

**SECTION x**

**SCOPE OF WORK**

**Prince William County**

**Central District Police Station Solar**

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# 1 PURPOSE

This scope of work sets forth the minimum work necessary for Contractor's engineering, design, procurement, construction, and commissioning of the Renewable Energy System (RES). Where this exhibit describes an activity to be performed by Contractor in general terms, but not in complete detail, it is understood and agreed by the Parties that the Work includes any such incidental work reasonably inferred as necessary to complete such activity. The Work must meet the requirements for generating electricity throughout its Design Life. It encompasses all tasks needed to deliver a safe and dependable project that can be efficiently operated and maintained.

The scope to be provided by the Contractor shall include all work (except for those items specifically excluded) required to deliver a RES capable of operating to the specifications provided herein and in accordance with Applicable Laws, Applicable Permits, and the Project Schedule. The Contractor's Scope of Work shall include but shall not be limited to, the engineering design, procurement, delivery, installation, construction, start-up, and testing, as necessary to deliver the commercially operational RES, unless otherwise excluded or described as Owner scope.

Contractor shall design and construct the Project in accordance with this Scope of Work, and all the related exhibits. Unless otherwise specifically excluded or described as Owner scope, all statements, requirements, and description of Work contained in this Scope of Work is to be assumed as the responsibility of the Contractor.

# 2 DEFINED TERMS

For purposes of this exhibit, the following terms shall have the meaning as defined below. Terms used herein, but not defined, shall have the meaning ascribed thereto in the Contract. In the event of any conflict or inconsistency as between a term defined in this exhibit and a term defined in the Contract, the term defined in the Contract shall prevail.

**“Alternating Current” (“AC”)** means an electric current that reverses direction at regular intervals, having a magnitude that varies continuously in sinusoidal manner.

**“Data Acquisition System” (“DAS”)** means the data storage, monitoring, and control equipment responsible for the monitoring of and control of the site equipment.

**“Design Life”** of a component or product is the period of time during which the item is expected to work within its specified parameters.

**“Direct Current” (“DC”)** means an electric current of constant direction, having a magnitude that does not vary or varies only slightly.

**“Kilovolt” (“kV”)** means 1,000 volts.

**“Medium Voltage” (“MV”)** means voltage 2kV – 34.5kV.

**“Minimum Performance Guarantee”** means the minimum power capacity (i.e. performance level) that the Performance Test results must meet or exceed in order to achieve Final Completion, expressed as a percentage.



**“Photovoltaic” (“PV”)** refers to the equipment capable of generating electrical energy by means of sunlight.

**“Point of Interconnection” (“POI”)** means the location of the physical electrical interconnection of the RES to the utility or to the existing system.

**“Performance Test”** means the test conducted to demonstrate the performance of the RES meets or exceeds its Minimum Capacity Guarantee.

**“Performance Test Ratio”** means the ratio of the expected test power at the mean reporting conditions vs actual test power at the mean reporting conditions, minus some uncertainty.

**“Renewable Energy System” (“RES”)** means the entire system and energy generating plant comprised of photovoltaic (PV) generation equipment and materials, including OWNER and Contractor supplied, that is the scope of this project.

**“Standard Test Conditions” (“STC”)** means the industry standard for the conditions under which solar modules are tested, such as temperature, solar irradiance, and mass of the air.

**“Useful Life”** means the capability of the system to withstand serviceability-loading condition, applicable to structural design only, considering all environmental loads beyond the design life to the end of the 30<sup>th</sup> year. During this period of time, the RES is reasonably expected to be functional and can be productively used in operations with the current technology.

## **3 PROJECT DETAILS**

### **3.1 RES CAPACITY**

3.1.1 The RES is to have a nominal total output power at the Point of Interconnection (POI) as shown on the preliminary design and detailed in **Section x** with nameplate AC/DC capacities meeting that minimum energy target and taking into account the sum of inverter nameplate ratings and sum of Module flash test ratings at Standard Test Conditions (STC). Contractor shall complete all RES design, engineering, and drawing packages for construction permitting, installation, and record documentation in accordance with **Section x and Section x**.

### **3.2 PROJECT IDENTIFICATION**

3.2.1 Prince William County, herein described as Owner, is developing this RES in Prince William County, VA at the existing **Central District Police Station** which will interconnect with the local utility, **Dominion Energy**, at the POI as shown in **Section x**.

### **3.3 SITE COORDINATES**

3.3.1 Latitude: **38.68580°N**, Longitude: **-77.35934°W**

## **4 LINE OF DEMARCATION**

The line of demarcation for the Contractor will be the first termination of the RES within the existing equipment at the facility. Contractor will be responsible for all work starting from this Line of Demarcation including all design, engineering, procurement of equipment and materials (except for those procured by Owner), construction, and commissioning. All work beyond the Line of Demarcation is the responsibility of others.

## **5 OWNER SCOPE**

### **5.1 OWNER SUPPLIED EQUIPMENT**

This section describes the major equipment to be supplied by Owner. Any equipment required for the proper design and functionality of the RES, but not specifically included in this Scope or its Exhibits shall be the responsibility of the Contractor.

It will be the Contractor's responsibility to install all the Owner supplied equipment. In addition, Contractor shall inspect Owner supplied equipment upon delivery to the project site and notify Owner immediately of any defects, deficiencies, and non-conformities.

List of Owner Supplied Equipment::

#### **5.1.1 None**

### **5.2 PRELIMINARY ENGINEERING AND DESIGN**

5.2.1 Owner has engaged in engineering services for preliminary layout and electrical design necessary to produce this RFP and SOW. Contractor shall understand that the complete design is in Contractor's scope and that the preliminary design or studies provided are to be used for information purposes only, such as orientation and/or for the calculation of Contractor's bid.

5.2.2 Contractor may choose (and is encouraged to) explore alternative panel layouts, equipment layouts, electrical designs, controls philosophies, etc. as part of Contractors bid offering.

### **5.3 INTERCONNECT SERVICES AGREEMENT**

5.3.1 Owner has not yet entered into an interconnection agreement the local utility. Contractor will be responsible for providing information, drawings, and technical assistance in order to support the requirements of the interconnection applications and agreement(s) during the design process.

### **5.4 PROJECT AND CONSTRUCTION PERMITS**

5.4.1 Contractor is responsible for obtaining necessary project and construction permits.

### **5.5 REAL ESTATE & LANDOWNER REQUIREMENTS**

5.5.1 Owner is responsible for obtaining necessary landowner property leases and easements for the delivery, storage, installation, and construction of all Project facilities including, but not limited to, PV modules locations, substation, civil site work and improvements, fencing,

access roads, collector system, and laydown yard. Except as may be modified below and accepted by Owner in writing, the Contractor will be responsible for incorporating the Owner provided landowner agreement requirements into the overall Project design, construction scheduling, sequencing, safety, quality/environmental, pricing, and subsequent construction work.

## **6 PROCUREMENT DETAILS**

### **6.1 LIST OF APPROVED EQUIPMENT MANUFACTURERS**

#### **6.1.1 Inverters:**

6.1.1.1 SMA, Chint Power Systems (CPS), SolarEdge, Sungrow, or other alternatives approved by Owner.

6.1.1.2 Inverters shall be certified UL 1741, UL 1699B, UL 1998, IEEE 519, & IEEE 1547.

#### **6.1.2 PV Modules**

6.1.2.1 Trina Solar, Canadian Solar, VSun, or other alternatives approved by Owner.

6.1.2.2 Any Tier 1 module.

6.1.2.3 PV modules shall be certified IEC 61215, IEC 61730, & UL 61730.

### **6.2 WARRANTY REQUIREMENTS**

6.2.1 Contractor shall submit manufacturers' warranties for Owner's acceptance as well as manufacturer's standard warranty documents executed by authorized Owner official. A Letter from Manufacturer should be submitted indicating they have inspected the installation, it conforms to their installation guidelines, and the full warranty is in effect. A point of contact for warranty service shall also be provided.

## **7 GENERAL REQUIREMENTS OF THE WORK**

### **7.1 GENERAL REQUIREMENTS**

7.1.1 "Requirements" related to the Work of the Contractor shall mean compliance to any and all applicable federal, state, and local laws, decrees or ordinances; all applicable permits; any applicable Project Storm Water Pollution Prevention Plan ("SWPPP"); applicable utility-crossing requirements; Owner specifications, and the Contract.

7.1.2 The Contractor's scope of work includes any supplemental site investigation including, but not limited to, site visits and/or local and regional evaluations of transportation routes, and structural analysis.

7.1.3 Applicable Codes and Standards include, but are not limited to, the following list:

7.1.3.1 Prince William County Building Development Policy 1.13.7

- 7.1.3.2 Prince William County Development Services Solar Energy Systems Plan Submission and Inspection Guidelines
- 7.1.3.3 NFPA 70 – National Electric Code
- 7.1.3.4 NFPA 70E – Electrical Workplace Safety
- 7.1.3.5 NESC – National Electric Safety Code
- 7.1.3.6 IEEE 1547-2018 - Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
- 7.1.3.7 IEEE 1547.1 – Conformance Test Procedure for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces
- 7.1.3.8 IEEE 519-2014 - Standard for Harmonic Distortion Limits
- 7.1.3.9 IEEE C37.1-2007 – IEEE Standard for SCADA and Automation Systems
- 7.1.3.10 IEEE C37.2-2008 – Standard Electrical Power System Device Function Numbers, Acronyms, and Contact Designations
- 7.1.3.11 UL 1449 - Standard for Surge Protective Devices
- 7.1.3.12 UL 1703 - Standard for Flat-Plate Photovoltaic Modules and Panels
- 7.1.3.13 UL 1741 - Standard for Inverters, Converters, Controllers, and Interconnection Equipment for Use with Distributed Energy Resources
- 7.1.3.14 UL 2703 - Standard for Mounting Systems
- 7.1.3.15 UL 4703 - Standard for Photovoltaic Wire
- 7.1.3.16 ASTM E2848-13 - Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance
- 7.1.4 Contractor shall install all equipment in accordance with the manufacturer’s instructions.

## **7.2 MAINTAINABILITY REQUIREMENTS**

- 7.2.1 The RES shall be constructed and designed to allow for maintenance of the RES to be performed safely and efficiently by technicians without significant dismantling or disruption to other items or parts of the Work or unduly curtailing power generation. In addition, the RES shall be constructed and designed to allow maintenance activities that can be performed by a limited crew including adequate access for inspection and for safely completing maintenance activities using typical equipment and tooling suitable for operating RES facilities.

7.2.2 In order to allow maintenance and emergency personal safe access to the DC components, the RES shall be constructed and designed to avoid crosstalk between the module level rapid shutdown devices.

7.2.3 Contractor shall provide sufficient access around the equipment to allow for effective maintenance and removal of items from service while maintaining operation of the RES unaffected by such maintenance tasks.

### **7.3 LICENSING AND SOFTWARE REQUIREMENTS**

7.3.1 Contractor will provide and implement all official release upgrades to software and firmware for the RES DAS system and equipment. Contractor will include checks and modifications required to maintain functionality of the Work through any upgrade implementation.

7.3.2 Contractor will provide licenses, software keys, hardware keys and the like for all software for the RES DAS system and equipment. Licenses and keys shall not expire and shall allow for transfer by Owner to any third party at the sole discretion of Owner.

### **7.4 SITE SECURITY**

7.4.1 Contractor shall be responsible for providing security during the course of the Work to protect the Work including fencing/guarding, appropriate lighting, and secure storage containers. Contractor shall supply a form of security plan for Owner review and subsequently develop a site-specific security plan for Owner approval. Security Plan must be approved by the Owner and initiated prior to the receipt of any Project materials to the Site.

### **7.5 ENVIRONMENTAL**

7.5.1 Dust Control. Contractor shall provide dust control for all applicable excavations, material sites, roads, and disposal areas in accordance with all Permits.

7.5.2 Leaks and spill prevention shall follow Owner policies. **PWC Policy?**

7.5.3 SWPPP. As applicable, Contractor shall be responsible to follow all permit requirements in National Pollutant Discharge Elimination System (NPDES) permits and storm water permits prior to starting construction on-site and during the course of construction.

7.5.4 Contractor is responsible for maintenance of BMPs through construction until a Notice of Termination (NOT) is submitted and accepted by the State. Contractor shall ensure that it and all its subcontractors covered by the NPDES permit submit a NOT upon project completion. Documentation pertaining to the SWPPP shall be maintained on-site and available for OWNER's inspection at any time.

7.5.5 Contractor shall perform monitoring in accordance with the approved SWPPP Plan.

### **7.6 TURNOVER DOCUMENTATION**

- 7.6.1 As-Built Documentation turned over will be certified as As-Built and stamped by licensed professional engineer in the state where the project is located. As-Built documents shall be updated to incorporate all documented changes during execution of the work. The professional engineer certification shall be in a discipline directly relevant to the As-Built Documentation being reviewed
- 7.6.2 The Contractor shall conduct a thorough review of the Contractor-assembled As-Built Documentation, verifying the accuracy and completeness in comparison to the actual constructed project.
- 7.6.3 The Contractor shall complete the following verification steps, among others, to ensure accuracy and compliance of the As-Built Documentation:
  - 7.6.3.1 Thoroughly examine the Contractor-assembled As-Built Documentation.
  - 7.6.3.2 Compare the As-Built Documentation with the original design documentation and specifications to identify any inconsistencies, omissions, or errors.
  - 7.6.3.3 Conduct site visits, if necessary, to physically inspect their alignment with the as-built documentation.
  - 7.6.3.4 Collaborate with project stakeholders, contractors, and relevant parties to gather additional information or clarify any discrepancies.
  - 7.6.3.5 Apply professional engineering judgement and expertise to assess the accuracy and compliance of the As-Built Documentation.
  - 7.6.3.6 Stamping and certifying the reviewed As-Built Documentation to signify its accuracy and compliance with applicable regulations and standards.
- 7.6.4 The Contractor shall prepare and transmit a comprehensive report detailing the findings, including any discrepancies or recommended, and final corrective actions, to Owner.
- 7.6.5 At the conclusion of the project and prior to Final Completion, Contractor shall supply to Owner a set of full-size hard-copy prints for all as-built documents. Contractor shall also send all final revisions of the drawings and documents listed below to Owner via **Owner's document management system**. This list is not guaranteed to be all inclusive and Contractor should verify the required submittals based on specific details contained within the Contract.

## **8 CONSTRUCTION MANAGEMENT**

### **8.1 PROJECT REPORTING**

- 8.1.1 Contractor shall, beginning on the date of issuance of Notice to Proceed (“NTP”) or Limited Notice to Proceed (“LNTP”) and ending on the date of substantial completion, prepare and submit to Owner monthly, weekly, and daily written progress reports (the “Progress Report(s)”) to be delivered electronically in accordance with the Contract or otherwise in a form reasonably satisfactory to Owner. It is deemed appropriate to commence daily

progress reports once mobilization to site has occurred. The Progress Report shall include as a minimum the following sections:

8.1.2 **Monthly Progress Report** – Reporting Project to Date and previous Month’s activities and data, including but not limited to the following:

- 8.1.2.1 Executive level summary of Project status and progress,
- 8.1.2.2 Safety and environmental performance statistics,
- 8.1.2.3 Summary of completed milestones and tasks,
- 8.1.2.4 A narrative of what was completed in the preceding month compared to what was planned and an explanation of variance and/or recovery plan should progress have fallen behind the plan,
- 8.1.2.5 Expected progress during next reporting period,
- 8.1.2.6 Report of potential problems,
- 8.1.2.7 Progress schedule updates including forecasting of remaining work activities,
- 8.1.2.8 Drawing specification/document control log,
- 8.1.2.9 Change Order status,
- 8.1.2.10 List of Subcontractors working on site,
- 8.1.2.11 Number of staff working on site including total work hours,
- 8.1.2.12 Graphic project completion S curve, depicting actual vs. schedule completion,
- 8.1.2.13 QA/QC statistics and open issues,
- 8.1.2.14 Photographs showing progress,
- 8.1.2.15 Table showing total quantities to be installed, quantities installed to date, and quantities remaining. The table should be broken down into sufficient detail such as:
  - 8.1.2.15.1 Modules (count)
  - 8.1.2.15.2 Cable (LF)
  - 8.1.2.15.3 Conduit (LF)
  - 8.1.2.15.4 Inverters (count)
  - 8.1.2.15.5 Any additional commodities that can convey project progress.
- 8.1.2.16 Materials on-hand, and
- 8.1.2.17 Schedule update and .XER native files.

8.1.3 **Weekly Progress Report** - Reporting all activities and date for the previous week including:

- 8.1.3.1 Executive level summary of Project status and progress,
- 8.1.3.2 Safety & environmental performance statistics,
- 8.1.3.3 Summary of completed milestones and tasks reported on a percent complete basis,
- 8.1.3.4 3-week Look Ahead – Activities for all active Scopes of Work with highlights on upcoming milestones or crucial activities,
- 8.1.3.5 A narrative of what was completed in the preceding week compared to what was planned and an explanation of variance and/or recovery plan should progress have fallen behind the plan,
- 8.1.3.6 Expected progress during next reporting period,
- 8.1.3.7 Report of potential problems or concerns,
- 8.1.3.8 Drawing specification/document control log,
- 8.1.3.9 Change Order status,
- 8.1.3.10 List of Subcontractors working on site,
- 8.1.3.11 Number of staff working on site including total work hours,
- 8.1.3.12 QA/QC statistics and open issues,
- 8.1.3.13 Photographs showing progress,
- 8.1.3.14 showing total quantities to be installed, quantities installed to date, and quantities remaining. The table should be broken down into sufficient detail such as:
  - 8.1.3.14.1 Modules (count)
  - 8.1.3.14.2 Cable (LF)
  - 8.1.3.14.3 Conduit (LF)
  - 8.1.3.14.4 Inverters (count)
  - 8.1.3.14.5 Any additional commodities that convey project process.
- 8.1.3.15 Materials on-hand, and
- 8.1.3.16 Schedule progress updates and narrative of critical path analysis, changes (proposed and modified), and issues/concerns.



#### **8.1.4 Daily Progress Report – Plan of the Day (“POD”)**

- 8.1.4.1 Morning POD meeting will be held at 8:00 AM each workday with true and accurate activities.
- 8.1.4.2 A POD form shall be submitted to OWNER for review and approval.
- 8.1.4.3 POD shall have detailed progress totals, activities for work performed yesterday, today, and forecast for work tomorrow.
- 8.1.4.4 All POD reporting, including previous day’s actuals, shall be turned into OWNER by 10:00 AM (local time of Project) each day throughout the duration of the Project.
- 8.1.4.5 Weekly Project status review telephone conferences shall be conducted with OWNER and Contractor personnel present. Each month, OWNER, Contractor, and others as appropriate, will meet on site to review and discuss the monthly report.

#### **8.2 QUALITY ASSURANCE PLAN**

- 8.2.1 Contractor shall submit to Owner a Project Quality Assurance Plan (“QAP”) and relevant supporting quality control specifications and procedures to be utilized on the Project. The Project QAP shall be sufficient to satisfy the current industry standards necessary to assure the level of quality expected for a solar facility.
- 8.2.2 Upon review of the Project QAP and procedures, Owner will inform the Contractor as to any additional documents that will be required to be submitted to Owner as they are generated during the normal course of the Project and upon completion as turnover documents to include documentation.
- 8.2.3 The implementation by Contractor of the above-described plan and procedures will be verified by Owner through the performance of audits and inspections, and any deficiencies noted during these audits and inspections shall be resolved within the framework of the Contractor’s Quality Plan.
- 8.2.4 Prior to beginning a new work sequence, the Contractor will conduct a pre-activity meeting with Owner’s representative and subcontractor. Discussion topics will be:
  - 8.2.4.1 Review of issue for IFC documents.
  - 8.2.4.2 Review of submittals.
  - 8.2.4.3 Review job hazard analysis (JHA).
  - 8.2.4.4 Review quality procedures and hold points.
  - 8.2.4.5 Review testing and reporting requirements.

### **8.3 TESTING, QUALITY CONTROL, AND DOCUMENT CONTROL**

- 8.3.1 Contractor shall provide a form of their commissioning testing, quality control and documentation control plans as an initial submittal with a requirement to submit these plans with approval from OWNER.
- 8.3.2 Contractor shall maintain a complete set of construction permits, current approved plan sets, as-built construction documentation (current red line drawings), proof of final construction permit inspection and sign-off for all Contractor-obtained permits, safety records, commissioning records, equipment and material shipping records and receipt inspection records, and O&M manuals at the Project Site during on-going Work at the Project Site and make such documentation available to OWNER upon OWNER's reasonable request.
- 8.3.3 As part of the O&M Manuals to be submitted to OWNER, Contractor shall provide sufficient documentation for the safe and effective use, operation, and installation of all required spares, consumables, tools, and vehicles, including relevant material safety data sheets.

### **8.4 HOURS OF CONSTRUCTION**

- 8.4.1 Owner, and Owner's other contractors (not contracted with Contractor) shall have an on-site presence during normal project hours - for approx. forty (40) hours Monday through Friday, eight (8) hours per day for all work unless local restriction mandate alternate work hours, in which, Contractor shall adhere to local work hour mandates. If Contractor's scheduled work hours requires Owner, or Owner's contractors, to be on site outside of those hours, Contractor will be responsible for the additional hours required. Owner will take all reasonable and economic measures to accommodate Contractor's hours outside of the normal work hours listed above. Contractor's hours are subject to Federal, State, and local regulations and laws.

### **8.5 TRANSPORTATION**

- 8.5.1 Contractor shall post signs for the direction and safety of on-site vehicular traffic. Such signage shall be maintained in good condition and removed when no longer needed. The nature and location of all signs including those for the direction of construction traffic shall be subject to approval by Owner.
- 8.5.2 To the extent possible, on-site vehicular traffic shall remain on roadways.
- 8.5.3 Contractor shall obtain and ensure the validity of all permits and licenses required in relation to the transportation of oversized loads on public roads.
- 8.5.4 Contractor shall take steps, including, but not limited to selecting appropriate routes, appropriate vehicles, and appropriate loading to avoid or mitigate the risk of damage to infrastructure such as roads, highways, bridges or overhead lines and maintain any requirements specified in Road Use or Conditional Use Permit ("CUP") agreements. Contractor shall immediately report to Owner any claims made against Contractor resulting from any alleged damage to any such infrastructure.

## **8.6 WASTE MATERIALS**

- 8.6.1 Contractor shall implement waste disposal programs that comply with the Requirements for the control and disposal of wastes which includes, but not limited to the following:
- 8.6.1.1 Contractor shall provide trash dumpsters or other suitable containers along with appropriate covers for proper disposal of construction debris, garbage, food wastes and other similar trash created from Contractor's Work. Contractor shall be responsible for the off-site disposal of such waste, all in accordance with the Requirements.
  - 8.6.1.2 Contractor shall be responsible for collection and disposal of any hazardous materials brought to the Project site for its Work.
  - 8.6.1.3 Contractor shall under no circumstances dump or dispose of fuel, oils, chemicals, paints, or other hazardous materials on the Project site.
  - 8.6.1.4 Contractor shall maintain its equipment so that it does not leak oil, hydraulic fluids, fuels, greases, cutting oils, anti-freeze or other chemicals. If leaks or spills of these or other hazardous materials occur, Contractor shall promptly clean up the spill and notify Owner's manager of the incident. Contractor shall be responsible for off-site disposal of resulting waste materials in full compliance with the Requirements.
  - 8.6.1.5 If, after written notice from Owner, at any time the Contractor fails to maintain its Work and storage areas free of accumulated waste material and rubbish or hazardous materials or conditions or otherwise not keep such areas in a neat, clean and orderly condition, OWNER may cause such maintenance to be performed and all costs associated therewith will be charged to Contractor.

## **8.7 VEHICLE OPERATION**

- 8.7.1 Operation of motor vehicles on the Project site shall be in accordance with general safe driving practices and specified speed limits and include the following requirements:
- 8.7.2 All vehicular accidents involving personal injury or property damage shall be promptly reported to Owner, but no later than 24 hours.
- 8.7.3 Specific measures shall be taken to reduce Project-related traffic impacts on local residents and businesses during Project construction. These measures include dust control and track out mitigation, signage and compliance with any requirements of the county and state. Any damage caused by the Contractor to existing roads, curbs, sidewalks, signs, etc. shall be repaired by Contractor at its expense.
- 8.7.4 Contractor's vehicles shall not be loaded beyond their capacity as prescribed by the manufacturer and/or applicable law. Contractor shall observe road and bridge limitations and take appropriate measures to stay in compliance with weight limits.

## **8.8 STORAGE**

- 8.8.1 Contractor shall provide appropriate storage arrangements for all required spares, consumables, tools, and vehicles in accordance with local climate conditions to prevent corrosion and other damage while in stock. Contractor shall include lockable boxes or other appropriate containers for storage.

## **9 ENGINEERING & DESIGN**

### **9.1 GENERAL**

- 9.1.1 Contractor shall complete all surveys, studies, and investigations required for Contractor to provide the detailed design for the RES. The Contractor's Scope of Work includes any supplemental site investigation, including site visits and/or local and regional evaluations of transportation routes, bridges, topography, geology, environment (including weather), availability of resources (including water, labor, union requirements, material, equipment, etc.), taxes, regulations or laws, supplemental structural investigations, permitting, and permitting requirements, engineering design, safety and environmental considerations. Contractor warrants that it is familiar with the Project and is able to construct and hand over a fully-functioning solar generating plant as a top tier contractor at the standard of a prudent professional with experience constructing similar projects with similar scopes of work.
- 9.1.2 Contractor shall complete all RES design, engineering, and drawing packages for construction permitting, installation, and record documentation in accordance with this Contract and all its Sections and Exhibits.
- 9.1.3 Contractor shall perform all Work in accordance with the most stringent of the site design criteria set forth in this Scope of Work and the associated exhibits. The RES shall be designed and constructed to withstand, without damage, for the Useful Life of the RES, all applicable environmental conditions set forth in the Design Life Requirements, as well as wind, frost, ice, solar radiation, dust, salt, condensation, corrosion, subsurface conditions, risk of attack from termites, vermin or other animals, brushfire risk, and risk of theft and vandalism. If any Equipment requires control of their temperature and/or humidity within the Design Requirements, the necessary equipment to ensure this control shall be provided by Contractor as part of the Work.
- 9.1.4 Contractor shall perform all Work in accordance with the minimum technical specifications set forth in this Scope of Work and the associated exhibits.
- 9.1.5 Contractor shall design, construct, commission, and test the RES based on optimizing the total life-cycle costs and energy deliveries to the POI in conjunction with Owner economic modeling while accounting for all electrical losses throughout the RES and Interconnection to the POI.
- 9.1.6 Contractor shall design, construct, commission, and test the RES to minimize generation and parasitic losses due to PV module shading, soiling, wire losses, inverter losses, and transformer losses.
- 9.1.7 Contractor shall design, construct, commission, and test the RES in accordance with both the Owner-Supplied Equipment and Contractor-Supplied equipment as specified in **Section xx and Section xx**.

