth in Section 26 of this Agreement (regarding Default and remedies) or (ii) any obligations of Lessee under this Agreement. In the event that any late charge imposed pursuant to this Section shall exceed a legal maximum, such late charge payable under this Agreement shall be payable instead at such legal maximum.

Section 7. Lessee's and Agency's Duties and Obligations; Easements; Taxes

Section 7.01 Lessee hereby agrees to design, construct and install the Improvements in accordance with this Agreement and applicable Laws, including but not limited to compliance with applicable building codes and site plan review, and NYSDEC approvals, where applicable. Lessee shall comply with Agency rules of general applicability regarding the Premises, of which it has notice. Lessee shall commence necessary submissions to obtain the permits and approvals in accordance with applicable Laws promptly following the Execution Date. The site plan attached hereto as Exhibit C describes Lessee's estimate of the final Approved Site Plan as of the Execution Date. Promptly following obtaining a final Approved Site Plan, Lessee shall provide that final Approved Site Plan to Agency and that final plan shall be the final Exhibit C and incorporated herein by this reference. An "Amended Approved Site Plan" may be substituted as Exhibit C upon mutual agreement of the parties. Notwithstanding the foregoing, the parties agree that solar energy technologies are improving at a rapid rate and that it is possible that Lessee may (although Lessee shall not be required to) replace from time to time existing Solar Energy Facilities on the Premises with newer models or design Solar Energy Facilities which have increased energy capture and efficiency, such replacement to be performed in accordance with the provisions of this Agreement.

Section 7.02 Lessee agrees to be solely responsible for any plans and specifications used by it and for any loss or damages resulting from the use thereof. Notwithstanding any rights the Agency may have reserved to itself hereunder, the Agency shall have no liabilities or obligations of any kind to any contractors engaged by Lessee or for any other matter in connection therewith and Lessee hereby releases and discharges the Town, the Agency, and their respective officers, representatives, and employees acting in their official capacity, of and from any and all liability, claims for damages, or losses of any kind, whether legal or equitable, including reasonable attorney's fees and other professional fees, or from any action or cause of action arising or alleged to arise out of or in connection with the performance of any of the construction associated with the Improvements pursuant to the contracts between Lessee and its contractors.

Section 7.03 Lessee agrees to provide a construction schedule to the Agency no less than thirty (30) days prior to the commencement of construction, which schedule shall minimize disruption to Agency's use of the Landfill during construction pursuant to Section 2.04.

Section 7.04 During the term of this Agreement, Lessee, its authorized representatives, contractors/subcontractors shall have the right at their own cost, expense, liability and risk, of access to the Property at all times, for the purposes set forth in this Agreement. Lessee shall use due care at all times that Lessee, its authorized representatives, contractors and/or subcontractors are on Agency Property and shall perform all work in connection with the construction, installation, maintenance or repair of the Improvements in a safe manner.

Section 7.05 Lessee shall use its commercially reasonable efforts to avoid interfering with the Agency's use of the Property described under Section 2.04, if any, where such use involves performance of the Agency's Closure Obligations. Lessee shall at all times cooperate with the Agency to allow the performance of Closure Obligations in a timely manner, and as required by Laws. If activities permitted under this Agreement may impact the Agency's Closure Obligations, Lessee shall obtain Agency's prior, written consent for those activities, not to be unreasonably conditioned, withheld or delayed. Lessee shall clean up and remove all debris and materials generated pursuant to its construction and installation on the Property at Lessee's sole cost, expense, liability, and risk.

Section 7.06 Lessee shall provide, at Lessee's sole cost and expense, all security measures reasonably necessary, in Lessee's opinion, subject to the Agency's prior written approval, such approval not to be unreasonably withheld, conditioned or delayed, for the Premises, including, warning signs, fencing, and other measures appropriate and reasonable to or destruction of Lessee's Improvements or injury or damage to persons or property on the Premises.

Section 7.07 Nothing contained herein shall create or be deemed to create any relationship between the Agency and any such contractor, architect, supplier, subcontractor, or any other person engaged by Lessee or any of its contractors in the performance of any part of the duties or obligations under this Agreement.

Section 7.08 Agency hereby grants the following easements on the Property for the Term, for the following purposes (each an "Easement", and collectively the "Easements"):

(a) to Lessee:

i. Access: the non-exclusive right of ingress to and egress from the Improvements over, under, and along the Property by means of any existing roads and lanes thereon, and by such other, mutually agreed upon route or routes as Lessee may construct on the Property from time to time, subject to the Agency's prior, written approval, which shall not be unreasonably withheld, conditioned or delayed, for the benefit of and for purposes incidental to Lessee's operation and maintenance in connection with the Improvements;

ii. Interconnection: an exclusive right to construct, operate, maintain, reconstruct, relocate, remove, and/or repair the electric utility service infrastructure and associated wires, lines and poles and other infrastructure necessary and convenient to interconnect the Renewable Energy System to the utility's electrical distribution system, the location of which will be determined by the utility prior to the commencement of construction; and

(b) To Long Island Lighting Co. dba LIPA: an easement for interconnection, in substantially the form as attached hereto as Exhibit H.

Lessee shall provide a plan to Agency showing Lessee's estimate of the Easements locations, and before commencing construction, Lessee shall provide a survey showing each easement location on the Property, and such survey shall then define the Easements locations on the Property.

If necessary, Agency shall executed documents reasonably necessary to give effect to the grant in this Section 7.08.

Section 7.09 The Agency shall not grant any rights in the Property purporting to permit others to conduct operations on the Property in derogation of Lessee's right to conduct operations on the Property in connection with the uses permitted under this Agreement.

Section 7.10 Lessee shall pay any personal property taxes, special assessments or amounts due under a PILOT agreement that may be levied or assessed on the Improvements (or any taxes that are directly attributable to the Improvements). Lessee shall also pay for any increase in the ad valorem property taxes levied against the Property that are assessed for the period from and after the Effective Date until the end of the Term hereof to the extent such increase is caused solely by the Renewable Energy System; provided, however, such obligation shall not include any recaptured taxes attributable to any period prior to the Effective Date or any interest or penalties thereon or to any increases in taxes due to reassessment upon a transfer of the fee interest in the Property by the Agency, and Lessee shall have the right, at its own expense, to appeal or contest any such taxes or increases thereto and to compromise and settle the same and Agency shall execute such petitions and agreements and otherwise cooperate with Lessee to the extent reasonably necessary for Lessee to do so.

Lessee and the Town intend to enter into a PILOT agreement addressing property taxes due to the Town related to the lease under this Agreement and the Improvements. To the extent permitted by law, Agency shall not impose additional property taxes or other assessments on the Improvements or on Lessee's leasehold due to the lease.

Section 7.11 Lessee shall not do or permit to be done anything which may interfere with the

effectiveness or accessibility of the utility, mechanical, electrical, drainage and sewer systems, and other systems installed or located on the Property, including any and all structures, systems and equipment installed in compliance with the Agency's Closure Obligations, without prior Agency written approval.

Section 7.12 To the extent the same exist, the Agency will provide Lessee with drawings, standard roadway and curbing details, and other information regarding existing site layouts and underground utilities. Lessee bears full responsibility for ensuring all underground utilities are identified prior to excavation and will be wholly liable for any damage to any utilities.

Section 7.13 Agency understands that the point of connection to LIPA's utility system shall be located on the Property. Lessee agrees that it shall provide the Transmission Facilities' location to Agency prior to the Operations Date.

Section 7.14 Lessee shall maintain and promptly repair the Premises to keep same in good repair and condition, regardless of fault, except in the event of negligence or willful misconduct by the Agency, and in accordance with general industry practice in the operation of such Renewable Energy System, at Lessee's sole cost and expense.

Section 7.15 Lessee warrants and represents that any exterior lighting installed as part of Lessee's Installation shall be in compliance with the Town's dark skies initiatives, policies, requirements and regulations. In the event existing lighting located on the Property needs to be altered as part of Lessee's Installation, Lessee agrees to provide, at its sole cost and expense, alternate lighting satisfactory to the Agency.

Section 7.16 Lessee shall not tie into, or in any manner use or otherwise access utility services to the Property in a manner which increases costs currently billed to the Agency.

Section 7.17 Lessee acknowledges and agrees that at its sole cost and expense, it will obtain and comply with all Governmental Authority requirements, including pre-construction permits and approvals, if any, for the construction and use of the Improvements.

Section 7.18 Lessee acknowledges and agrees to comply with the prevailing wage requirements in connection with the construction of the Improvements. No person performing, aiding in, or assisting in Lessee's construction of the Improvements shall be paid less than the said prevailing rates as defined and utilized under Section 220 of the Labor Law. The wages to be paid shall not be less than the prevailing rate of wages and supplements as set forth by law.

(a) Lessee, its contractors, and subcontractors shall file transcripts of original payrolls for the construction of the Improvements under this Agreement, in connection with the construction and preparation of the entire Premises, with the Department, within ten (10) Days after its first payroll, and every thirty Days

thereafter, said payroll transcripts to be subscribed and affirmed as true under penalty of perjury.

(b) Lessee, its contractors and subcontractors, shall keep their books open for inspection by representatives of the Agency and/or its representatives, on a monthly basis during the construction of the Improvements, to ensure that Lessee, its contractors and subcontractors are in compliance with these terms and conditions, provided that twenty-four (24) hour-notice is given to Lessee, its contractors and/or subcontractors prior to the inspection.

(c) Lessee agrees that it shall include clauses in all of its agreements with its contractors and subcontractors for the construction of the Improvements stating that: (i) said contractors and subcontractors shall pay prevailing wages, as agreed to in this Agreement; (ii) said contractors and subcontractors shall file transcripts of original payrolls for all work performed in connection with the construction and preparation of the Improvements under this Agreement with the Department within ten (10) Days after its first payroll, and every thirty Days thereafter, said transcripts to be subscribed and affirmed as true under penalty of perjury and (iii) Lessee, its contractors, and subcontractors shall keep their books open for inspection by representatives of the Agency and/or its representatives, including the Law Department, on a monthly basis during the construction of the Improvements to ensure that Lessee, its contractors and subcontractors are in compliance with these terms and conditions.

Section 8. Other Construction by Lessee. Except as otherwise expressly provided herein, Lessee shall not erect any structures, make any improvements, or do any other work on the Property, or install any fixtures other than as set forth in the Approved Site Plan, in an Amended Approved Site Plan, and in Section 7.01 without the prior written approval of the Agency, which approval shall be limited solely to issues impacting its Closure Obligations. In the event any construction, improvement, alteration, modification, addition, repair, or replacement is made without such approval, then upon reasonable notice to do so, Lessee shall remove the same or, at the option of the Agency, cause the same to be changed to the satisfaction of the Agency. Lessee agrees to comply with all reasonable requests for special inspections by the Agency during construction including, but not limited to, concrete testing, and electrical inspections.

Section 9. Requirements of Governmental Agencies

Section 9.01 Lessee will proceed with due diligence to construct and install the Renewable Energy System and shall comply in all material respects with Laws, in force as of the Commencement Date, and all requirements, obligations and conditions of all instruments of record which may be applicable to the Premises. All work of Lessee and its subcontractors which impacts Agency's Closure Obligations will be coordinated with the Agency. Lessee reserves the right, in its sole discretion and at its sole expense, to contest the validity or applicability of any Laws.

Section 9.02 Lessee understands that the Town of Islip is the authority having jurisdiction with respect to Building Permits relating to construction on Agency property. Lessee agrees to secure, maintain and comply with all provisions of the Town Building Permit for the Improvement including compliance and cooperation with Town inspections by its Building Department during construction of the Renewable Energy System.

Section 10. Liens. Lessee shall keep the Agency's interest in the Property free and clear of all liens and claims of liens for labor and services performed on, and materials, supplies and equipment furnished in connection with Lessee's use of the Premises under this Agreement. In the event it is permissible for any mechanics' or other liens to be filed against any portion of the Property by reason of Lessee's acts or omissions or because of a claim against Lessee, Lessee shall cause the same to be cancelled or discharged of record by bond or otherwise within ninety (90) Days after notice from the Agency of the filing thereof. Lessee shall indemnify and save the Agency harmless from and against all costs, liabilities, suits, penalties, claims and demands, including reasonable attorneys' fees, resulting therefrom. Nothing herein contained shall be construed to limit the right of Lessee to contest any claim of a contractor, subcontractor, tradespersons, workman, or other person, and no such claim shall be considered to be an obligation of Lessee within the meaning of this Section unless and until the same shall have been finally adjudicated. If Lessee shall fail to cancel or discharge said lien or liens within said 90-Day period, Agency may cancel or discharge the same and upon Agency's demand, Lessee shall reimburse the Agency for the costs or expenses thereof, within sixty (60) days after receipt of an invoice therefore. Nothing contained in this Agreement shall be deemed or construed in any way as constituting the consent or request of the Agency, express or implied, by inference or otherwise, to any contractor, subcontractor, laborer or materialman for the performance of any labor or the furnishing of any materials for any specific improvement, alteration to or repair of the Property or any part thereof, nor as giving Lessee any right, power or authority to contract for or permit the rendering of such services of the furnishing of any materials that would give rise to the filing of any lien against the Property or any part thereof .

Section 11. Waiver of Nuisance. The Agency has been informed by Lessee and understands that the presence and operation of the Improvements on the Property may potentially result in some nuisance to the Agency, such as visual impact ("Nuisances"). It is the intent of the parties hereto that these Nuisances shall be held to a commercially reasonable minimum. To this end Lessee shall take all possible care, caution and precaution and shall use its commercially reasonable efforts to minimize Nuisances.

Section 12. Temporary Storage

Section 12.01 The Agency will use commercially reasonable efforts to provide sufficient space on the Property, if needed, for the temporary storage and staging of tools, materials and equipment

and for the parking of construction crew vehicles and temporary construction trailers and facilities reasonably necessary during the installation of the Renewable Energy System. The Agency will also provide Lessee a reasonable area on the Property, if needed, for construction type lay-down and staging. The Agency and Lessee will coordinate and cooperate in determining the amount of space required for such purposes.

Section 12.02 The Agency will use commercially reasonable efforts to provide sufficient space adjacent to the Premises, if needed, for the temporary storage and staging of tools, materials and equipment during any maintenance of the Renewable Energy System. The Agency and Lessee will coordinate and cooperate in determining the amount of space required for such purposes.

Section 13. Insurance

Section 13.01 Lessee shall procure and continuously maintain, without interruption, during the Term, insurance, naming the Agency as an additional insured, in amounts not less than as follows:

(i) Commercial General Liability, in an amount not less than One Million Dollars $1,000,000.00) per occurrence, Two Million Dollars ($2,000,000) Aggregate, Two Million Dollars ($2,000,000) Products & Completed Operations, One Million Dollars ($1,000,000) Personal and Advertising Injury. The Town of Islip and the Agency must be listed as an additional insured by using endorsement CG 20 10 11 85 or equivalent, and such coverage shall be primary and non-contributory. Coverage to include a Per Project Aggregate, Blanket Contractual Coverage, & Broad Form Property Damage, Coverage cannot contain any exclusion for (your) Subcontractors or Sub-Contractors. Certificates of Insurance must describe the specific services and sites of the work.

If the contractor is performing any Asbestos or Lead abatement, site cleanup, or any work involving know or potentially contaminated material, the policy must include coverage for any pollution related events including third part liability claims for bodily injury, property damage and clean-up costs resulting from removal, replacement enclosure, encapsulation and/ or disposal of the hazardous material. Limits must be $2,000,000 per occurrence/$2,000,000 Products and Completed Operations Aggregate.

(ii) Automobile Liability Insurance (if any vehicles are used by Lessee in the performance of the Ground Lease) for Owned, Leased, and Non-Owned & Hired Vehicles in an amount not less than One Million Dollars ($1,00,000.00) combined single limit for bodily injury and property damage. If the contractor is removing/transporting hazardous waste (asbestos, Lead or other hazardous materials), the Automobile policy shall provide pollution liability broadened coverage (ISOCA 9948 or equivalent) as well as proof of MCS 90.

(iii) Workers' Compensation and Employer's Liability insurance in compliance with all applicable New York State laws and regulations and Disability Benefits insurance, if

required by law. Lessee shall furnish to the Agency, prior to its execution of this Agreement, the documentation required by the State of New York Workers' Compensation Board of coverage or exemption from coverage pursuant to §§ 57 and 220 of the Workers' Compensation Law. In accordance with General Municipal Law §108, this Agreement shall be void and of no effect unless Lessee shall provide and maintain coverage during the Term for the benefit of such employees as are required to be covered by the provisions of the Workers' Compensation Law;

(iv) Builders Risk Insurance "All Risk" coverage in an amount equal to the total value of the Improvements which shall be obtained prior to commencement of construction of the Improvements and shall remain in effect until a permanent Certificate of Occupancy is obtained therefore. Such coverage shall include vandalism and malicious mischief, in broad form covering improvements in place and all material and equipment at the job site furnished under contract, but excluding contractor's, subcontractor's, and construction manager's equipment and property owned by contractor's or subcontractor's employees.

(v) Umbrella Liability coverage in excess of Commercial General Liability, Automobile Liability and Employers Liability at a limit of not less than Five Million Dollars ($5,000,000.

(v) Mandatory Insurance – All insurance required by any Requirements. With respect to insurance requirements during construction of the Improvements, Lessee may provide such insurance by requiring each contractor engaged by it for the construction to procure and maintain such insurance including such contractual liability endorsement, said insurance not to contain any care, custody or control exclusions, any exclusions for explosions, collapses, or damage to, bodily injury to, or sickness, disease, or death of any employee of Lessee or of any of its contractors which would conflict with or in any way impair coverage under the contractual liability endorsement. There shall be no self insurance retention aspects to such insurance unless agreed to in writing by the Agency.

Section 13.02 All policies of insurance described in this Section 13 shall:

(a) Be written as primary policies not contributing with and not in excess of coverage that Agency may carry;

(b) The Contractor shall furnish to the Agency Declaration Pages for each such policy of insurance and upon request, a true and certified original copy of each such policy, evidencing compliance with the aforesaid insurance requirements. In the case of commercial general liability insurance, the Agency shall be named as an additional insured and the Contractor shall furnish a Declaration Page and

endorsement page evidencing the Agency's status as an additional insured on said policy;

(c) Expressly provide that Agency shall have no liability for premiums;

(d) Shall be issued by insurance companies with an A.M. Best rating of A-or better and are licensed to do business in the State of New York; and

(e) All such Declaration Pages, certificates and other evidence of insurance shall provide for the Agency to be notified in writing thirty (30) days prior to any cancellation, nonrenewal or material change in said policies. Such Declaration Pages, certificates, policies and other evidence of insurance and notices shall be mailed to the Agency at its address as set forth in this Agreement or at such other address of which the Agency shall have given the Contractor notice in writing.

Section 13.03 In addition to the obligations set forth in this Section 13, and all other insurance required under this Agreement, the policy or policies of insurance shall also provide or contain an endorsement providing that the protections afforded Lessee there under with respect to any claim or action against Lessee by a third person shall pertain and apply with like effect with respect to any claim or action against Lessee by the Agency, but such endorsement shall not limit, vary, change, or affect the protections afforded the Agency there under as an additional insured. In addition, all the aforesaid policy or policies of insurance shall also provide or contain an endorsement providing that the protections afforded the Agency there under with respect to any claim or action against the Agency by Lessee shall be the same as the protections afforded Lessee there under with respect to any claim or action against Lessee by a third person as if the Agency were the named insured thereunder.

Section 13.04 In the event Lessee shall fail to provide the Declaration Pages or certificates of insurance or to maintain any insurance required by this Agreement, the Agency may, but shall not be required to, obtain such policies and add the cost thereof to payments due Agency under this Agreement or any other agreement between the Agency and Lessee. However, no such steps will be taken without the Agency having provided thirty (30) day prior written notice to the Lessee of such intention.

Section 13.05 Each policy of insurance required by this Section 13 shall contain a provision that the insurer shall not, without obtaining express advance permission from the Agency, raise any defense involving in any way the jurisdiction of the court over the person of the Agency, the immunity of the Agency, its officers, agents or employees, the governmental nature of the Agency or the provisions of any statutes respecting suits against the Agency.

Section 13.06 Failure to maintain insurance in the amounts required herein and commercially available from insurers licensed to do business in the State of New York, shall constitute grounds to terminate this Agreement. However, no such steps will be taken without the Agency having

provided thirty (30) day prior written notice to the Lessee of such intention and notice to any Lender as required by Section 23.02.

Section 14. Indemnity

Section 14.01 Subject to Section 17 (regarding Hazardous Waste and the Landfill), Lessee shall protect, indemnify and hold harmless the Agency and the Town of Islip, their respective commissioners, officers, officials, employees, agents, and representatives, from and against all liabilities, fines, penalties, actions, damages, claims and demands, judgments, losses, costs, expenses, suits, or actions and reasonable attorney's fees, including, but not limited to, claims and demands for death or personal injuries, or for property damages, arising out of or in connection with Lessee's use of the Property under this Agreement, except for claims, liabilities and damages arising out of the Town's or the Agency's, or either the Town's or the Agency's officials, contractors', employees', agents', or representatives' sole negligence or willful misconduct or, arising out of the acts or omissions or negligence of Lessee, its officers, officials, employees, subcontractors, lessees, licensees, invitees or agents, if any, in connection with this Agreement.

Section 14.02 For any claim for which Lessee shall be required to indemnify the Agency, Lessee shall defend any such claim or demand with counsel of Lessee's selection (approved by the Agency) even if such suit, claim or demand is groundless, false or fraudulent, at its own expense, and in handling such it shall not, without obtaining express advance permission from the Agency, make any material decisions related to the defense of the claim on the Agency's behalf without obtaining express advance permission from the Agency's counsel. Lessee shall reimburse the Agency for any costs or expenses, including legal expenses, incurred by the Agency expressly related to such claim.

14.03 Lessee hereby represents and warrants the Lessee will not infringe upon any copyrighted work or material in accordance with the Federal Copyright Act during the term of this Agreement.

Section 14.04 Lessee waives all rights against the Town of Islip, the Agency and their agents, officers, directors and employees for recovery of damages to the extent damages are covered and payable by commercial general liability, commercial umbrella liability, business auto liability or workers compensation and employers liability insurance maintained per requirements stated above

Section 15. Removal and Restoration; Purchase Option

Section 15.01 Simultaneous with any Notice of Termination or, at least three (3) months prior to the expiration of the Term or any Term extension, if applicable, present to the Agency a decommissioning plan ("Decommissioning Plan") for the Improvements, subject to the approval of the Agency, which shall not be unreasonably conditioned, withheld or delayed. The

Decommissioning Plan shall include the removal of all physical material related to the Improvements (excluding any subsurface items, including buried electrical and communications lines except any underground structures, materials, or other appurtenances that are easily and quickly removed without significant excavations, or which create an impediment to future renovation and/or development of the Premises) and restoration of the Premises by restoring grades damaged in the removal of physical material, re-seeding grass, and re-installing lighting, reasonable wear and tear, condemnation, casualty damage and acts of God excepted (the Decommissioning Plan activities and restoration hereinafter referred to as "Restoration"). Lessee shall use commercially reasonable efforts to complete the Restoration within sixty (60) Days following the expiration or earlier termination of this Agreement. In the event Lessee shall abandon all or any part of the Improvements, Lessee shall be liable for any costs incurred by the Agency in removing and disposing of such Improvements in accordance with the provisions of this Section 15.01.

Section 15.02 Within twenty (20) business Days of receipt of the Decommissioning Plan, the Agency shall have the right to purchase all or any portion of the Improvements on the Premises (the "Purchase Request"). In the event the Agency does not submit a Purchase Request, the Agency shall review the Decommissioning Plan, and upon Agency approval thereof, Lessee shall proceed with the approved Decommissioning Plan. If the Agency does submit a Purchase Request, Lessee shall then have ten (10) business days to respond to such Purchase Request with its acceptance or rejection of such Purchase Request. Failure by the Lessee to respond to any Purchase Request shall be deemed to be an approval of such Purchase Request. Further, Lessee shall execute and deliver any required transfer documentation of Lessee's right, title and interest in and to the Improvements including title to any portion of the Improvements to be abandoned by Lessee following the expiration or earlier termination of the Agreement which shall be deemed to have vested in the Agency.

Section 15.03 To determine a value of the Improvements should Agency purchase the Improvements pursuant to Section 15.02, Lessee shall obtain a valuation from a qualified appraiser licensed in New York State notify the Agency of the name and address of the appraiser which it has selected. Within thirty (30) days thereafter, Lessee shall provide the valuation to the Agency. In the event Agency is not in agreement with Lessee's estimated valuation, Agency may, at its own cost and expense, obtain its own estimate within thirty (30) days of Lessee presenting same. If the valuations are within a 10% difference of the cost of the other, Lessee shall be entitled to use the bid from its appraiser as the basis for the valuation. In the event the estimates are more than 10% different, a third appraiser shall be selected by the existing appraisers. If they cannot agree upon such third appraiser within a sixty (60) day period, the third appraiser shall be selected by an Arbitrator of the American Arbitration Association for the Agency in which the Property is located upon application of either party. Within thirty (30) days of the appointment of the third

appraiser, the three appraisers shall meet and exchange their estimates and the valuation shall be the average of the estimates of the three appraisers.

Section 15.04 As surety for the estimated costs of Restoration ("Restoration Costs"), Lessee shall provide to the Agency surety, with a corporate surety licensed to do business in the State of New York, with the Agency designated as the beneficiary, to be deposited with the Agency. An example of a form of surety is set forth in Exhibit D. Agency and Lessee shall determine the amount of the Restoration Costs as follows:

(a) Lessee shall obtain an estimate of the Restoration Costs from a qualified contractor licensed in the state in which the Property is located and notify the Agency of the name and address of the contractor which it has selected. Within thirty (30) days thereafter, Lessee shall provide the estimate to Agency. In the event Agency is not in agreement with Lessee's estimate, Agency may, at its own cost and expense, obtain its own estimate within thirty (30) days of Lessee presenting its estimate. If the bids are within a 10% difference of the cost of the other, Lessee shall be entitled to use the bid from its contractor as the basis for the Restoration Costs. In the event the bids are more than 10% different, a third contractor shall be selected by the existing contractors. If they cannot agree upon such third contractor within a sixty (60) day period, the third contractor shall be selected by an Arbitrator of the American Arbitration Association for the Agency in which the Property is located upon application of either party. Within thirty (30) days of the appointment of the third contractor, the three contractors shall meet and exchange their estimates and the Restoration Costs shall be the average of the estimates of the three contractors.

(b) Lessee shall provide the surety to Agency prior to the Operations Date, and shall remain in force through the later of the expiration or earlier termination of this Agreement and the completion of the Restoration. Upon written request, no more than once in any calendar year, Agency may request that Lessee provide Agency with information and documentation to confirm the existence and maintenance of such security in favor of Agency.

Section 16. Ownership of Attributes

Section 16.01 Agency acknowledges that, as an integral component of the transaction contemplated by this Agreement, Lessee has applied and may in the future apply, for Environmental Attributes and Renewable Energy Incentives, which Lessee believes to be necessary for the commercially feasible development, construction and use of the Premises (collectively, "Benefits") under certain governmental incentive programs for which Lessee or the Premises may be eligible ("Incentive Programs"), including but not limited to, Incentive Programs provided by the Town of Islip Industrial Development Agency (the "IDA"). The

Agency will cooperate with Lessee in Lessee's efforts to apply for and to meet the requirements for any certification, registration, or reporting program relating to the Benefits or to the Incentive Programs, including acknowledging and delivering to Lessee applications, consents, agreements, certifications and other documents required to be executed by the Agency in its capacity as owner of the Property, and the Agency shall provide Lessee with such further cooperation as may reasonably be requested by Lessee, in connection with the Incentive Programs.

Section 16.02 The Agency acknowledges that Lessee shall have all right, title and interest in and to all Environmental Attributes and Renewable Energy Incentives, and other items of whatever nature which are available as result of solar energy being produced from, or ownership of, the Renewable Energy System. If any Environmental Attributes, Renewable Energy Incentives or other items are initially credited or paid to the Agency, the Agency will cause such Environmental Attributes, Renewable Energy Incentives and other items to be assigned or transferred to Lessee without delay.

Section 16.03 Agency acknowledges and agrees that in order to obtain IDA Benefits, Lessee may be required to structure any IDA Benefits transaction as a lease transaction. In that connection, Agency agrees that, notwithstanding any provision contained herein to the contrary, (i) Lessee may, without Agency's consent assign to the IDA of all of its right, title and interest in and to this Lease, (ii) Lessee may lease the Premises to the IDA, and the IDA may sublease the Premises to Lessee, (iii) Lessee may sublease the Premises to the IDA, or (iii) such other structure as the IDA shall require, in each case on such terms and conditions as shall be agreed to between Lessee and the IDA.

Section 17. Hazardous Substances and Waste; Landfill Closure Obligations

Section 17.01 The Agency represents and warrants to Lessee that (i) the Property has been formerly used as a landfill for the disposal of municipal solid waste and ash residue as the product of resource recovery within the meaning of the Laws; (ii) the portion of the Landfill that is part of the Premises has been capped and closed in accordance with Laws; and (iii) the Agency is, and will remain in compliance with its Closure Obligations for the duration of the Term of this Lease.

The Agency shall indemnify, defend, and hold harmless the Lessee, its contractors, sub-contractors, officers, agents, and employees from all fines, suits, procedures, claims and action of every kind, and all costs associated therewith (including attorney's and consultants' fees) arising out of or in any way connected with, directly or indirectly, (i) any deposit, spill, discharge, leakage or other release of Hazardous Substances, flammable explosives, or contamination on the Property, or related to the Landfill, or as proximately caused by the Agency's or Town's use of the Landfill, and not caused by any act or omission of the Lessee, or (ii) the Agency's or Town's violation of the Closure Obligations. The Agency's obligations and liabilities under this Section 17.01 shall survive the expiration or earlier termination of this Agreement. The Lessee

warrants and represents to the Agency that it is aware of the Closure Obligations of the Agency and will not interfere with the Agency's performance of current Closure Obligations and future Closure Obligations of which Agency has provided notice to Lessee.

Section 17.02 During its time of possession and excluding any pre-possession claims, Lessee hereby covenants that Lessee shall not (i) use, store, dispose or release on or to the Property or (ii) cause or permit to exist or be used, stored, disposed of or released on or to the Property any Hazardous Material except in such quantities as may be required in its development of the Renewable Energy System on the Property and only if such use is in full compliance with all applicable Laws. Should any claim or action be brought against Lessee in connection with its operations with respect to any of the foregoing in this Section 17.02, Lessee shall immediately notify the Agency.

Section 17.03 Lessee shall indemnify, defend, and hold harmless the Agency, its officers, agents, and employees from all fines, suits, procedures, claims and action of every kind, and all costs associated therewith (including attorney's and consultants' fees) arising out of or in any way connected with, directly or indirectly, any deposit, spill, discharge, leakage or other release of Hazardous Substances, flammable explosives, or contamination caused by Lessee, or its agents, or subcontractors. Lessee's obligations and liabilities under this Section shall survive the expiration or earlier termination of this Agreement.

Section 18. Signs Except as required by any regulatory agency or with the prior written approval of the Agency, Lessee shall not erect, maintain, or display any advertising, signs, or similar device on the Property, which approval shall not be unreasonably withheld.

Section 19. Quiet Enjoyment The Agency agrees that Lessee shall quietly and peaceably hold, possess and enjoy the Premises and Easements pursuant to the terms of this Agreement, and for the Term of this Agreement without any hindrance or molestation caused by any party claiming by, through or under the Agency. Except as may be required by law, the Agency shall not enter into or modify any documents, including any declarations, easements, restrictions or other similar instruments, which may materially affect the rights and/or obligations of Lessee hereunder, without first obtaining the prior written consent of Lessee.

Section 20. Representations, Warranties and Covenants

Section 20.01 The Agency shall not take any actions, or permit others to take any actions, at the Property that cause shading of the Renewable Energy System or otherwise interfere with the direct solar radiation of the Renewable Energy System without obtaining the prior written consent of the Lessee.

Section 20.02 If the Agency becomes aware of any circumstances relating to the Renewable Energy System or the Property which creates an imminent risk of damage or injury to any person or any person's property, the Agency will immediately notify Lessee of such threat. If the threat relates to the Property and not to the Renewable Energy System, the Agency shall promptly take such action as is necessary or appropriate to prevent such damage or injury.

Section 20.03 The Agency represents and warrants the each person executing this Agreement on behalf of the Agency is duly and validly authorized to do so and that the Agency has the full right and authority to enter into this Agreement, perform all of its obligations hereunder and grant the interests herein granted. The Agency warrants that the execution and delivery of this Agreement was duly authorized by all necessary action of the Agency, none of which action has been rescinded or otherwise modified. No consents, approvals, permits or other actions are required by the Agency for the Agency's performance of the terms and provisions herein. This Agreement is a legal, valid, and binding obligation of the Agency, enforceable against the Agency in accordance with its terms.

Section 20.04 The Lessee represents and warrants that each person executing this Agreement on behalf of Lessee is duly and validly authorized to do so and that Lessee has the full right and authority to enter into this Agreement and perform all of its obligations hereunder.

Section 20.05 Agency represents and warrants to Lessee that it owns the Property in fee simple, subject to no liens or encumbrances except as disclosed in writing to Lessee prior to the execution of this Lease and attached hereto as Exhibit E and incorporated herein by this reference.

Section 20.06 The Agency hereby waives any statutory or common law lien that it might otherwise have in or to the Improvements or any portion thereof. As between Agency and Lessee, Lessee shall at all times retain title to the Improvements, with the right, at any time and in its sole discretion, to remove, replace or repair one or more Improvements as otherwise set forth herein, except as provided in Section 26.

Section 20.07 Lessee warrants that the execution and delivery of this Agreement was duly authorized by all necessary action of the Lessee, none of which action has been rescinded or otherwise modified. Lessee has full power and authority to execute and deliver this Agreement and to perform its obligations under this Agreement. No consents, approvals or permits are required for the performance of the terms and provisions herein, or, if any such consents, approvals or permits are required, they have been or will be obtained in a timely fashion. This Agreement is a legal, valid, and binding obligation of the Lessee, enforceable against Lessee in accordance with its terms.

Section 21. Confidentiality Fully executed contracts, including leases, are subject to the New York Freedom of Information Law (FOIL). Therefore, if Lessee believes that any information it

may provide or is contained herein constitutes a trade secret or is otherwise information which if disclosed would cause substantial injury to its competitive position in the industry (collectively, "Lessee Confidential Information") and Lessee wishes such information to be withheld if requested pursuant to FOIL, Lessee shall submit a separate letter to the Agency, specifically identifying the page number(s), section(s), lines(s) or other appropriate designation(s) containing such information, explaining in detail why such information is a trade secret or is other information which if disclosed would cause substantial injury to the competitive position of Lessee, and formally requesting that such information be kept confidential. Failure by Lessee to submit such a letter may constitute a waiver of any rights Lessee may have under the FOIL relating to protection of trade secrets. The proprietary nature of the information designated confidential by Lessee may be subject to disclosure if it is requested under FOIL and the Agency deems it disclosable or if ordered by a court of competent jurisdiction. A request that an entire Agreement be kept confidential will not be considered. Such a letter may constitute a waiver of any rights Lessee may have under the FOIL relating to protection of trade secrets. The proprietary nature of the information designated confidential by Lessee may be subject to disclosure if it is requested under FOIL and the Agency deems it disclosable or if ordered by a court of competent jurisdiction. A request that an entire Agreement be kept confidential will not be considered.

Section 22. Successors and Assigns This Agreement shall inure to the benefit of, and be binding upon, the Agency and Lessee, and their respective heirs, successors and assigns. Lessee covenants that it shall not assign this Agreement nor sublet the Premises or any part thereof, by operation of law or otherwise; provide, however, that Lessee may assign the Agreement or portion thereof with the prior written consent of the Agency in each instance, not to be unreasonably withheld, conditioned or delayed. Any attempt by Lessee without the Agency's prior written consent to assign, encumber or mortgage this Agreement or a portion thereof shall be null and void, provided however, that Lessee may without obtaining the Agency's prior consent, (but with complying with the other provisions of this Section), assign this Agreement or sublet all or any portion of the Premises to (a) an "Affiliate", (b) a Lender in connection with any financing by Lessee of the Renewable Energy System in accordance with Section 23 below, or (c) to a person or entity to which it sells or assigns all or substantially all of its assets or equitable ownership interest or with which it may be consolidated or merged (a "Successor Entity"), provided such Successor Entity shall also (i) be an entity having experience in the operation and maintenance of solar photovoltaic systems (ii) be financially capable of performing Lessee's obligations under this Agreement, and (iii) agree to assume all of Lessee's obligations under this Agreement in writing. Each assignment, assumption or sublease, as applicable, shall be in writing, and Lessee shall deliver to the Agency a fully-executed original of such assignment and assumption or sublease, as applicable, within ten (10) Days following the full execution thereof.

Section 23. Leasehold Financing

Section 23.01 Right to Encumber. Lessee or any authorized successor or assignee under Section 22 (each, an "Obligor") may at any time assign, encumber, hypothecate, mortgage or pledge (including by mortgage, deed of trust or personal property security instrument) all or any portion the Renewable Energy Estate to any Lender. Lessee shall provide the Agency written notice of such assignment, encumbrance, hypothecation, mortgage or pledge within a reasonable time of Renewable Energy Estate being encumbered.

Section 23.02 Covenants for Lenders' Benefit. Should an Obligor mortgage any of its interest as provided in Section 23.01 above, the Agency expressly agrees for the benefit of Lessee and any Lenders as follows:

(a) The Agency will not amend or modify, or take any action causing, consenting to or accepting the amendment or modification of this Agreement, if such amendment or modification would reduce the rights or remedies of any Lender hereunder or impair or reduce the security for any lien held by such Lender, as determined by Lessee, in its reasonable discretion.

(b) Lender shall have the right to do any act or thing required to be performed by Obligor under this Agreement, and any such act or thing performed by a Lender shall be as effective to prevent a default under this Agreement and/or a forfeiture of any of Obligor's rights under this Agreement as if done by Obligor itself.

(c) The right of a Lender to receive notices and to act on behalf of Obligor as set forth in this Section 23.02 shall be available only to those Lenders which shall have notified the Agency (or which Lessee has notified the Agency of) in writing of their name and address ("Registered Lenders").

The Agency shall provide notice of the occurrence of any Event of Default hereof to all Registered Lenders, and no Event of Default shall be effective unless a like notice is given to all such Registered Lenders. If the Agency shall become entitled to terminate this Agreement due to an uncured Event of Default by Obligor, the Agency will not terminate this Agreement unless it has first given written notice of such uncured Event of Default and of its intent to terminate this Agreement to each Registered Lender and has given each Registered Lender at least thirty (30) Days after the expiration of the cure period which this Agreement provides to Obligor for curing such Event of Default, to cure the Event of Default to prevent such termination of this Agreement. Furthermore, if within such thirty (30) Day period a Registered Lender notifies the Agency that it must foreclose on Obligor's interest or otherwise take possession of Obligor's interest under this Agreement in order to cure a Non-

Monetary Default, the Agency shall not terminate this Agreement and shall permit such Registered Lender a sufficient period of time as may be necessary for such Registered Lender, with the exercise of due diligence, to foreclose or acquire Obligor's interest under this Agreement and to perform or cause to be performed all of the covenants and agreements to be performed and observed by Obligor. In the event a Registered Lender shall elect to exercise its rights hereunder, the sole recourse of the Agency in seeking enforcement of its rights under this Agreement or any new lease entered into pursuant to 23.02(d) shall be to such Registered Lender's interest in this Agreement and the Improvements. Upon the sale or other transfer of any interest in the rights granted hereunder by any Registered Lender, such Registered Lender shall have no further duties or obligations hereunder.

(d) In case of the termination of this Agreement as a result of any Event of Default, the Agency shall give prompt notice to the Registered Lenders. The Agency shall, upon written request of the first priority Registered Lender, made within forty (40) Days after notice to such Registered Lender, enter into a new lease agreement with such Registered Lender, or its designee, within twenty (20) Days after the receipt of such request. Such new lease agreement shall be effective as of the date of the termination of this Agreement by reason of Event of Default by Obligor, upon the same terms, covenants, conditions and agreements as contained in this Agreement. Upon the execution of any such new lease agreement, the Registered Lender shall (i) pay the Agency any amounts which are due the Agency from Obligor, (ii) pay the Agency any and all amounts which would have been due under this Agreement (had this Agreement not been terminated) from the date of the termination of this Agreement to the date of the new lease agreement, and (iii) agree in writing to perform or cause to be performed all of the other covenants and agreements set forth in this Agreement to be performed by Obligor to the extent that Obligor failed to perform the same prior to the execution and delivery of the new lease agreement.