- 9.1.8 Contractor is responsible for the design and complete integration of the RES which includes both Owner-Supplied Equipment and Contractor-Supplied equipment. This includes all control, monitoring, and power system relay capabilities.
- 9.1.9 Voltage insulation levels, equipment interrupting and continuous current capacities, circuit protection and mechanical strengths shall be selected and coordinated in accordance with calculations and the recommendations of IEEE, NEMA and ANSI.
- 9.1.10 Contractor shall perform all studies and analyses as set forth in **Section xx Exhibit xx**. This includes, but is not limited to, glint/glare studies, lightning risk assessments, noise studies, and power studies such as short circuit studies, coordination studies, load flow studies, and arc flash analysis. Contractor is required to provide and apply the resulting arc flash labels. **Owner will provide the existing facility power model in either SKM or ETAP.**
- 9.1.11 Contractor is responsible for the design, supply, and installation of the grounding systems, including those required for Owner-supplied equipment.
- 9.1.12 Contractor shall include a rapid shutdown function to reduce shock hazard for firefighters in accordance with adopted version of NEC 690.12.

## **9.2 SITE LAYOUT REQUIREMENTS**

- 9.2.1 Contractor shall utilize the Preliminary design as set forth in **Section xx** which includes Helioscope Reports and Single Line Diagrams as the conceptual design basis for the RES. This Preliminary design is indicative in nature. Contractor shall fully design the RES in order to meet the requirements and goals for the RES. Adjustments to the layout and design that vary from the Preliminary design are permitted. However, any significant changes to the general layout will have to be approved by Owner.
- 9.2.2 Contractor will be required to develop and design the site layout and electrical design utilizing existing electrical equipment and roof condition.
- 9.2.3 Contractor shall design actual layout and orientation of equipment pads with construction and maintenance optimization in mind while including sufficient space for operations and maintenance of the equipment as per the manufacturer's recommendations and requirements.
- 9.2.4 Contractor is responsible for the design, supply, and installation of all foundation and mounting required for equipment racking or equipment pads.

## **9.3 REQUIREMENTS OF NET METERING**

- 9.3.1 There may be informational requirements and support required by the Contractor related to net metering with the utility. Contractor shall provide reasonable information and related assistance to Owner as reasonably requested by Owner to fulfill Owner's obligations under such agreements.

## **9.4 DESIGN LIFE REQUIREMENTS**

- 9.4.1 The RES shall be constructed and designed to operate for a Design Life of thirty (30) years.

- 9.4.2 To ensure compliance with Useful Life requirement of the Project, the following design documents and reports shall be provided as part of Contract:

#### Equipment Data Sheets

1. Comprehensive data sheets and product specifications for all major equipment components supplied by Contractor.
2. These data sheets shall emphasize the expected lifespan, performance characteristics, and detailed warranty information for each equipment item.

#### System Performance Analysis

1. A thorough assessment of solar resources, including solar resource assessments and energy yield predictions.
2. The analysis shall include degradation models to estimate the long-term performance of the solar power field throughout its Useful Life.

#### Operation and Maintenance Plan

1. A comprehensive operating and maintenance manual detailing the protocols, procedures, and schedules for ongoing maintenance and inspections.
2. This plan shall encompass all relevant warranties and service agreements that are in place to ensure the efficient operation and longevity of the Project.

#### Testing and Commissioning Reports

1. Reports documenting the testing and commissioning activities performed during the project implementation phase.
2. Reports should include details of the various tests conducted to validated equipment, electrical connections, and overall system performance.

### **9.5 UTILITY AND INTERCONNECTION ENGINEERING REQUIREMENTS**

- 9.5.1 Contractor is responsible for complying with the Utility Connection Requirements. Refer to **Section xx Exhibit xx**. Contractor shall provide information and related assistance to Owner as reasonably requested by Owner to fulfill Owner's obligations of meeting the requirements of the Interconnection procedure, requirements, and any Interconnection Agreement(s).

## **10 CIVIL AND STRUCTURAL SITE WORK**

### **10.1 MOBILIZATION**

- 10.1.1 Contractor shall mobilize to the Project Site all required personnel, equipment, machinery, tools, consumables, temporary structures or other items as may be required for Contractor to complete the Work. Contractor shall not mobilize to site without Owner issued Notice to Proceed or Limited Notice to proceed specifically communicating authority to mobilize to the site.

## **10.2 GENERAL RACKING REQUIREMENTS**

- 10.2.1 The racking system shall provide physical support for the module for all environmental loading conditions including wind, snow, and subsurface conditions. The Contractor is responsible to select a racking system and module support details for the applied environmental loads. Contractor is responsible for selecting and designing a racking system that will, in conjunction with the site location and panel selection, remain within wind load tolerances and maintain compliance with all warranty obligations of both the racking system as well as Owner supplied PV modules. Contractor to assume ASHRAE extreme values for the project site.
- 10.2.2 The modules shall be supported in accordance with the module manufacturer's installation manual. Any deviation from the module manufacturer's requirements shall require the approval of Owner and the module manufacturer. The proposed racking system module mounting location and hardware shall be qualified by the module manufacturer for the project specific loads. A copy of the module manufacturer approval of the module racking system support system shall be provided to Owner.
- 10.2.3 Racking system shall be electrically grounded. The grounding system shall be designed to the requirements of the National Electric Code.

## **10.3 OTHER STRUCTURAL WORK**

- 10.3.1 Contractor shall design, procure, and install the support structures (racking) for the PV Modules, including all grounding screws, ballasts, wind deflectors, clamps, and any accessory equipment and hardware. The Preliminary designs presented to the Contractor are based on actual racking tolerances and specifications. Final selection of the racking manufacturer and layout details are the responsibility of the Contractor.
- 10.3.2 Contractor will be responsible for the design, procurement, installation, and construction of all foundations to support project equipment.
- 10.3.3 The Contractor shall provide a design that maintains the existing roof membrane warranty, including selecting a rooftop anchor and flashing method that's approved by the roofing manufacturer and/or roof membrane warranty holder, filing notice of alternation, and providing slip sheets as required under cable stumps, equipment foot pads, and any other equipment which may be subject to thermally driver oscillation movement or material compatibility requirements.
- 10.3.4 The contractor shall ensure that the design and Project Site conditions are compatible with the racking manufacture product specifications, including verifying maximum roof slope, maximum roof height, and selecting approved rooftop anchors and UL2703 listed PV modules.

- 10.3.5 Ballast blocks shall be compatible with the racking system, and shall meet the specifications given by the racking manufacturer. Ballast blocks shall conform to ASTM C1491 or C1884 where applicable. Ballast blocks shall be manufactured and tested for freeze-thaw durability.
- 10.3.6 Electrical rooftop equipment shall be evaluated for sliding and overturning per the adopted edition of ASCE 7 supported appropriately by either Durablock DB10/DB20 or rooftop anchors.
- 10.3.7 Contractor shall provide access pathways to new and existing rooftop equipment.

#### **10.4 GENERAL CIVIL WORK**

- 10.4.1 Contractor is responsible for obtaining ROW, Access, Building and Grading Permits - Multiple right-of-way, access, building and grading permits as issued by the County and State as identified in the Matrix included in **Exhibit xx**.

#### **10.5 DRAINAGE**

- 10.5.1 Contractor shall implement and maintain design solutions for the drainage systems, which avoid or minimize any potential damage or loss that may result from, or be contributed by, water drainage entering or leaving the Project Site.
- 10.5.2 Module racking and equipment shall be integrated with the existing roof drainage system to minimize ponding.

#### **10.6 DEMOBILIZATION AND RESTORATION**

- 10.6.1 All areas of the Project Site disturbed during Contractor's performance of the Work, such as laydown, parking, or temporary office trailers areas, shall be restored by Contractor.
- 10.6.2 All interior roads disturbed during the course of the Work shall be restored to the original design. Additionally, Contractor shall be responsible for repairing any damage to public roads directly and solely caused by Contractor and/or in accordance with FDOT permit stipulations.
- 10.6.3 Reinstatement and vegetation additions shall be in accordance with all Permits, planning and environmental constraints on the Work. All seeding and/or vegetative plantings, regardless of when seeding / vegetative plantings occurs, is the responsibility of Contractor. All seed mixes and vegetative plantings must be approved by Owner prior to use.
- 10.6.4 Contractor is responsible for demobilizing and restoring the area disturbed as a result of the course of the Work in accordance with any Landowner Agreements, and to Owner-acceptable conditions and is required to take all steps necessary to ensure that there are no conditions on the Project Site at the conclusion of the Work that violate adherence to contract for post construction conditions.



- 10.6.5 Contractor shall demobilize and remove all construction equipment, facilities, and temporary construction use area.

## **11 ELECTRICAL SITE WORK**

### **11.1 GENERAL REQUIREMENTS**

- 11.1.1 Contractor is responsible for the full installation and testing of all electrical circuits from the construction demarcation point out through the RES.
- 11.1.2 The use of either copper or aluminum is permitted, provided that it does not violate any code or manufacturer requirements and warranties or the requirements of the utility.
- 11.1.3 Contractor is responsible for coordinating any required building shutdowns. Shutdowns shall be organized for all required work to be performed in a timely manner to minimize downtime, and limit impact to building operations.

### **11.2 PV COLLECTION**

- 11.2.1 Contractor shall be responsible for full offloading, inspection for damage, installation, and testing of PV modules.
- 11.2.2 Contractor shall inspect panels immediately upon delivery. Contractor shall promptly notify Owner of damaged panels found during offloading and inspection.
- 11.2.3 Contractor shall install PV modules on racking system, including connecting all electrical leads and supplying and connecting necessary jumpers.
- 11.2.4 Modules shall be installed such that the top of the module shall not exceed the module height limits as set forth by any local building codes or ordinances.
- 11.2.5 If applicable, Contractor shall design, supply, and install DC Combiner boxes and disconnects.
- 11.2.6 The combiner box output circuit (homerun) shall be provided with a load-break contactor with an externally mounted switch, rated for the voltage and current of the combined PV strings. For 1000 Vdc and 1500 Vdc systems, a manual disconnect may be used in place of a load break contactor.
- 11.2.7 The combiner box string fuses and fuse holders shall be finger safe.
- 11.2.8 The manufacturer shall supply a fully assembled combiner box and shall provide detailed drawings, specifications sheets, mounting instructions, and maintenance requirements of its product.
- 11.2.9 Conduit entries into the combiner box shall be from the side or bottom to prevent water ingress.
- 11.2.10 Each combiner box shall include a provision for a padlock, including a padlock and key.
- 11.2.11 All padlocks shall be keyed the same.

- 11.2.12 The combiner box door shall be interlocked with the load-break contactor, or disconnect, in such a manner that the door cannot be opened when the contactor is closed. In addition, the contactor control switch shall not be capable of being placed in the closed position unless the combiner box door is fully closed.
- 11.2.13 An external door interlock defeat mechanism shall be provided to allow authorized personnel access to the interior of the combiner box while the contactor, or disconnect, is in the closed position for periodic inspection, troubleshooting, and electrical field measurements.
- 11.2.14 Each combiner box shall be suitable for application of permanent labels in the field and shall include electrical warning labels.
- 11.2.15 Arc Flash PPE requirements shall be provided on a permanent label attached to each combiner.
- 11.2.16 DC cabling shall be sized to not exceed a maximum voltage drop of 2% total from PV Module to inverter at Standard Test Conditions.
- 11.2.17 AC cabling shall be sized to not exceed an average AC loss of 1.5%.

### **11.3 PV MODULES**

- 11.3.1 PV Modules shall be certified to IEC 61215, IEC 61730, and UL 61730.
- 11.3.2 Factory fitted module cables with prefabricated suitable cable connectors (same type and make) shall be long enough to allow the modules to be interconnected electrically in series to form strings in the specified configuration. The PV cable connectors provided with the PV modules shall fulfil at least the requirements of a rating IP67 as defined in IEC 60529.
- 11.3.3 All connectors shall be same type and make.
- 11.3.4 To avoid galvanic corrosion, at the contact point, the PV module frame (if applicable) must be fully electrically isolated from incompatible material.

### **11.4 CABLES, CONDUITS, AND RACEWAYS**

- 11.4.1 The maximum current must be established according to the standards and the manufacturer information, and consider the type of cable and the installation methods.
- 11.4.2 Cabling and stringing arrangements shall follow the equipment manufacturer recommendations.
- 11.4.3 The color coding of LV cables shall comply with the adopted version of the NEC.
- 11.4.4 Any exposed cabling which is subject to direct sunlight, shall be listed for such use.
- 11.4.5 Ampacity criteria: The current carrying capacity of a cable is the maximum current that can flow continuously based on the PV system Load Factor through a cable without damaging the cable's insulation and other components.

- 11.4.6 Short circuit criteria: In short circuit conditions the current flowing through the cable increases causing a temperature rise within the cable. Cables shall be sized to withstand the largest short circuit that it is expected to see.
- 11.4.7 If applicable, DC cables from separate inverters shall be sufficiently spaced to avoid rapid shutdown system cross talk.
- 11.4.8 A suitable load break switch disconnect must be installed at the inverters DC input. The switch shall be readily and easily accessible.

## **11.5 EQUIPMENT PADS**

- 11.5.1 Contractor shall design, supply, and install any required auxiliary power transformers, switchboards, and associated cabling and conduit needed at any existing or new equipment pads for auxiliary power. The use of such auxiliary power includes, but is not limited to the control power or auxiliary power for the following equipment:
- DAS
  - Area lighting, if applicable
  - 120 and/or 240 VAC convenience receptacles, if applicable

## **11.6 INSTRUMENTATION WORK**

- 11.6.1 Contractor shall provide and install instrumentation and meteorological stations required to monitor and control the RES.
- 11.6.2 At a minimum, Contractor shall include the following:
- (1) Ambient Temperature Sensor
  - (1) Wind Direction Sensor
  - (1) Wind Speed Sensor
  - (2) Pyranometers
  - (2) PV Module Temperature Sensors

## **11.7 DAS**

- 11.7.1 Contractor shall provide the RES DAS in accordance with this scope, requirements, and associated exhibits. The RES DAS System shall interface and coordinate with all the equipment comprising the RES. DAS refers to the collection, logging, and reporting of site data. The collected data shall be displayed on a remote monitoring platform accessible over the web. The DAS monitoring platform shall include, but not limited to, the following functionality:
- Ability to create and manipulate dashboards to monitor real time site performance and KPIs

- Ability to create and manipulate trends of historical data
- Ability to export historical data points from all monitored equipment
- Automatic reporting of faults and alarms

## **11.8 TELECOM WORK**

- 11.8.1 Contractor shall acquire, coordinate and install: all external telecommunication lines, high speed internet connection, phone lines, either copper or fiber from the existing facility to the RES equipment requiring communication. Contractor shall be responsible for routing the communication lines throughout the RES equipment requiring communication interfaces.
- 11.8.2 Contractor shall verify with the Owner the telecom point of demarcation for the telecom service;
- 11.8.3 During the construction period, the Contractor shall arrange for and provide telecommunication service to their office compound and distribute within temporary office trailers.

## **12 TESTING & COMMISSIONING**

### **12.1 GENERAL REQUIREMENTS**

- 12.1.1 Contractor shall be responsible to coordinate with Owner and utility to develop and implement an energization plan.
- 12.1.2 Contractor may utilize a third-party to perform the testing. Owner reserves the right to attend and witness all installation and equipment testing on site. Contractor must provide 72-hour notice to Owner prior to any testing such that Owner may opt to attend. All test data must be submitted to Owner within 72 hours for Owner's independent verification. Relay testing must be performed by an independent third-party contractor and is the responsibility of the Contractor.
- 12.1.3 Contractor to provide complete and legible, yellow-lined drawings along with completed and detailed test reports.
- 12.1.4 Contractor to provide testing and commissioning for all equipment in the RES and in accordance with this Scope of Work and **Exhibit xx**.
- 12.1.5 Contractor shall perform testing according to NETA standards and recommendations unless otherwise directed.
- 12.1.6 Contractor shall be responsible to ensure that all engineers, technicians, and personnel performing the testing and inspections are trained to perform such activities in a safe manner. They must be trained, experienced, and familiar with the equipment being used and the associated documentation, including manuals, testing standards, and best practices.
- 12.1.7 Contractor shall be responsible to ensure that all test equipment is properly calibrated and within manufacturer's specifications.

- 12.1.8 Insulation testing, using a megohmmeter, shall be done prior to termination and energization of conductors. Contractor shall record all resistances values and provide them to Owner. Test voltages shall be dependent on the conductor insulation rating. All conductors shall be isolated from all other conductors and tested separately, including parallel conductors. Testing shall include all field-installed AC and DC wiring.
- 12.1.9 Contractor shall perform Open Circuit Voltage (Voc) and Current (Isc) tests of each string to ensure that each string has the correct polarity, number of modules in the string, and that all the modules are generating the correct voltage and current. Testing shall be done with stable irradiance conditions of at least 500 W/m<sup>2</sup>.
- 12.1.10 Contractor shall perform IV Curve Tracing of each string. Testing shall be done with stable irradiance conditions of at least 700 W/m<sup>2</sup> and shall use a Solmetric PVA 1500 IV Curve Tracer, or a Owner approved equivalent, to record string generation values while also capturing irradiance and cell temperatures. Contractor shall provide and evaluate performance data and identify any anomalies, mismatches, or under-performing strings. Contractor may alternatively propose selective tracing of strings in combination with drone thermography, IR scans, and other methods. Any alternative testing methods must be approved by Owner.

## **12.2 PERFORMANCE TESTING**

- 12.2.1 Contractor shall develop and furnish to Owner for review and comment a comprehensive test procedure for conducting the Performance Test. Contractor will furnish the Performance Test procedure to Owner at least thirty (30) Days prior to the start of the Performance Test. Owner shall provide any comments on the Performance Test procedure within ten (10) Days of receipt of the Performance Test procedure, and the Parties will cooperate in good faith regarding any necessary or appropriate modifications to be made. If Owner does not provide any comments on the Performance Test procedures within such ten (10) Day period, Contractor shall be deemed to have no comments on the Performance Test procedures.
- 12.2.2 The procedure shall calculate the system performance based on the criteria outlined in the ASTM E2848 "Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance". The Performance Test shall follow the defined process of determining reporting conditions and actual test output as outlined in the standard.
- 12.2.3 The Performance Test report shall include all applicable datasheets, calibration records for all measurement devices and their corresponding locations, and the PVsyst model and 8760 as the "Expected Test Data Set".
- 12.2.4 Not less than two (2) weeks prior to the date the Contractor anticipates it will be ready to conduct the Performance Test, Contractor shall provide notice to Owner of such anticipated readiness date. Owner and Contractor will thereafter coordinate to schedule the Performance Test on or as close as possible after such date.
- 12.2.5 All test measurement devices shall be fully defined for their make/model, accuracy, calibration and location, including the pyranometer in the plane of array, module cell

temperature sensor, ambient temperature sensor, wind speed and direction sensor, and revenue meter.

- 12.2.6 All test measurement devices shall have current NIST or equivalent calibration certificates.
- 12.2.7 The Performance Test shall verify and demonstrate to Owner that the RES has achieved at least the Minimum Performance Guarantee. The AC power output of the Project shall be measured at the PV production meter(s).
- 12.2.8 Losses will be calculated using mutually agreed calculation methods.
- 12.2.9 The actual test data set must contain at minimum measurements of plane of the array irradiance, module cell temperature and power output at the revenue meter. Each data point shall be represented by the average of all primary measurement devices installed on-site. All recorded data points shall be filtered per section 9.1 of ASTM E2848-13, with the following additional explicit filtering requirements:
  - 12.2.9.1 All data points with POA irradiances less than 200 W/m<sup>2</sup> will be filtered out.
  - 12.2.9.2 Any data points during a sensor or equipment failure and/or malfunction shall be removed.
  - 12.2.9.3 Data points during times of grid instability or inverter operation off utility-required power factor or off MPPT (clipping) shall be removed.
  - 12.2.9.4 Data points considered outliers due to unstable atmospheric conditions may be removed with Owner approval.
- 12.2.10 For the reporting conditions, the plane of array reference irradiance shall be determined based on the actual test data set. Contractor shall select the plane of array reference irradiance by determining the median plane of array irradiance value of the actual test data set. If the median irradiance value is less than 500W/m<sup>2</sup> then the recommendations of ASTM E2939- 13 section 8.4 shall prevail (i.e. calculate the plane of array irradiance value that exceeds 80% of the actual test data set. This shall be the plane of array reference irradiance).
- 12.2.11 Contractor shall calculate the actual regression coefficients and the actual test power at the mean reporting conditions per ASTM E2848-13. Contractor may choose to take recourse to the provision in section 8.3 of ASTM E2848-13 and use the provision of “moving window” as stipulated therein if the Owner suspects that the data collected is not consistent.
- 12.2.12 Contractor shall calculate the expected test output with PVsyst simulated 3D models based on the construction set (or as-built if available) of the RES. The PVsyst hourly data shall be filtered to remove and irradiances below 200W/m<sup>2</sup> or if the inverter is clipping.
  - 12.2.12.1 Soiling shall be assumed to be a 1% loss during the test period.
  - 12.2.12.2 Assume the RES is 100% available for energy generation.
- 12.2.13 Contractor shall provide the calculation of results per Section 9 of ASTM E2848-13 and shall provide a summary table of the following:

- 12.2.13.1 Actual Power at Mean Reporting Conditions
- 12.2.13.2 Expected Power at Mean Reporting Conditions
- 12.2.13.3 Uncertainty
- 12.2.13.4 Performance Test Ratio
- 12.2.13.5 Test Result
- 12.2.14 Contractor shall submit a detailed test report within two weeks of the completion of the Performance Test, whether successful or unsuccessful. The report shall include all test procedures, instrumentation calibration sheets, test data, field notes and observations, calculations, results, and any conclusion narrative.

## **13 TRAINING**

### **13.1 GENERAL REQUIREMENTS**

- 13.1.1 Contractor shall develop a training program for the operations and maintenance of the RES to be submitted to Owner. Such training program shall include the following:
  - 13.1.1.1 Step-by-step instructions for safe and reliable start-up, operations, and shut-down of the RES;
  - 13.1.1.2 Details on all major equipment and the RES's control system; and
  - 13.1.1.3 RES safety parameters, limits, and interlocks.
- 13.1.2 Contractor's training program shall avoid interference with Contractor's installation and testing activities and be conducted to enable the Owner's nominated personnel to participate, to a practical extent, in the commissioning of a system and/or a section of the RES.
- 13.1.3 Contractor's training program shall be comprised of both formal classroom and "hands-on" training. The "hands-on" training means utilizing installed equipment, if available, to familiarize Owner's nominated personnel with the equipment, its location in the RES, and its operation. Contractor shall ensure that adequate supply of training manuals are made available early enough prior to the commencement of training.
- 13.1.4 In addition to the training program describe above, Contractor shall train, or shall cause the inverter manufacturer to train, Owner's nominated personnel on preventative/scheduled maintenance of such equipment and level-1 corrective maintenance events, such as inverter resets and minor parts replacement.

|                                                   |                                                                 |             |             |             |
|---------------------------------------------------|-----------------------------------------------------------------|-------------|-------------|-------------|
| Project Name: PWC Central District Police Station |                                                                 |             |             |             |
| Project Size: <b>XXkwDC</b>                       |                                                                 | CONTRACTOR  | PWC         | OTHERS      |
| Phase                                             | Scope                                                           | Responsible | Responsible | Responsible |
| Due Diligence                                     | Electrical and structural audits                                | X           |             |             |
|                                                   | Interconnection Agreements                                      | X           | X           |             |
|                                                   | GPR/Subsurface Conditions Survey                                | X           |             |             |
|                                                   | Glare Study Report                                              | X           |             |             |
|                                                   | Discretionary Permits                                           | X           |             |             |
| Design                                            | Civil SWPPP                                                     | X           |             |             |
|                                                   | Civil Concrete Pads                                             | X           |             |             |
|                                                   | Civil Design                                                    | X           |             |             |
|                                                   | Architectural Design                                            | X           |             |             |
|                                                   | Structural Design                                               | X           |             |             |
|                                                   | Electrical Design                                               | X           |             |             |
|                                                   | Buss flag/IX design (as needed)                                 | X           |             |             |
|                                                   | Mechanical Design                                               | X           |             |             |
| Permits                                           | Building Permit                                                 | X           |             |             |
|                                                   | Encroachment Permit (if necessary)                              | X           |             |             |
|                                                   | IOR Scheduling/Fees                                             | X           |             |             |
|                                                   | Glare Study Approval                                            | X           |             |             |
|                                                   | SWPPP approval                                                  | X           |             |             |
|                                                   | Special Inspections                                             | X           |             |             |
|                                                   | Utility Inspection                                              | X           |             |             |
|                                                   | Civil Permit                                                    | X           |             |             |
|                                                   | Electrical Permit                                               | X           |             |             |
|                                                   | All other discretionary approval(s)                             | X           |             |             |
|                                                   | All other ministerial approval(s)                               | X           |             |             |
| Procurement                                       | PV modules (safe harbor)                                        | X           |             |             |
|                                                   | PV modules (non-safe harbor)                                    | X           |             |             |
|                                                   | MLSD                                                            | X           |             |             |
|                                                   | Inverters                                                       | X           |             |             |
|                                                   | Panelboards                                                     | X           |             |             |
|                                                   | Switchboards                                                    | X           |             |             |
|                                                   | Transformers                                                    | X           |             |             |
|                                                   | Combiner box                                                    | X           |             |             |
|                                                   | MV material / equipment                                         | X           |             |             |
|                                                   | DC material / equipment                                         | X           |             |             |
|                                                   | AC material / equipment                                         | X           |             |             |
|                                                   | Interconnection material / equipment                            | X           |             |             |
|                                                   | Electrical BOS                                                  | X           |             |             |
|                                                   | Data Acquisition System                                         | X           |             |             |
|                                                   | MET station                                                     | X           |             |             |
|                                                   | Meter/CTs/PTs                                                   | X           |             |             |
|                                                   | Signage / Labels                                                | X           |             |             |
|                                                   | SWPPP material                                                  | X           |             |             |
|                                                   | Roofing materials                                               | X           |             |             |
|                                                   | Equipment Pads (precast slab, vault, or free form)              | X           |             |             |
|                                                   | Roof slip sheets                                                | X           |             |             |
|                                                   | Roof Mechanical Attachments                                     | X           |             |             |
|                                                   | Ballast blocks                                                  | X           |             |             |
|                                                   | Rooftop Mounting System                                         | X           |             |             |
| GC Management                                     | Receiving / Unloading all material                              | X           |             |             |
|                                                   | Administrative reporting and mgmt                               | X           |             |             |
|                                                   | AHJ/State Building compliance (Building/Electrical Inspections) | X           |             |             |
|                                                   | State Agency compliance (SWPPP/General Permit)                  | X           |             |             |
|                                                   | Logistic Planning                                               | X           |             |             |
|                                                   | Project Schedule                                                | X           |             |             |
|                                                   | Project Reporting                                               | X           |             |             |
|                                                   | Safety Management (On-Site)                                     | X           |             |             |
|                                                   | Construction Management (On-Site)                               | X           |             |             |
|                                                   | All Meetings                                                    | X           |             |             |
|                                                   | Insurance                                                       | X           |             |             |
|                                                   | Tax                                                             | X           |             |             |
|                                                   | 5 yr Workmanship warranty                                       | X           |             |             |
|                                                   | Bonds (if req'd)                                                | X           |             |             |
| Temp facilities                                   | Bathrooms / Wash stations                                       | X           |             |             |
|                                                   | Temp storage / Offices / Office supplies                        | X           |             |             |
|                                                   | Construction Signage (Roadway, logistic, etc.)                  | X           |             |             |
|                                                   | Site security provisions (temp fence, etc)                      | X           |             |             |
|                                                   | Safety materials (PPE/Fall Protection)                          | X           |             |             |
|                                                   | Equipment rentals                                               | X           |             |             |
|                                                   | Hoisting / Cranes                                               | X           |             |             |
|                                                   | Temp Power                                                      | X           |             |             |
|                                                   | Dumpsters                                                       | X           |             |             |
|                                                   | Dust mitigation                                                 | X           |             |             |
| Roof Work                                         | Roof protection                                                 | X           |             |             |
|                                                   | Roof safety equipment                                           | X           |             |             |
|                                                   | Ballast block installation                                      | X           |             |             |
|                                                   | Mechanical attachment installation                              | X           |             |             |