(e) As long as there is a Renewable Energy Estate, neither the bankruptcy nor the insolvency of Lessee shall operate to terminate, nor permit the Agency to terminate, this Agreement as long as all Quarterly Operating Payments and other charges payable by Lessee continue to be paid in accordance with the terms of this Agreement.

(f) The time available to a Registered Lender to initiate foreclosure proceedings as aforesaid shall be extended by the number of Days of delay occasioned by judicial restriction against such initiation or occasioned by other circumstances beyond such Registered Lender's reasonable control.

Section 24. Condemnation. Should title or possession of all or any portion of the Premises be taken in condemnation proceedings by a government body or private party under the exercise of

the right of eminent domain, or should a partial taking render the remaining portion of the Premises wholly unsuitable for Lessee's use, as determined by Lessee in its reasonable discretion, then this Agreement shall terminate upon the earlier of such vesting of title or taking of possession, at which time Agency and Lessee shall be relieved of any further obligations and duties to each other under this Agreement, except for indemnity obligations and other obligations which survive any termination hereunder.

In the event of a partial taking that does not render the remaining portion of the Premises unsuitable for Lessee's use, as determined by Lessee in its sole discretion, this Agreement shall continue in full force and effect (with an equitable reduction in the Quarterly Operating Payments). The Parties shall enter into an amendment of the Agreement to reflect such partial taking.

Lessee shall have the right to participate in any settlement proceedings with the Condemnor and Agency shall not enter into any binding settlement agreement with the Condemnor without the prior written consent of Lessee, which consent shall not be unreasonably withheld.

All payments, including damages and interest, made by a Condemnor on account of any taking of the fee estate by eminent domain shall be made to Agency and Lessee according to their respective interests under this Agreement. In determining their respective interests:

(a) Agency's interest shall be based on the value of its interest in the Premises (but excluding any of Lessee's interest in the Improvements), taking into account the amounts paid or due to be paid by Lessee hereunder and all other terms and provisions of this Agreement; and

(b) Lessee's interest of shall be based on the value of its interest in the Premises (determined at the time of the taking), including the value of the Improvements for the Term, and any cost or loss that Lessee may sustain in removing and/or relocating the Improvements; provided, however, that in each case the value of the respective interests of Agency and Lessee shall be calculated as if no taking were to occur.

Section 25. Reserved

Section 26. Termination; Default Remedies and Damages

Section 26.01 This Agreement shall terminate at the end of the full term hereof and Lessee shall have no further right or interest in the Premises.

Section 26.02 At any time before beginning to construct the Renewable Energy System, Lessee may, in its sole discretion, terminate this Agreement upon 30-days' notice to Agency (the thirtieth day after delivery of the notice shall be the effective date of the termination). Lessee shall execute and deliver to Agency any amendments to the Notice of Lease and/or other documents reasonably necessary to evidence terminating this Agreement. Termination in accordance with this Section 26.02 shall not release either Party from any obligations arising prior to the effective date of such termination, but neither Party shall have the obligation to perform any obligations hereunder which, but for such termination, would have arisen after the effective date of such termination.

Section 26.03 The following shall constitute an "Event of Default":

(a) Lessee shall fail duly and punctually to pay any Quarterly Operating Payment under Section 5 of this Agreement, or to make any other payment required hereunder when due to the Agency and such default shall persist in its failure for a period of six (6) months following the receipt of written notice of such default ("Notice of Default") from the Agency ("Monetary Default"); or

(b) Lessee shall fail to keep, perform, or observe each and every material promise and agreement set forth in this Agreement on its part to be kept, performed, or observed, within thirty (30) Days after receipt of written notice from the Agency (except where fulfillment of its obligation requires activity over a period of time and Lessee shall have commenced substantially to perform whatever may be required for fulfillment within thirty (30) Days after receipt of notice and continues diligently such substantial performance without interruption except for causes beyond its control); or

(c) Lessee shall become insolvent, or shall take the benefit of any present or future insolvency statute, or shall make a general assignment for the benefit of creditors, or file a voluntary petition in bankruptcy or a petition or an answer seeking an arrangement or its reorganization or the readjustment of its indebtedness under the federal bankruptcy laws or under any other law or statute of the United States or of any State thereof: or consent to the appointment of a receiver, trustee or liquidator of all or substantially all of its property; or

(d) By order of decree of a court Lessee shall be adjudged bankrupt or an order shall be made approving a petition filed by any of the creditors or, if Lessee is a corporation, by any of the stockholders of Lessee, seeking its reorganization or the readjustment of its indebtedness under the federal bankruptcy laws or under any law or statute of the United States or of any State thereof; or

(e) A petition under any part of the federal bankruptcy laws or an action under any present or future insolvency law or statute shall be filed against Lessee and shall not be dismissed within ninety (90) Days after the filing thereof; or

(f) By or pursuant to, or under authority of any legislative act, resolution or rule, or any order or decree of any court or governmental board, agency or officer having jurisdiction, a receiver, trustee, or liquidator shall take possession or control of all or substantially all of the Property of Lessee and such possession or control shall continue in effect for a period of ninety (90) Days.

The events described in subsections (3), (4), (5), or (6) above are collectively referred to herein as a "Non-Monetary Default."

Section 26.04 Upon the occurrence of either a Monetary or a Non-Monetary Default other than an Event of Default described in Section 26.03(b), and after the applicable cure periods have elapsed, or at any time thereafter during the continuance thereof or during the term of this Agreement, the Agency shall be entitled to exercise any and all remedies available to it at law or in equity, including the right to terminate this Agreement and/or evict Lessee from the Property upon the date specified in a Notice of Termination, which date shall not be less than ninety (90) days after the date of the Notice of Termination (the "Termination Date") (in addition to the initial written notice of default as described in Section 26.03), such termination to be effective upon the date specified in such notice in the event Lessee has not cured the default . In such case, Lessee's rights to the possession of the Property shall end absolutely as of the Termination Date as fully and completely and with the same force and effect as if the day so specified were the Expiration Date; this Agreement shall also terminate in all respects except for Lessee's liabilities arising prior to, out of, or following the Event(s) of Default and the ensuing termination.

Section 26.05 Upon the occurrence of an Event of Default described in subsection (b) of Section 26.03 (after the applicable cure periods have elapsed), Agency shall not be entitled to terminate this Agreement or evict Lessee from the Property and Agency's remedies shall be limited to the Agency's actual damages, costs and out-of-pocket expenses incurred by the Agency as a result of the Event of Default described in subsection (b) above and/or efforts by the Agency to cure such Event of Default (including, without limitation, reasonable attorneys' fees and disbursements).

Section 26.06 *Reserved.*

Section 26.07 Unless and until this Agreement is terminated due to an event of default by either party, each Party shall remain fully liable and responsible to perform all of its covenants and to observe all the conditions of this Agreement throughout the remainder of the Term.

Section 26.08 The Parties may each enforce and protect their respective rights hereunder by a suit or suits in equity or at law for the specific performance of any covenant or agreement contained herein, and for the enforcement of any other appropriate legal or equitable remedy, including, without limitation, injunctive relief., and for recovery of all money due or to become due from Lessee under any of the provisions of this Agreement. No rights or remedy herein conferred upon or reserved to Agency or Lessee shall be exclusive of any other right or remedy, but shall be cumulative and in addition to all other rights and remedies given hereunder or now or hereafter existing at law.

Section 26.09 No delay or forbearance by either Party in exercising any right or remedy hereunder, or either Party's undertaking or matter which is not expressly required to be undertaken by that Party shall be construed, respectively, to be a waiver of that Party's rights or to represent any agreement by that Party to undertake or perform such act or matter thereafter. Waiver by either Party of any breach by the other Party of any covenant or condition herein contained (which waiver shall be effective only if so expressed in writing) or failure by either Party to exercise any right or remedy in respect of any such breach shall not constitute a waiver or relinquishment for the future of that Party's right to have any such covenant or condition duly performed or observed by the other Party, or of either Party's rights arising because of any subsequent breach of any such covenant or condition nor bar any right or remedy of that Party in respect of such breach or any subsequent breach. Agency's receipt and acceptance of any payment from Lessee which is tendered not in conformity with the provisions of this Agreement or following an Event of Default (regardless of any endorsement or notation on any check or any statement in any letter accompanying any payment) shall not operate as an accord and satisfaction or a waiver of the right of Agency to recover any payments then owing by Lessee which are not paid in full.

Section 26.10 In the event Agency shall fail to keep, perform, and observe each and every material promise and agreement set forth in this Agreement on its part to be kept, performed, or observed, within thirty (30) Days after receipt of written notice of default thereunder from the Lessee (except where fulfillment of its obligation requires activity over a period of time, and Agency shall have commenced substantially to perform whatever may be required for fulfillment within thirty (30) Days after receipt of the written notice and continues diligently such substantial performance without interruption except for causes beyond its control), the same shall constitute a default on the part of the Agency for which Lessee shall have all rights available under law.

Section 26.11 In no event shall either party be liable in any way, regardless of the form in which any legal or equitable action may be brought (whether in tort, contract, strict liability or otherwise), for any special, incidental, indirect, punitive, or consequential damages whatsoever, however caused, even if the Parties have been advised of the possibility of such loss or damage and regardless of whether these limitations cause any remedy to fail its essential purpose. The

limitations of liability in this Section 26.11 are material conditions to the Parties entering into this Agreement and shall survive the termination or expiration of this Agreement.

Section 27. Force Majeure

Section 27.01 Neither Party will be liable to the other Party in the event it is prevented from performing its obligations hereunder in whole or in part due to a Force Majeure Event. The Party rendered unable to fulfill any obligation by reason of a Force Majeure Event shall take reasonable actions necessary to remove such inability with due speed and diligence. Nothing herein shall be construed as permitting that Party to continue to fail to perform after said cause has been removed. The obligation to use due speed and diligence shall not be interpreted to require resolution of labor disputes by acceding to demands of the opposition when such course is inadvisable in the discretion of the Party having such difficulty. Neither Party shall be considered in breach or have caused an uncured Event of Default of this Agreement if and to the extent that any failure or delay in the Party's performance of one or more of its obligations hereunder is caused by a Force Majeure Event. The occurrence and continuation of a Force Majeure Event shall not suspend or excuse the obligation of a Party to make any payments due hereunder.

Section 27.02 In the event of any delay or nonperformance resulting from a Force Majeure Event, the Party suffering the Force Majeure Event shall (a) as soon as practicable, notify the other Party in writing of the nature, cause, estimated date of commencement thereof, and the anticipated extent of any delay or interruption in performance, and (b) notify the other Party of the cessation or termination of such Force Majeure Event, all as known or estimated in good faith by the affected Party; provided, however, that a Party's failure to give timely notice shall not affect such Party's ability to assert Force Majeure unless the delay in giving notice materially prejudices the other Party.

Section 28. Notices Any communication, notice or other submission necessary or required to be made by the parties regarding this Agreement shall be deemed given upon receipt went sent by overnight mail, certified mail, return receipt requested, to the following addresses:

AGENCY: Islip Resource Recovery Agency
401 Main St.
Islip, N.Y. 11751
ATTN: President

LESSEE: ACE – Blydenburgh Solar, LLC
360 Merrimack Street
Building 9, Entrance K, Suite 202
Lawrence, MA 01843
Attn: Legal Department

Section 29. Broker Lessee and Agency each represents and warrants that no broker has been concerned on its behalf in the negotiation of this Agreement and that there is no such broker who is or may be entitled to be paid a commission in connection therewith. Each Party shall indemnify and save harmless the other Party of and from any claim for commission or of brokerage made by any and all persons, firms, or corporations whatsoever for services rendered to such party, whether or not such claims, demands, causes of action, liabilities, etc., are made or asserted before or after termination or expiration of this Agreement (to include reasonable attorneys and other professional fees).

Section 30. Paragraph Headings The section and subsection headings, if any, in this Agreement, are inserted only as a matter of convenience and for reference and in no way define, limit, or describe the scope of intent of any provision hereof.

Section 31. Agency Approval This Agreement is subject to the approval of the Agency Board and shall not become effective until fully executed.

Section 32. Parent Guarantee. In consideration for, and in order to secure the faithful performance of the obligations of the Lessee, the Lessee agrees to deliver, on the date of execution of this Agreement, a Parent Guaranty from American Capital Energy, Inc. (the "Guarantor") for the benefit of the Agency in the form set forth in Exhibit I hereto (the "Guaranty"). If the Guarantor fails to maintain the Guaranty in accordance with the terms of this Section, then the Agency shall have the right to terminate this Agreement. In order to exercise its right to terminate pursuant to this Section, the Agency shall provide at least forty (40) days prior notice to the Lessee and the Guarantor and the Agency shall designate any date of termination after the expiration of such forty (40) day period, provided that the Guarantor and the Lessee shall have the right to cure the breach during the period from its receipt of the notice through the date designated by the Agency as the termination date and any such cure by the Lessee or the Guarantor shall negate any right of the Agency to terminate this Agreement for such breach.

Section 33. Off-set of Arrears or Default Lessee warrants that it is not, and shall not be, during the Term of this Agreement, in arrears to the Agency for taxes or upon debt or contract and is not, and shall not be during the term of this Agreement, in default as surety, contractor or otherwise on any obligation to the Agency.

Section 34. Cooperation on Claims

Section 34.01 The Parties each agree to render diligently to the other any and all cooperation, without additional compensation, that may be required to defend the Party against any claims, demand, or action that may be brought against the other in connection with this Agreement.

Section 34.02 The Agency shall fully support and cooperate with Lessee in the conduct of its operations and the exercise of its rights under this Agreement including with Lessee's efforts to (a) obtain from any Governmental Authority or any other person or entity any environmental impact review, permit, entitlement, approval, authorization or other rights or (b) sell any portion of the Solar Energy System, assign or otherwise transfer all or any part of or interest under this Agreement or obtain any financing in accordance with the provisions of this Agreement, and the Agency shall perform all such acts including executing and delivering maps, instruments and documents within twenty (20) Days after receipt of a written request made from time to time by Lessee, as Lessee may reasonably specify to fully effectuate each and all of the purposes and intent of the Agreement. Without limiting the generality of the foregoing, within ten (10) Days after receipt of a written request made from time to time by either Party to the other, the Parties shall: enter into any reasonable amendment hereto (aa) to correct an error in this Agreement, (bb) to amend the legal description attached hereto, including replacing said legal description with a revised description prepared or provided by Lessee's surveyor or title company. Within Ten (10) Days after receipt of a written request made from time to time by the Lessee, the Agency shall: (i) execute and deliver to Lessee any owner's affidavit reasonably requested by any title company or Lessee; or (ii) enter into any reasonable consent and subordination and nondisturbance agreement with any Lender, or deliver any estoppel reasonably requested by such Lender, within ten (10) Days after written request from Lessee or any Lender as to any of the foregoing. Without limiting the generality of the foregoing, the Agency shall not oppose, in any way, whether directly or indirectly, any application by Lessee for any permit, approval or entitlement submitted in accordance with the terms and conditions of this Agreement at any administrative, judicial, legislative or other level.

Section 35. Not a Co-Partnership or Joint Venture Nothing herein contained shall create or be construed as creating a co-partnership, Joint Venture or any other association between the Agency and Lessee other than the relationship of landlord and tenant. Neither Lessee nor any person authorized by Lessee to use the Premises shall be considered employees of the Agency for any purpose. Lessee shall neither hold itself out as nor claim to be an officer, agent, or employee of the Agency by reason hereof except as expressly authorized by Agency, and Lessee, its owners and employees, shall not, by reason hereof, make any claims, demands or application to or for any right of privilege including, but not limited to, workers' compensation coverage, unemployment insurance benefits, social security coverage or retirement membership of credit as officers, employees or agents of the Agency.

Section 36. Agency Representative It is expressly understood and agreed by and between the Parties hereto that the officers, officials, employees, and agents of the Agency, are acting in a representative capacity for the Agency and not for their own benefit, and that neither Lessee nor its officers, employees agents or representatives shall have any claim against them or any of them as individuals in any event whatsoever.

Section 37. No Credit Lessee agrees that this Agreement shall not be pledged, hypothecated, or put up as security for a loan, credit or for any reason whatsoever, except as may otherwise be permitted in this Agreement.

Section 38. Certification The Parties to this Agreement hereby certify that, other than the funds provided in this Agreement and other valid Agreements with the Agency, there is no known relationship within the third degree of consanguinity, life partner or business, commercial, economic, or financial relationship between the Parties, the signatories to this Agreement, and any partners, members, directors, or shareholders of five percent (5%) (or more) of any Party to this Agreement.

Section 39. Lawful Hiring of Employees This Agreement is subject to Town of Islip Code requiring completion and submission by Lessee and Lessee's contractors' Affidavits certifying compliance with the requirements of federal Code Section 1324a and any amendments thereto, with respect to lawful alien status of employees, owners, principals, partners, officers or members.

Section 40. Agency Requirements The Parties agree to be bound by the terms of the Agency's Requirements, attached hereto as Exhibit F, and made a part hereof.

Section 41. Governing Law This Agreement shall be governed by the laws of the State of New York. In the event of any dispute or litigation, the venue of any proceeding to determine the rights and liabilities of the respective parties arising under this Agreement shall be in State Supreme Court, Suffolk County; or in the event of a proceeding in the federal courts, in the District Court for the Eastern District of New York.

Section 42. Severability. If any non-material part of this Agreement is held to be unenforceable, the rest of the Agreement will continue in effect. If a material provision is determined to be unenforceable and the Party which would have been benefited by the provision does not waive its unenforceability, then the Parties shall negotiate in good faith to amend the Agreement to restore to the Party that was the beneficiary of such unenforceable provision the benefits of such provision. If the Parties are unable to agree upon an amendment that restores the Parties benefits, an arbitrator or court of law may reform the Agreement as deemed just and equitable in order to restore to the Party that was the beneficiary of the unenforceable provision the economic benefits of such provision.

Section 43. Interpretation Each Party has reviewed this Agreement and has been given an opportunity to obtain the assistance of counsel, and any rule of construction holding that ambiguities are to be resolved against the drafting Party shall not apply in the interpretation of this Agreement.

Section 44. Memorandum The Agency and Lessee shall execute in recordable form and Lessee shall record, a memorandum of this Agreement substantially in the form of Exhibit G. The Agency consents to the recordation of the interest of any Lender or assignee of Lessee's interest in this Agreement.

Section 45. Execution in Counterparts This Agreement may be executed in one or more counterparts, all of which together shall constitute one and the same instrument, and each of which shall be deemed an original.

Section 46. Entire Agreement This Agreement consists of the following: Sections 1 through 47, inclusive, and stated Exhibits. The foregoing constitutes the entire Agreement of the Parties on the subject matter hereof. It may not be changed, modified, discharged or extended except by written instrument duly executed by the Agency and Lessee.

Section 47. References. References contained herein to Sections, Exhibits and/or Schedules shall be deemed to be references to the Sections, Exhibits and/or Schedules of and to this Agreement unless specified to the contrary.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed and delivered as of the date first set forth above.

ACE – Blydenburgh Solar, LLC

By: _____

Name:_____
It's Managing Member

ISLIP RESOURCE RECOVERY AGENCY

By :_____

Name:_____

Title: _____

ACKNOWLEDGEMENT TO LEASE

STATE OF NEW YORK}
SS:
COUNTY OF SUFFOLK}

On the ____ day of _____ in the year 2016, before me, the undersigned, personally appeared_____[name],Managing Member of **ACE – Blydenburgh Solar, LLC**, personally known to me or proved to me on the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his capacity, and that by his signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

_____
Notary Public

STATE OF NEW YORK}
SS:
COUNTY OF SUFFOLK}

On the ____ day of _____ in the year 2016, before me, the undersigned, personally appeared _____[Name], _____[Title] of **Islip Resource Recovery Agency**, personally known to me or proved to me on the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his capacity, and that by his signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

_____
Notary Public

EXHIBIT A

DESCRIPTION OF PREMISES

The Premises is the approximately 8 acres of land identified as "Lease Parcel" on the survey attached as Exhibit A-1, dated 3-8-2016, and prepared by Weston & Sampson; being a portion of the property conveyed by deed recorded in the Suffolk County Clerk's office at Book 9939, page 54.

EXHIBIT A-1

PREMISES SURVEY

[attach 3/89/16 survey]

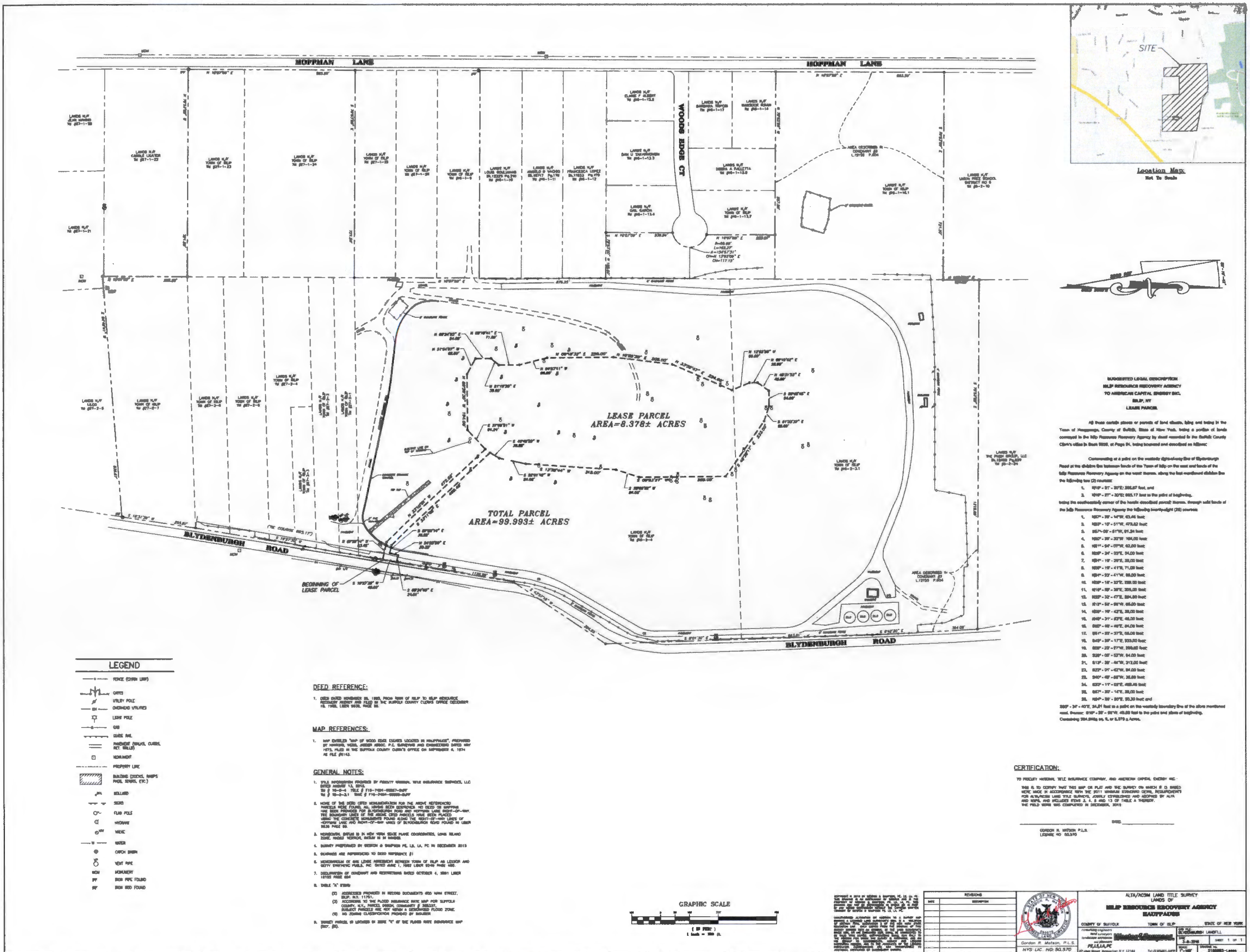

HOFFMAN LANE
WOODS EDGE CT
LEASE PARCEL
AREA=8.378± ACRES
TOTAL PARCEL
AREA=99.993± ACRES
BLYDENBURGH ROAD
BEGINNING OF LEASE PARCEL
SITE
Location Map
LEGEND
DEED REFERENCE:
MAP REFERENCES:
GENERAL NOTES:
GRAPHIC SCALE
CERTIFICATION:
ALTA/ACSM LAND TITLE SURVEY
LANDS OF
COUNTY OF SUFFOLK
TOWN OF ISLIP
Gordon R. Matson, P.L.S.
NYS LIC NO: 50,570

EXHIBIT B

QUARTERLY OPERATING PAYMENT ESTIMATE

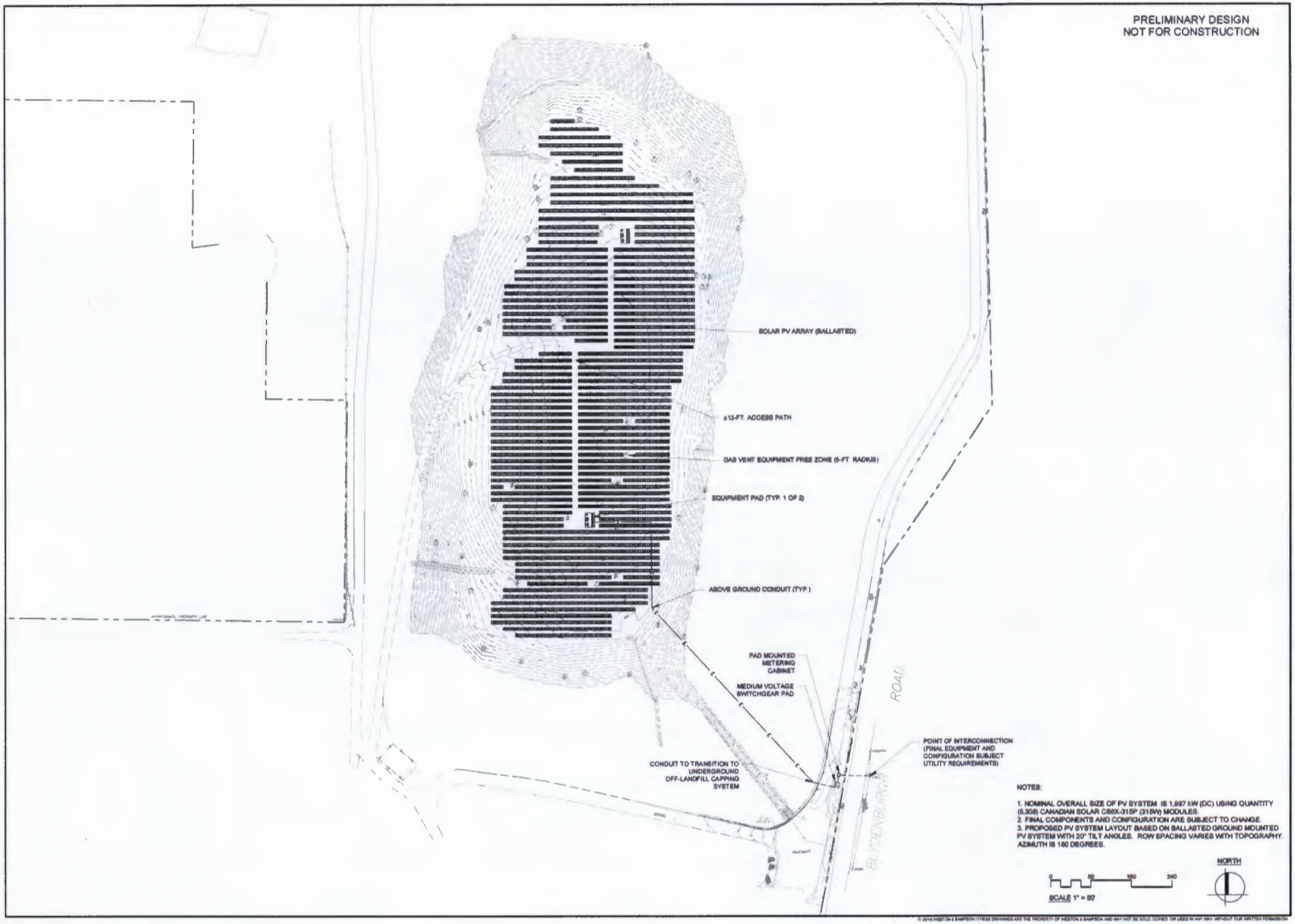
$27,000 per year, per 1.5 MW (DC) capacity awarded to the project under the LIPA FIT 2 Program, which amount shall be reduced by any amount paid by Lessee to the IDA under the PILOT agreement. The parties shall finalize the Quarterly Operating Payment due according to Section 5.01.

EXHIBIT C

APPROVED SITE PLAN

[attach, date 1/8/16, sheet number C-3, Weston & Sampson]

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION



NOTES:

1. NOMINAL OVERALL SIZE OF PV SYSTEM IS 1,987 kW (DC) USING QUANTITY (6,308) CANADIAN SOLAR CS6X-315P (315W) MODULES.
2. FINAL COMPONENTS AND CONFIGURATION ARE SUBJECT TO CHANGE.
3. PROPOSED PV SYSTEM LAYOUT BASED ON BALLASTED GROUND MOUNTED PV SYSTEM WITH 20° TILT ANGLES. ROW SPACING VARIES WITH TOPOGRAPHY. AZIMUTH IS 180 DEGREES.

NORTH

0 60 120 240

SCALE 1" = 60'

Project:
LONG ISLAND POWER AUTHORITY (LIPA) FEED IN TARIFF (FIT) PROGRAM

ELYDENBURG LANDFILL SOLAR PROJECT

AMERICAN CAPITAL ENERGY
360 Merrimack Street Suite 202
Lawrence, Massachusetts 01843
(978) 521-4200
www.americancapitalenergy.com

Weston & Sampson
301 Manchester Road, Suite 201A
Poughkeepsie New York, 12603
(845) 454-6364 (800) Sampson
www.westonandsampson.com

Revisions:

Rev	Date	Description

Seal:

JOB NO. 2150683

Date:	01.08.16
Scale:	AS SHOWN
Designed By:	MEB
Reviewed By:	DCH
Checked By:	RM
Approved By:	-

Drawing Title:
PROPOSED DEVELOPMENT PLAN

Sheet Number:
C-3

EXHIBIT D

FORM OF LETTER OF CREDIT/BOND

To be provided prior to the Operations Date, according to Section 15.04.

PERFORMANCE BOND FORM SAMPLE

Bond No.: _____

KNOW ALL MEN BY THESE PRESENTS, that we _____ of _____ (the "Principal") and _____ a _____created and existing under the laws of the State of _____, having a principal office in _____(the "Surety") are held and firmly bound unto the Islip Resource Recovery Agency (the "Agency") in the full and just sum of _____Dollars ($_____) good and lawful money of the United States of America, for the payment of which said sum of money well and truly to be made and done, the said Principal binds himself/herself, his/her heirs, executors and administrators, successors and assigns, and the said Surety binds itself, its successors and assigns jointly and severally firmly by these presents:

Signed and Sealed this _____ day of _____, 2015.

WHEREAS, said Principal has entered into a certain written Lease, bearing date of _____, 2015, with the Agency which provides for the restoration of certain lands and properties of the Agency upon its termination, and this bond is provided to secure the performance of the Principal in conducting such restoration in accordance with the terms of the Lease.

NOW, THEREFORE, THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH, that if the said Principal shall well, truly and faithfully comply with and perform all the terms, covenants and conditions of said Lease on his/her part to be kept and performed, according to the true intent and meaning of said Lease, and shall protect the said Agency against, and pay any and all amounts, damages, costs and judgments which may or shall be recovered against said Agency or its officers or agents or which the said Agency may be called upon to pay to any person or corporation by reason of any damages arising or growing out of the doing of said work, or the manner of doing the same, or the neglect of the said Principal or his/her agents or servants, or the improper performance of the said work by the said Principal, or his/her agents or servants, or otherwise, then this obligation shall be null and void, otherwise to remain in full force and virtue.

And, the said Surety, for value received, hereby stipulates and agrees, if requested to do so by the Agency, to perform and complete the work mentioned and described in said Lease, pursuant to the terms, conditions and covenants thereof using Lease or other than the Principal named herein. If for any cause, said Principal fails or neglects to so fully perform and complete said work, the said Surety further agrees to commence said work of completion within seven (7) days after notice thereof from the Agency, and to complete the same with all due diligence.

And, the said Surety, for value received, hereby stipulates and agrees, if requested to do so by the Agency, and at the Agency's sole option in place of performance and completion of the Lease to pay the Agency the penalties and/or liquidated damages assessed against the Principal as set forth in the Lease.

And the said Surety for value received hereby stipulates and agrees that no change, extension, alteration or addition to the terms of this Lease or specifications accompanying the same shall in any way affect its obligation of this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

PRINCIPAL

[SEAL]

By:_____
Title:_____

SURETY

[SEAL]

By:_____
Title:_____

(The Surety Company must append statement of its financial condition and a copy of the Resolution authorizing the execution of Bonds by Officers of the Company).

ACKNOWLEDGEMENT OF LEASE OR, IF AN INDIVIDUAL

STATE OF NEW YORK)
ss.:
COUNTY OF SUFFOLK)

On the _____ day of _____, in the year 2014, before me, the undersigned, personally appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Signature and Office of Individual
Taking Acknowledgement

ACKNOWLEDGEMENT OF LEASE OR, IF A PARTNERSHIP

STATE OF NEW YORK)

ss.:

COUNTY OF SUFFOLK)

On this _____day of _____, 2014, before me personally came _____, to me known to be the person who executed the foregoing instrument, and who, being duly sworn by me, did depose and say that he/she is a partner in _____, a co-partnership, and that he/she executed the foregoing instrument in the partnership name of _____ and that he/she had authority to sign the same, and he/she acknowledged to me that he/she executed the same as the act and deed of said partnership for the uses and purposes therein mentioned.

_____

Signature and Office of Individual
Taking Acknowledgement

ACKNOWLEDGEMENT OF LEASE OR, IF A CORPORATION

STATE OF NEW YORK)

ss.:

COUNTY OF SUFFOLK)

Before me the undersigned authority on this day personally appeared _____ in his/her capacity as _____ for _____, a corporation, and after being duly sworn deposed and stated that he executed the foregoing Agreement on behalf of _____for the purposes and consideration therein expressed in the capacity therein stated.

SWORN AND SUBSCRIBED before me on this _____ day of _____, 2014.

_____

Signature and Office of Individual
Taking Acknowledgement

ACKNOWLEDGEMENT OF SURETY COMPANY

STATE OF NEW YORK)

ss.:

COUNTY OF SUFFOLK)

On the _____day of _____, 2014, before me came _____, to me known, who being by me duly sworn, did depose and say that he/she resides at , that he/she is the of the corporation described in and which executed the foregoing instrument; that he/she knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he/she signed his/her name thereto by like order.

_____

Signature and Office of Individual
Taking Acknowledgement

(The Surety Company must append statement of its financial condition and a copy of the Resolution authorizing the execution of Bonds by Officers of the Company).

EXHIBIT E

LIENS AND ENCUMBRANCES

The Property is subject to a certain Pledge, Assignment, Mortgage and Security Agreement (1985 Facility) dated as of December 1, 1985, and as subsequently amended and extended, between the Agency and the Bank of New York, as Trustee for certain bonds of the Agency.

In addition, the Landfill property is subject to certain covenants and restrictions set forth as follows:

Controls include components in compliance with 6 NYCRR Parts 360 and 375: a 52 acre modified geosynthetic membrane cap, stormwater runoff control system, landfill gas monitoring and control program, 350 GPM P&T system designed to capture GW within the 50 ppm contour, long term monitoring for remedy effectiveness and plume management, the GW program specifically including natural attenuation processes until GW standards are met for GW not intended to be captured, NY State Pollution Elimination and Discharge System permit equivalent, land use restriction to run with the land, fencing access/control, per ROD and CO.

EXHIBIT F

AGENCY REQUIREMENTS

The parties and their respective employees, agents, contractors and licensees shall abide by all traffic and safety rules effective within the fenced grounds of the Landfill, including but not limited to posted signage, as the same may be amended from time to time during the term of the agreement.

EXHIBIT G

FORM OF MEMORANDUM OF LEASE

Recording Requested By and When Recorded Return To:
@

MEMORANDUM OF LEASE

THIS MEMORANDUM OF LEASE, dated as of the day of , 2015, between, ISLIP RESOURCE RECOVERY AGENCY with its principal offices at One Independence Hill, Farmingville, New York 11738 (hereinafter "Landlord"), and _____, with an address at _____ (hereinafter "Tenant").

1. DEFINITIONS. Capitalized terms used herein that are not otherwise defined shall have the meanings ascribed to such terms in the Lease (as hereinafter defined).

2. DEMISED PREMISES. Landlord and Tenant have entered into a Lease dated as of _____, 2015 (the "Lease"), pursuant to which Tenant has leased from Landlord certain land _____, in the Agency of Islip _____, County of Suffolk, State of New York (the "Premises") and further described on the legal description attached hereto and made a part hereof as Exhibit A.

3. TERM The term of the Lease (the "Term") shall begin on the Effective Date and shall remain in effect until the later to occur of (a) the twenty-first (21st) anniversary of the Operations Date, or (b) the date which is three (3) months following the expiration of Lessee's power purchase agreement with LIPA, unless earlier terminated as provided in the Lease.

4. PURPOSE. The purpose of this instrument is to give notice of the Lease and all of its terms, covenants and conditions to the same extent as if the Lease were fully set forth herein. This instrument shall in no way amend or be used to interpret the Lease, and in the or inconsistency between any of the terms and conditions of this Memorandum of Lease and any term and/or condition of the Lease, the term and/or condition of the Lease shall govern and control.

5. EASEMENT. Tenant has any easement for ingress and egress to the Premises across the Property and to establish interconnection facilities across the Property according to the provisions of the Lease.

6. COUNTERPARTS. This Memorandum of Lease may be executed in counterparts, each of which shall be deemed to be and required and all of which, when taken together, shall be deemed to be one and the same instrument.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Lease as of the day and year first above written.

ISLIP RESOURCE RECOVERY AGENCY

By_____:
Name:
Title:

ACE – Blydenburgh Solar, LLC
By: _____
Name:
Title:

STATE OF _____)
SS
STATE OF _____)

On the _____ day of _____ in the year 2015 before me, the undersigned, personally appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Signature and Office of individual taking acknowledgment

STATE OF _____)
ss.:
COUNTY OF _____)

On the _____ day of _____ in the year 2015 before me, the undersigned, personally appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Signature and Office of individual taking acknowledgment

EXHIBIT H

Interconnection Easement to LIPA

RENEWABLE ENERGY FACILITY ELECTRIC INTERCONNECTION EASEMENT

THIS INDENTURE, made this _____day of _____2015, by and between Islip Resource Recovery Agency,with its principal offices at One Independence Hill, Farmingville, New York 11738 (hereinafter referred to as "Grantor"); and the PSE&G-Long Island (hereinafter referred to as "LIPA") having its principal office at 333 Earl Ovington Boulevard, Suite 403, Uniondale, New York 11533 (hereinafter referred to "Grantee"). (Grantor and Grantee are collectively referred to herein as the "Parties").

RECITALS

WHEREAS, the Grantor is the owner in fee simple absolute of certain parcels of land and all the estate therein, which parcels are located in the Town of Islip, County of Suffolk, State of New York and are designated on the Suffolk County Tax Map as set forth in "Exhibit A" which is attached hereto and made a part hereof (collectively, the "Agency Property");

WHEREAS, Grantee is willing to accept an easement over the Agency Property (the "Easement") for the uses and purposes and on the terms and conditions herein set forth;

WHEREAS, Grantee, and _____ ("Lessee") are parties to a certain Contract for the Purchase and Sale of Renewable Energy, Renewable Energy Certificates and Capacity dated as of _____, 2015 as same may be amended, restated or otherwise modified from time to time (the "PPA"), pursuant to which Lessee is to construct solar generating facilities ("SGFs") and/or wind energy facilities ("WEFs") related electrical transmission lines on the Agency's Property;

WHEREAS, pursuant to the PPA, Grantee is to construct, install and maintain electrical interconnection lines between Lessee's SGFs and WEFs and Grantee's electrical system to be located on the parcels identified in Exhibit A and in accordance with the terms and conditions set forth in that certain Lease between Lessee and Grantor, dated as of _____, 2015 (the "Renewable Energy Lease").