CONTRACTOR prepares files and drawings

Should be NA



|                                                           |                                                                                                                    |   |  |  |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---|--|--|
| Roof Work                                                 | Slipsheet installation                                                                                             | X |  |  |
|                                                           | Lightning Protection (if required)                                                                                 | X |  |  |
|                                                           | Roof Inspections (pre + post PV install)                                                                           | X |  |  |
|                                                           | Roof repair (as part of construction)                                                                              | X |  |  |
| Mounting System Install (Rooftop)                         | Survey                                                                                                             | X |  |  |
|                                                           | Racking installation                                                                                               | X |  |  |
|                                                           | PV installation                                                                                                    | X |  |  |
| Civil Install                                             | SWPPP material                                                                                                     | X |  |  |
|                                                           | Site Demolition                                                                                                    | X |  |  |
|                                                           | Permanent Fence                                                                                                    | X |  |  |
|                                                           | Tree removal                                                                                                       | X |  |  |
|                                                           | Site preparations (Earthwork, retention basins, drainage, etc.)                                                    | X |  |  |
|                                                           | Site Restoration (seeding)                                                                                         | X |  |  |
|                                                           | Staging / Access preparations                                                                                      | X |  |  |
|                                                           | Field Survey / Stakeing                                                                                            | X |  |  |
|                                                           | Excavation                                                                                                         | X |  |  |
|                                                           | ADA Install                                                                                                        | X |  |  |
|                                                           | Equipment Pad installation                                                                                         | X |  |  |
| PV Install                                                | PV installation (PV in final racking system)                                                                       | X |  |  |
| DC Electrical Install                                     | Combiner box installation                                                                                          | X |  |  |
|                                                           | MLSD installation                                                                                                  | X |  |  |
|                                                           | DC wiring, wire mgmt, terminations                                                                                 | X |  |  |
|                                                           | Grounding installation                                                                                             | X |  |  |
|                                                           | PV wiring, wire mgmt, terminations                                                                                 | X |  |  |
|                                                           | Cable tray / wire mgmt installation                                                                                | X |  |  |
|                                                           | Array trenching and electrical installation                                                                        | X |  |  |
|                                                           | Set all DC equipment                                                                                               | X |  |  |
| AC Electrical Install                                     | Set all AC equipment                                                                                               | X |  |  |
|                                                           | Trenching / Backfill from inverters to interconnection                                                             | X |  |  |
|                                                           | Electrical installation                                                                                            | X |  |  |
|                                                           | Grounding / Bonding of equipment                                                                                   | X |  |  |
|                                                           | Interconnection Tie-In(off hour work)                                                                              | X |  |  |
|                                                           | Core drilling and patch for conduit                                                                                | X |  |  |
|                                                           | Cable tray / Conduit / MC installation                                                                             | X |  |  |
| Communication, Controls, and Monitoring Install           | Wire installation, testing, termination                                                                            | X |  |  |
|                                                           | DAS & SCADA installation                                                                                           | X |  |  |
|                                                           | Communication Conduit, Wire, Testing, Termination                                                                  | X |  |  |
|                                                           | MET station installation                                                                                           | X |  |  |
| Inverter, Panelboard, Switchboard and Transformer Install | Set, terminate & test inverters, panelboards, switchboards, disconnects, transformers and all electrical equipment | X |  |  |
| System Commissioning                                      | DAS & SCADA Commissioning                                                                                          | X |  |  |
|                                                           | PV Commissioning                                                                                                   | X |  |  |
|                                                           | All other Commissioning Tests                                                                                      | X |  |  |
|                                                           | Performance Validation                                                                                             | X |  |  |



# ARM Group LLC

Engineers and Scientists

January 9, 2024

Kevin Milsted  
Energy Coordinator  
Prince William County  
Property Management Division  
9517 Innovation Drive  
Manassas, Virginia 20109

Re: Chinn Aquatic Center Battery Storage  
Assessment Report

Dear Mr. Milsted:

Per Task 8: Battery Storage Assessment in the project proposal shared with Prince William County (PWC), ARM studied the feasibility of providing battery storage for at least 24 hours to different loads at the Chinn Aquatic Center.

ARM concluded that it is *impractical* to provide 24 hour battery storage to any of the loads due to high costs and the lack of commercially available products that provide enough storage for 24 hours of power. However, Virginia power customers only experience 4.25 hours of electrical service interruption per year, usually spread over multiple outages<sup>1</sup>. The following load feasibility assessments examine the practicality of 1-4 hour battery storage. The estimated loads for each scenario can be found in Table 2 of Appendix A. See Table 1 for price estimates for lighting, outlets, IT systems, HVAC, and the entire building for a battery system capable of supplying backup power for each load over different outage lengths. This battery cost is compared to the estimated cost of owning a backup natural gas generator capable of supplying the same loads. Note that the generator can essentially run indefinitely when connected to a natural gas line. The table displays the cost to purchase, install, and maintain over the system lifetime. The cost estimate does not include the cost of fuel or electricity over the lifetime of the generator.

Along with the cost to own each backup system, ARM analyzed the complexity of integrating into the existing building infrastructure. A combination of complexity and financial cost were used to help determine a status of *easy*, *difficult*, or *impractical* to supply 1-4 hour battery backup for each load category.

## **Lighting - Difficult**

It would be *difficult* to provide 1-4 hours of battery storage to lighting loads. There are three 480V lighting panels (H1A, H1B, and H2) spread among separate electrical rooms. Each 480V lighting panel feeds a 45kVA transformer that supplies 120V power to outlets and a small portion of the lighting load; thus, to back up all the lighting load would require backing up the outlets as well. The

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combined load of lighting and outlets would be large, around 180 kVA. While it would be possible to provide battery power to only the main 480V lighting circuits, it would add another layer of complexity to the system to automatically disconnect the 480V panels from the 120V transformers during switch over. The 480V lighting load only would still be 110 kVA which is large enough that it is difficult to justify battery storage over a gas generator.

A 1 hour, 180kVA battery and inverter would be more expensive than a 180kVA gas generator. In terms of physical space needed, both a gas generator and battery backup would be large enough to require installation outdoors. In addition to either form of backup power generation, three separate automatic transfer switches (ATS) would be required for each of the 480V lighting panels. These additional ATSs would not only increase the installation cost and complexity, but also would take up valuable space in the main electrical room with the 1600A switchboard. See Table 1 in the appendix for price estimates of battery storage vs. natural gas generators.

### **Outlets - Easy**

Assuming there is sufficient room in the electrical rooms to install an uninterruptible power supply (UPS), it would be *easy* to provide 1-4 hours of battery storage to the outlets. Based on the energy density of an Eaton lithium ion battery<sup>2</sup>, approximately 8kWH of batteries can fit on one electrical rack (61.2" x 17.3" x 25.4"). Assuming a 50% load on the outlets, each 45kVA transformer panel would require a 22.5 kVA battery storage system. To provide 1 hour of battery power, 3 battery racks would be needed. A floor area of approximately 4.5' x 2' (51.9" x 25.4") would be required near each 45kVA transformer to install the battery storage system. The floor space required will increase linearly as the hours of battery storage installed increases. For example, 4 hours of battery storage would require approximately 17.5' x 2' of floor space for each 45kVA transformer.

Space concerns aside, 20kVA UPSs are commonly available with customizable battery sizes and require minimal electrical work to install between the 45kVA transformers and 120V panels.

### **IT Systems - Easy**

It would be *easy* to provide 1-4 hours of battery storage to the IT systems. Battery storage is often used to backup essential IT loads so there are many commercial battery solutions available. Even a relatively large UPS of 10kVA can fit in the equipment rack of a server room with relatively simple installation. Larger battery sizes (greater than 1 hour) may require an extra rack to fit the additional batteries.

### **HVAC - Impractical**

It would be *impractical* to provide 1-4 hours of battery storage to the HVAC system. Because each HVAC load has its own feeder from the main switchboard, extensive electrical work would be needed to power only the HVAC loads. Backup battery storage systems large enough to power all the HVAC loads are rare since a natural gas generator is almost always the more economical option.

Rather than powering the entire HVAC system, specific HVAC equipment could be identified to require backup power. For specific HVAC loads, the feasibility of furnishing battery storage will vary depending on load size and type.

**Appendix:**

| Load Type       | Required Battery Output (kVA) | Lithium Ion Battery Storage Cost (15-20 Year Lifespan) <sup>3</sup> |                |                |                |                | Comparable Natural Gas Generator Over 25 Year Lifetime Cost <sup>4</sup> |
|-----------------|-------------------------------|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|--------------------------------------------------------------------------|
|                 |                               | 1 Hr                                                                | 2 Hr           | 4 Hr           | 12 Hr          | 24 Hr          |                                                                          |
| Lighting        | 110                           | \$162,004.54                                                        | \$188,543.33   | \$241,620.90   | \$453,931.20   | \$772,396.66   | \$103,253.33                                                             |
| HVAC            | 540                           | \$795,295.01                                                        | \$925,576.33   | \$1,186,138.98 | \$2,228,389.55 | \$3,791,765.41 | \$532,224.00                                                             |
| IT Systems      | 10                            | \$14,727.69                                                         | \$17,140.30    | \$21,965.54    | \$41,266.47    | \$70,217.88    | \$9,386.67                                                               |
| Outlets         | 70                            | \$103,093.80                                                        | \$119,982.12   | \$153,758.76   | \$288,865.31   | \$491,525.15   | \$65,706.67                                                              |
| Entire Building | 730                           | \$1,075,121.03                                                      | \$1,251,242.08 | \$1,603,484.17 | \$3,012,452.54 | \$5,125,905.10 | \$719,488.00                                                             |

Table 1: Cost Estimates for Battery Storage vs. Natural Gas Generator (Installation Cost Included)

| Load Type  | Load Breakdown                                                                                                                                                                        | Total Load | Notes                                                                                                                                                  |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lighting   | -102 kVA at 100% duty factor<br>-20 kVA outside are lighting (not included in total load)                                                                                             | 102 kVA    | Based on lighting load calculations from original building drawings. If more energy efficient lights have been installed, lighting load might be less. |
| HVAC       | -RTU-1: 123.3 kVA<br>-RTU-2: 99.6 kVA<br>-RTU-3: 33.3 kVA<br>-ERU-1: 27.3 kVA<br>-ERU-2: 27.3 kVA<br>-DHP-1: 36.6 kVA<br>-DHP-2: 63.9 kVA<br>-DHP-3: 84.6 kVA<br>-ACC-1, 2, 3: 39 kVA | 535 kVA    | Total load assumes all HVAC units running simultaneously at 100% load.                                                                                 |
| IT Systems | -Assumed 10 kVA load                                                                                                                                                                  | 10 kVA     | No data available on IT load at Chinn Aquatic Center. Estimated 10 kVA load is based on size of commonly available UPSs for small server rooms.        |
| Outlets    | -124 kVA total outlet load<br>-10 kVA at 100% duty factor<br>-Remaining load at 50% duty factor: 57 kVA                                                                               | 67 kVA     | It is unlikely for every outlet to be used at the same time and at full load, so 50% load is assumed with a small number of 100% loads.                |

Table 2: Chinn Aquatic Center Load Estimates

## Citations

1. [Annual Electric Power Industry Report, Form EIA-861 detailed data files](#)
2. [Eaton 9PX Distribution Module UPS, Hardwire, 3U | Eaton](#)
3. [Commercial Battery Storage | Electricity | 2023 | ATB | NREL](#)
4. [0204200-Total-Cost-of-Ownership-Diesel-vs-Natural-Gas-Generators.pdf \(generac.com\)](#)

# ADC Jail PWC - ADC Jail, 9320 Lee Avenue, Manassas, VA

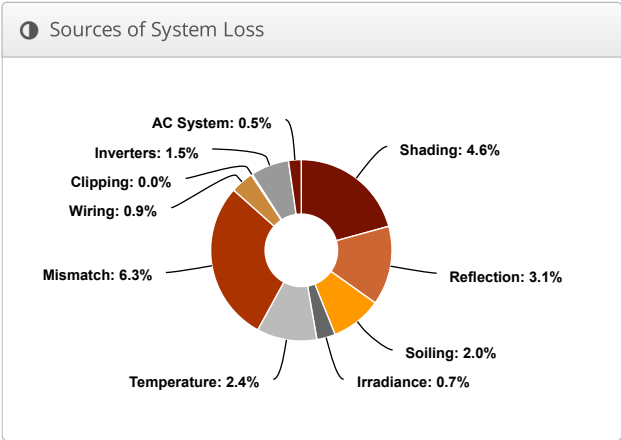
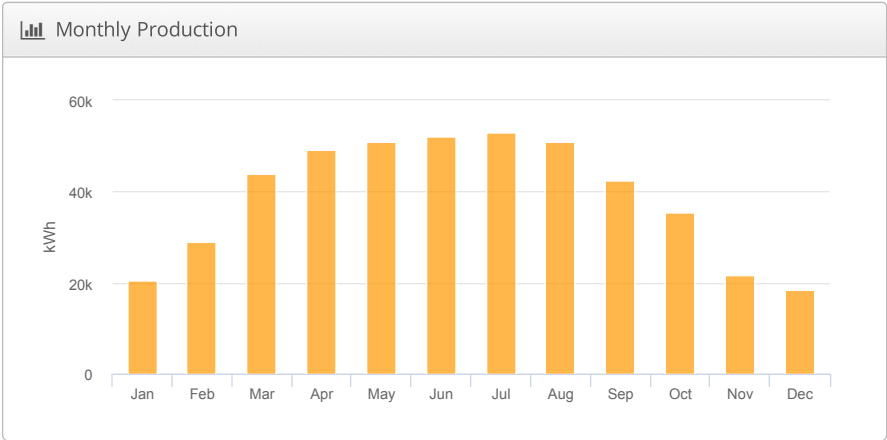
Report

|                     |                                                          |
|---------------------|----------------------------------------------------------|
| Project Name        | PWC - ADC Jail                                           |
| Project Description | 57,886 sq ft 9,180,000 kwh per year 1,606 kw peak demand |
| Project Address     | 9320 Lee Avenue, Manassas, VA                            |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net                    |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | ADC Jail                                         |
| Module DC Nameplate   | 348.7 kW                                         |
| Inverter AC Nameplate | 300.0 kW<br>Load Ratio: 1.16                     |
| Annual Production     | 467.2 MWh                                        |
| Performance Ratio     | 79.9%                                            |
| kWh/kWp               | 1,339.8                                          |
| Weather Dataset       | TMY, 10km Grid (38.75,-77.45), NREL (prospector) |
| Simulator Version     | 6a74034394-483c6c6be2-aa4cb1d45e-4e9afde0e0      |

Project Location



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance<br>(kWh/m²)      | Annual Global Horizontal Irradiance | 1,552.3   |         |
|                             | POA Irradiance                      | 1,677.1   | 8.0%    |
|                             | Shaded Irradiance                   | 1,600.6   | -4.6%   |
|                             | Irradiance after Reflection         | 1,550.9   | -3.1%   |
|                             | Irradiance after Soiling            | 1,519.9   | -2.0%   |
|                             | Total Collector Irradiance          | 1,520.0   | 0.0%    |
| Energy<br>(kWh)             | Nameplate                           | 529,843.6 |         |
|                             | Output at Irradiance Levels         | 525,992.0 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 513,559.7 | -2.4%   |
|                             | Output After Mismatch               | 481,268.3 | -6.3%   |
|                             | Optimal DC Output                   | 476,915.3 | -0.9%   |
|                             | Constrained DC Output               | 476,685.5 | 0.0%    |
|                             | Inverter Output                     | 469,533.9 | -1.5%   |
|                             | Energy to Grid                      | 467,186.2 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.8 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.7 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4666      |         |
| Solved Hours                |                                     | 4666      |         |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA50KTL-DO/US-480 (2022) (CPS)   | 6 (300.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 30 (6,289.9 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 634 (348.7 kW)  |

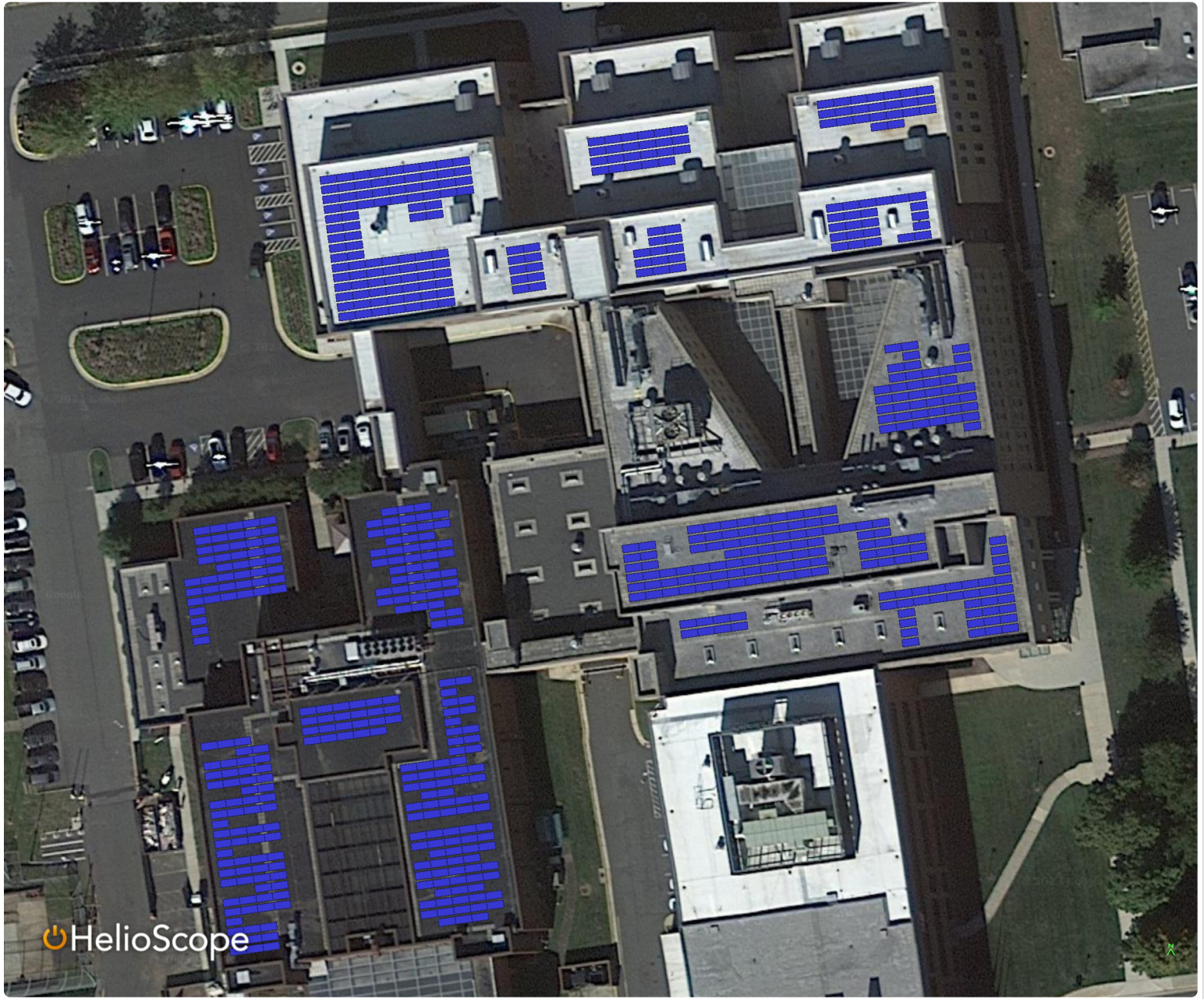
| ☁ Condition Set              |                                                  |       |         |                   |   |   |             |             |                                  |                  |   |   |
|------------------------------|--------------------------------------------------|-------|---------|-------------------|---|---|-------------|-------------|----------------------------------|------------------|---|---|
| Description                  | Condition Set 1                                  |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Weather Dataset              | TMY, 10km Grid (38.75,-77.45), NREL (prospector) |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Transposition Model          | Perez Model                                      |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Temperature Model            | Sandia Model                                     |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Temperature Model Parameters | Rack Type                                        | a     | b       | Temperature Delta |   |   |             |             |                                  |                  |   |   |
|                              | Fixed Tilt                                       | -3.56 | -0.075  | 3°C               |   |   |             |             |                                  |                  |   |   |
|                              | Flush Mount                                      | -2.81 | -0.0455 | 0°C               |   |   |             |             |                                  |                  |   |   |
|                              | East-West                                        | -3.56 | -0.075  | 3°C               |   |   |             |             |                                  |                  |   |   |
|                              | Carport                                          | -3.56 | -0.075  | 3°C               |   |   |             |             |                                  |                  |   |   |
| Soiling (%)                  | J                                                | F     | M       | A                 | M | J | J           | A           | S                                | O                | N | D |
|                              | 2                                                | 2     | 2       | 2                 | 2 | 2 | 2           | 2           | 2                                | 2                | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Cell Temperature Spread      | 4° C                                             |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |         |                   |   |   |             |             |                                  |                  |   |   |
| AC System Derate             | 0.50%                                            |       |         |                   |   |   |             |             |                                  |                  |   |   |
| Module Characterizations     | Module                                           |       |         |                   |   |   | Uploaded By |             | Characterization                 |                  |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |         |                   |   |   | HelioScope  |             | Spec Sheet Characterization, PAN |                  |   |   |
| Component Characterizations  | Device                                           |       |         |                   |   |   |             | Uploaded By |                                  | Characterization |   |   |
|                              | CPS SCA50KTL-DO/US-480 (2022) (CPS)              |       |         |                   |   |   |             | HelioScope  |                                  | Spec Sheet       |   |   |

| 👤 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 21-23       | Along Racking      |

| 🏠 Field Segments |            |                        |      |            |                  |            |        |         |         |
|------------------|------------|------------------------|------|------------|------------------|------------|--------|---------|---------|
| Description      | Racking    | Orientation            | Tilt | Azimuth    | Intrarow Spacing | Frame Size | Frames | Modules | Power   |
| Field Segment 1  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 92     | 92      | 50.6 kW |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 171.66893° | 1.1 ft           | 1x1        | 42     | 42      | 23.1 kW |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 44     | 44      | 24.2 kW |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 69     | 69      | 38.0 kW |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 134    | 134     | 73.7 kW |
| Field Segment 6  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 23     | 23      | 12.7 kW |
| Field Segment 7  | Fixed Tilt | Landscape (Horizontal) | 10°  | 171.32184° | 1.1 ft           | 1x1        | 46     | 46      | 25.3 kW |
| Field Segment 8  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172.24821° | 1.1 ft           | 1x1        | 92     | 92      | 50.6 kW |
| Field Segment 10 | Fixed Tilt | Landscape (Horizontal) | 10°  | 172.24821° | 1.1 ft           | 1x1        | 23     | 23      | 12.7 kW |
| Field Segment 11 | Fixed Tilt | Landscape (Horizontal) | 10°  | 172.24821° | 1.1 ft           | 1x1        | 23     | 23      | 12.7 kW |
| Field Segment 12 | Fixed Tilt | Landscape (Horizontal) | 10°  | 172.24821° | 1.1 ft           | 1x1        | 23     | 23      | 12.7 kW |
| Field Segment 13 | Fixed Tilt | Landscape (Horizontal) | 10°  | 172.24821° | 1.1 ft           | 1x1        | 13     | 13      | 7.15 kW |
| Field Segment 13 | Fixed Tilt | Landscape (Horizontal) | 10°  | 171.47429° | 1.1 ft           | 1x1        | 10     | 10      | 5.50 kW |



 Detailed Layout



# Bull Run Library PWC - Bull Run Library, 8051 Ashton Ave., Manassas VA

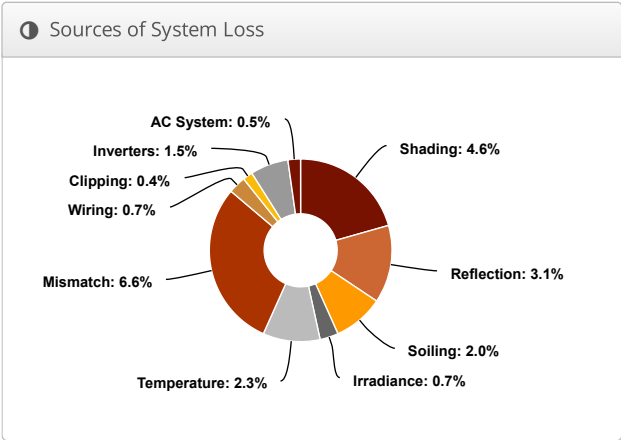
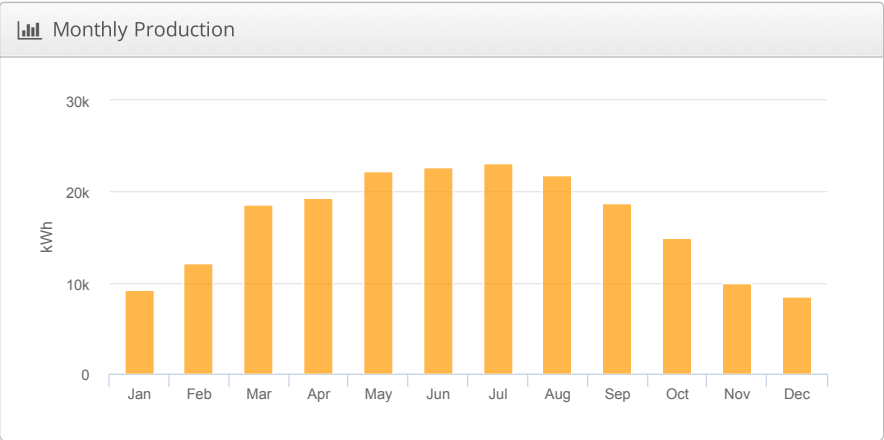
Report

|                     |                                               |
|---------------------|-----------------------------------------------|
| Project Name        | PWC - Bull Run Library                        |
| Project Description | 20,000 sq ft 500,114 kWh per year 151 kW peak |
| Project Address     | 8051 Ashton Ave., Manassas VA                 |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net         |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Bull Run Library                                 |
| Module DC Nameplate   | 151.8 kW                                         |
| Inverter AC Nameplate | 120.0 kW<br>Load Ratio: 1.27                     |
| Annual Production     | 201.2 MWh                                        |
| Performance Ratio     | 79.6%                                            |
| kWh/kWp               | 1,325.3                                          |
| Weather Dataset       | TMY, 10km grid (38.75,-77.55), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |

Project Location



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,551.6   |         |
|                             | POA Irradiance                      | 1,665.6   | 7.3%    |
|                             | Shaded Irradiance                   | 1,588.8   | -4.6%   |
|                             | Irradiance after Reflection         | 1,539.9   | -3.1%   |
|                             | Irradiance after Soiling            | 1,509.1   | -2.0%   |
|                             | Total Collector Irradiance          | 1,509.1   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 228,996.6 |         |
|                             | Output at Irradiance Levels         | 227,324.7 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 222,181.2 | -2.3%   |
|                             | Output After Mismatch               | 207,523.6 | -6.6%   |
|                             | Optimal DC Output                   | 206,092.8 | -0.7%   |
|                             | Constrained DC Output               | 205,284.1 | -0.4%   |
|                             | Inverter Output                     | 202,193.9 | -1.5%   |
|                             | Energy to Grid                      | 201,182.9 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.2 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.0 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4655      |         |
| Solved Hours                |                                     | 4655      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|---|----------------------------------|---|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
| Weather Dataset              | TMY, 10km grid (38.75,-77.55), NREL (prospector) |       |   |         |   |                   |             |   |                                  |   |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |   |                                  |   |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |   |                                  |   |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A | S                                | O | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2 | 2                                | 2 | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |   |                                  |   |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |   | Spec Sheet Characterization, PAN |   |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | CPS SCA60KTL-DO/480 (Chint)                      |       |   |         |   |                   | HelioScope  |   | Spec Sheet                       |   |   |   |

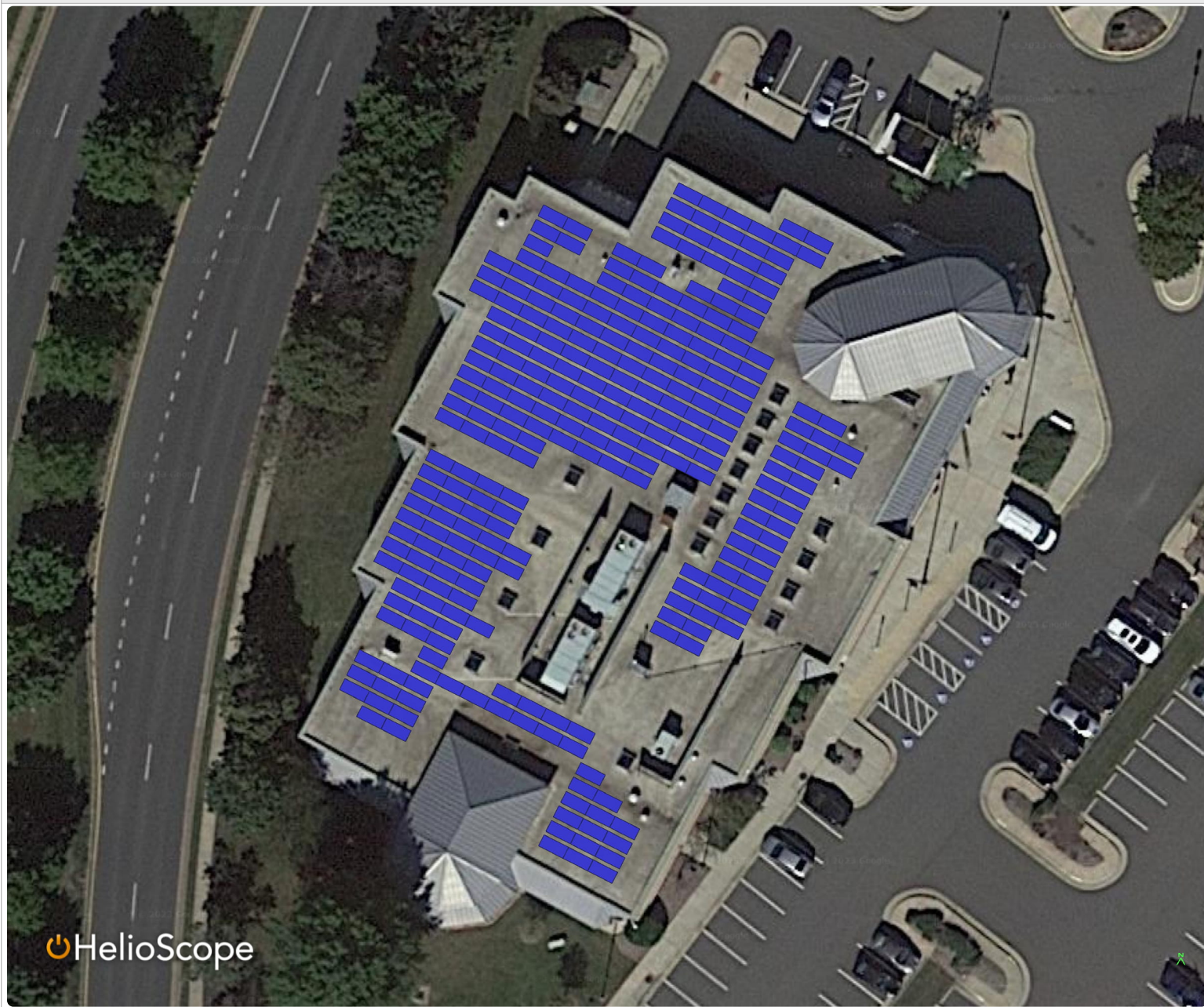
| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA60KTL-DO/480 (Chint)           | 2 (120.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 12 (1,170.1 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 276 (151.8 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 20-23       | Along Racking      |

| 🏠 Field Segments |            |                        |      |         |                  |            |        |         |         |
|------------------|------------|------------------------|------|---------|------------------|------------|--------|---------|---------|
| Description      | Racking    | Orientation            | Tilt | Azimuth | Intrarow Spacing | Frame Size | Frames | Modules | Power   |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 207°    | 1.1 ft           | 1x1        | 155    | 155     | 85.3 kW |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 207°    | 1.1 ft           | 1x1        | 39     | 39      | 21.5 kW |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 207°    | 1.1 ft           | 1x1        | 82     | 82      | 45.1 kW |



Detailed Layout



# Central District Police PWC - Central District Police Station, 5036 Davis Ford Rd, Woodbridge VA

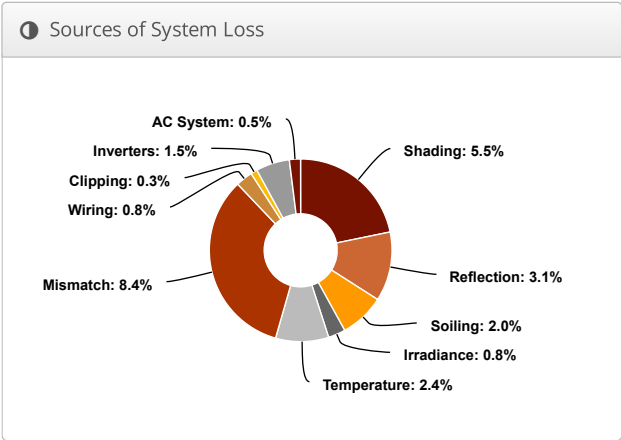
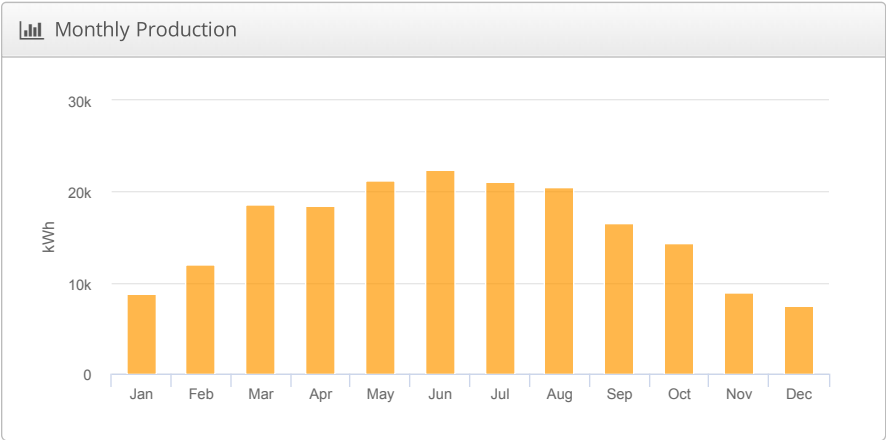
Report

|                     |                                       |
|---------------------|---------------------------------------|
| Project Name        | PWC - Central District Police Station |
| Project Description | 24,500 sq ft 989,760 kWh/yr 212 peak  |
| Project Address     | 5036 Davis Ford Rd, Woodbridge VA     |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Central District Police                          |
| Module DC Nameplate   | 149.6 kW                                         |
| Inverter AC Nameplate | 120.0 kW<br>Load Ratio: 1.25                     |
| Annual Production     | 190.4 MWh                                        |
| Performance Ratio     | 77.2%                                            |
| kWh/kWp               | 1,272.5                                          |
| Weather Dataset       | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |

Project Location



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,522.7   |         |
|                             | POA Irradiance                      | 1,647.7   | 8.2%    |
|                             | Shaded Irradiance                   | 1,557.3   | -5.5%   |
|                             | Irradiance after Reflection         | 1,509.2   | -3.1%   |
|                             | Irradiance after Soiling            | 1,479.0   | -2.0%   |
|                             | Total Collector Irradiance          | 1,479.3   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 221,250.7 |         |
|                             | Output at Irradiance Levels         | 219,546.0 | -0.8%   |
|                             | Output at Cell Temperature Derate   | 214,357.2 | -2.4%   |
|                             | Output After Mismatch               | 196,296.5 | -8.4%   |
|                             | Optimal DC Output                   | 194,815.3 | -0.8%   |
|                             | Constrained DC Output               | 194,247.5 | -0.3%   |
|                             | Inverter Output                     | 191,327.6 | -1.5%   |
|                             | Energy to Grid                      | 190,370.9 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.9 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.5 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4657      |         |
| Solved Hours                |                                     | 4657      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|---|----------------------------------|---|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
| Weather Dataset              | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |       |   |         |   |                   |             |   |                                  |   |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |   |                                  |   |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |   |                                  |   |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A | S                                | O | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2 | 2                                | 2 | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |   |                                  |   |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |   | Spec Sheet Characterization, PAN |   |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | CPS SCA60KTL-DO/480 (Chint)                      |       |   |         |   |                   | HelioScope  |   | Spec Sheet                       |   |   |   |

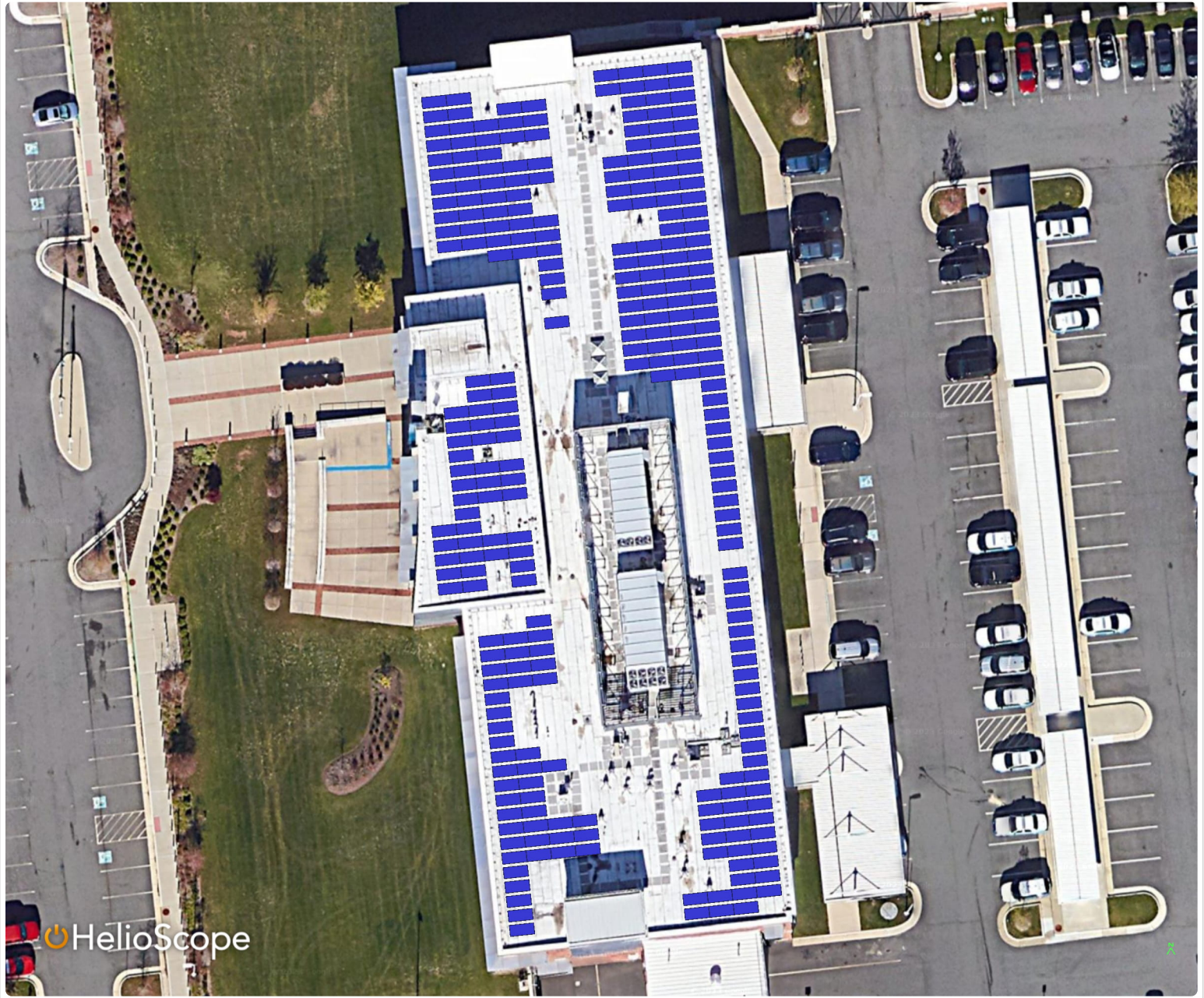
| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA60KTL-DO/480 (Chint)           | 2 (120.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 12 (1,684.7 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 272 (149.6 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 20-23       | Along Racking      |

| 🏠 Field Segments |            |                        |      |         |                  |            |        |         |         |
|------------------|------------|------------------------|------|---------|------------------|------------|--------|---------|---------|
| Description      | Racking    | Orientation            | Tilt | Azimuth | Intrarow Spacing | Frame Size | Frames | Modules | Power   |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173.9°  | 1.1 ft           | 1x1        | 40     | 40      | 22.0 kW |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173.9°  | 1.1 ft           | 1x1        | 45     | 45      | 24.8 kW |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173.9°  | 1.1 ft           | 1x1        | 42     | 42      | 23.1 kW |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173.9°  | 1.1 ft           | 1x1        | 91     | 91      | 50.1 kW |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173.9°  | 1.1 ft           | 1x1        | 54     | 54      | 29.7 kW |



 Detailed Layout



# Chinn Aquatic

PWC - Chinn Aquatic and Fitness Center, 13025 Chinn Park Dr., Woodbridge, VA

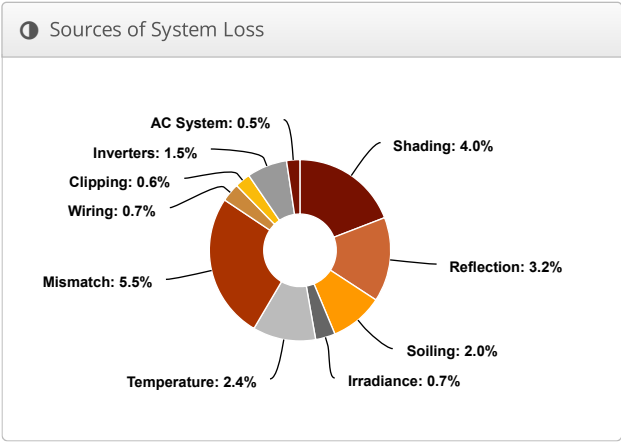
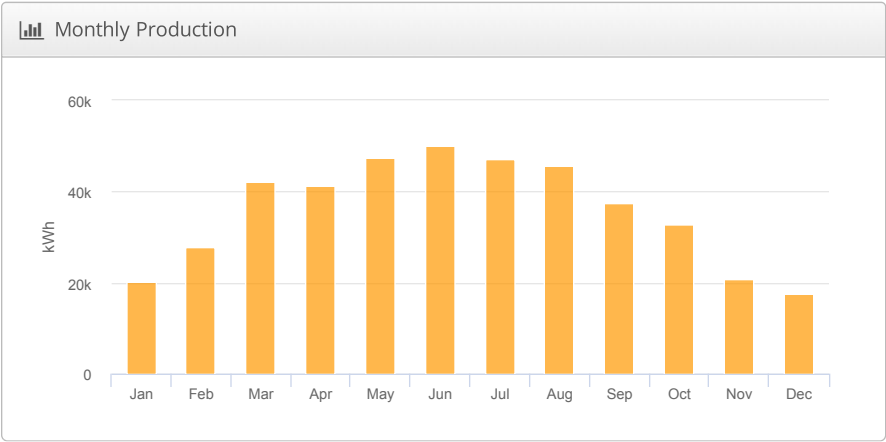
Report

|                     |                                           |
|---------------------|-------------------------------------------|
| Project Name        | PWC - Chinn Aquatic and Fitness Center    |
| Project Description | 40,000 sq ft 2,334,605 kWh/yr 733 kW peak |
| Project Address     | 13025 Chinn Park Dr., Woodbridge, VA      |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net     |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Chinn Aquatic                                    |
| Module DC Nameplate   | 323.4 kW                                         |
| Inverter AC Nameplate | 250.0 kW<br>Load Ratio: 1.29                     |
| Annual Production     | 430.2 MWh                                        |
| Performance Ratio     | 80.7%                                            |
| kWh/kWp               | 1,330.4                                          |
| Weather Dataset       | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |

Project Location





| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance<br>(kWh/m²)      | Annual Global Horizontal Irradiance | 1,522.7   |         |
|                             | POA Irradiance                      | 1,648.5   | 8.3%    |
|                             | Shaded Irradiance                   | 1,582.1   | -4.0%   |
|                             | Irradiance after Reflection         | 1,531.8   | -3.2%   |
|                             | Irradiance after Soiling            | 1,501.2   | -2.0%   |
|                             | Total Collector Irradiance          | 1,501.3   | 0.0%    |
| Energy<br>(kWh)             | Nameplate                           | 485,379.5 |         |
|                             | Output at Irradiance Levels         | 481,783.9 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 470,361.7 | -2.4%   |
|                             | Output After Mismatch               | 444,701.1 | -5.5%   |
|                             | Optimal DC Output                   | 441,601.3 | -0.7%   |
|                             | Constrained DC Output               | 439,021.0 | -0.6%   |
|                             | Inverter Output                     | 432,399.6 | -1.5%   |
|                             | Energy to Grid                      | 430,237.6 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.9 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.6 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4657      |         |
| Solved Hours                |                                     | 4657      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|-------------|----------------------------------|------------------|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Weather Dataset              | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |             |                                  |                  |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |             |                                  |                  |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A           | S                                | O                | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2           | 2                                | 2                | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |             | Characterization                 |                  |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |             | Spec Sheet Characterization, PAN |                  |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   |             | Uploaded By |                                  | Characterization |   |   |
|                              | CPS SCA50KTL-DO/US-480 (2022) (CPS)              |       |   |         |   |                   |             | HelioScope  |                                  | Spec Sheet       |   |   |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA50KTL-DO/US-480 (2022) (CPS)   | 5 (250.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 30 (4,106.9 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 588 (323.4 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 19-21       | Along Racking      |

| 🏠 Field Segments |            |                        |      |         |                  |            |        |         |          |
|------------------|------------|------------------------|------|---------|------------------|------------|--------|---------|----------|
| Description      | Racking    | Orientation            | Tilt | Azimuth | Intrarow Spacing | Frame Size | Frames | Modules | Power    |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 177.77° | 1.1 ft           | 1x1        | 230    | 230     | 126.5 kW |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 177.77° | 1.1 ft           | 1x1        | 21     | 21      | 11.6 kW  |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 177.77° | 1.1 ft           | 1x1        | 208    | 208     | 114.4 kW |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 177.77° | 1.1 ft           | 1x1        | 39     | 39      | 21.5 kW  |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 177.77° | 1.1 ft           | 1x1        | 50     | 50      | 27.5 kW  |
| Field Segment 6  | Fixed Tilt | Landscape (Horizontal) | 10°  | 177.77° | 1.1 ft           | 1x1        | 40     | 40      | 22.0 kW  |

Detailed Layout



# County Government Center

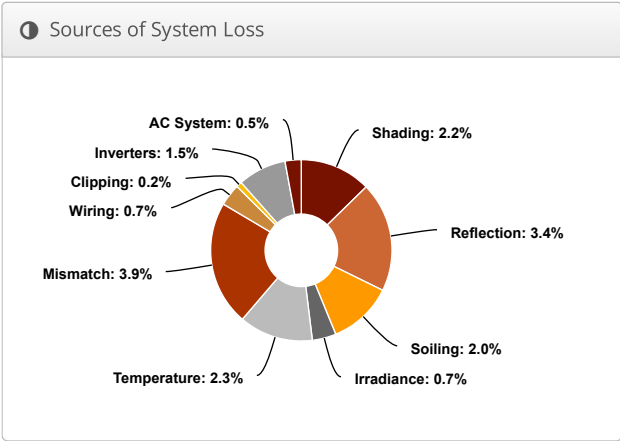
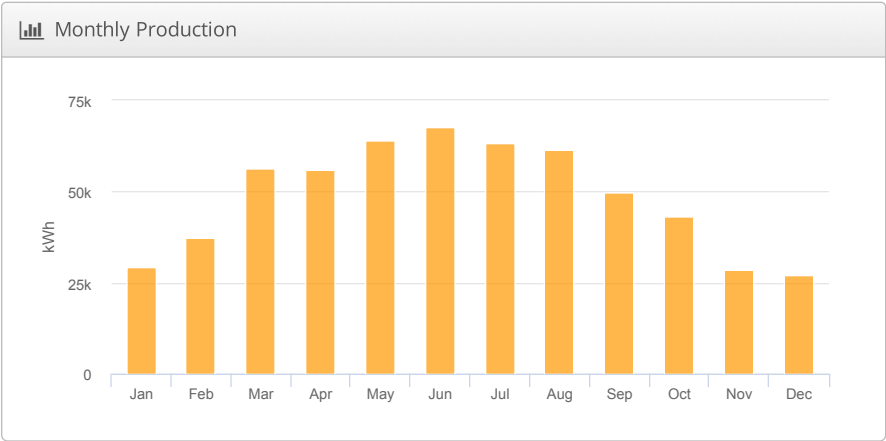
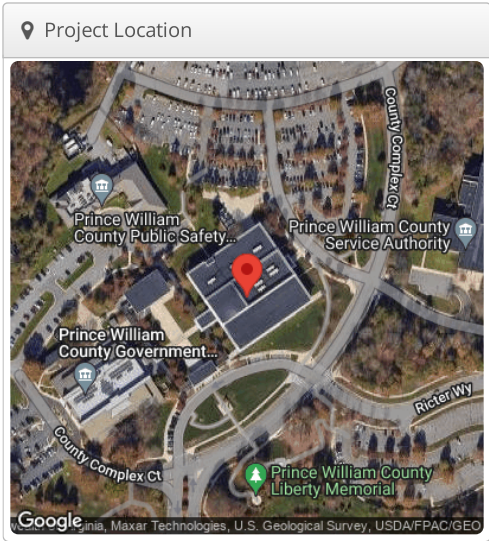
PWC - County Government Center, 5 County Complex Court,  
Woodbridge, VA

**Report**

|                     |                                                                 |
|---------------------|-----------------------------------------------------------------|
| Project Name        | PWC - County Government Center                                  |
| Project Description | ~55,000 roof square footage 2,172,000 kWh/yr 670 kW Peak demand |
| Project Address     | 5 County Complex Court, Woodbridge, VA                          |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net                           |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | County Government Center                         |
| Module DC Nameplate   | 429.6 kW                                         |
| Inverter AC Nameplate | 360.0 kW<br>Load Ratio: 1.19                     |
| Annual Production     | 584.9 MWh                                        |
| Performance Ratio     | 83.9%                                            |
| kWh/kWp               | 1,361.7                                          |
| Weather Dataset       | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,522.7   |         |
|                             | POA Irradiance                      | 1,623.6   | 6.6%    |
|                             | Shaded Irradiance                   | 1,587.9   | -2.2%   |
|                             | Irradiance after Reflection         | 1,534.0   | -3.4%   |
|                             | Irradiance after Soiling            | 1,503.3   | -2.0%   |
|                             | Total Collector Irradiance          | 1,503.3   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 645,523.0 |         |
|                             | Output at Irradiance Levels         | 640,756.7 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 626,086.0 | -2.3%   |
|                             | Output After Mismatch               | 601,937.0 | -3.9%   |
|                             | Optimal DC Output                   | 597,848.4 | -0.7%   |
|                             | Constrained DC Output               | 596,808.8 | -0.2%   |
|                             | Inverter Output                     | 587,842.0 | -1.5%   |
|                             | Energy to Grid                      | 584,902.8 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.9 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.6 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4657      |         |
| Solved Hours                |                                     | 4657      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|---|----------------------------------|---|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
| Weather Dataset              | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |       |   |         |   |                   |             |   |                                  |   |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |   |                                  |   |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |   |                                  |   |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A | S                                | O | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2 | 2                                | 2 | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |   |                                  |   |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |   | Spec Sheet Characterization, PAN |   |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | CPS SCA60KTL-DO/480 (Chint)                      |       |   |         |   |                   | HelioScope  |   | Spec Sheet                       |   |   |   |