NOW, THEREFORE, for and in consideration of the premises and the sum of _____ AND NO/100 DOLLARS ($_____.00) and other good and valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, Grantor does hereby grant and convey to the Grantee, and its successors and assigns, an easement in, on, under, over, upon, across and through a portion of Grantor's Property described in

Schedule "A" (hereinafter referred to as the "Easement Area"), attached hereto and made a part hereof, of which a map or survey is also attached herein and made a part hereof as Schedule "B".

1. Recitals. The Parties acknowledge that the foregoing recitals are true and correct and hereby incorporated into this Easement as if fully set forth herein.

2. Grant of Easement. Grantor does hereby grant and convey to the Grantee and its agents, successors and assigns, a non-exclusive easement in, on, under, over, upon, across and through the Easement Area for utility purposes including, but not limited to constructing, reconstructing, relocating, operating, repairing, maintaining and, at their pleasure removing overhead, underground or grade level electric interconnection systems, including but not limited to interconnection structures, poles, wires, cables, guys, anchors, switchgear and transformers together with the necessary manholes, conduits, appurtenances and accessories (collectively, the "Utility Facilities") as said Grantee may now and from time to time deem necessary, all within the Easement Area, as well as ingress and egress in, over, under, upon, across and through the Easement Area, with full rights and authority to enter upon and excavate the Easement Area.

3. Grantee shall have the right to do all things necessary, useful or convenient for the purpose outlined in Section 2 hereof. Grantor hereby covenants with Grantee that Grantee shall have quiet and peaceful possession, use and enjoyment of the easement granted herein. The Grantee agrees to reasonably restore any Easement Area or other areas of the Grantor's Property disturbed by the Grantee to a condition reasonably similar to that which existed prior to the disturbance.

4. Access From Street. The privilege of such access from the street to the Easement Area as is necessary for the enjoyment of the easements and right-of-ways herein granted.

5. Ownership of Utility Facilities. The Utility Facilities from time to time installed, constructed and maintained by Grantee in the Easement Area shall at all times be and remain the property of Grantee, and be maintained and serviced exclusively by Grantee.

6. Warranty of Title. Grantor covenants that it is seized of the Property and, for itself, its successors and assigns, forever warrants its title thereto and will defend the Easements and right-of-ways herein granted, forever, against all lawful claims and demands.

7. Covenants Running with the Land. This Easement, and all the rights, conditions, covenants and interests set forth herein and created hereby are intended to and shall run with the land and shall be binding upon and inuring to the benefit of the Parties hereto and their respective successors and assigns.

8. Approvals/Effect and Duration of Easement. This Easement shall become effective when executed by both Parties and in accordance with Section 112 of the New York State Finance Law,

shall not be valid, effective or binding upon the Parties until the approval of the Comptroller of the State of New York, the New York State Attorney General and the approval of the Grantor have been received and the Parties agree to be bound by the clauses in Appendix A hereto, which is made a part of this Agreement. This Easement shall remain in full force and effect until the later to occur of: (i) the twenty-first (21st) anniversary of the date on which electricity is generated, delivered and sold (excluding start-up and testing) by to Grantee for the last SGF to be installed, in accordance with the terms and conditions set forth in the PPA or, (ii) the date which is three (3) months after the expiration of the PPA.

9. Rights Reserved. The easement rights granted herein are non-exclusive in nature and are subject to all matters of record. Grantor shall have the right to use the Easement Area, or any portion thereof, or any property of Grantor adjoining the Easement Area for any purpose not inconsistent with the full use and enjoyment of the rights granted herein in favor of Grantee. Grantor agrees not to erect or maintain within the Easement Area any permanent buildings, structures or physical obstructions of any kind, including trees and shrubbery, or permit the same to be so erected or maintained, except such as Grantee may specifically consent to in writing, which consent shall not be unreasonably withheld or delayed.

10. Compliance with Requirements. Grantee covenants, warrants and represents that it shall, at all times, comply with any and all orders, directives, requests and rules and regulations of the Grantor and of each and every municipality, Agency and/or agency having jurisdiction of any work to be performed in the Easement Area.

11. No Gratuities. Grantor represents and warrants that neither the Grantor nor any official, officer, or employee of Grantor, has offered or given any gratuity to any official, employee or agent of Grantee, New York State or any political party with the purpose or intent of securing favorable treatment with respect to the awarding or amending of an agreement, or the making of any determinations with respect to the performance of an agreement.

12. Execution. The Parties warrant and represent that their execution of this Easement has been properly authorized.

13. No Waiver. This Easement is not a waiver of any claim for damage or for use of any property not restored promptly to Grantor, nor a waiver of any claim for personal injury.

14. Miscellaneous. No modification or amendment of this Easement shall be of any force or effect unless in writing executed by both Grantor and Grantee and recorded in the Suffolk County Clerk's Office. This Easement sets forth the entire agreement between Grantor and Grantee relating to the easement and all subject matter herein and supersedes all prior and contemporaneous negotiations, understandings and agreements, written or oral, between the Parties.

IN WITNESS WHEREOF, the Grantor and Grantee have duly executed this Easement as of the date first above written.

PSEG fka Long Island Lighting Company d/b/a LIPA
By: _____
Name:
Title:
Date:

Agency of Islip
By: _____
Name:
Title:
Date:

STATE OF NEW YORK}
SS:
COUNTY OF SUFFOLK}

in the year 2015 before me, the undersigned, personally appeared_____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individuals(s), or the person upon behalf of which the

_____
(signature and office of individual taking acknowledgement)

STATE OF NEW YORK}
SS:
COUNTY OF }

in the year 2015 before me, the undersigned, personally appeared_____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individuals(s), or the person upon behalf of which the

_____
(signature and office of individual taking acknowledgement)

EXHIBIT A to LIPA Easement

SCHEDULE A to LIPA Easement
[Description of Easement Area]

SCHEDULE B to LIPA Easement

[Map/Survey of Easement Area]

APPENDIX A to LIPA Easement

[unknown 'clauses' – TBD by LIPA]

EXHIBIT I

Form of Parent Guarantee

PARENT GUARANTY AGREEMENT

THIS PARENT GUARANTY AGREEMENT (this "**Guaranty**") is entered into as of the ____ day of March, 2016, by **American Capital Energy, Inc.**, as guarantor (the "**Guarantor**"), for the benefit of the **Town of Islip Resource Recovery Agency**, a body corporate and politic constituting a public benefit corporation and a public authority (the "**Agency**").

WITNESSETH:

WHEREAS, **ACE – Blydenburgh Solar, LLC** (the "**Company**") and the Agency are parties to a Renewable Energy Lease Agreement (the "**Lease**") dated March ___, 2016; and

WHEREAS, as a condition of, and in accordance with, the Lease, the Company is required to cause this Guaranty to be executed and delivered by the Guarantor to the Agency; and

WHEREAS, the Guarantor is a member/shareholder of the Company, and the Guarantor will receive a benefit from the Company and the Agency as a result of their entering into the Lease; and

WHEREAS, the Guarantor, as an inducement to the Agency to enter into the Lease, is entering into this Guaranty; and

WHEREAS, capitalized terms used but not defined in this Guaranty shall have the meanings ascribed to such terms in the Lease, and the term "parties" as used herein, shall mean the Guarantor and the beneficiary of this Guaranty, the Agency.

NOW, THEREFORE, for the purposes described in the foregoing recitals and intending to be legally bound, the Guarantor hereby agrees as follows:

ARTICLE I
Representations and Warranties of the Guarantor

1.01 **Representations and Warranties**. The Guarantor represents and warrants that:

(a) The Guarantor is a Massachusetts corporation in good standing;

(b) The Guarantor possesses all requisite power and authority under applicable laws to enter into and to perform all of the covenants and agreements set forth in this Guaranty;

(c) The Guarantor has duly authorized all necessary action on its part to enter into this Guaranty in accordance with applicable laws; and

(d) The Guarantor has duly executed and delivered this Guaranty.

ARTICLE II
Covenants and Agreements of the Guarantor

2.01 **Unconditional Guaranty; Defenses and Claims.**

(a) Guarantor hereby guarantees, absolutely, unconditionally and irrevocably, for the benefit of the Agency, the full and prompt performance of all obligations of the Company to the Agency under the Lease in accordance with its respective provisions, including without limitation, the obligation to pay money or damages owed by the Company for its failure to so perform such obligations (collectively, the "**Guaranteed Obligations**").

(b) Notwithstanding the unconditional nature of Guarantor's obligations in Section 2.01(a), Guarantor shall have the right to assert any and all legal or equitable rights or defenses, including, but not limited to, counterclaims, set-offs or deductions, the Company may have under the Lease or under applicable law (other than bankruptcy or insolvency of the Company, and other than any defense which Company or Guarantor expressly waived), and may bring independent claims against the Agency not arising from the Lease.

(c) Guarantor expressly does not waive or release any such right or defense, and any of the same may be asserted by Guarantor against the Agency, and shall remain in full force and effect for the Guaranty term.

2.02 **Assignment.** Guarantor acknowledges that the Agency may assign all of its rights and interests in this Guaranty to the Bank of New York, as Trustee under an Indenture of Trust dated as of December 1, 1985 between the Agency and the Trustee. Guarantor may assign this Guaranty only with the Agency's prior, written consent, which shall not be unreasonably withheld, delayed, or conditioned.

2.03 **Manner of Payment**. All payments required to be made by the Guarantor under this Guaranty shall be made in lawful money of the United States of America.

2.04 **Obligations of Guarantor Absolute**. The obligations of the Guarantor under this Guaranty shall be absolute, irrevocable and unconditional, and, except as expressly set forth in the Lease as an underlying right of the Company, shall not be subject to any set-off, counterclaim, reduction or diminution due to any event or condition affecting the ability of the Company to perform the obligations of the Company in accordance with the Lease (other than events or conditions for which, under the specific provisions of the Lease, there is a discharge, release, or such performance is otherwise excused), or to any requirement in any case that the Agency first enforce any remedies that it may have against the Company or any other person, or seek to compel the Company to perform under the Lease before proceeding against Guarantor hereunder; and the Guaranteed Obligations shall not be affected, modified, diminished or impaired upon the happening, from time to time, of any of the following events, each of which is hereby expressly waived as a defense to its liability hereunder:

(a) The failure of the Guarantor to receive notice of the occurrence of a default under the Lease;

(b) The neglect or failure of the Company to enforce, to assert, or to exercise or preserve, any right, or rights of action, or power or remedy, against any party, person or property;

(c) The compromise, settlement, release, alteration, indulgence, waiver or any other change or modification of any obligation or liability of the Company under the Lease, except to the extent to which such obligation or liability shall have been expressly compromised, settled, released, altered, indulged, waived, changed or modified in writing by the Agency;

(d) The voluntary or involuntary liquidation, dissolution, sale or other disposition of all or substantially all the assets, marshalling of assets and liabilities, receivership, insolvency, bankruptcy, assignment for the benefit of creditors, reorganization, arrangement, composition with creditors or readjustments or other similar proceedings relating to the Company or any of its assets;

(e) The release of the Guarantor from performance or observance of any obligation, covenant or agreement contained in this Guaranty, except to the extent such may be expressly released in writing by the Agency;

(f) The default or failure of the Guarantor fully to perform any of its obligations set forth in this Guaranty;

(g) The Guarantor's assignment or delegation by operation of law or otherwise of this Guaranty or its obligations hereunder, other than those assignments consented to by Agency, pursuant to Section 2.02;

(h) Any allegation or contest of the validity of this Guaranty in any proceeding; or

(i) The transfer, assignment or encumbrance, or the purported or attempted transfer, assignment or encumbrance, by the Company of all or any part of its interest in the Facility or its rights under the Lease.

2.05 **Obligations of Guarantor Not Affected by Bankruptcy**. The obligations of the Guarantor hereunder shall not be affected by any bankruptcy, arrangement of creditors, reorganization or other similar proceedings of the Company; and the Guarantor specifically waives any right or benefit which could accrue to it by reason of any such proceeding and agrees that the same shall not affect the liability of the Guarantor hereunder, regardless of the effect that such proceedings may have with respect to the obligations of the Company.

2.06 **Dissolution or Merger of Guarantor; Restrictions on Guarantor**. The Guarantor covenants and agrees that at all times during the term of this Guaranty, it will (i) maintain its corporate existence, (ii) continue to be a corporation subject to service of process in New York State and either organized under the laws of the New York State, or organized under the laws of any other state of the United States and duly qualified to do business as a foreign corporation in New York, (iii) continue to be a corporation organized under the laws of a state of the United States, (iv) not liquidate, wind-up or dissolve or otherwise dispose of all or

substantially all of its property, business or assets, and (v) not consolidate with or merge into another corporation or permit one or more corporations to consolidate with or merge into it. The Guarantor may, however, without violating the foregoing, consolidate with or merge into another corporation, or permit one or more corporations to consolidate with or merge into it, or sell or otherwise transfer all or substantially all of its property, business or assets to another such corporation (and thereafter liquidate, wind-up or dissolve or not, as the Guarantor may elect) if (i) the Guarantor is the surviving, resulting or transferee corporation, as the case may be, or (ii) in the event that the Guarantor is not the surviving, resulting or transferee corporation, as the case may be, such corporation (A) is a solvent corporation and either organized under the laws of New York State, or organized under the laws of any other state in the United States and has consented to jurisdiction in New York State and service of process pursuant to the terms of Section 3.04 hereof, (B) assumes in writing all of the obligations of the Guarantor contained in this Guaranty, and in an opinion of counsel, which opinion and which counsel is acceptable to the Agency and the Trustee, (x) such corporation shall be bound by all of the terms applicable to the Guarantor of this Guaranty and (y) such action does not legally impair the security for the Holders of the 1985 Facility Bonds, and (C) has a net worth (as determined in accordance with generally accepted accounting principles and certified by an independent public accountant) after the merger, consolidation, sale or transfer at least equal to that of the Guarantor immediately prior to such merger, consolidation, sale or transfer.

ARTICLE III
Miscellaneous

3.01 **Time When Guaranty Effective**. The Lease has been fully executed and delivered by the Company and the Agency as of the date hereof, and, therefore, the obligations of the Guarantor hereunder shall be effective as of the date hereof.

3.02 **Remedies of Agency**. In the event of default by the Guarantor in the punctual discharge of its obligations hereunder, the Agency shall be entitled to enforce this Guaranty to the fullest extent provided by applicable law.

3.03 **Pursuit; Waiver**. No remedy conferred upon or reserved to the Agency hereunder is intended to be exclusive of any other available remedy or remedies, but each and every such remedy shall be cumulative and shall be in addition to every other remedy given under this Guaranty or now or hereafter existing at law or in equity or by statute. The Agency shall have no obligation to pursue its remedies against the Company before pursuing the Guarantor under this Guaranty. If the Company has breached or defaulted on any obligations that are Guaranteed Obligations hereunder, Guarantor shall be obligated hereunder upon receipt of notice thereof given as provided in Section 3.06. In order to entitle the Agency to exercise any remedy reserved in this Guaranty, it shall not be necessary to give any notice, other than such notice. No delay or omission to exercise any right or power accruing upon any default, omission or failure of performance hereunder shall impair any such right or power or shall be construed to be a waiver thereof, but any such right and power may be exercised, from time to time, and as often as may be deemed expedient. In the event any provision contained in this Guaranty should be breached by any party and thereafter duly waived by the other party so empowered to act, such waiver shall be limited to the particular breach so waived and shall not be deemed to waive any other breach hereunder. No waiver, amendment, release or modification hereof shall be

established by conduct, custom or course of dealing, but shall be established solely by an instrument, in writing, duly executed by the appropriate parties.

3.04 **Consent to Jurisdiction; Service of Process**. The Guarantor irrevocably and unconditionally (a) agrees that any suit, action or other legal proceeding arising out of this Guaranty may be brought in the courts of record of the State of New York or the courts of the United States, Eastern District of New York; (b) consents to the jurisdiction of each such court in any such suit, action or proceeding; and (c) waives any objection which it may have to the laying of venue of any such suit, action or proceeding in any of such courts; provided, however, that nothing in this Guaranty shall be deemed to limit or deny the applicability of those provisions of the Lease governing dispute procedures which shall apply to the Guarantor as well as the Company. Guarantor hereby designates and appoints, without power of revocation, the Chief Operating Officer of Guarantor and his successor(s) as its agent for service of process, and if such agent shall cease to act or otherwise cease to be subject to service of process in the State of New York, the Secretary of State of the State of New York, as the respective agents of the Guarantor upon whom may be served all process, pleadings, notices or other papers which may be served upon the Guarantor as a result of any of its obligations under this Guaranty; provided, however, that the serving of such process, pleadings, notices or other papers shall not constitute a condition to the obligations of Guarantor hereunder. A copy of all such process, pleadings, notices or other papers shall, concurrently with service upon such agent, be sent by registered or certified mail, postage prepaid, to the persons set forth in Section 3.07 hereof, or to such persons and addresses as may be furnished by Guarantor to the Agency and the Trustee in writing. Guarantor agrees and consents that any such service of process upon such agent and written notice of such service to Guarantor in the manner set forth herein shall be taken and held to be valid personal service upon Guarantor whether or not Guarantor shall then be doing, or at any time shall have done, business within the State of New York and that any such service of process shall be of the same force and validity as if service were made upon it according to the laws governing the validity and requirements of such service in the State of New York and waives all claim of error by reason of any such service. Such agent shall not have any power or authority to enter an appearance or to file any pleadings in connection with any suit, action or other legal proceedings against Guarantor or to conduct the defense of any such suit, action or any other legal proceeding except as expressly authorized by Guarantor.

3.05 **Liability**. Nothing contained in this Guaranty shall create any obligation of or right to look to any Guarantor director, officer, employee or stockholder (or any affiliate thereof) to satisfy a Guarantor obligations hereunder, and no judgment, order or execution with respect to or in connection with this Guaranty shall be taken against any such director, officer, employee or stockholder.

3.06 **Entire Agreement**. This Guaranty constitutes the entire agreement, and supersedes all prior agreements and understandings, both written and oral, among the parties with respect to the subject matter hereof.

3.07 **Expenses**. Guarantor shall pay to the Agency all reasonable costs and expenses (including the fees and disbursements of counsel) incurred in the enforcement of its rights against Guarantor hereunder, if Agency is the prevailing party in such enforcement action.

3.08 **Notices**. All notices or demands and other communications under this Guaranty shall be in writing and shall be sufficiently given if (i) delivered in person, (ii) sent by overnight courier and evidence of delivery is obtained, (iii) sent by e-mail with evidence of receipt of such email, or (iv) sent by certified or registered mail, return receipt requested, postage prepaid, and (where applicable) addressed as provided below:

To Guarantor:	American Capital Energy, Inc. 360 Merrimack Street Building 9, Entrance K Suite 202 Lawrence, Ma. 01843 Attention: Chief Operating Officer
With a copy to:	American Capital Energy, Inc. 360 Merrimack Street Building 9, Entrance K Suite 202 Lawrence, Ma. 01843 Attention: Chief Legal Officer
To Agency:	Islip Resource Recovery Agency 401 Main St. Islip, N.Y. 11751 ATTN: President

3.09 **Severability**. The provisions of this Guaranty shall be severable, and in the event of the invalidity or unenforceability of any one or more phrases, sentences, clauses, Articles, Sections or parts contained in this Guaranty, such invalidity or unenforceability shall not affect the validity or enforceability of any remaining portions thereof.

3.10 **Choice of Law**. This Guaranty shall be construed in accordance with and shall be governed by the laws of the State of New York, without regard to conflict of laws principles.

3.11 **Term**. This Guaranty shall remain in full force and effect until the Guaranteed Obligations shall have been fully performed.

3.12 **Amendment**. This Guaranty may be amended and/or supplemented, from time to time, only by a written document duly executed by the Guarantor and the Agency.

IN WITNESS WHEREOF, the Guarantor, intending to be legally bound and pursuant to proper authorization of its governing body, does hereby cause this Guaranty to be executed by its duly authorized officer, all as of the day and year first above written.

AMERICAN CAPITAL ENERGY, INC.

By: _____
Name: _____
Title: _____

APPENDIX IE

Loading Calculations

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (Mid Aisle Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	5.5	#
No. of Panel Widths per Span	5.50	#
No. of Panel Widths per Overhang	0.75	#
Purlin Span Length	18.24	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE 7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE 7-10

According to Equation (27.3-1)

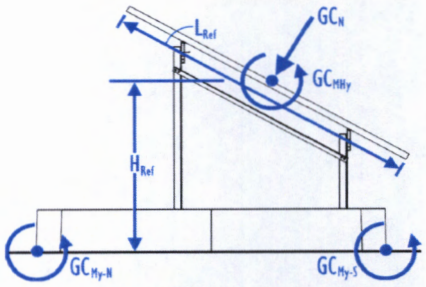
qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.

GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.



Schematic of wind load coefficients – PourInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$

Zone	Tilt/height*	GC_N		GC_{Mv}		$GC_{Mv\text{-}N}$		$GC_{Mv\text{-}S}$	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

* Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

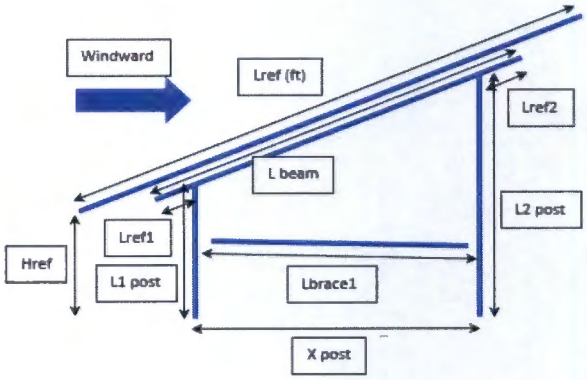
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv	SF_{FDN}
Safety Factor	1.5	1.5	1.5	1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50	
Post	GC361WP 12 Ga	Grade	50	

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	6x3.12Sx1
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)				
	Axial load (kip)				
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)	0.00	13.72	10.29	-13.43
	Axial load (kip)	1.40	1.39	1.98	-1.01
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\le 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Aisle	ΩcP/Pn	0.027	0.027	0.039	0.020	
	ΩbMx/Mnx	0.000	0.127	0.095	0.124	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
Post	Sum	**0.027**	**0.154**	**0.134**	**0.144**	<1 OK
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

Axial force (kip)	Combo 2	Combo 3	Combo 4	Combo 5 (Upl	kip P	kip-in Mx	kip-in My
North Row End							
North Row Mid							
Mid Aisle	0.00	0.08	0.06	-0.08	0.08	0	
Mid Row Mid							
Mid Row End							
South Row Mid							
South Row End							

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

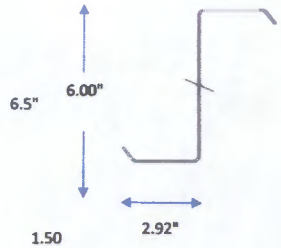
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum
North Row End				
North Row Mid				
Mid Aisle	0.004	0.000	0.008	0.012 OK
Mid Row Mid				
Mid Row End				
South Row Mid				
South Row End				

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)	9.63	10.66	14.45	-8.00
	Axial load (kip)	0.39	0.06	0.31	0.04
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

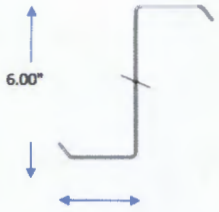
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Aisle	ΩcP/Pn	0.014	0.002	0.011	0.001	
	ΩbMx/Mnx	0.186	0.206	0.279	0.154	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
	Sum	**0.200**	**0.208**	**0.290**	**0.155**	<1 OK
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
[illegible]	[illegible]					
	[illegible]					
	[illegible]					
	[illegible]					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
[illegible]	[illegible]				
North Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Aisle	moment major (kip-in)	28.95	32.04	43.42	-24.02
	moment minor (kip-in)	2.57	0.41	2.03	0.25
Mid Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
[illegible]	[illegible]				
South Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
South Row End	moment major (kip-in)				
	moment minor (kip-in)				

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	68.08	79.89	56.75	74.64
Light Grade Strength	68.08	79.89	56.75	74.64

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	68.06	25.45	56.73	23.78
Light Grade Strength	68.06	25.45	56.73	23.78

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\leq 1.0$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Aisle	ΩbMx/Mnx	0.510	0.565	0.765	0.423	
	ΩbMy/Mny	0.108	0.017	0.086	0.010	
Light Grade	Sum	**0.618**	**0.582**	**0.851**	**0.434**	<1 OK
Mid Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					

Deflection Check

Allowable deflection per panel manufacturer = L/ 100 (0.01mm/mm)

	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Max at midspan (in)		0.309			
Δ / L		0.001			
Check		OK			

Purlin Angle Check: OK

Note:
The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values

Ss	0.195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 11.5-2
W	3.15	psf	
Cs	0.06	g	Per Eq. 12.8-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated for analysis.

Wind load controls the design.

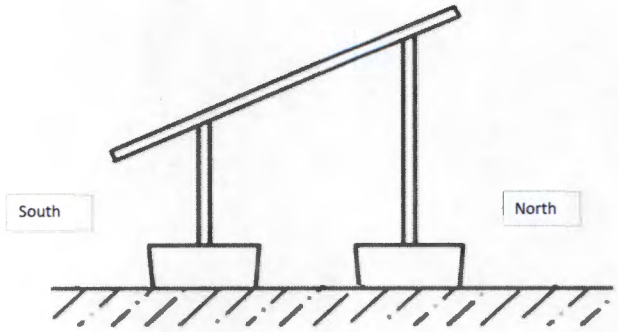
4. Foundation

Ballast Properties

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Concrete Height (in)							
Weight of Ballast (lb)			2931				

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)			6.59				
Resistive Moment			11.14				
Overturning Check			1.69				
Safety Factor Check			OK				

Max Uplift / Sliding Check

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Wind Uplift (k)			-1.36				
Ballast Weight (lb)			2931				
Horizontal Resistance (k)			1.15				
Horizontal Load (k)			0.65				
Safety Factor			1.77				
Safety Factor Check			OK				

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
[illegible]	[illegible]						
North Row Mid	Max Bearing Pressure						
Mid Aisle	Max Bearing Pressure	0.43	0.44	0.50	496	3.45	OK
Mid Row Mid	Max Bearing Pressure						
[illegible]	[illegible]						
South Row Mid	Max Bearing Pressure						
South Row End	Max Bearing Pressure						

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (Mid Row End Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	4	#
No. of Panel Widths per Span	4.00	#
No. of Panel Widths per Overhang	0.50	#
Purlin Span Length	13.26	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE7-10

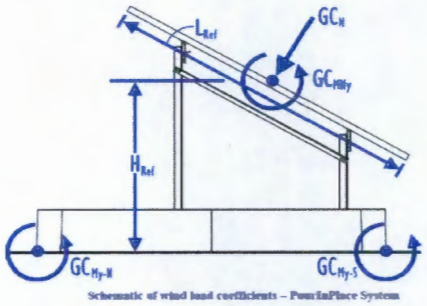
According to Equation (27.3-1)

qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.
GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.

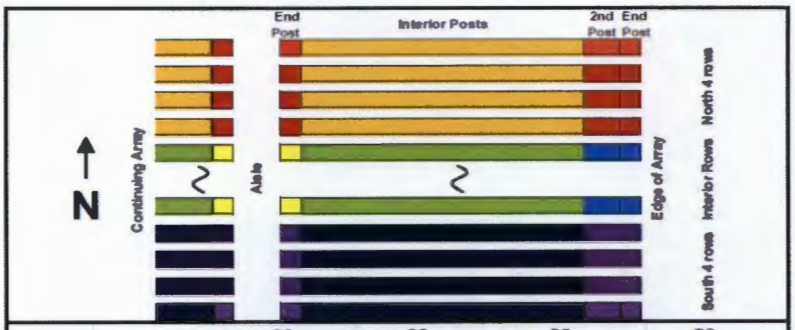


Schematic of wind load coefficients – PourInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$



Zone	Tilt/height*	GC_N		GC_{Mv}		$GC_{Mv\text{-}N}$		$GC_{Mv\text{-}S}$	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

* Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

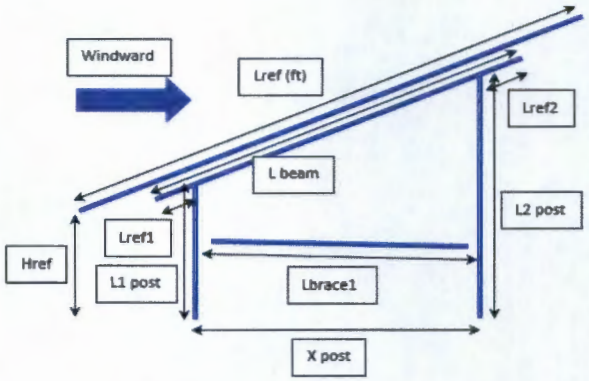
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv		SF_{FDNL}
Safety Factor	1.5	1.5	1.5		1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50
Post	GC361WP 12 Ga	Grade	50

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel 6x3.125x1
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)				
	Axial load (kip)				
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)	0.00	9.35	7.02	-14.91
	Axial load (kip)	1.02	0.96	1.40	-1.17
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\leq 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
[illegible]	[illegible]	0.020	0.019	0.027	0.023	
		0.000	0.087	0.065	0.138	
		0.000	0.000	0.000	0.000	
[illegible]	[illegible]	**0.020**	**0.105**	**0.092**	**0.161**	<1 OK
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

Axial force (kip)	Combo 2	Combo 3	Combo 4	Combo 5 (Upl	kip P	kip-in Mx	kip-in My
North Row Mid							
Mid Aisle							
Mid Row Mid							
South Row Mid	0.00	0.06	0.04	-0.09	0.09	0	
South Row End							

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

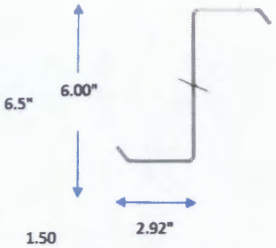
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum
North Row Mid				
Mid Aisle				
Mid Row Mid				
South Row Mid	0.004	0.000	0.009	0.013 <1 OK
South Row End				

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
[illegible]	[illegible]				
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
[illegible]	[illegible]	6.98	7.31	10.15	-9.19
	[illegible]	0.28	0.05	0.22	0.05
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

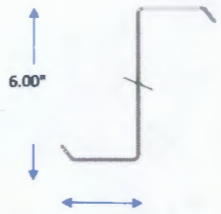
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
[illegible]	[illegible]	0.010	0.002	0.008	0.002	
	[illegible]	0.134	0.141	0.196	0.177	
	[illegible]	0.000	0.000	0.000	0.000	
	[illegible]	**0.145**	**0.142**	**0.204**	**0.179**	<1 OK
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Aisle	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row End	moment major (kip-in)	15.18	15.90	22.09	-20.00
	moment minor (kip-in)	1.34	0.21	1.06	0.21
South Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
South Row End	moment major (kip-in)				
	moment minor (kip-in)				

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	78.65	81.08	72.77	81.08
Light Grade Strength	78.65	81.08	72.77	81.08

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	78.62	25.83	72.74	25.83
Light Grade Strength	78.62	25.83	72.74	25.83

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\leq 1.0$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
[illegible]	[illegible]					
[illegible]	[illegible]					
North Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Aisle	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
[illegible]	[illegible]	0.209	0.219	0.304	0.275	
	[illegible]	0.052	0.008	0.041	0.008	
[illegible]	[illegible]	**0.260**	**0.227**	**0.345**	**0.283**	<1 OK
South Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					

Deflection Check

Allowable deflection per panel manufacturer = L/ 180 (0.01mm/mm)

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Max at midspan (in)					0.082		
Δ / L					0.001		
Check					OK		

Purlin Angle Check: OK

Note:

The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values

Ss	0.195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 1.5-2
W	3,315	psf	
Cs	0.06	g	Per Eq. 15.4-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated for analysis.

Wind load controls the design.

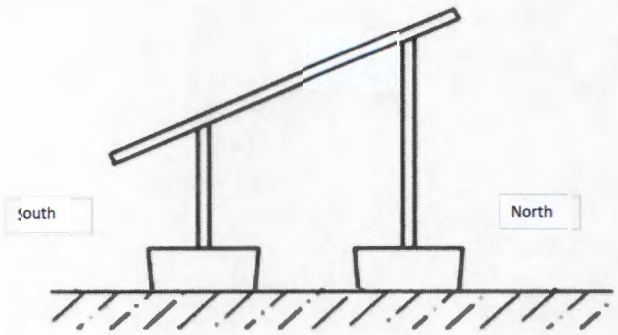
4. Foundation

Ballast Properties

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Concrete Height (in)							
Weight of Ballast (lb)					3311		

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)					7.57		
Resistive Moment					12.09		
Overturning Check					1.60		
Safety Factor Check					OK		

Max Uplift / Sliding Check

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Wind Uplift (k)					-1.53		
Ballast Weight (lb)					3311		
Horizontal Resistance (k)					1.22		
Horizontal Load (k)					0.56		
Safety Factor					2.18		
Safety Factor Check					OK		

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
[illegible]	[illegible]						
North Row Mid	Max Bearing Pressure						
Mid Aisle	Max Bearing Pressure						
Mid Row Mid	Max Bearing Pressure						
[illegible]	[illegible]	0.38	0.44	0.46	464	3.22	OK
South Row Mid	Max Bearing Pressure						
South Row End	Max Bearing Pressure						

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (Mid Row Mid Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	7	#
No. of Panel Widths per Span	7.00	#
No. of Panel Widths per Overhang	1.50	#
Purlin Span Length	23.21	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE 7-10

According to Equation (27.3-1)

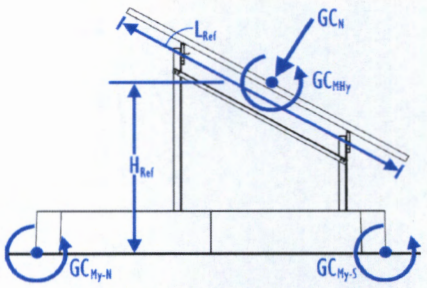
qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.

GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.

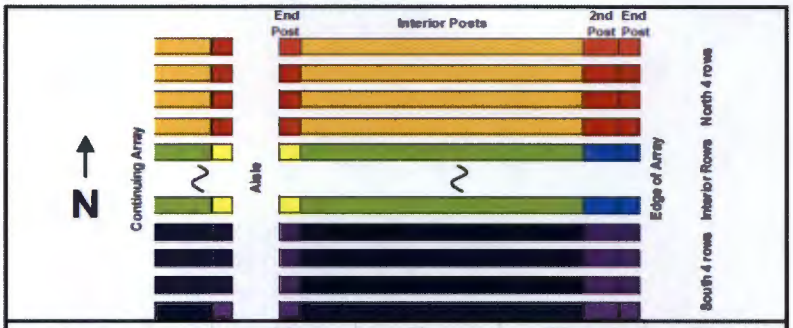


Schematic of wind load coefficients – PourInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$



Zone	Tilt/height*	GC_N		GC_{Mlv}		$GC_{Mv\text{-}N}$		$GC_{Mv\text{-}S}$	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

*Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

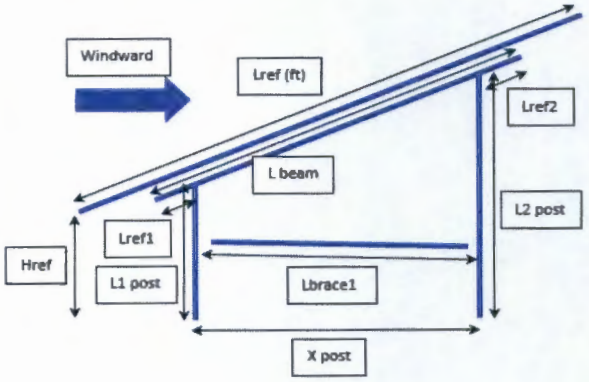
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv		$SF_{FDN.}$
Safety Factor	1.5	1.5	1.5		1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50
Post	GC361WP 12 Ga	Grade	50

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel 6x3.125x1
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)				
	Axial load (kip)				
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)	0.00	7.35	5.51	-15.58
	Axial load (kip)	1.78	0.91	1.87	-1.15
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}} \le 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row Mid	ΩcP/Pn	0.035	0.018	0.037	0.023	
	ΩbMx/Mnx	0.000	0.068	0.051	0.144	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
Post	Sum	**0.035**	**0.086**	**0.088**	**0.167**	<1 OK
Mid Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

Axial force (kip)	Combo 2	Combo 3	Combo 4	Combo 5 (Upl	kip P	kip-in Mx	kip-in My
North Row Mid							
Mid Aisle							
Mid Row Mid	0.00	0.05	0.03	-0.10	0.10	0	
South Row Mid							
South Row End							

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

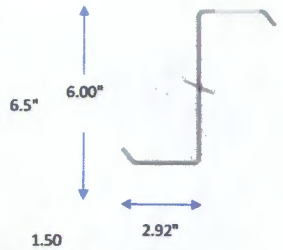
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \le 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum	
North Row Mid					
Mid Aisle					
Mid Row Mid	0.004	0.000	0.009	0.014	<1 OK
South Row Mid					
South Row End					

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)	12.29	6.87	13.38	-9.19
	Axial load (kip)	0.50	0.08	0.39	0.08
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

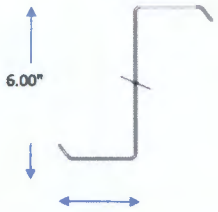
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Row Mid	ΩcP/Pn	0.018	0.003	0.014	0.003	
	ΩbMx/Mnx	0.237	0.132	0.258	0.177	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
	Sum	**0.255**	**0.135**	**0.272**	**0.180**	<1 OK
[illegible]	[illegible]					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Aisle	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row Mid	moment major (kip-in)	32.51	18.16	35.40	-24.32
	moment minor (kip-in)	3.58	0.57	2.83	0.57
South Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
South Row End	moment major (kip-in)				
	moment minor (kip-in)				

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	54.08	73.49	37.20	64.94
Light Grade Strength	54.08	73.49	37.20	64.94

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	54.06	23.41	37.19	20.69
Light Grade Strength	54.06	23.41	37.19	20.69

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0 \quad (C$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Aisle	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Row Mid	ΩbMx/Mnx	0.601	0.336	0.655	0.450	
	ΩbMy/Mny	0.153	0.025	0.121	0.025	
Light Grade	Sum	**0.754**	**0.361**	**0.776**	**0.474**	<1 OK
South Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					

Deflection Check

Allowable deflection per panel manufacturer = L/ 100 (0.01mm/mm)

	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Max at midspan (in)			0.595		
Δ / L			0.002		
Check			OK		

Purlin Angle Check: OK

Note:
The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values

Ss	0.195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 1.5-2
W	3.15	psf	
Cs	0.06	g	Per Eq. 15.4-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated for analysis.

Wind load controls the design.

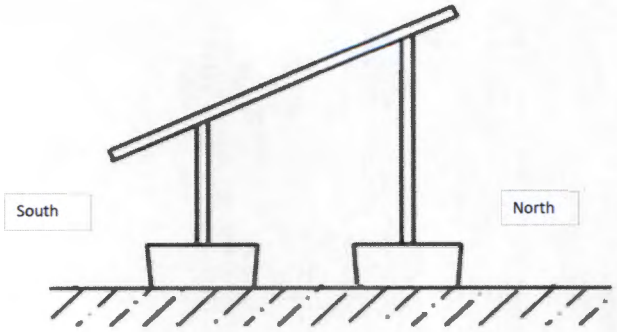
4. Foundation

Ballast Properties

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Concrete Height (in)							
Weight of Ballast (lb)				3506			

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)				8.08			
Resistive Moment				13.42			
Overturning Check				1.66			
Safety Factor Check				OK			

Max Uplift / Sliding Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Wind Uplift (k)				-1.52			
Ballast Weight (lb)				3506			
Horizontal Resistance (k)				1.46			
Horizontal Load (k)				0.55			
Safety Factor				2.65			
Safety Factor Check				OK			

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
North Row End	Max Bearing Pressure						
North Row Mid	Max Bearing Pressure						
Mid Aisle	Max Bearing Pressure						
Mid Row Mid	Max Bearing Pressure	0.43	0.46	0.51	513	3.56	OK
Mid Row End	Max Bearing Pressure						
South Row Mid	Max Bearing Pressure						
South Row End	Max Bearing Pressure						

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (North Row End Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	3.5	#
No. of Panel Widths per Span	3.50	#
No. of Panel Widths per Overhang	0.75	#
Purlin Span Length	11.61	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE7-10

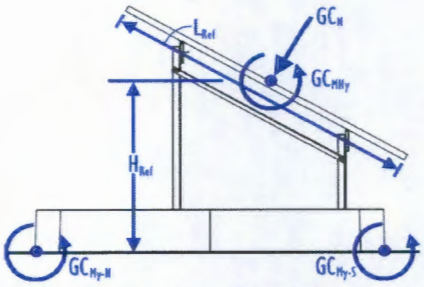
According to Equation (27.3-1)

qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.
GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.