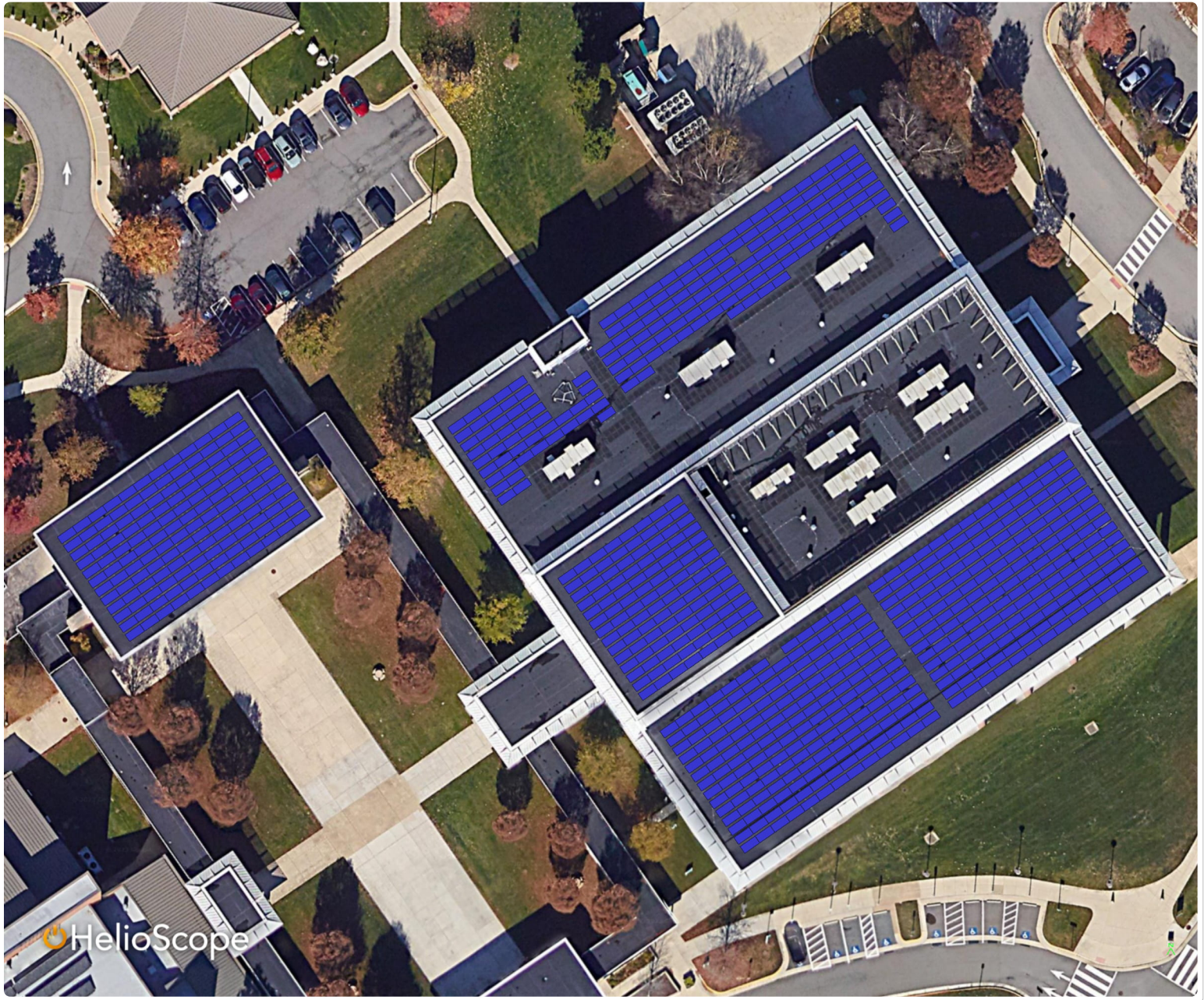
| 🗄 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA60KTL-DO/480 (Chint)           | 6 (360.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 37 (4,922.2 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 781 (429.6 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 20-23       | Along Racking      |
| Wiring Zone 2  | -              | 20-23       | Along Racking      |

| 🏠 Field Segments |            |                        |      |            |                  |            |        |         |          |
|------------------|------------|------------------------|------|------------|------------------|------------|--------|---------|----------|
| Description      | Racking    | Orientation            | Tilt | Azimuth    | Intrarow Spacing | Frame Size | Frames | Modules | Power    |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 145.1634°  | 1.1 ft           | 1x1        | 181    | 181     | 99.6 kW  |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 145.29845° | 1.1 ft           | 1x1        | 144    | 144     | 79.2 kW  |
| Field Segment 1  | Fixed Tilt | Landscape (Horizontal) | 10°  | 145.16965° | 1.1 ft           | 1x1        | 112    | 112     | 61.6 kW  |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 145.16965° | 1.1 ft           | 1x1        | 182    | 182     | 100.1 kW |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 145.16965° | 1.1 ft           | 1x1        | 162    | 162     | 89.1 kW  |



 Detailed Layout





## Dr. AJ Building PWC - Dr. AJ Ferlazzo Building, 15941 Donald Curtis Dr., Woodbridge VA

### Report

|                     |                                           |
|---------------------|-------------------------------------------|
| Project Name        | PWC - Dr. AJ Ferlazzo Building            |
| Project Description | 77,500 sq ft 1,583,280 kWh/yr 436 kW peak |
| Project Address     | 15941 Donald Curtis Dr., Woodbridge VA    |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net     |

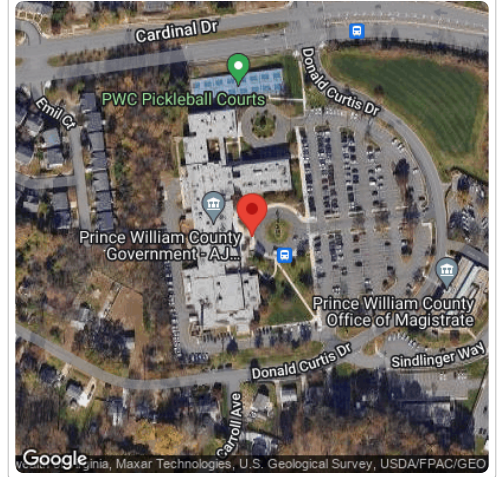


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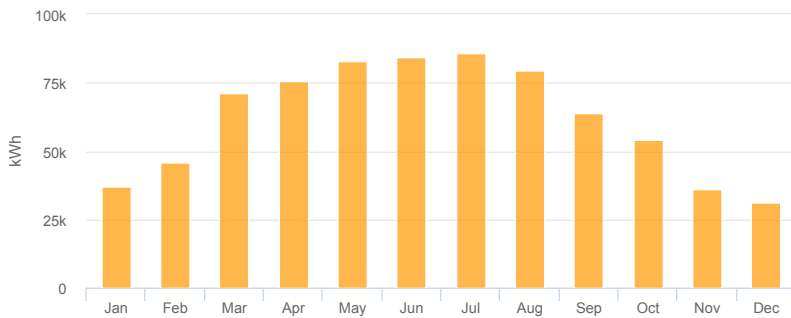
### System Metrics

|                       |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Dr. AJ Building                                  |
| Module DC Nameplate   | 548.9 kW                                         |
| Inverter AC Nameplate | 480.0 kW<br>Load Ratio: 1.14                     |
| Annual Production     | 747.7 MWh                                        |
| Performance Ratio     | 81.2%                                            |
| kWh/kWp               | 1,362.3                                          |
| Weather Dataset       | TMY, 10km Grid (38.65,-77.25), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |

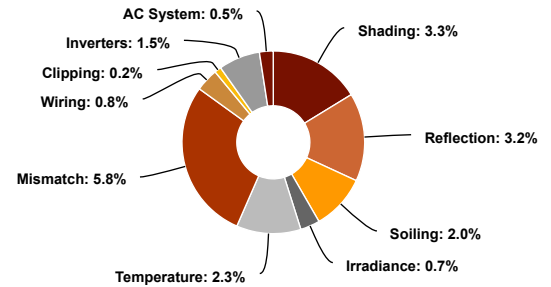
### Project Location



### Monthly Production



### Sources of System Loss



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,551.0   |         |
|                             | POA Irradiance                      | 1,677.5   | 8.2%    |
|                             | Shaded Irradiance                   | 1,621.8   | -3.3%   |
|                             | Irradiance after Reflection         | 1,570.0   | -3.2%   |
|                             | Irradiance after Soiling            | 1,538.6   | -2.0%   |
|                             | Total Collector Irradiance          | 1,538.5   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 844,219.5 |         |
|                             | Output at Irradiance Levels         | 838,264.8 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 818,732.9 | -2.3%   |
|                             | Output After Mismatch               | 771,197.5 | -5.8%   |
|                             | Optimal DC Output                   | 764,825.1 | -0.8%   |
|                             | Constrained DC Output               | 762,949.7 | -0.2%   |
|                             | Inverter Output                     | 751,504.5 | -1.5%   |
|                             | Energy to Grid                      | 747,746.9 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.7 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.6 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4665      |         |
| Solved Hours                |                                     | 4665      |         |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA60KTL-DO/480 (Chint)           | 8 (480.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 48 (9,050.7 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 998 (548.9 kW)  |

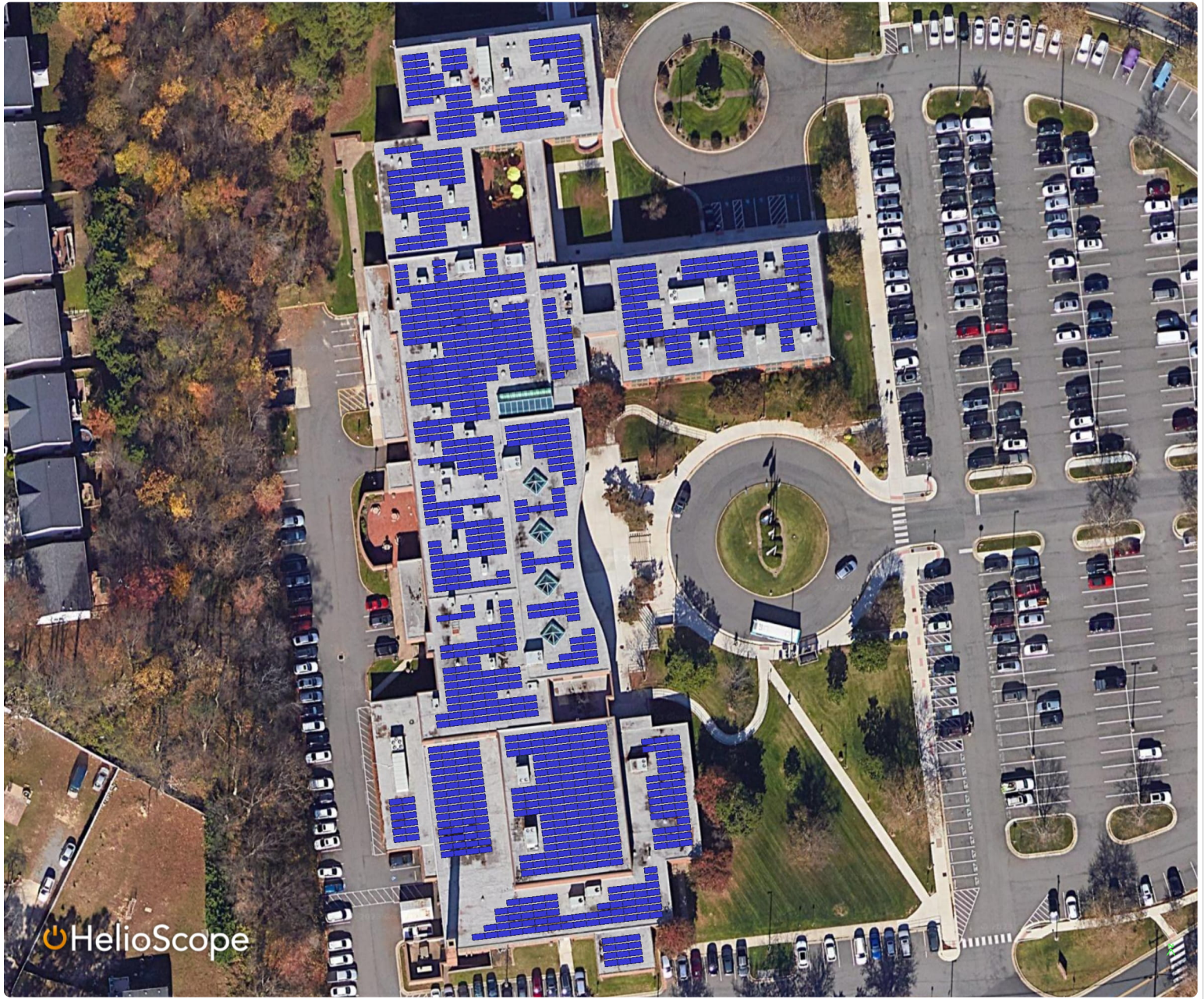
| ☁ Condition Set              |                                                  |       |             |                   |                                  |                  |   |   |   |   |   |   |
|------------------------------|--------------------------------------------------|-------|-------------|-------------------|----------------------------------|------------------|---|---|---|---|---|---|
| Description                  | Condition Set 1                                  |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Weather Dataset              | TMY, 10km Grid (38.65,-77.25), NREL (prospector) |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Transposition Model          | Perez Model                                      |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Temperature Model            | Sandia Model                                     |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Temperature Model Parameters | Rack Type                                        | a     | b           | Temperature Delta |                                  |                  |   |   |   |   |   |   |
|                              | Fixed Tilt                                       | -3.56 | -0.075      | 3°C               |                                  |                  |   |   |   |   |   |   |
|                              | Flush Mount                                      | -2.81 | -0.0455     | 0°C               |                                  |                  |   |   |   |   |   |   |
|                              | East-West                                        | -3.56 | -0.075      | 3°C               |                                  |                  |   |   |   |   |   |   |
|                              | Carport                                          | -3.56 | -0.075      | 3°C               |                                  |                  |   |   |   |   |   |   |
| Soiling (%)                  | J                                                | F     | M           | A                 | M                                | J                | J | A | S | O | N | D |
|                              | 2                                                | 2     | 2           | 2                 | 2                                | 2                | 2 | 2 | 2 | 2 | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Cell Temperature Spread      | 4° C                                             |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |             |                   |                                  |                  |   |   |   |   |   |   |
| AC System Derate             | 0.50%                                            |       |             |                   |                                  |                  |   |   |   |   |   |   |
| Module Characterizations     | Module                                           |       | Uploaded By |                   | Characterization                 |                  |   |   |   |   |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       | HelioScope  |                   | Spec Sheet Characterization, PAN |                  |   |   |   |   |   |   |
| Component Characterizations  | Device                                           |       |             | Uploaded By       |                                  | Characterization |   |   |   |   |   |   |
|                              | CPS SCA60KTL-DO/480 (Chint)                      |       |             | HelioScope        |                                  | Spec Sheet       |   |   |   |   |   |   |



| 👤 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 20-23       | Along Racking      |

| 🏠 Field Segments |            |                        |      |         |                  |            |        |         |          |
|------------------|------------|------------------------|------|---------|------------------|------------|--------|---------|----------|
| Description      | Racking    | Orientation            | Tilt | Azimuth | Intrarow Spacing | Frame Size | Frames | Modules | Power    |
| Field Segment 1  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 134    | 134     | 73.7 kW  |
| Field Segment 6  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 12     | 12      | 6.60 kW  |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 60     | 60      | 33.0 kW  |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 12     | 12      | 6.60 kW  |
| Field Segment 6  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 98     | 98      | 53.9 kW  |
| Field Segment 6  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 74     | 74      | 40.7 kW  |
| Field Segment 7  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 67     | 67      | 36.9 kW  |
| Field Segment 8  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 237    | 237     | 130.4 kW |
| Field Segment 9  | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 136    | 136     | 74.8 kW  |
| Field Segment 10 | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 91     | 91      | 50.1 kW  |
| Field Segment 11 | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 55     | 55      | 30.3 kW  |
| Field Segment 12 | Fixed Tilt | Landscape (Horizontal) | 10°  | 173°    | 1.1 ft           | 1x1        | 22     | 22      | 12.1 kW  |

📍 Detailed Layout





# Fire Station 22 - 208V PWC - Fire Station 22, 7500 Century Park Drive, Manassas VA

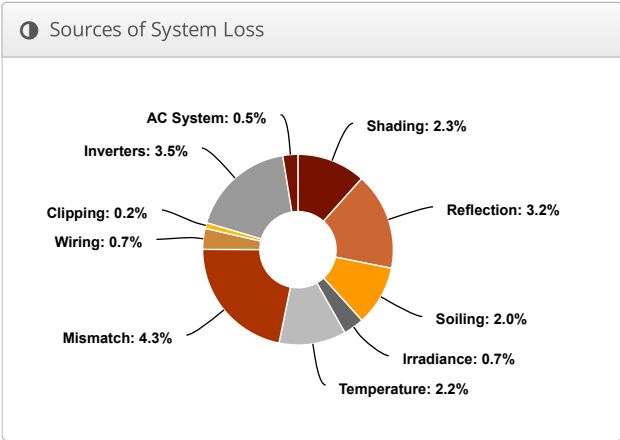
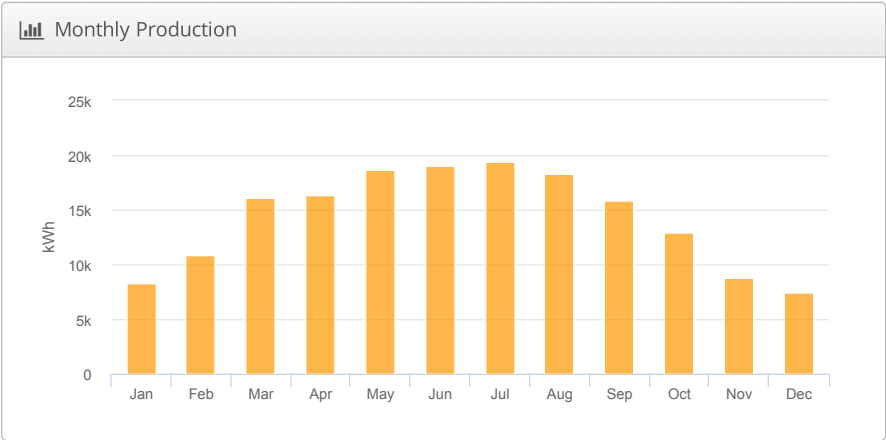
**Report**

|                     |                                         |
|---------------------|-----------------------------------------|
| Project Name        | PWC - Fire Station 22                   |
| Project Description | 20,000 sq ft 750,000 kWh/yr 150 kW peak |
| Project Address     | 7500 Century Park Drive, Manassas VA    |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net   |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Fire Station 22 - 208V                           |
| Module DC Nameplate   | 124.9 kW                                         |
| Inverter AC Nameplate | 100.0 kW<br>Load Ratio: 1.25                     |
| Annual Production     | 171.7 MWh                                        |
| Performance Ratio     | 81.9%                                            |
| kWh/kWp               | 1,375.3                                          |
| Weather Dataset       | TMY, 10km grid (38.75,-77.55), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |

**Project Location**



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance<br>(kWh/m²)      | Annual Global Horizontal Irradiance | 1,551.6   |         |
|                             | POA Irradiance                      | 1,679.0   | 8.2%    |
|                             | Shaded Irradiance                   | 1,640.7   | -2.3%   |
|                             | Irradiance after Reflection         | 1,587.5   | -3.2%   |
|                             | Irradiance after Soiling            | 1,555.8   | -2.0%   |
|                             | Total Collector Irradiance          | 1,555.7   | 0.0%    |
| Energy<br>(kWh)             | Nameplate                           | 194,155.8 |         |
|                             | Output at Irradiance Levels         | 192,825.5 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 188,515.7 | -2.2%   |
|                             | Output After Mismatch               | 180,439.3 | -4.3%   |
|                             | Optimal DC Output                   | 179,180.2 | -0.7%   |
|                             | Constrained DC Output               | 178,838.6 | -0.2%   |
|                             | Inverter Output                     | 172,567.6 | -3.5%   |
|                             | Energy to Grid                      | 171,704.7 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.2 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.2 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4655      |         |
| Solved Hours                |                                     | 4655      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|-------------|----------------------------------|------------------|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Weather Dataset              | TMY, 10km grid (38.75,-77.55), NREL (prospector) |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |             |                                  |                  |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |             |                                  |                  |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A           | S                                | O                | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2           | 2                                | 2                | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |             | Characterization                 |                  |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |             | Spec Sheet Characterization, PAN |                  |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   |             | Uploaded By |                                  | Characterization |   |   |
|                              | CPS SCA25KTL-DO/US-208 (2020) (CPS)              |       |   |         |   |                   |             | HelioScope  |                                  | Spec Sheet       |   |   |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA25KTL-DO/US-208 (2020) (CPS)   | 4 (100.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 12 (1,445.8 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 227 (124.9 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 18-19       | Along Racking      |

| 🏠 Field Segments |            |                        |      |         |                  |            |        |         |         |
|------------------|------------|------------------------|------|---------|------------------|------------|--------|---------|---------|
| Description      | Racking    | Orientation            | Tilt | Azimuth | Intrarow Spacing | Frame Size | Frames | Modules | Power   |
| Field Segment 1  | Fixed Tilt | Landscape (Horizontal) | 10°  | 180°    | 1.1 ft           | 1x1        | 128    | 128     | 70.4 kW |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 180°    | 1.1 ft           | 1x1        | 22     | 22      | 12.1 kW |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 180°    | 1.1 ft           | 1x1        | 23     | 23      | 12.7 kW |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 180°    | 1.1 ft           | 1x1        | 54     | 54      | 29.7 kW |

Detailed Layout



# Judicial Center PWC - Judicial Center, 9311 Lee Avenue, Manassas, VA

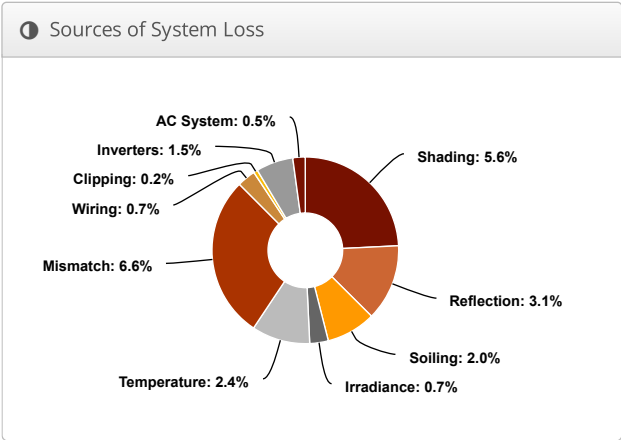
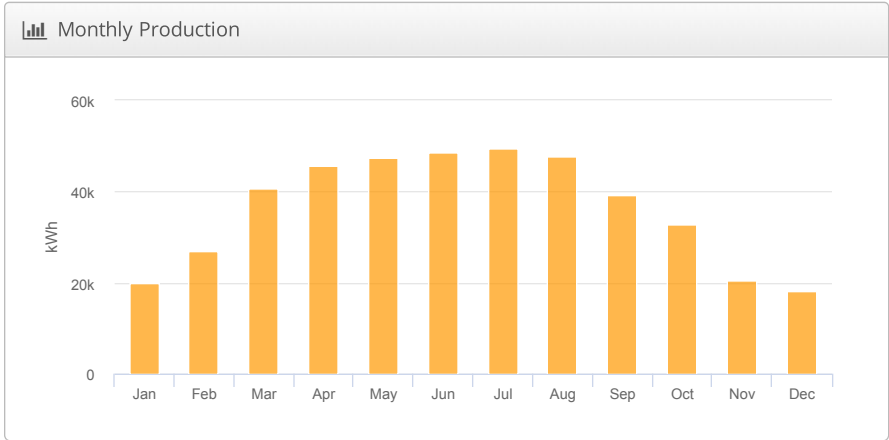
Report

|                     |                                           |
|---------------------|-------------------------------------------|
| Project Name        | PWC - Judicial Center                     |
| Project Description | 43,000 sq ft 2,531,200 kWh/yr 712 kW peak |
| Project Address     | 9311 Lee Avenue, Manassas, VA             |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net     |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Judicial Center                                  |
| Module DC Nameplate   | 331.1 kW                                         |
| Inverter AC Nameplate | 300.0 kW<br>Load Ratio: 1.10                     |
| Annual Production     | 437.5 MWh                                        |
| Performance Ratio     | 78.8%                                            |
| kWh/kWp               | 1,321.4                                          |
| Weather Dataset       | TMY, 10km Grid (38.75,-77.45), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |

Project Location





| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,552.3   |         |
|                             | POA Irradiance                      | 1,677.0   | 8.0%    |
|                             | Shaded Irradiance                   | 1,582.4   | -5.6%   |
|                             | Irradiance after Reflection         | 1,533.7   | -3.1%   |
|                             | Irradiance after Soiling            | 1,503.0   | -2.0%   |
|                             | Total Collector Irradiance          | 1,502.9   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 497,438.3 |         |
|                             | Output at Irradiance Levels         | 493,711.4 | -0.7%   |
|                             | Output at Cell Temperature Derate   | 482,100.7 | -2.4%   |
|                             | Output After Mismatch               | 450,478.5 | -6.6%   |
|                             | Optimal DC Output                   | 447,120.6 | -0.7%   |
|                             | Constrained DC Output               | 446,402.0 | -0.2%   |
|                             | Inverter Output                     | 439,705.0 | -1.5%   |
|                             | Energy to Grid                      | 437,506.4 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.8 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.6 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4666      |         |
| Solved Hours                |                                     | 4666      |         |

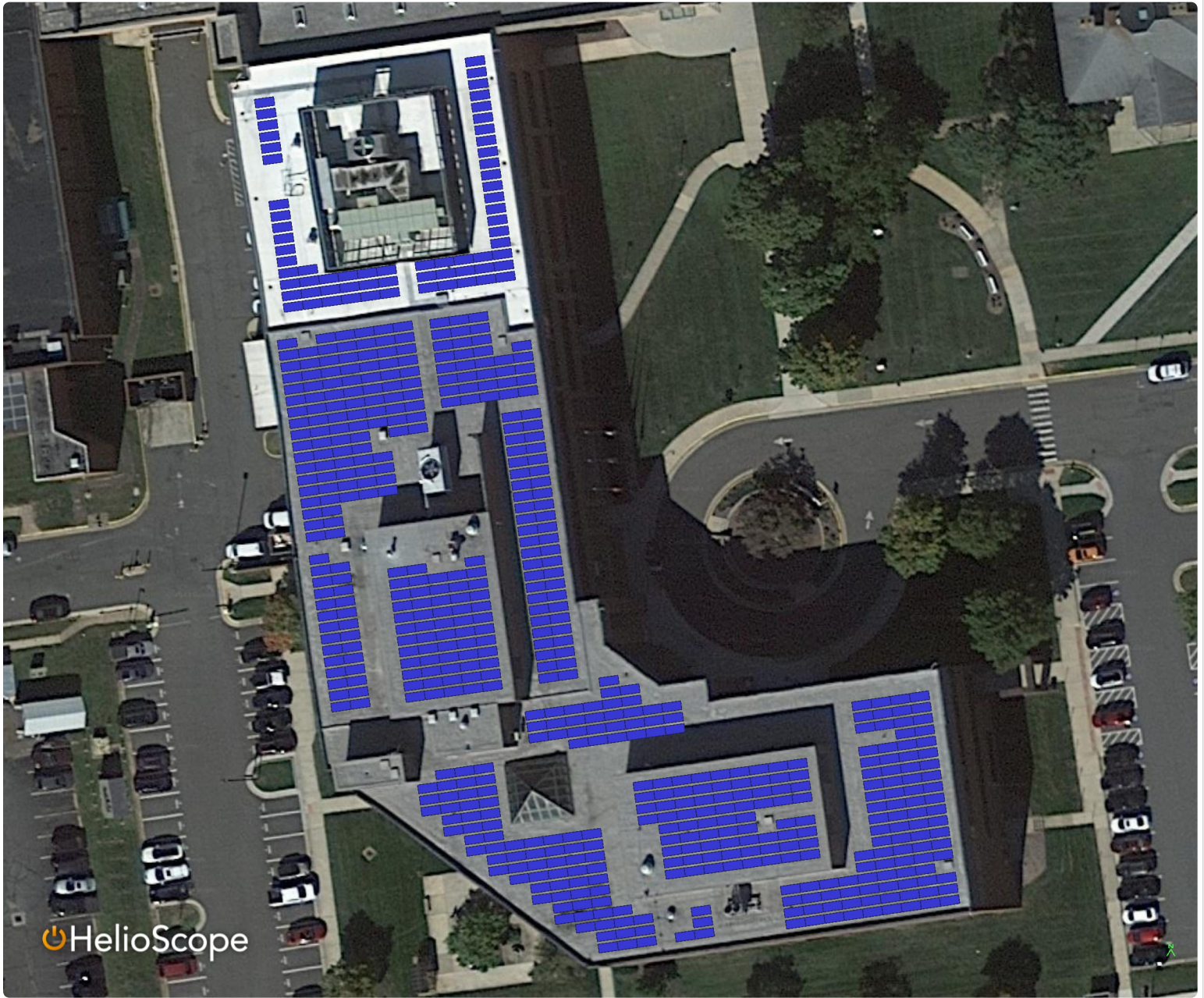
| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|---|----------------------------------|---|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
| Weather Dataset              | TMY, 10km Grid (38.75,-77.45), NREL (prospector) |       |   |         |   |                   |             |   |                                  |   |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |   |                                  |   |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |   |                                  |   |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A | S                                | O | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2 | 2                                | 2 | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |   |                                  |   |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |   | Spec Sheet Characterization, PAN |   |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | CPS SCA60KTL-DO/480 (Chint)                      |       |   |         |   |                   | HelioScope  |   | Spec Sheet                       |   |   |   |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA60KTL-DO/480 (Chint)           | 5 (300.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 27 (4,820.7 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 602 (331.1 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 21-23       | Along Racking      |

| 🏠 Field Segments |            |                        |      |            |                  |            |        |         |         |
|------------------|------------|------------------------|------|------------|------------------|------------|--------|---------|---------|
| Description      | Racking    | Orientation            | Tilt | Azimuth    | Intrarow Spacing | Frame Size | Frames | Modules | Power   |
| Field Segment 1  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 64     | 64      | 35.2 kW |
| Field Segment 2  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 81     | 81      | 44.6 kW |
| Field Segment 3  | Fixed Tilt | Landscape (Horizontal) | 10°  | 171.80046° | 1.1 ft           | 1x1        | 107    | 107     | 58.9 kW |
| Field Segment 4  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 58     | 58      | 31.9 kW |
| Field Segment 5  | Fixed Tilt | Landscape (Horizontal) | 10°  | 172°       | 1.1 ft           | 1x1        | 72     | 72      | 39.6 kW |
| Field Segment 6  | Fixed Tilt | Landscape (Horizontal) | 10°  | 171.60213° | 1.1 ft           | 1x1        | 95     | 95      | 52.3 kW |
| Field Segment 7  | Fixed Tilt | Landscape (Horizontal) | 10°  | 171.60213° | 1.1 ft           | 1x1        | 125    | 125     | 68.8 kW |