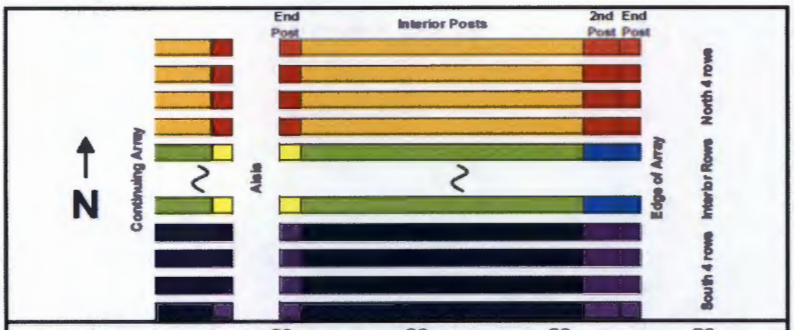


Schematic of wind load coefficients – PourInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$



Zone	Tilt/height*	GC_N		GC_{M-Int}		GC_{M-N}		GC_{M-S}	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

* Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

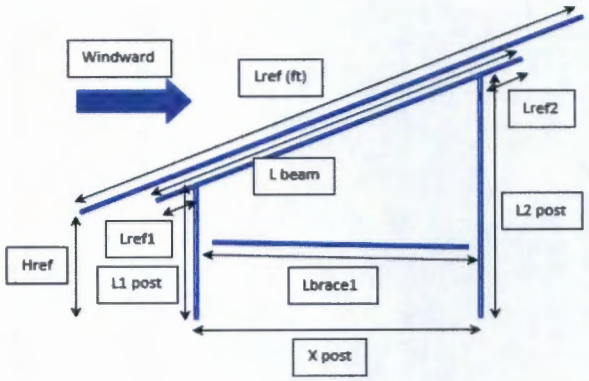
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv	$SF_{FDN.}$
Safety Factor	1.5	1.5	1.5	1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50
Post	GC361WP 12 Ga	Grade	50

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	6x3.125x1
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)	0.00	9.83	7.37	-14.48
	Axial load (kip)	0.89	0.98	1.33	-1.15
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\leq 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
[illegible]	[illegible]	0.017	0.019	0.026	0.022	
	[illegible]	0.000	0.091	0.068	0.134	
	[illegible]	0.000	0.000	0.000	0.000	
[illegible]	[illegible]	**0.017**	**0.110**	**0.094**	**0.156**	<1 OK
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
[illegible]	[illegible]					
	[illegible]					
	[illegible]					
[illegible]	[illegible]					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

					kip	kip-in	kip-in
Axial force (kip)	**Combo 2**	**Combo 3**	**Combo 4**	**Combo 5 (Upl**	**P**	**Mx**	**My**
[illegible]	0.00	0.06	0.05	-0.09	0.09	0	0.07
North Row Mid							0.06
Mid Aisle							0.04
Mid Row Mid							0.04
[illegible]							0.06
South Row Mid							0.05
South Row End							0.08

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

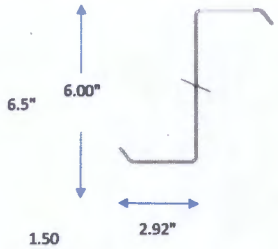
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum	
[illegible]	0.004	0.000	0.009	0.013	<1 OK
North Row Mid					
Mid Aisle					
Mid Row Mid					
[illegible]					
South Row Mid					
South Row End					

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
[illegible]	[illegible]	6.09	7.47	9.68	-8.97
	[illegible]	0.25	0.04	0.19	0.02
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
[illegible]	[illegible]				
	[illegible]				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

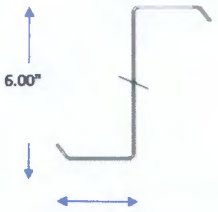
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn	0.009	0.001	0.007	0.001	
	ΩbMx/Mnx	0.117	0.144	0.187	0.173	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
	Sum	**0.126**	**0.145**	**0.194**	**0.174**	<1 OK
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
[illegible]						
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
		11.57	14.18	18.38	-17.04
		1.01	0.16	0.80	0.10
North Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Aisle	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row End	moment major (kip-in)				
	moment minor (kip-in)				
South Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
South Row End	moment major (kip-in)				
	moment minor (kip-in)				

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	81.08	81.08	76.95	81.08
Light Grade Strength	81.08	81.08	76.95	81.08

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	81.05	25.83	76.92	25.83
Light Grade Strength	81.05	25.83	76.92	25.83

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
[illegible]	[illegible]	0.150	0.184	0.239	0.221	
	[illegible]	0.039	0.006	0.031	0.004	
[illegible]	[illegible]	**0.190**	**0.191**	**0.270**	**0.225**	<1 OK
North Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Aisle	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
[illegible]	[illegible]					
[illegible]	[illegible]					
South Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					

Deflection Check

Allowable deflection per panel manufacturer = L/ 100 (0.01mm/mm)

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Max at midspan (in)	0.052						
Δ / L	0.000						
Check	OK						

Purlin Angle Check: OK

Note:
The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values

Ss	0.195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 1.5-2
W	3.15	psf	
Cs	0.06	g	Per Eq. 15.4-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated for analysis.

Wind load controls the design.

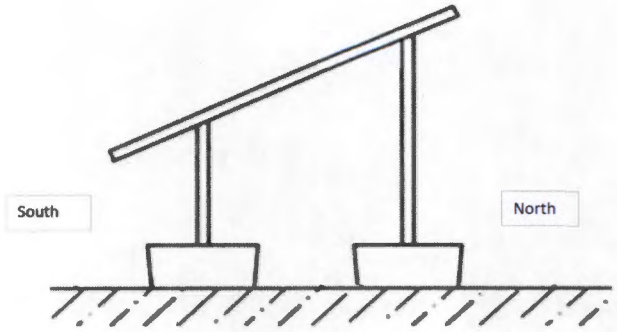
4. Foundation

Ballast Properties

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Concrete Height (in)	20	20	18	21	20	21	19
Weight of Ballast (lb)	3311						

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)	7.57						
Resistive Moment	11.97						
Overturning Check	1.58						
Safety Factor Check	OK						

Max Uplift / Sliding Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Wind Uplift (k)	-1.45						
Ballast Weight (lb)	3311						
Horizontal Resistance (k)	1.25						
Horizontal Load (k)	0.53						
Safety Factor	2.36						
Safety Factor Check	OK						

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
North Row End	Max Bearing Pressure	0.37	0.44	0.45	450	3.13	OK
North Row Mid	Max Bearing Pressure						
Mid Aisle	Max Bearing Pressure						
Mid Row Mid	Max Bearing Pressure						
Mid Row End	Max Bearing Pressure						
South Row Mid	Max Bearing Pressure						
South Row End	Max Bearing Pressure						

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (North Row Mid Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	4.5	#
No. of Panel Widths per Span	4.50	#
No. of Panel Widths per Overhang	0.75	#
Purlin Span Length	14.92	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE7-10

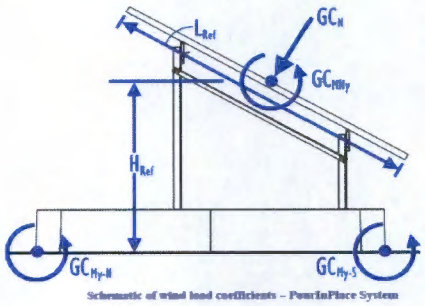
According to Equation (27.3-1)

qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.
GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.

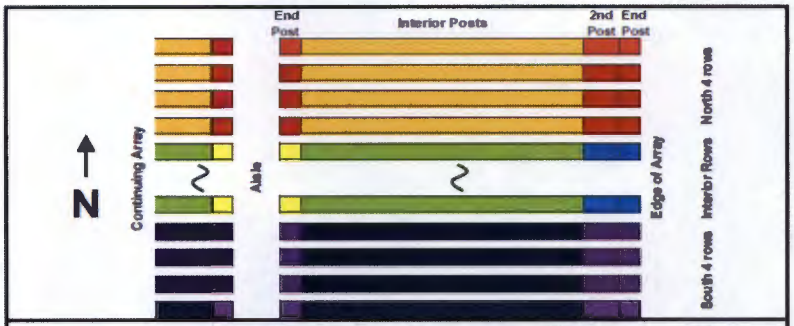


Schematic of wind load coefficients – PowerInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$



Zone	Tilt/height*	GC_N		GC_{MHv}		$GC_{Mv\text{-}N}$		$GC_{Mv\text{-}S}$	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

* Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

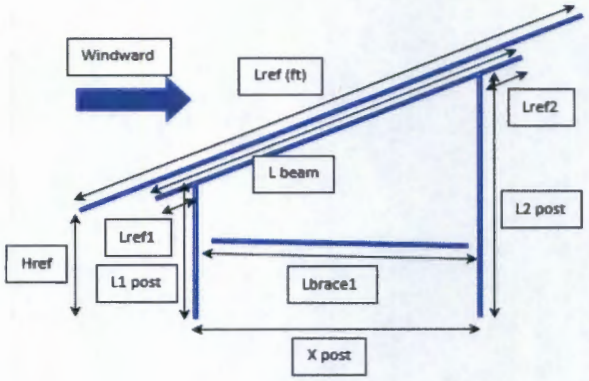
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv	$SF_{FDN.}$
Safety Factor	1.5	1.5	1.5	1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50
Post	GC361WP 12 Ga	Grade	50

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel 6x3.125x1
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)				
	Axial load (kip)				
North Row Mid	Moment (kip-in)	0.00	5.55	4.16	-14.68
	Axial load (kip)	1.14	0.65	1.26	-1.14
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\leq 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row Mid	ΩcP/Pn	0.022	0.013	0.025	0.022	
	ΩbMx/Mnx	0.000	0.051	0.039	0.136	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
Post	Sum	**0.022**	**0.064**	**0.063**	**0.158**	<1 OK
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

Axial force (kip)	Combo 2	Combo 3	Combo 4	Combo 5 (Upl	kip P	kip-in Mx	kip-in My
North Row Mid	0.00	0.03	0.03	-0.09	0.09	0	
Mid Aisle							
Mid Row Mid							
South Row Mid							
South Row End							

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

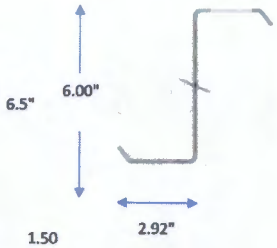
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum	
North Row Mid	0.004	0.000	0.009	0.013	<1 OK
Mid Aisle					
Mid Row Mid					
South Row Mid					
South Row End					

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	Moment (kip-in)	7.86	4.94	8.97	-8.97
	Axial load (kip)	0.32	0.05	0.25	0.03
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

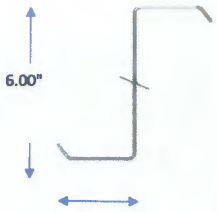
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
North Row Mid	ΩcP/Pn	0.012	0.002	0.009	0.001	
	ΩbMx/Mnx	0.152	0.095	0.173	0.173	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
	Sum	**0.163**	**0.097**	**0.182**	**0.174**	<1 OK
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
[illegible]	[illegible]					
	[illegible]					
	[illegible]					
	[illegible]					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	moment major (kip-in)	16.39	10.29	18.70	-18.69
	moment minor (kip-in)	1.45	0.23	1.14	0.14
Mid Aisle	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row End	moment major (kip-in)				
	moment minor (kip-in)				
South Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
South Row End	moment major (kip-in)				
	moment minor (kip-in)				

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	75.51	81.08	68.01	79.80
Light Grade Strength	75.51	81.08	68.01	79.80

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	75.48	25.83	67.98	25.42
Light Grade Strength	75.48	25.83	67.98	25.42

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
North Row Mid	ΩbMx/Mnx	0.217	0.136	0.248	0.248	
	ΩbMy/Mny	0.056	0.009	0.044	0.005	
Light Grade	Sum	**0.273**	**0.145**	**0.292**	**0.253**	<1 OK
Mid Aisle	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					

Deflection Check

Allowable deflection per panel manufacturer = L/ 100 (0.01mm/mm)

	North Row End	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Max at midspan (in)		0.104				
Δ / L		0.001				
Check		OK				

Purlin Angle Check: OK

Note:
The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values

Ss	0195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 1.5-2
W	3.15	psf	
Cs	0.06	g	Per Eq. 15.4-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated foranalysis.

Wind load controls the design.

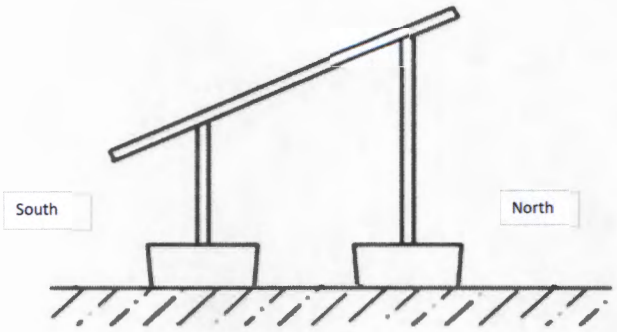
4. Foundation

Ballast Properties

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Concrete Height (in)							
Weight of Ballast (lb)		3311					

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)		7.45					
Resistive Moment		12.20					
Overturning Check		1.64					
Safety Factor Check		OK					

Max Uplift / Sliding Check

	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Wind Uplift (k)	-1.50				
Ballast Weight (lb)	3311				
Horizontal Resistance (k)	1.26				
Horizontal Load (k)	0.54				
Safety Factor	2.31				
Safety Factor Check	OK				

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
North Row Mid	Max Bearing Pressure	0.39	0.47	0.49	490	3.40	OK
Mid Aisle	Max Bearing Pressure						
Mid Row Mid	Max Bearing Pressure						
Mid Row End	Max Bearing Pressure						
South Row Mid	Max Bearing Pressure						
South Row End	Max Bearing Pressure						

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (South Row End Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	3	#
No. of Panel Widths per Span	3.00	#
No. of Panel Widths per Overhang	0.50	#
Purlin Span Length	9.95	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE7-10

According to Equation (27.3-1)

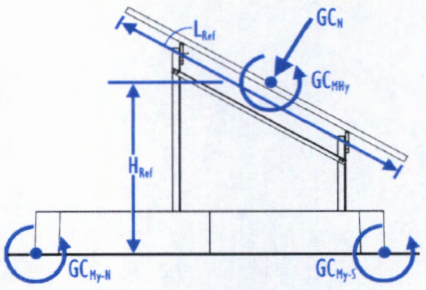
qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.

GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.

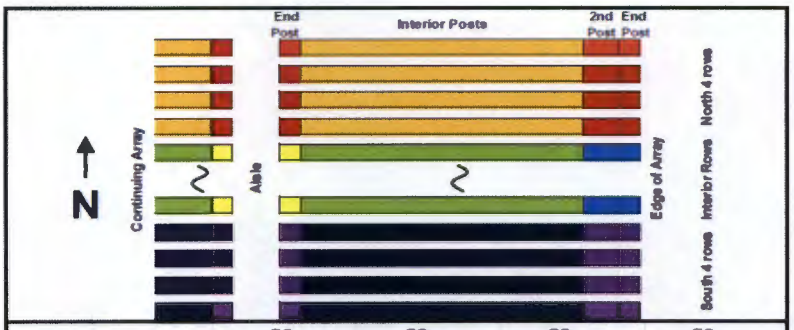


Schematic of wind load coefficients – PourInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$



Zone	Tilt/height*	GC_N		GC_{Mtv}		$GC_{Mv\text{-}N}$		$GC_{Mv\text{-}S}$	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

* Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

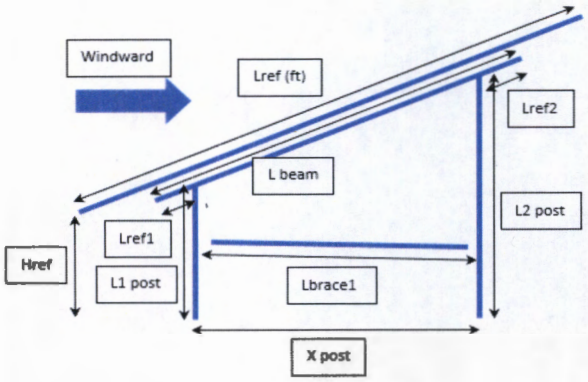
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv	$SF_{FDN.}$
Safety Factor	1.5	1.5	1.5	1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50
Post	GC361WP 12 Ga	Grade	50

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel 6x3.125x1
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)				
	Axial load (kip)				
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)	0.00	8.31	6.23	-13.19
	Axial load (kip)	0.76	0.83	1.13	-1.05

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row End	ΩcP/Pn	0.015	0.016	0.022	0.020	
	ΩbMx/Mnx	0.000	0.077	0.058	0.122	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
Post	Sum	**0.015**	**0.093**	**0.080**	**0.143**	<1 OK

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

Axial force (kip)	Combo 2	Combo 3	Combo 4	Combo 5 (Upl	kip P	kip-in Mx	kip-in My
[illegible]							
North Row Mid							
Mid Aisle							
Mid Row Mid							
[illegible]							
South Row Mid							
South Row End	0.00	0.05	0.04	-0.08	0.08	0	

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

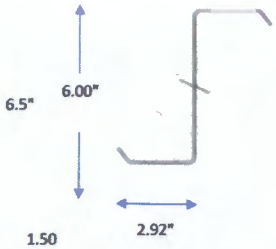
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum	
[illegible]					
North Row Mid					
Mid Aisle					
Mid Row Mid					
[illegible]					
South Row Mid					
South Row End	0.004	0.000	0.008	0.012	<1 OK

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)				
	Axial load (kip)				
South Row End	Moment (kip-in)	5.20	6.30	8.21	-8.18
	Axial load (kip)	0.21	0.03	0.17	0.02

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

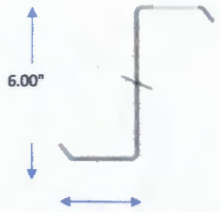
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
[illegible]	[illegible]					
	[illegible]					
	[illegible]					
	[illegible]					
South Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
South Row End	ΩcP/Pn	0.008	0.001	0.006	0.001	
	ΩbMx/Mnx	0.100	0.121	0.158	0.158	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
	Sum	**0.108**	**0.123**	**0.164**	**0.158**	<1 OK

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Aisle	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row End	moment major (kip-in)				
	moment minor (kip-in)				
South Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
South Row End	moment major (kip-in)	8.45	10.23	13.33	-13.27
	moment minor (kip-in)	0.74	0.12	0.58	0.07

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	81.08	81.08	80.56	81.08
Light Grade Strength	81.08	81.08	80.56	81.08

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	81.05	25.83	80.52	25.83
Light Grade Strength	81.05	25.83	80.52	25.83

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}} \le 1.0$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
[illegible]	[illegible]					
[illegible]	[illegible]					
North Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Aisle	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
[illegible]	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]					
South Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
South Row End	ΩbMx/Mnx	0.105	0.127	0.166	0.165	
	ΩbMy/Mny	0.028	0.005	0.023	0.003	
Light Grade	Sum	**0.133**	**0.132**	**0.188**	**0.168**	<1 OK

Deflection Check

Allowable deflection per panel manufacturer = L/ 100 (0.01mm/mm)

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Max at midspan (in)							0.028
Δ / L							0.000
Check							OK

Purlin Angle Check: OK

Note:
The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values:

Ss	0.195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 1.5-2
W	3.35	psf	
Cs	0.06	g	Per Eq. 15.4-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated for analysis.

Wind load controls the design.

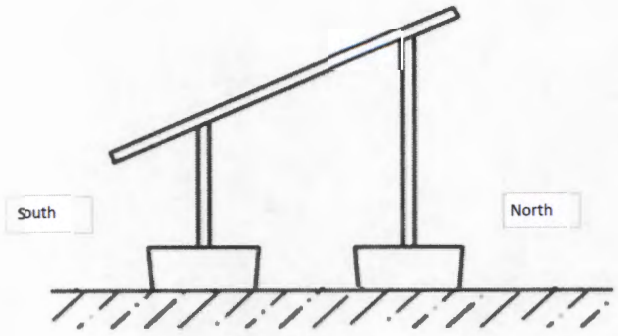
4. Foundation

Ballast Properties

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Concrete Height (in)							
Weight of Ballast (lb)							3120

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Ends	North Row Mid	Mid Aisles	Mid Row Mid	Mid Row Ends	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)							6.86
Resistive Moment							11.21
Overturning Check							1.63
Safety Factor Check							OK

Max Uplift / Sliding Check

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Wind Uplift (k)							-1.36
Ballast Weight (lb)							3120
Horizontal Resistance (k)							1.17
Horizontal Load (k)							0.49
Safety Factor							2.37
Safety Factor Check							OK

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
[illegible]	[illegible]						
North Row Mid	Max Bearing Pressure						
Mid Aisle	Max Bearing Pressure						
Mid Row Mid	Max Bearing Pressure						
Mid Row End	Max Bearing Pressure						
South Row Mid	Max Bearing Pressure						
South Row End	Max Bearing Pressure	0.36	0.42	0.44	435	3.02	OK

GAMECHANGE SOLAR
REPOWERING THE PLANET

Calculation Package for GCS Pour-in-Place System (South Row Mid Zone)

Project: Blydenbourgh Landfill
Address: Islip, NY
Update: 11/17/2016 **By:** LF

General Information

Setup	Portrait	
Tilt	20	degree
Clearance	30	in
Panel Length	77.17	in
Panel Width	39.29	in
Panel Weight	50.71	lbs
Space between Panels N-S	0.5	in
Space between Panels E-W	0.5	in
Number of Panels Up	1	#
Number of Purlins	2	#
No. of Panels Supported	6	#
No. of Panel Widths per Span	6.00	#
No. of Panel Widths per Overhang	1.00	#
Purlin Span Length	19.90	ft
Loading Code	ASCE7-10	
Occupancy Category	I	
Exposure Category	C	
Seismic Site Class	D	
Assumed Load Bearing Capacity of Soil	1	ksf
Dead Load:	3.2	psf
Ground Snow Load (Pg)	30	psf
Basic Wind Speed	130	mph

Seismic Design Values

Ss	0.195	g
S1	0.061	g
Fa	1.6	
Fv	2.4	
SDS	0.208	g
SD1	0.098	g

1. Loading Calculations

1.1 Snow Load

Snow load is calculated per ASCE7

Pg (psf)	30.00	
Ce	0.90	Per Table 7-2.
Ct	1.20	Per Table 7-3.
Is	0.80	Per Table 7-4.
Cs	0.91	Per Figure 7-2c.

According to equation (7-1) and (7-2)

Ps=Cs*Pf = Cs*(0.7Ce*Ct*Is*Pg) Ps = 16.49

1.2 Wind Load

Wind pressure is calculated per ASCE7

V (mph)	130.00	
Kd	0.85	Per Table 26.6-1
Kz	1.00	Per Wind Tunnel Test Report
Kzt	1.00	Per Section 26.8
Iw	1.00	Wind Importance Factor equals unity for ASCE7-10

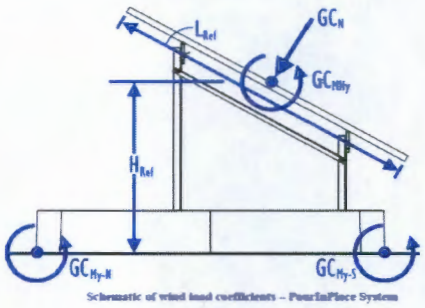
According to Equation (27.3-1)

qh = 0.00256*Kd*Kz*Kzt*(V^2)*I qh = 36.77

According to equation (27.4-3)

$P=q_h GC_N$

The results of wind load factors including normal and overturning moments provided by CPP are located in the calculation sheets. The results are given for two opposite directions of wind which causes upward and downward wind forces calculated based on worst case design wind loads.
GC_N is the normal force factor, GC-My is the moment at the base of the post. The factor of safety is calculated based on the worst case scenario, when the dead load and full wind loads are present. These factors are used to generate all wind load components for the following calculations.



Schematic of wind load coefficients – PostInPlace System

$$GC_N = \frac{F_N}{q_z A_{ref}}$$

$$GC_{MHy} = \frac{M_{Hy}}{q_z A_{ref} L_{ref}}$$

$$GC_{My} = \frac{M_y}{q_z A_{ref} H_{ref}}$$

Zone	Tilt/height*	GC_N		GC_{Mfr}		$GC_{Mfr\text{-}N}$		$GC_{Mfr\text{-}S}$	
		Min	Max	Min	Max	Min	Max	Min	Max
	15° / 0.12	-0.72	0.62	-0.16	0.03	-1.83	1.43	-1.76	0.89
	15° / 0.46	-0.84	0.60	-0.18	0.04	-0.66	0.54	-1.00	0.47
	30° / 0.12	-1.14	1.14	-0.17	0.04	-1.65	1.14	-1.94	1.36
	30° / 0.46	-1.20	1.24	-0.22	0.05	-0.64	0.29	-1.40	1.05
	15° / 0.12	-0.66	0.28	-0.10	0.02	-0.84	1.48	-1.40	0.44
	15° / 0.46	-0.71	0.26	-0.16	0.02	-0.29	0.50	-0.84	0.19
	30° / 0.12	-0.85	0.47	-0.09	0.04	-0.60	0.95	-1.31	0.65
	30° / 0.46	-0.86	0.45	-0.14	0.06	-0.23	0.27	-0.94	0.39
	15° / 0.12	-0.34	0.50	-0.09	0.02	-1.48	0.72	-0.81	0.70
	15° / 0.46	-0.58	0.59	-0.11	0.03	-0.66	0.40	-0.66	0.42
	30° / 0.12	-0.56	0.88	-0.09	0.03	-1.31	0.58	-0.93	1.02
	30° / 0.46	-0.63	1.11	-0.12	0.03	-0.59	0.19	-0.69	0.92
	15° / 0.12	-0.43	0.24	-0.10	0.01	-0.72	0.80	-1.09	0.33
	15° / 0.46	-0.46	0.25	-0.12	0.01	-0.27	0.29	-0.57	0.19
	30° / 0.12	-0.53	0.38	-0.07	0.03	-0.51	0.56	-0.86	0.52
	30° / 0.46	-0.57	0.43	-0.10	0.02	-0.23	0.16	-0.64	0.36
	15° / 0.12	-0.54	0.44	-0.11	0.02	-1.28	1.12	-1.24	0.67
	15° / 0.46	-0.77	0.51	-0.15	0.03	-0.54	0.53	-0.88	0.38
	30° / 0.12	-1.03	0.95	-0.16	0.02	-1.39	0.99	-1.78	1.12
	30° / 0.46	-1.19	1.12	-0.20	0.02	-0.57	0.32	-1.35	0.96
	15° / 0.12	-0.49	0.52	-0.11	0.02	-1.70	0.90	-1.22	0.57
	15° / 0.46	-0.48	0.87	-0.14	0.02	-1.02	0.28	-0.62	0.56
	30° / 0.12	-0.65	0.67	-0.08	0.03	-1.03	0.69	-1.05	0.74
	30° / 0.46	-0.75	0.88	-0.13	0.02	-0.47	0.20	-0.85	0.73
	15° / 0.12	-0.67	0.47	-0.12	0.03	-1.48	1.36	-1.55	0.72
	15° / 0.46	-0.88	0.76	-0.17	0.03	-0.89	0.60	-1.02	0.48
	30° / 0.12	-1.31	0.92	-0.20	0.02	-1.35	1.20	-2.28	1.08
	30° / 0.46	-1.42	1.10	-0.25	0.03	-0.57	0.32	-1.66	0.93

* Height is expressed as the ratio of the gap from the ground to the low edge of the PV divided by the cl
Interpolation between configurations is allowed

1.3 Load Combinations:

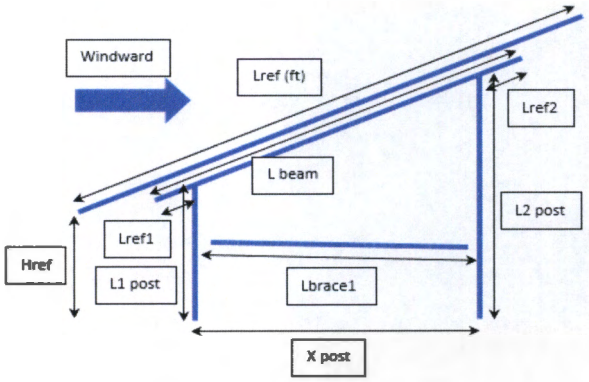
Basic load combinations are per ASCE7-10 and ASD design method.

1	D				
2	D	+	S		
3	D	+	0.60W		
4	D	+	0.75S	+	0.45W
5	0.6D	+/-	0.60W		
6	D	+	0.7E		

1.4 Safety Factors

	Ωc	Ωb	Ωv		$SF_{FDN.}$
Safety Factor	1.5	1.5	1.5		1.5

2.0 Analysis and Design: Geometry



Tilt (degrees)	20
Href (in)	30.00
Lref (in)	77.17
Lref1 (in)	9.00
Lref2 (in)	-8.50
Bottom Overhang (in)	15.27
Top Overhang (in)	15.27
X post (in)	43.35
L1 post (in)	16.55
L2 post (in)	32.33
Brace to Beam (in)	7.00
L brace1 (in)	43.70
Brace1 Angle w/ Horiz	0.00
L beam (in)	46.63
H_{CG} (in)	43.20

NOTES:
Post Lengths are unbraced lengths from top of concrete to connection with NS Beam

2.1 Post Design (AISI S100-07)

Post Heavy	GC361P 12 Ga	Grade	50
Post	GC361WP 12 Ga	Grade	50

Material Type: Pre-Galvanized Steel

Effective section properties at applied loads:

Post Heavy	Ae (in^2)	1.059	Ixe(in^4)	3.726	Iye (in^4)	0.853	C Channel
			Sxe(t) (in^3)	1.59	Sye(l) (in^3)	1.08	6x3.125x1
			Sxe(b) (in^3)	1.59	Sye(r) (in^3)	0.51	
Post	Ae (in^2)	1.401	Ixe(in^4)	8.101	Iye (in^4)	1.945	
			Sxe(t) (in^3)	2.70	Sye(l) (in^3)	1.84	
			Sxe(b) (in^3)	2.70	Sye(r) (in^3)	0.94	

Reactions at Post Base (Worst case of both posts)

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row End	Moment (kip-in)				
	Axial load (kip)				
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)	0.00	16.09	12.07	-15.55
	Axial load (kip)	1.52	1.61	2.23	-1.17
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

			Pn/Ωc	Mxn/Ωb	Myn/Ωb
Post Heavy	Strength	Compress.	28.49	63.42	20.31
		Tension	42.36		
Post	Strength	Compress.	51.19	108.01	37.66
		Tension	56.04		

Section Check at Post Base

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
Mid Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					
South Row Mid	ΩcP/Pn	0.030	0.031	0.044	0.023	
	ΩbMx/Mnx	0.000	0.149	0.112	0.144	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
Post	Sum	**0.030**	**0.180**	**0.155**	**0.167**	<1 OK
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
Post	Sum					

2.2 Brace Design

Brace (Channel 4.6x2.6, 14 Gauge)

Material Type:Pre-galvanized Steel, Fy= 50 ksi

Effective section properties at applied loads

Ae (in^2)	0.699	Ixe (in^4)	2.421	Iye (in^4)	0.492
		Sxe(t) (in^4)	1.0526	Sye(l) (in^4)	0.6999
		Sxe(b) (in^4)	1.0526	Sye(r) (in^4)	0.2594

Brace is technically a zero force member. Conservatively check for axial load = 20% of frame lateral load

Axial force (kip)	Combo 2	Combo 3	Combo 4	Combo 5 (Upl	kip P	kip-in Mx	kip-in My
North Row End							
North Row Mid							
Mid Aisle							
Mid Row Mid							
Mid Row End							
South Row Mid	0.00	0.10	0.07	-0.10	0.10	0	
South Row End							

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	22.24	33.49	8.25

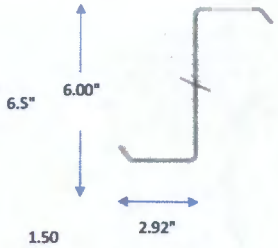
According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3.As ΩbP/Pn>0.15, equation C5.2.1-2 should be adopted.

$$\frac{\Omega_c P}{P_{no}} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \le 1.0$$

	ΩcP/Pn	ΩbMx/Mnx	ΩbMy/Mny	Sum	
North Row End					
North Row Mid					
Mid Aisle					
Mid Row Mid					
Mid Row End					
South Row Mid	0.004	0.000	0.010	0.014	<1 OK
South Row End					

2.3 Beam Design (AISI S100-07)

Grade	Gauge
50	Gauge 14



Material Type: Pre-galvanized Steel

Section Properties

Ae (in^2)	0.93	Ixe (in^4)	5.29	Iye (in^4)	1.50
		Sxe(t) (in^3)	1.76	Sye(l) (in^3)	0.51
		Sxe(b) (in^3)	1.76	Sye(r) (in^3)	0.51

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Aisle	Moment (kip-in)				
	Axial load (kip)				
Mid Row Mid	Moment (kip-in)				
	Axial load (kip)				
Mid Row End	Moment (kip-in)				
	Axial load (kip)				
South Row Mid	Moment (kip-in)	10.52	12.39	16.34	-9.32
	Axial load (kip)	0.43	0.07	0.34	0.04
South Row End	Moment (kip-in)				
	Axial load (kip)				

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007

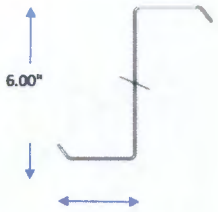
$$\frac{\Omega_c P}{P_n} + \frac{\Omega_b M_x}{M_{nx}} + \frac{\Omega_b M_y}{M_{ny}} \leq 1.0$$

	Pn/Ωc	Mxn/Ωb	Myn/Ωb
Strength	27.36	51.88	15.11

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
North Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Aisle	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
Mid Row Mid	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					
[illegible]	[illegible]					
	[illegible]					
	[illegible]					
	[illegible]					
South Row Mid	ΩcP/Pn	0.016	0.002	0.012	0.001	
	ΩbMx/Mnx	0.203	0.239	0.315	0.180	
	ΩbMy/Mny	0.000	0.000	0.000	0.000	
	Sum	**0.218**	**0.241**	**0.327**	**0.181**	<1 OK
South Row End	ΩcP/Pn					
	ΩbMx/Mnx					
	ΩbMy/Mny					
	Sum					

2.4 Purlin Design

	Grade	Gauge
Heavy Grade	80	Gauge 16
Light Grade	80	Gauge 16



Section dimension 6.00*2.92*0.57

Effective Properties

Heavy Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017
Light Grade	Ae (in^2)	0.7978	Ixe (in^4)	4.7232	Iye (in^4)	1.6331
			Sxe(t) (in^3)	1.5744	Sye(l) (in^3)	0.5017
			Sxe(b) (in^3)	1.5744	Sye(r) (in^3)	0.5017

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)
North Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Aisle	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row Mid	moment major (kip-in)				
	moment minor (kip-in)				
Mid Row End	moment major (kip-in)				
	moment minor (kip-in)				
South Row Mid	moment major (kip-in)	29.34	34.55	45.56	-26.00
	moment minor (kip-in)	2.61	0.42	2.06	0.25
South Row End	moment major (kip-in)				
	moment minor (kip-in)				

Buckling Check (Per Equation C3.1.2.1-15):

	Continuous Spans		End Spans	
	Fc(x) (ksi)	Fc(y) (ksi)	Fc(x) (ksi)	Fc(y) (ksi)
Heavy Grade Strength	63.80	77.93	50.26	71.67
Light Grade Strength	63.80	77.93	50.26	71.67

	Mx+/Ωb	My+/Ωb	Mx-/Ωb	My-/Ωb
	kip-in	kip-in	kip-in	kip-in
Heavy Grade Strength	63.77	24.82	50.24	22.83
Light Grade Strength	63.77	24.82	50.24	22.83

According to North American Specification for the Design of Cold-Formed Steel Structural Members (2007 Edition), Equation C5.2.1-1-C5.2.1.3

$$\frac{\Omega_c P}{P_n}+\frac{\Omega_b M_x}{M_{nx}}+\frac{\Omega_b M_y}{M_{ny}}\leq 1.0$$

		Combo 2	Combo 3	Combo 4	Combo 5 (Uplift)	
North Row End	[illegible]					
[illegible]	[illegible]					
North Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Aisle	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
Mid Row Mid	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					
[illegible]	[illegible]					
[illegible]	[illegible]					
South Row Mid	ΩbMx/Mnx	0.460	0.542	0.714	0.408	
	ΩbMy/Mny	0.105	0.017	0.083	0.010	
Light Grade	Sum	**0.565**	**0.559**	**0.798**	**0.418**	<1 OK
South Row End	ΩbMx/Mnx					
	ΩbMy/Mny					
Light Grade	Sum					

Deflection Check

Allowable deflection per panel manufacturer = L/ [illegible] (0.01mm/mm)

	[illegible]	North Row Mid	Mid Aisles	Mid Row Mid	[illegible]	South Row Mid	South Row Ends
Max at midspan (in)						0.455	
Δ / L						0.002	
Check						OK	

Purlin Angle Check: OK

Note:
The Purlin analysis above accounts for the longest acceptable purlin length for this project. Some purlins supplied for this project may be shorter than this length due to site geometry or to match the number of panels in a rack with a client requested string size. As the shorter purlins will have less load applied to them and a shorter unbraced length, they have sufficient structural capacty to resist the applied loads.

3. Seismic Forces

Seismic Design Values

Ss	0.195	g	
S1	0.061	g	
Fa	1.6		
Fv	2.4		
SDS	0.21	g	
SD1	0.10	g	
R	3.25		Per Table 12.2-1
Ie	1		Per Table 1.5-2
W	3.15	psf	
Cs	0.06	g	Per Eq. 15.4-2
V	0.20	psf	Per Eq. 12.8-1

Seismic force is much lower than lateral wind loads calculated for analysis.

Wind load controls the design.

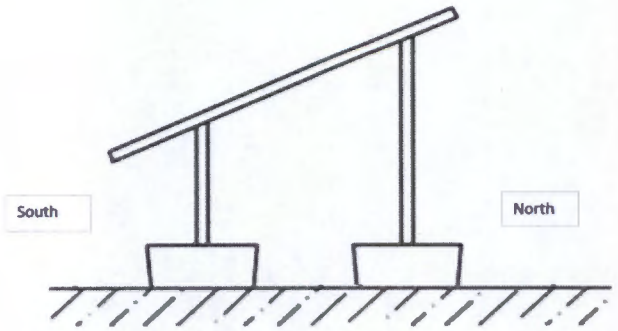
4. Foundation

Ballast Properties

	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Concrete Height (in)					
Weight of Ballast (lb)				3506	

All Tubs

South Tub Diameter (in)	38
North Tub Diameter (in)	38
Front of panel to front of tub(in)	3.9
Soil bearing capacity (psf)	1000
weight of concrete (pcf)	150



Overturning Moment Check

	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Max Overturning Moment (k*ft)				8.07	
Resistive Moment				13.19	
Overturning Check				1.63	
Safety Factor Check				OK	

Max Uplift / Sliding Check

	North Row Mid	Mid Aisles	Mid Row Mid	South Row Mid	South Row Ends
Wind Uplift (k)				-1.50	
Ballast Weight (lb)				3506	
Horizontal Resistance (k)				1.43	
Horizontal Load (k)				0.78	
Safety Factor				1.83	
Safety Factor Check				OK	

Note:
Sliding Resistance includes 0.6 Friction Coefficient per Intertek Testing

Max Bearing Pressure Check

		Combo 2	Combo 3	Combo 4	Max Pressure (psf)	Max Pressure (psi)	
North Row Mid	Max Bearing Pressure						
Mid Aisle	Max Bearing Pressure						
Mid Row Mid	Max Bearing Pressure						
Mid Row End	Max Bearing Pressure						
South Row Mid	Max Bearing Pressure	0.41	0.44	0.49	488	3.39	OK
South Row End	Max Bearing Pressure						