📍 Detailed Layout



# Owens Building PWC - Owens Operations Building, 3 County Complex Court, Woodbridge VA

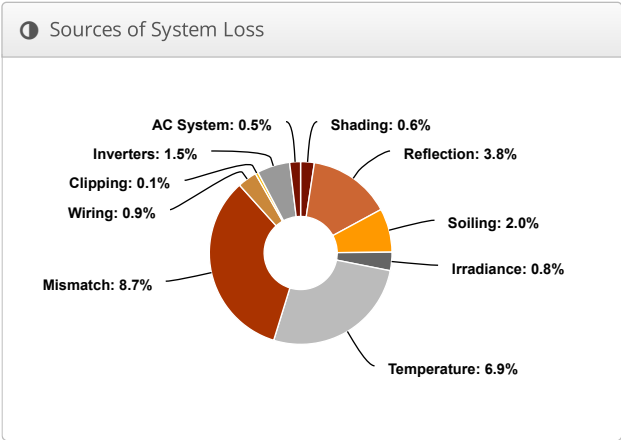
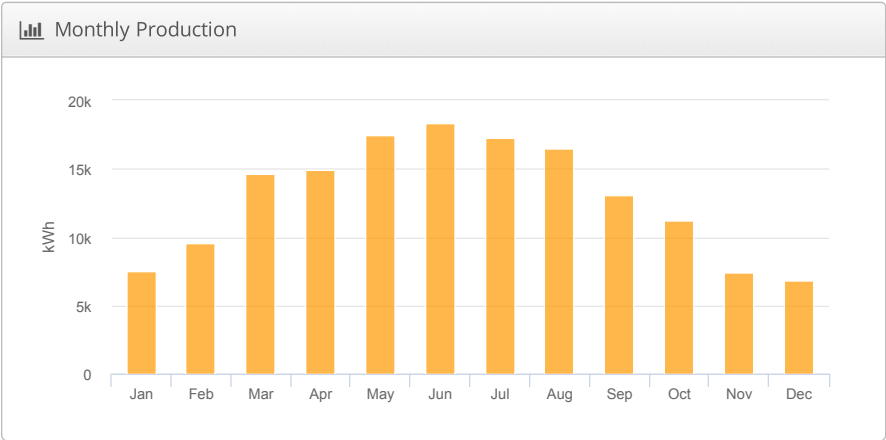
**Report**

|                 |                                       |
|-----------------|---------------------------------------|
| Project Name    | PWC - Owens Operations Building       |
| Project Address | 3 County Complex Court, Woodbridge VA |
| Prepared By     | ARM Group<br>armsoftware@armgroup.net |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Owens Building                                   |
| Module DC Nameplate   | 132.6 kW                                         |
| Inverter AC Nameplate | 120.0 kW<br>Load Ratio: 1.10                     |
| Annual Production     | 154.6 MWh                                        |
| Performance Ratio     | 76.6%                                            |
| kWh/kWp               | 1,166.7                                          |
| Weather Dataset       | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |
| Simulator Version     | 6a74034394-483c6c6be2-aa4cb1d45e-4e9afde0e0      |

**Project Location**



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,522.7   |         |
|                             | POA Irradiance                      | 1,522.1   | 0.0%    |
|                             | Shaded Irradiance                   | 1,512.7   | -0.6%   |
|                             | Irradiance after Reflection         | 1,455.3   | -3.8%   |
|                             | Irradiance after Soiling            | 1,426.1   | -2.0%   |
|                             | Total Collector Irradiance          | 1,426.1   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 188,991.5 |         |
|                             | Output at Irradiance Levels         | 187,404.4 | -0.8%   |
|                             | Output at Cell Temperature Derate   | 174,506.5 | -6.9%   |
|                             | Output After Mismatch               | 159,395.9 | -8.7%   |
|                             | Optimal DC Output                   | 157,990.8 | -0.9%   |
|                             | Constrained DC Output               | 157,784.5 | -0.1%   |
|                             | Inverter Output                     | 155,417.7 | -1.5%   |
|                             | Energy to Grid                      | 154,640.6 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.9 °C   |         |
| Avg. Operating Cell Temp    |                                     | 30.5 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4657      |         |
| Solved Hours                |                                     | 4657      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|---|----------------------------------|---|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |   |                                  |   |   |   |
| Weather Dataset              | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |       |   |         |   |                   |             |   |                                  |   |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |   |                                  |   |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |   |                                  |   |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |   |                                  |   |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |   |                                  |   |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A | S                                | O | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2 | 2                                | 2 | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |   |                                  |   |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |   |                                  |   |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |   |                                  |   |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |   | Spec Sheet Characterization, PAN |   |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   | Uploaded By |   | Characterization                 |   |   |   |
|                              | CPS SCA60KTL-DO/480 (Chint)                      |       |   |         |   |                   | HelioScope  |   | Spec Sheet                       |   |   |   |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA60KTL-DO/480 (Chint)           | 2 (120.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 11 (1,927.7 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 241 (132.6 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 21-23       | Along Racking      |

| 🏠 Field Segments |             |                        |      |            |                  |            |        |         |         |  |
|------------------|-------------|------------------------|------|------------|------------------|------------|--------|---------|---------|--|
| Description      | Racking     | Orientation            | Tilt | Azimuth    | Intrarow Spacing | Frame Size | Frames | Modules | Power   |  |
| Field Segment 1  | Flush Mount | Landscape (Horizontal) | 22°  | 144.40923° | 0.0 ft           | 1x1        | 12     | 12      | 6.60 kW |  |
| Field Segment 3  | Flush Mount | Landscape (Horizontal) | 22°  | 144.40923° | 0.0 ft           | 1x1        | 13     | 13      | 7.15 kW |  |
| Field Segment 4  | Flush Mount | Landscape (Horizontal) | 22°  | 235.54904° | 0.0 ft           | 1x1        | 11     | 11      | 6.05 kW |  |
| Field Segment 5  | Flush Mount | Landscape (Horizontal) | 18°  | 146.71248° | 0.0 ft           | 1x1        | 6      | 6       | 3.30 kW |  |
| Field Segment 6  | Flush Mount | Landscape (Horizontal) | 18°  | 235.00798° | 0.0 ft           | 1x1        | 44     | 44      | 24.2 kW |  |
| Field Segment 7  | Flush Mount | Landscape (Horizontal) | 18°  | 235.00798° | 0.0 ft           | 1x1        | 17     | 17      | 9.35 kW |  |
| Field Segment 8  | Flush Mount | Landscape (Horizontal) | 18°  | 144.7188°  | 0.0 ft           | 1x1        | 21     | 21      | 11.6 kW |  |
| Field Segment 12 | Flush Mount | Landscape (Horizontal) | 30°  | 144.59785° | 0.0 ft           | 1x1        | 6      | 6       | 3.30 kW |  |
| Field Segment 9  | Flush Mount | Landscape (Horizontal) | 18°  | 55.494556° | 0.0 ft           | 1x1        | 87     | 87      | 47.9 kW |  |
| Field Segment 10 | Fixed Tilt  | Landscape (Horizontal) | 10°  | 326.65097° | 1.1 ft           | 1x1        | 24     | 24      | 13.2 kW |  |



Detailed Layout



# Owens Building - No Flat Roof

PWC - Owens Operations Building, 3 County Complex Court, Woodbridge VA

## Report

|                 |                                       |
|-----------------|---------------------------------------|
| Project Name    | PWC - Owens Operations Building       |
| Project Address | 3 County Complex Court, Woodbridge VA |
| Prepared By     | ARM Group<br>armsoftware@armgroup.net |

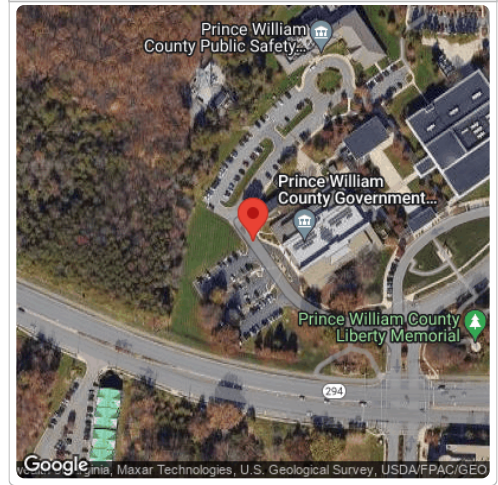


**ARM Group LLC**  
Engineers and Scientists

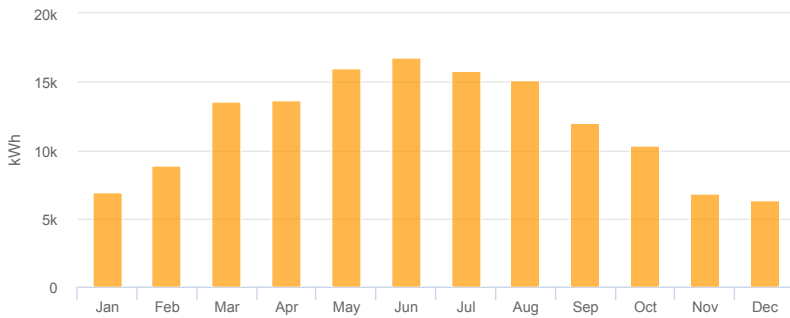
## System Metrics

|                       |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Owens Building - No Flat Roof                    |
| Module DC Nameplate   | 119.4 kW                                         |
| Inverter AC Nameplate | 100.0 kW<br>Load Ratio: 1.19                     |
| Annual Production     | 142.1 MWh                                        |
| Performance Ratio     | 77.5%                                            |
| kWh/kWp               | 1,190.6                                          |
| Weather Dataset       | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |
| Simulator Version     | 6a74034394-483c6c6be2-aa4cb1d45e-4e9afde0e0      |

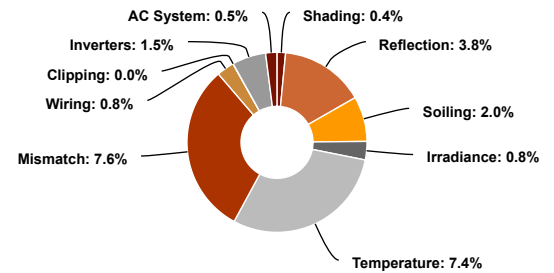
## Project Location



## Monthly Production



## Sources of System Loss





| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,522.7   |         |
|                             | POA Irradiance                      | 1,535.4   | 0.8%    |
|                             | Shaded Irradiance                   | 1,529.5   | -0.4%   |
|                             | Irradiance after Reflection         | 1,472.1   | -3.8%   |
|                             | Irradiance after Soiling            | 1,442.6   | -2.0%   |
|                             | Total Collector Irradiance          | 1,442.6   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 172,143.9 |         |
|                             | Output at Irradiance Levels         | 170,732.8 | -0.8%   |
|                             | Output at Cell Temperature Derate   | 158,179.4 | -7.4%   |
|                             | Output After Mismatch               | 146,136.8 | -7.6%   |
|                             | Optimal DC Output                   | 144,996.3 | -0.8%   |
|                             | Constrained DC Output               | 144,988.5 | 0.0%    |
|                             | Inverter Output                     | 142,813.7 | -1.5%   |
|                             | Energy to Grid                      | 142,099.6 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.9 °C   |         |
| Avg. Operating Cell Temp    |                                     | 31.3 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4657      |         |
| Solved Hours                |                                     | 4657      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|-------------|----------------------------------|------------------|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Weather Dataset              | TMY, 10km Grid (38.65,-77.35), NREL (prospector) |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |             |                                  |                  |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |             |                                  |                  |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A           | S                                | O                | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2           | 2                                | 2                | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |             | Characterization                 |                  |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |             | Spec Sheet Characterization, PAN |                  |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   |             | Uploaded By |                                  | Characterization |   |   |
|                              | CPS SCA50KTL-DO/US-480 (2022) (CPS)              |       |   |         |   |                   |             | HelioScope  |                                  | Spec Sheet       |   |   |

| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA50KTL-DO/US-480 (2022) (CPS)   | 2 (100.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 10 (1,228.9 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 217 (119.4 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 21-23       | Along Racking      |

| 🏠 Field Segments |             |                        |      |            |                  |            |        |         |         |  |
|------------------|-------------|------------------------|------|------------|------------------|------------|--------|---------|---------|--|
| Description      | Racking     | Orientation            | Tilt | Azimuth    | Intrarow Spacing | Frame Size | Frames | Modules | Power   |  |
| Field Segment 1  | Flush Mount | Landscape (Horizontal) | 22°  | 144.40923° | 0.0 ft           | 1x1        | 12     | 12      | 6.60 kW |  |
| Field Segment 3  | Flush Mount | Landscape (Horizontal) | 22°  | 144.40923° | 0.0 ft           | 1x1        | 13     | 13      | 7.15 kW |  |
| Field Segment 4  | Flush Mount | Landscape (Horizontal) | 22°  | 235.54904° | 0.0 ft           | 1x1        | 11     | 11      | 6.05 kW |  |
| Field Segment 5  | Flush Mount | Landscape (Horizontal) | 18°  | 146.71248° | 0.0 ft           | 1x1        | 6      | 6       | 3.30 kW |  |
| Field Segment 6  | Flush Mount | Landscape (Horizontal) | 18°  | 235.00798° | 0.0 ft           | 1x1        | 44     | 44      | 24.2 kW |  |
| Field Segment 7  | Flush Mount | Landscape (Horizontal) | 18°  | 235.00798° | 0.0 ft           | 1x1        | 17     | 17      | 9.35 kW |  |
| Field Segment 8  | Flush Mount | Landscape (Horizontal) | 18°  | 144.7188°  | 0.0 ft           | 1x1        | 21     | 21      | 11.6 kW |  |
| Field Segment 12 | Flush Mount | Landscape (Horizontal) | 30°  | 144.59785° | 0.0 ft           | 1x1        | 6      | 6       | 3.30 kW |  |
| Field Segment 9  | Flush Mount | Landscape (Horizontal) | 18°  | 55.494556° | 0.0 ft           | 1x1        | 87     | 87      | 47.9 kW |  |

Detailed Layout





# Western District Police

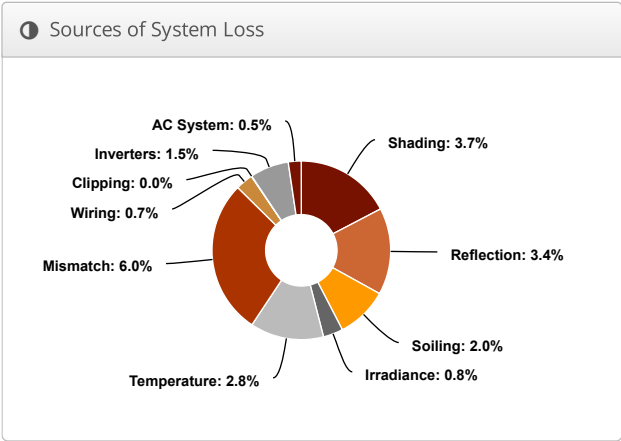
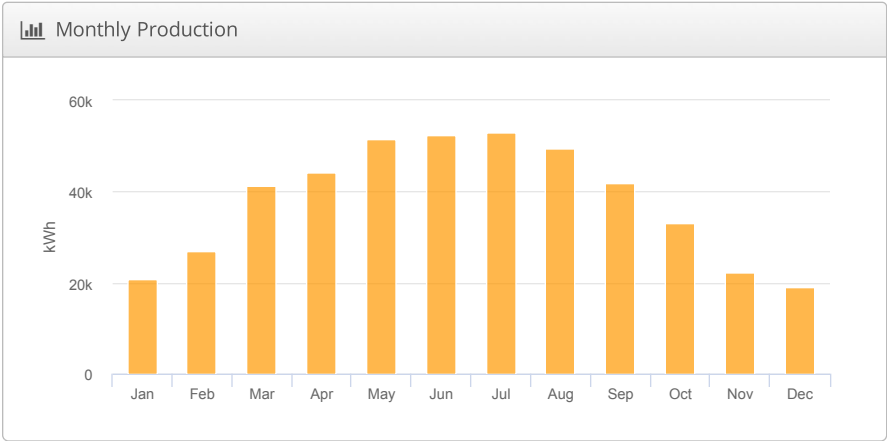
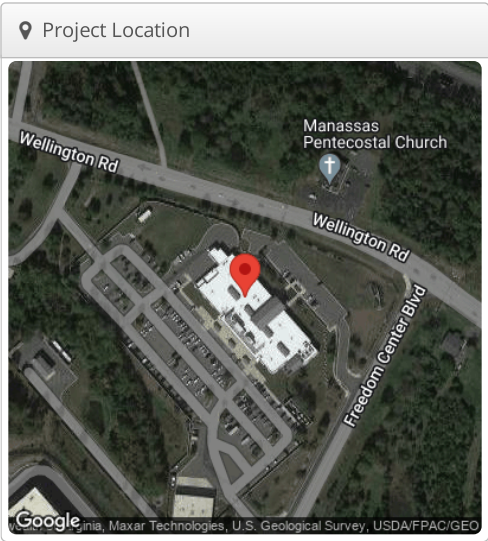
PWC - Western District Police Station, 8900 Freedom Center Blvd,  
Manassas, VA

**Report**

|                     |                                           |
|---------------------|-------------------------------------------|
| Project Name        | PWC - Western District Police Station     |
| Project Description | 35,000 sq ft 1,422,301 kWh/yr 249 kW peak |
| Project Address     | 8900 Freedom Center Blvd, Manassas, VA    |
| Prepared By         | ARM Group<br>armsoftware@armgroup.net     |

**ARM Group LLC**  
 Engineers and Scientists

| System Metrics        |                                                  |
|-----------------------|--------------------------------------------------|
| Design                | Western District Police                          |
| Module DC Nameplate   | 349.8 kW                                         |
| Inverter AC Nameplate | 300.0 kW<br>Load Ratio: 1.17                     |
| Annual Production     | 456.3 MWh                                        |
| Performance Ratio     | 80.4%                                            |
| kWh/kWp               | 1,304.5                                          |
| Weather Dataset       | TMY, 10km grid (38.75,-77.55), NREL (prospector) |
| Simulator Version     | 4a7a51a18e-217fa52167-10ebb3552c-d7489039d4      |



| ⚡ Annual Production         |                                     |           |         |
|-----------------------------|-------------------------------------|-----------|---------|
|                             | Description                         | Output    | % Delta |
| Irradiance (kWh/m²)         | Annual Global Horizontal Irradiance | 1,551.6   |         |
|                             | POA Irradiance                      | 1,622.1   | 4.5%    |
|                             | Shaded Irradiance                   | 1,562.1   | -3.7%   |
|                             | Irradiance after Reflection         | 1,509.7   | -3.4%   |
|                             | Irradiance after Soiling            | 1,479.5   | -2.0%   |
|                             | Total Collector Irradiance          | 1,479.3   | 0.0%    |
| Energy (kWh)                | Nameplate                           | 517,276.7 |         |
|                             | Output at Irradiance Levels         | 513,306.9 | -0.8%   |
|                             | Output at Cell Temperature Derate   | 498,720.2 | -2.8%   |
|                             | Output After Mismatch               | 468,836.0 | -6.0%   |
|                             | Optimal DC Output                   | 465,680.6 | -0.7%   |
|                             | Constrained DC Output               | 465,605.1 | 0.0%    |
|                             | Inverter Output                     | 458,620.5 | -1.5%   |
|                             | Energy to Grid                      | 456,327.4 | -0.5%   |
| Temperature Metrics         |                                     |           |         |
| Avg. Operating Ambient Temp |                                     | 15.2 °C   |         |
| Avg. Operating Cell Temp    |                                     | 23.8 °C   |         |
| Simulation Metrics          |                                     |           |         |
| Operating Hours             |                                     | 4655      |         |
| Solved Hours                |                                     | 4655      |         |

| ☁ Condition Set              |                                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
|------------------------------|--------------------------------------------------|-------|---|---------|---|-------------------|-------------|-------------|----------------------------------|------------------|---|---|
| Description                  | Condition Set 1                                  |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Weather Dataset              | TMY, 10km grid (38.75,-77.55), NREL (prospector) |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Solar Angle Location         | Meteo Lat/Lng                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Transposition Model          | Perez Model                                      |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model            | Sandia Model                                     |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Temperature Model Parameters | Rack Type                                        | a     |   | b       |   | Temperature Delta |             |             |                                  |                  |   |   |
|                              | Fixed Tilt                                       | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Flush Mount                                      | -2.81 |   | -0.0455 |   | 0°C               |             |             |                                  |                  |   |   |
|                              | East-West                                        | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
|                              | Carport                                          | -3.56 |   | -0.075  |   | 3°C               |             |             |                                  |                  |   |   |
| Soiling (%)                  | J                                                | F     | M | A       | M | J                 | J           | A           | S                                | O                | N | D |
|                              | 2                                                | 2     | 2 | 2       | 2 | 2                 | 2           | 2           | 2                                | 2                | 2 | 2 |
| Irradiation Variance         | 5%                                               |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Cell Temperature Spread      | 4° C                                             |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Binning Range         | -2.5% to 2.5%                                    |       |   |         |   |                   |             |             |                                  |                  |   |   |
| AC System Derate             | 0.50%                                            |       |   |         |   |                   |             |             |                                  |                  |   |   |
| Module Characterizations     | Module                                           |       |   |         |   |                   | Uploaded By |             | Characterization                 |                  |   |   |
|                              | TSM-DEG19C.20 550 (Trina Solar)                  |       |   |         |   |                   | HelioScope  |             | Spec Sheet Characterization, PAN |                  |   |   |
| Component Characterizations  | Device                                           |       |   |         |   |                   |             | Uploaded By |                                  | Characterization |   |   |
|                              | CPS SCA50KTL-DO/US-480 (2022) (CPS)              |       |   |         |   |                   |             | HelioScope  |                                  | Spec Sheet       |   |   |

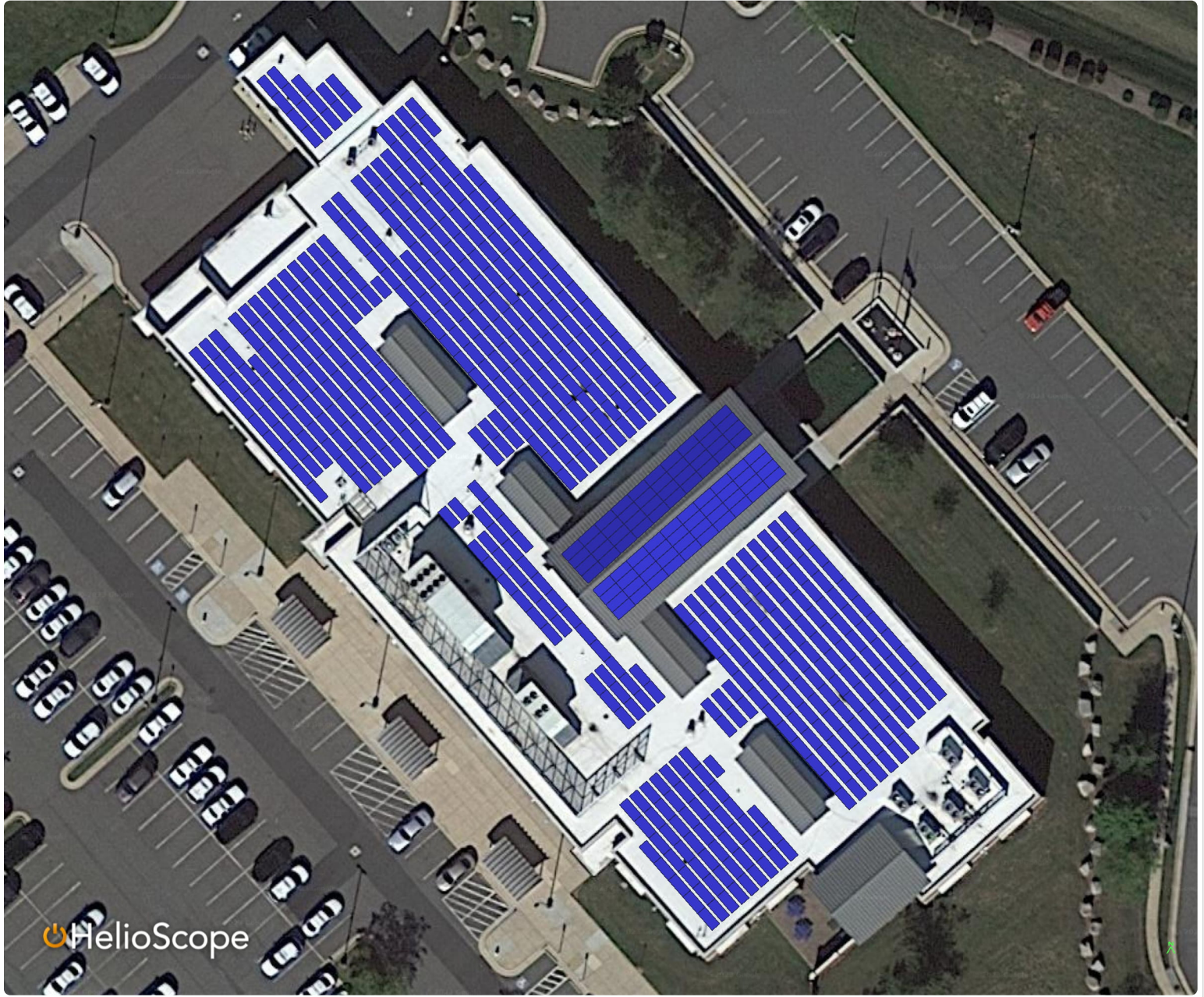
| 📦 Components |                                       |                 |
|--------------|---------------------------------------|-----------------|
| Component    | Name                                  | Count           |
| Inverters    | CPS SCA50KTL-DO/US-480 (2022) (CPS)   | 6 (300.0 kW)    |
| Strings      | 10 AWG (Copper)                       | 30 (3,357.7 ft) |
| Module       | Trina Solar, TSM-DEG19C.20 550 (550W) | 636 (349.8 kW)  |

| 🔌 Wiring Zones |                |             |                    |
|----------------|----------------|-------------|--------------------|
| Description    | Combiner Poles | String Size | Stringing Strategy |
| Wiring Zone    | -              | 20-23       | Along Racking      |

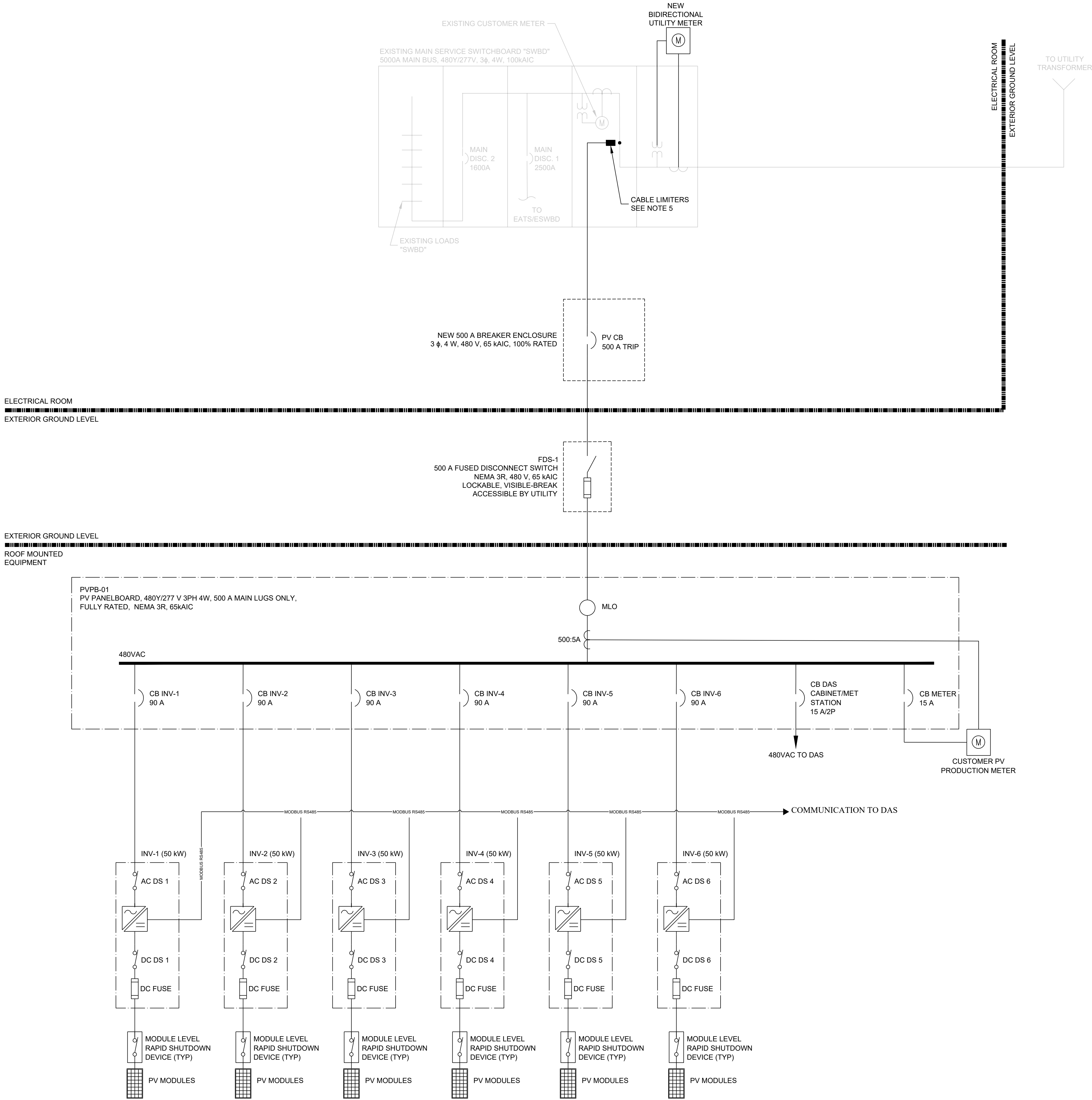
| 🏠 Field Segments |             |                        |      |            |                  |            |        |         |          |  |
|------------------|-------------|------------------------|------|------------|------------------|------------|--------|---------|----------|--|
| Description      | Racking     | Orientation            | Tilt | Azimuth    | Intrarow Spacing | Frame Size | Frames | Modules | Power    |  |
| Field Segment 2  | Fixed Tilt  | Landscape (Horizontal) | 10°  | 228.7°     | 1.1 ft           | 1x1        | 15     | 15      | 8.25 kW  |  |
| Field Segment 3  | Flush Mount | Landscape (Horizontal) | 15°  | 317.68823° | 0.0 ft           | 1x1        | 40     | 40      | 22.0 kW  |  |
| Field Segment 4  | Flush Mount | Landscape (Horizontal) | 15°  | 138.89482° | 0.0 ft           | 1x1        | 40     | 40      | 22.0 kW  |  |
| Field Segment 5  | Fixed Tilt  | Landscape (Horizontal) | 10°  | 228.67577° | 1.4 ft           | 1x1        | 134    | 134     | 73.7 kW  |  |
| Field Segment 6  | Fixed Tilt  | Landscape (Horizontal) | 10°  | 228.74298° | 1.1 ft           | 1x1        | 58     | 58      | 31.9 kW  |  |
| Field Segment 7  | Fixed Tilt  | Landscape (Horizontal) | 10°  | 228.67073° | 1.1 ft           | 1x1        | 38     | 38      | 20.9 kW  |  |
| Field Segment 7  | Fixed Tilt  | Landscape (Horizontal) | 10°  | 228.67073° | 1.1 ft           | 1x1        | 311    | 311     | 171.1 kW |  |



📍 Detailed Layout





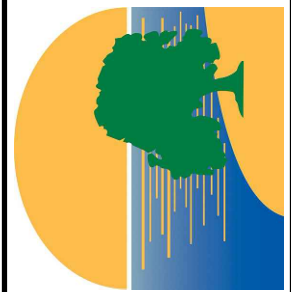


- GENERAL NOTES:
1. ALL EQUIPMENT SHALL BE UL LISTED FOR USE IN SYSTEM CONFIGURATION.
  2. INSTALLATION SHALL COMPLY WITH LATEST ADOPTED NEC CODE.
  3. RELAY PROTECTION SETTINGS PROVIDED ARE PRELIMINARY AND SUBJECT TO COORDINATION WITH LOCAL UTILITY.
  4. NOT FOR CONSTRUCTION: PRELIMINARY FEASIBILITY DESIGN.
  5. LINE SIDE CONNECTION IN ACCORDANCE WITH NEC ART 705.11. BUS CONNECTION SHALL BE MADE USING EXISTING BOLT HOLES AND SHALL NOT BE DRILLED. BUS CONNECTIONS SHALL BE RELISTED BY A 3RD PARTY TESTING AGENCY IF THE CONNECTION IS NOT IN ACCORDANCE WITH THE LISTING OF THE EQUIPMENT. IF WIRE RUN EXCEEDS 10FT, WIRES SHALL BE TERMINATED IN SERVICE EQUIPMENT WITH CABLE LIMITERS PER NEC.
  6. PV SYSTEM TO BE DISCONNECTED IF ON SITE GENERATOR IS TURNED ON.
  7. BUILDING IS FED BY MULTIPLE SERVICES. DETAILED PLAN VIEW DIAGRAMS SHOWING THE LOCATION OF FDS-1 RAPID SHUTDOWN INITIATION DEVICE SHALL BE PROVIDED IN THE MAIN ELECTRICAL ROOMS

| INVERTER TRIP SETTINGS  |                            |                             |
|-------------------------|----------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | ≤57 Hz                     | 0.16                        |
| UNDER FREQUENCY 1 (81U) | ≤59.5 HZ                   | 300                         |
| OVER FREQUENCY 1 (81O)  | 60.5 Hz ≤ f < 62.0 HZ      | 300                         |
| OVER FREQUENCY 2 (81O)  | ≥ 62 Hz                    | 0.16                        |
| UNDER VOLTAGE (27)      | ≤ 50% OF NOMINAL           | 1.1                         |
| UNDER VOLTAGE (27)      | 50% < V ≤ 88% OF NOMINAL   | 2                           |
| OVER VOLTAGE (59)       | 110% ≤ V < 120% OF NOMINAL | 2                           |
| OVER VOLTAGE (59)       | ≤ 120% OF NOMINAL          | 0.16                        |

| SYSTEM DETAILS       |                          |
|----------------------|--------------------------|
| INVERTER(S):         | CPS SCA50KTL-DO/US-480   |
| INVERTER QUANTITY:   | 6                        |
| SYSTEM PV SIZE (DC): | 348.7 KW                 |
| SYSTEM SIZE (AC):    | 300.0 KW                 |
| DC/AC RATIO:         | 1.16                     |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20 550W |
| MODULE QUANTITY:     | 634                      |
| STRING COUNT:        | 30                       |
| RACKING:             | FIXED TILT 10°           |
| SITE LATITUDE        | 38.75239°                |
| SITE LONGITUDE       | -77.47948°               |

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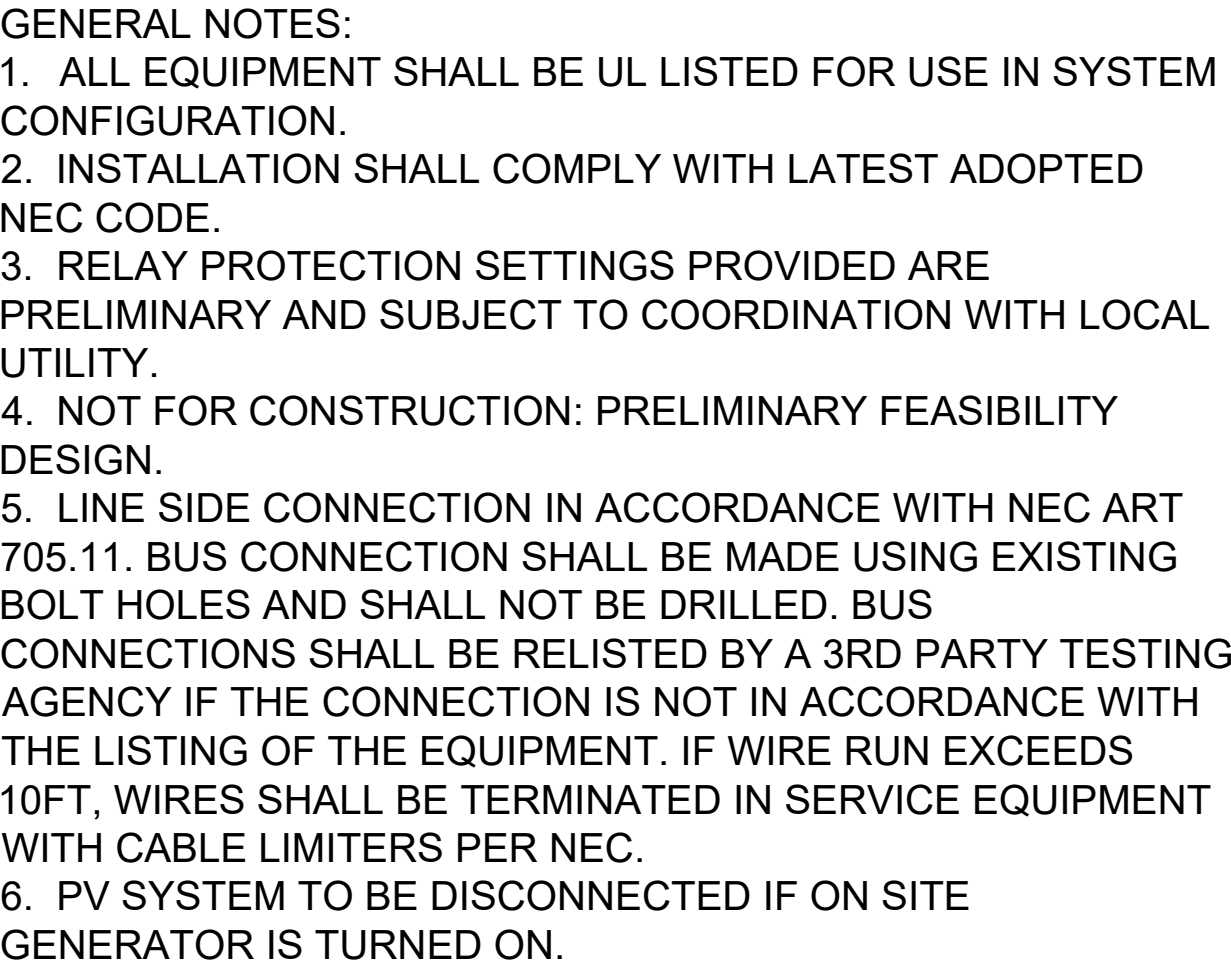


|                   |          |
|-------------------|----------|
| ARM               | By       |
| 2023/12/06        | Date     |
| FEASIBILITY STUDY | Revision |
| A                 | No.      |

|          |            |          |
|----------|------------|----------|
| N/A      | 2023/12/06 | 23010749 |
| NJ       | BW         | ARM      |
| Designed | Checked    | Drawn    |

|                                       |                       |
|---------------------------------------|-----------------------|
| SINGLE LINE DIAGRAM                   |                       |
| 9320 LEE AVENUE<br>MANASSAS, VA 20110 |                       |
| ADULT DETENTION CENTER SOLAR          | PRINCE WILLIAM COUNTY |



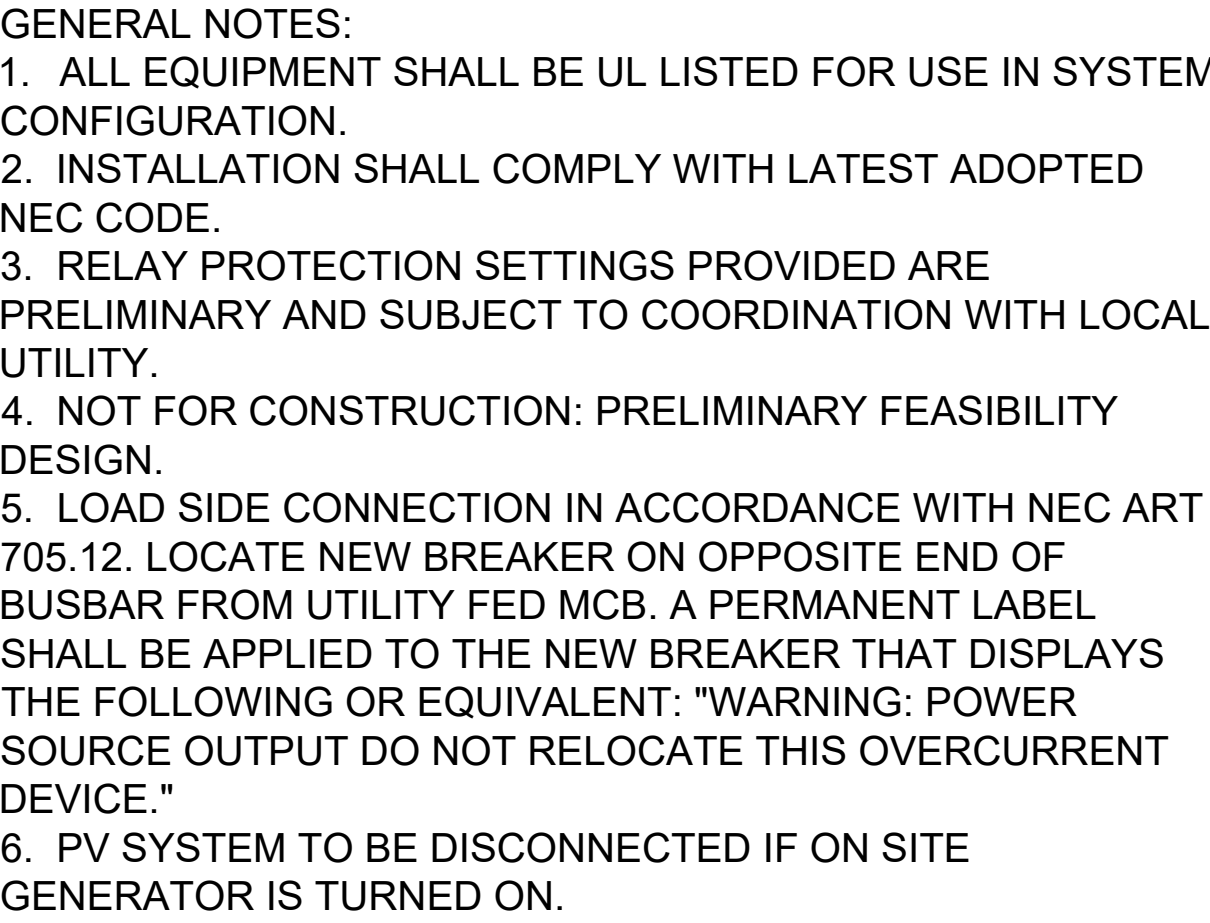


| INVERTER TRIP SETTINGS  |                            |                             |
|-------------------------|----------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | ≤57 Hz                     | 0.16                        |
| UNDER FREQUENCY 1 (81U) | ≤59.5 HZ                   | 300                         |
| OVER FREQUENCY 1 (81O)  | 60.5 Hz ≤ f < 62.0 HZ      | 300                         |
| OVER FREQUENCY 2 (81O)  | ≥ 62 Hz                    | 0.16                        |
| UNDER VOLTAGE (27)      | ≤ 50% OF NOMINAL           | 1.1                         |
| UNDER VOLTAGE (27)      | 50% < V ≤ 88% OF NOMINAL   | 2                           |
| OVER VOLTAGE (59)       | 110% ≤ V < 120% OF NOMINAL | 2                           |
| OVER VOLTAGE (59)       | ≤ 120% OF NOMINAL          | 0.16                        |

| SYSTEM DETAILS       |                             |
|----------------------|-----------------------------|
| INVERTER(S):         | CPS<br>SCA60KTL-SO/US-480   |
| INVERTER QUANTITY:   | 2                           |
| SYSTEM PV SIZE (DC): | 151.8 kW                    |
| SYSTEM SIZE (AC):    | 120.0 KW                    |
| DC/AC RATIO:         | 1.27                        |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20<br>550W |
| MODULE QUANTITY:     | 276                         |
| STRING COUNT:        | 12                          |
| RACKING:             | FIXED TILT 10°              |
| SITE LATITUDE        | 38.78700°                   |
| SITE LONGITUDE       | -77.52046°                  |

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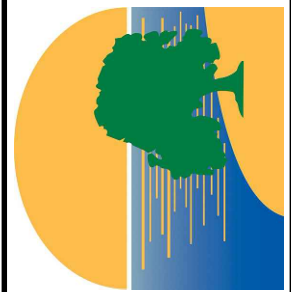




| INVERTER TRIP SETTINGS     |                            |                             |
|----------------------------|----------------------------|-----------------------------|
| DEVICE                     | PICKUP RANGE               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2<br>(81U) | ≤57 Hz                     | 0.16                        |
| UNDER FREQUENCY 1<br>(81U) | ≤59.5 HZ                   | 300                         |
| OVER FREQUENCY 1<br>(81O)  | 60.5 Hz ≤ f < 62.0 HZ      | 300                         |
| OVER FREQUENCY 2<br>(81O)  | ≥ 62 Hz                    | 0.16                        |
| UNDER VOLTAGE (27)         | ≤ 50% OF NOMINAL           | 1.1                         |
| UNDER VOLTAGE (27)         | 50% < V ≤ 88% OF NOMINAL   | 2                           |
| OVER VOLTAGE (59)          | 110% ≤ V < 120% OF NOMINAL | 2                           |
| OVER VOLTAGE (59)          | ≤ 120% OF NOMINAL          | 0.16                        |

| SYSTEM DETAILS       |                             |
|----------------------|-----------------------------|
| INVERTER(S):         | CPS<br>SCA60KTL-SO/US-480   |
| INVERTER QUANTITY:   | 2                           |
| SYSTEM PV SIZE (DC): | 149.6 kW                    |
| SYSTEM SIZE (AC):    | 120.0 kW                    |
| DC/AC RATIO:         | 1.25                        |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20<br>550W |
| MODULE QUANTITY:     | 272                         |
| STRING COUNT:        | 12                          |
| RACKING:             | FIXED TILT 10°              |
| SITE LATITUDE        | 38.68580°                   |
| SITE LONGITUDE       | -77.35934°                  |

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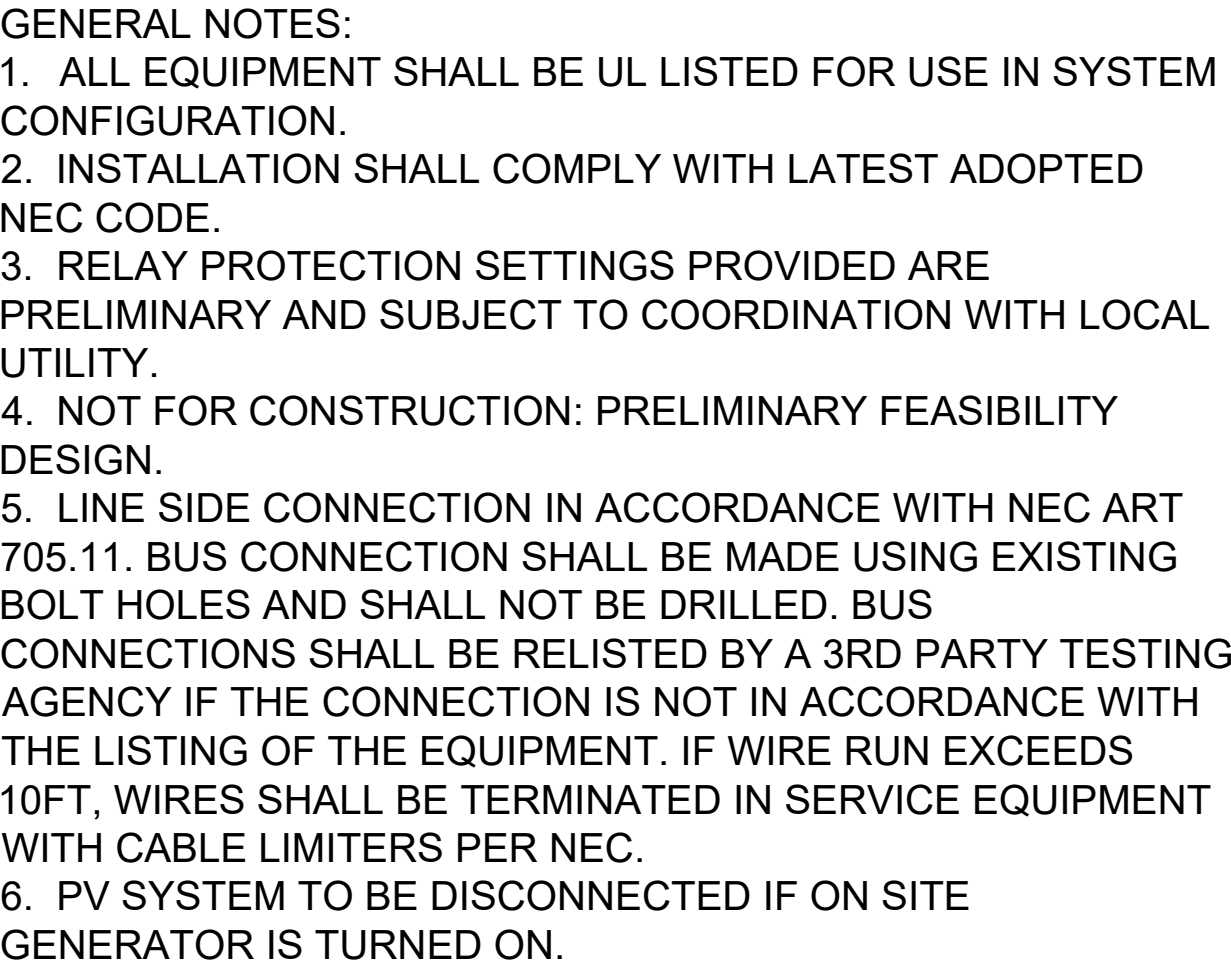


|  |     |                   |            |     |
|--|-----|-------------------|------------|-----|
|  | A   | FEASIBILITY STUDY | 2023/12/06 | ARM |
|  | No. | Revision          | Date       | By  |
|  |     |                   |            |     |
|  |     |                   |            |     |
|  |     |                   |            |     |
|  |     |                   |            |     |

|          |     |                      |
|----------|-----|----------------------|
| designed | NJ  | N/A                  |
| checked  | BW  | 2023/12/06           |
| drawn    | ARM | project no. 23010749 |

| SINGLE LINE DIAGRAM                              |                                           |
|--------------------------------------------------|-------------------------------------------|
| CENTRAL DISTRICT POLICE<br>PRINCE WILLIAM COUNTY | 5036 DAVIS FORD RD<br>WOODBIDGE, VA 22192 |

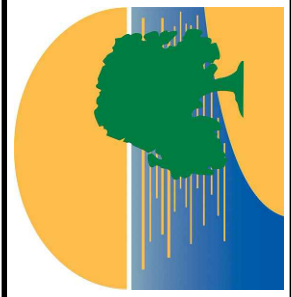




| INVERTER TRIP SETTINGS  |                            |                             |
|-------------------------|----------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | ≤57 Hz                     | 0.16                        |
| UNDER FREQUENCY 1 (81U) | ≤59.5 HZ                   | 300                         |
| OVER FREQUENCY 1 (81O)  | 60.5 Hz ≤ f < 62.0 HZ      | 300                         |
| OVER FREQUENCY 2 (81O)  | ≥ 62 Hz                    | 0.16                        |
| UNDER VOLTAGE (27)      | ≤ 50% OF NOMINAL           | 1.1                         |
| UNDER VOLTAGE (27)      | 50% < V ≤ 88% OF NOMINAL   | 2                           |
| OVER VOLTAGE (59)       | 110% ≤ V < 120% OF NOMINAL | 2                           |
| OVER VOLTAGE (59)       | ≤ 120% OF NOMINAL          | 0.16                        |

| SYSTEM DETAILS       |                             |
|----------------------|-----------------------------|
| INVERTER(S):         | CPS SCA50KTL-DO/US-480      |
| INVERTER QUANTITY:   | 5                           |
| SYSTEM PV SIZE (DC): | 323.4 KW                    |
| SYSTEM SIZE (AC):    | 250.0 KW                    |
| DC/AC RATIO:         | 1.29                        |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20<br>550W |
| MODULE QUANTITY:     | 588                         |
| STRING COUNT:        | 30                          |
| RACKING:             | FIXED TILT 10°              |
| SITE LATITUDE        | 38.67024°                   |
| SITE LONGITUDE       | -77.33202°                  |

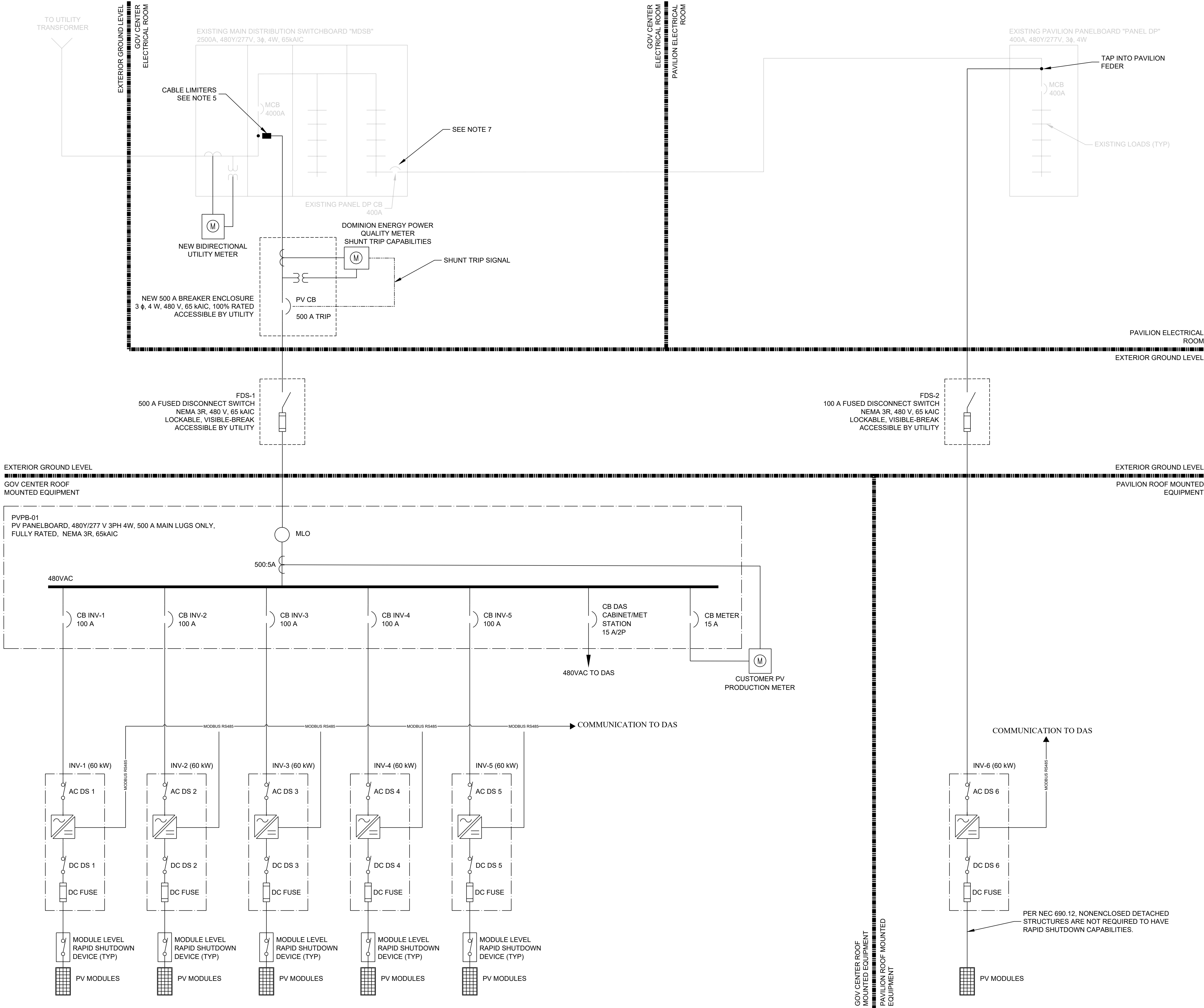
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[illegible]

|          |     |                      |
|----------|-----|----------------------|
| designed | NJ  | N/A                  |
| checked  | BW  | 2023/12/06           |
| drawn    | ARM | project no. 23010749 |

|                                                                            |                                              |
|----------------------------------------------------------------------------|----------------------------------------------|
| SINGLE LINE DIAGRAM                                                        |                                              |
| PROPOSED LINE<br>CHINN AQUATIC AND FITNESS CENTER<br>PRINCE WILLIAM COUNTY | 13025 CHINN PARK DR.<br>WOODBRIDGE, VA 22192 |



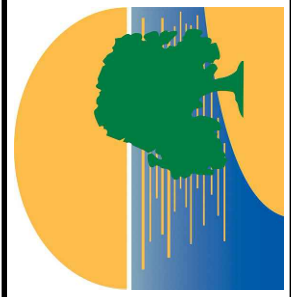


- GENERAL NOTES:
1. ALL EQUIPMENT SHALL BE UL LISTED FOR USE IN SYSTEM CONFIGURATION.
  2. INSTALLATION SHALL COMPLY WITH LATEST ADOPTED NEC CODE.
  3. RELAY PROTECTION SETTINGS PROVIDED ARE PRELIMINARY AND SUBJECT TO COORDINATION WITH LOCAL UTILITY.
  4. NOT FOR CONSTRUCTION: PRELIMINARY FEASIBILITY DESIGN.
  5. LINE SIDE CONNECTION IN ACCORDANCE WITH NEC ART 705.11. BUS CONNECTION SHALL BE MADE USING EXISTING BOLT HOLES AND SHALL NOT BE DRILLED. BUS CONNECTIONS SHALL BE RELISTED BY A 3RD PARTY TESTING AGENCY IF THE CONNECTION IS NOT IN ACCORDANCE WITH THE LISTING OF THE EQUIPMENT. IF WIRE RUN EXCEEDS 10FT, WIRES SHALL BE TERMINATED IN SERVICE EQUIPMENT WITH CABLE LIMITERS PER NEC.
  6. PV SYSTEM TO BE DISCONNECTED IF ON SITE GENERATOR IS TURNED ON.
  7. LOAD SIDE CONNECTION IN ACCORDANCE WITH NEC ART 705.12. A PERMANENT LABEL SHALL BE APPLIED TO THE NEW BREAKER THAT DISPLAYS THE FOLLOWING OR EQUIVALENT: "WARNING: POWER SOURCE OUTPUT DO NOT RELOCATE THIS OVERCURRENT DEVICE."

| INVERTER TRIP SETTINGS  |                                            |                             |
|-------------------------|--------------------------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE                               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | $\leq 57$ Hz                               | 0.16                        |
| UNDER FREQUENCY 1 (81U) | $\leq 59.5$ HZ                             | 300                         |
| OVER FREQUENCY 1 (81O)  | $60.5 \text{ Hz} \leq f < 62.0 \text{ HZ}$ | 300                         |
| OVER FREQUENCY 2 (81O)  | $\geq 62$ Hz                               | 0.16                        |
| UNDER VOLTAGE (27)      | $\leq 50\%$ OF NOMINAL                     | 1.1                         |
| UNDER VOLTAGE (27)      | $50\% < V \leq 88\%$ OF NOMINAL            | 2                           |
| OVER VOLTAGE (59)       | $110\% \leq V < 120\%$ OF NOMINAL          | 2                           |
| OVER VOLTAGE (59)       | $\leq 120\%$ OF NOMINAL                    | 0.16                        |

| SYSTEM DETAILS       |                          |
|----------------------|--------------------------|
| INVERTER(S):         | CPS SCA60KTL-DO/US-480   |
| INVERTER QUANTITY:   | 6                        |
| SYSTEM PV SIZE (DC): | 429.6 KW                 |
| SYSTEM SIZE (AC):    | 360.0 KW                 |
| DC/AC RATIO:         | 1.19                     |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20 550W |
| MODULE QUANTITY:     | 781                      |
| STRING COUNT:        | 37                       |
| RACKING:             | FIXED TILT 10°           |
| SITE LATITUDE        | 38.68031°                |
| SITE LONGITUDE       | -77.35157°               |

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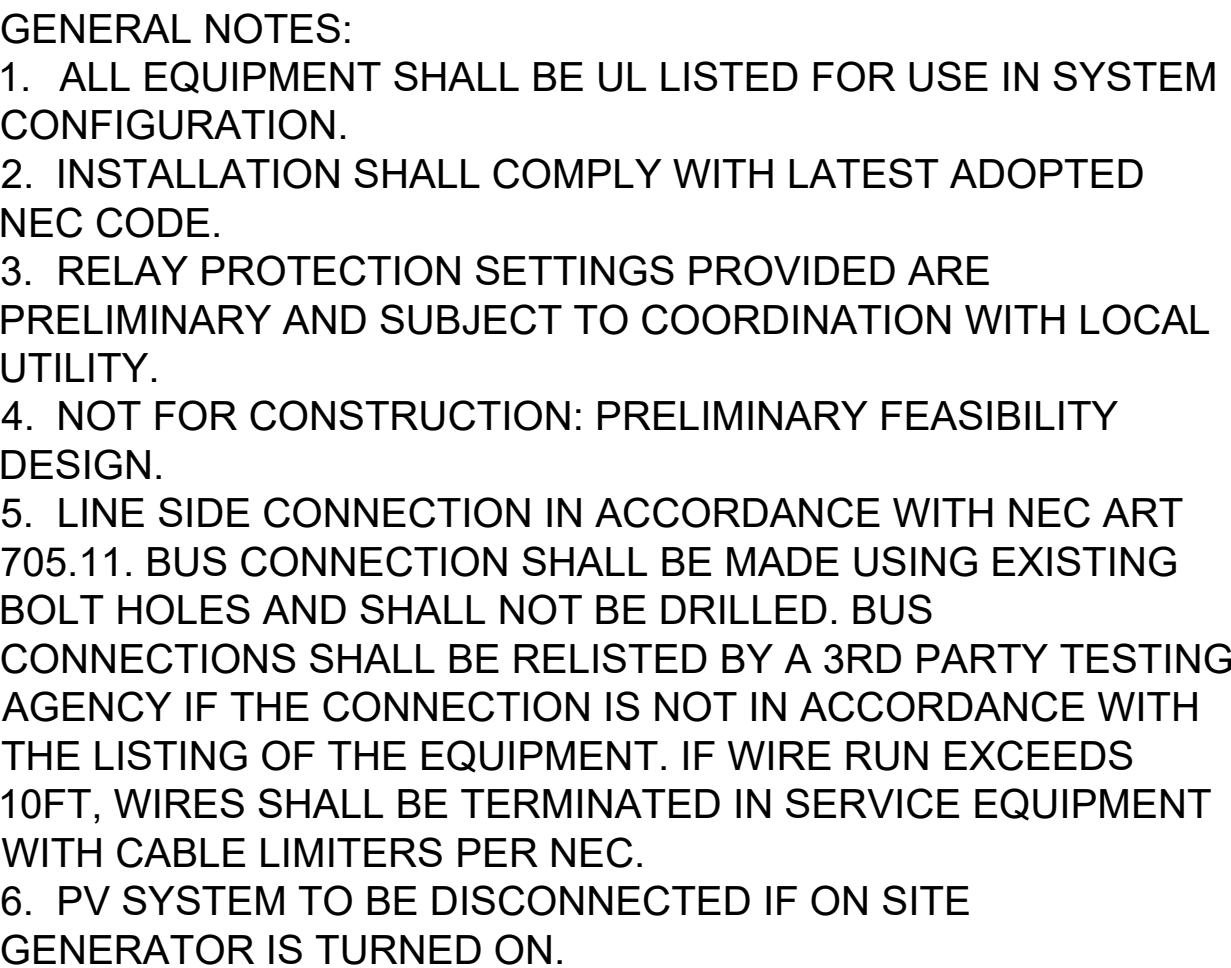


|            |                   |          |
|------------|-------------------|----------|
| 2023/12/06 | ARM               | By       |
| 2023/12/06 | ARM               | Date     |
| A          | FEASIBILITY STUDY | Revision |
| No         |                   | No       |

|        |            |          |
|--------|------------|----------|
| N/A    | 2023/12/06 | 23010749 |
| NJ     | BW         | ARM      |
| Design | Check      | Draw     |

|                                                   |  |
|---------------------------------------------------|--|
| SINGLE LINE DIAGRAM                               |  |
| 5 COUNTY COMPLEX COURT<br>WOODBRIDGE, VA 22192    |  |
| COUNTY GOVERNMENT CENTER<br>PRINCE WILLIAM COUNTY |  |

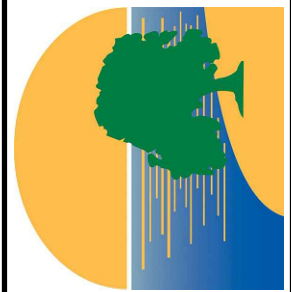




| INVERTER TRIP SETTINGS  |                            |                             |
|-------------------------|----------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | ≤57 Hz                     | 0.16                        |
| UNDER FREQUENCY 1 (81U) | ≤59.5 HZ                   | 300                         |
| OVER FREQUENCY 1 (81O)  | 60.5 Hz ≤ f < 62.0 HZ      | 300                         |
| OVER FREQUENCY 2 (81O)  | ≥ 62 Hz                    | 0.16                        |
| UNDER VOLTAGE (27)      | ≤ 50% OF NOMINAL           | 1.1                         |
| UNDER VOLTAGE (27)      | 50% < V ≤ 88% OF NOMINAL   | 2                           |
| OVER VOLTAGE (59)       | 110% ≤ V < 120% OF NOMINAL | 2                           |
| OVER VOLTAGE (59)       | ≤ 120% OF NOMINAL          | 0.16                        |

| SYSTEM DETAILS       |                             |
|----------------------|-----------------------------|
| INVERTER(S):         | CPS SCA60KTL-DO/US-480      |
| INVERTER QUANTITY:   | 8                           |
| SYSTEM PV SIZE (DC): | 548.9 KW                    |
| SYSTEM SIZE (AC):    | 480.0 KW                    |
| DC/AC RATIO:         | 1.14                        |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20<br>550W |
| MODULE QUANTITY:     | 998                         |
| STRING COUNT:        | 48                          |
| RACKING:             | FIXED TILT 10°              |
| SITE LATITUDE        | 38.60819°                   |
| SITE LONGITUDE       | -77.29556°                  |

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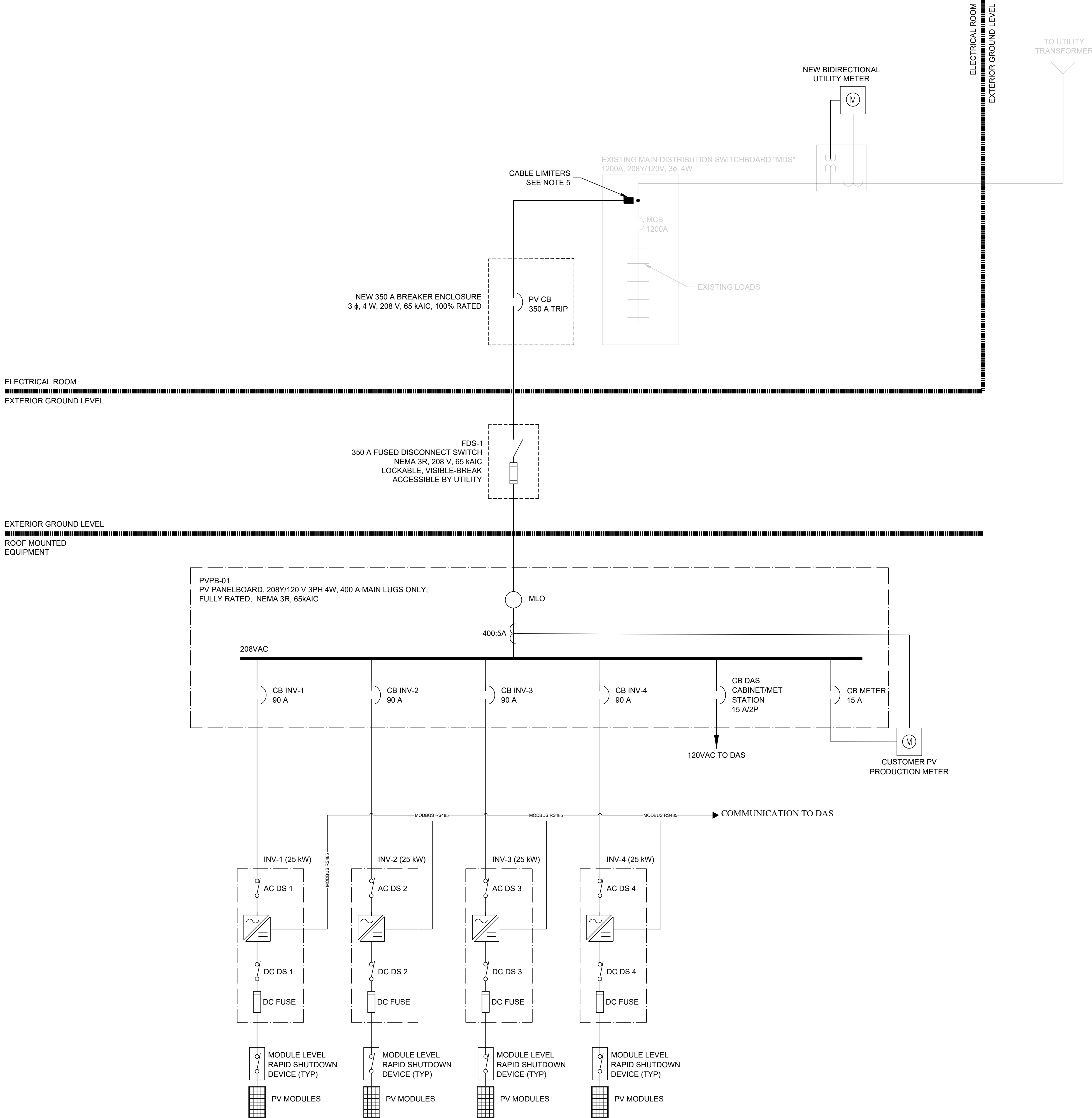


|  |     |                   |            |     |
|--|-----|-------------------|------------|-----|
|  | A   | FEASIBILITY STUDY | 2023/12/06 | ARM |
|  | No. | Revision          | Date       | By  |
|  |     |                   |            |     |
|  |     |                   |            |     |
|  |     |                   |            |     |
|  |     |                   |            |     |

|          |     |                      |
|----------|-----|----------------------|
| designid | NJ  | N/A                  |
| checked  | BW  | date 2023/12/06      |
| drawn    | ARM | project no. 23010749 |

| SINGLE LINE DIAGRAM                               |                                                |
|---------------------------------------------------|------------------------------------------------|
| drawing title                                     | project title                                  |
| DR. AJ FERLAZZO BUILDING<br>PRINCE WILLIAM COUNTY | 15941 DONALD CURTIS DR.<br>WOODBIDGE, VA 22191 |



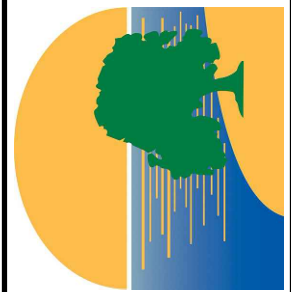


- GENERAL NOTES:
1. ALL EQUIPMENT SHALL BE UL LISTED FOR USE IN SYSTEM CONFIGURATION.
  2. INSTALLATION SHALL COMPLY WITH LATEST ADOPTED NEC CODE.
  3. RELAY PROTECTION SETTINGS PROVIDED ARE PRELIMINARY AND SUBJECT TO COORDINATION WITH LOCAL UTILITY.
  4. NOT FOR CONSTRUCTION: PRELIMINARY FEASIBILITY DESIGN.
  5. LINE SIDE CONNECTION IN ACCORDANCE WITH NEC ART 705.11. BUS CONNECTION SHALL BE MADE USING EXISTING BOLT HOLES AND SHALL NOT BE DRILLED. BUS CONNECTIONS SHALL BE RELISTED BY A 3RD PARTY TESTING AGENCY IF THE CONNECTION IS NOT IN ACCORDANCE WITH THE LISTING OF THE EQUIPMENT. IF WIRE RUN EXCEEDS 10FT, WIRES SHALL BE TERMINATED IN SERVICE EQUIPMENT WITH CABLE LIMITERS PER NEC.
  6. PV SYSTEM TO BE DISCONNECTED IF ON SITE GENERATOR IS TURNED ON.
  7. EXISTING POWER METER TO BE REPLACED WITH NEW METER WITH NET METERING CAPABILITIES.

| INVERTER TRIP SETTINGS  |                                            |                             |
|-------------------------|--------------------------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE                               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | $\leq 57$ Hz                               | 0.16                        |
| UNDER FREQUENCY 1 (81U) | $\leq 59.5$ HZ                             | 300                         |
| OVER FREQUENCY 1 (81O)  | $60.5 \text{ Hz} \leq f < 62.0 \text{ HZ}$ | 300                         |
| OVER FREQUENCY 2 (81O)  | $\geq 62$ Hz                               | 0.16                        |
| UNDER VOLTAGE (27)      | $\leq 50\%$ OF NOMINAL                     | 1.1                         |
| UNDER VOLTAGE (27)      | $50\% < V \leq 88\%$ OF NOMINAL            | 2                           |
| OVER VOLTAGE (59)       | $110\% \leq V < 120\%$ OF NOMINAL          | 2                           |
| OVER VOLTAGE (59)       | $\leq 120\%$ OF NOMINAL                    | 0.16                        |

| SYSTEM DETAILS       |                          |
|----------------------|--------------------------|
| INVERTER(S):         | CPS SCA25KTL-DO/US-208   |
| INVERTER QUANTITY:   | 4                        |
| SYSTEM PV SIZE (DC): | 124.9 KW                 |
| SYSTEM SIZE (AC):    | 100.0 KW                 |
| DC/AC RATIO:         | 1.25                     |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20 550W |
| MODULE QUANTITY:     | 227                      |
| STRING COUNT:        | 12                       |
| RACKING:             | FIXED TILT 10°           |
| SITE LATITUDE        | 38.79358°                |
| SITE LONGITUDE       | -77.54117°               |

This drawing, its contents, and each component of this drawing are the property of and proprietary to ARM Group LLC and shall not be reproduced or used in any manner except for the purpose identified on the Title Block, and only by or on behalf of this client for the identified project unless otherwise authorized by the express, written consent of ARM Group LLC.



|                   |          |
|-------------------|----------|
| ARM               | By       |
| 2023/12/06        | Date     |
| FEASIBILITY STUDY | Revision |
| A                 | No.      |

|          |            |          |
|----------|------------|----------|
| N/A      | 2023/12/06 | 23010749 |
| NJ       | BW         | ARM      |
| Designed | Checked    | Drawn    |

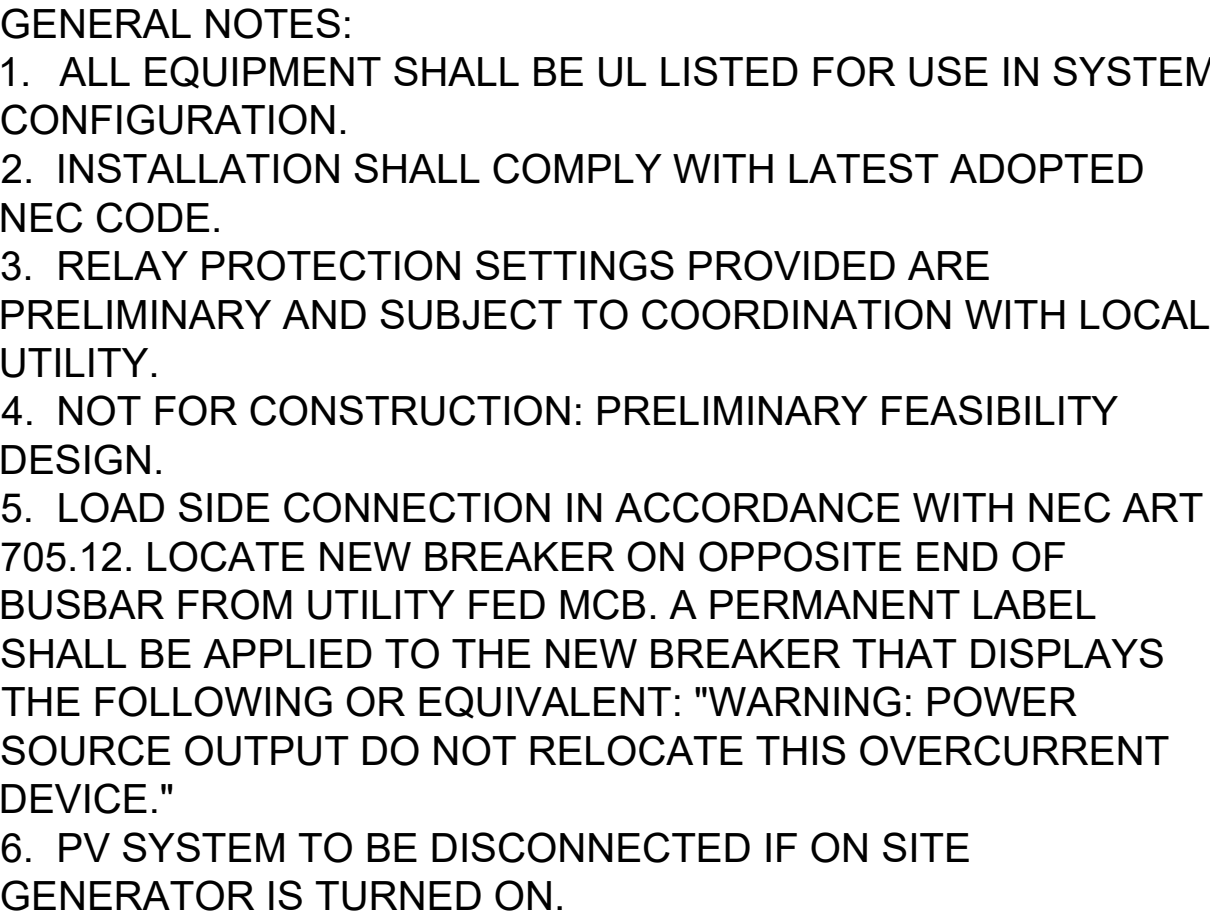
|                                          |  |                                               |
|------------------------------------------|--|-----------------------------------------------|
| SINGLE LINE DIAGRAM                      |  | 7500 CENTURY PARK DRIVE<br>MANASSAS, VA 20109 |
| FIRE STATION 22<br>PRINCE WILLIAM COUNTY |  |                                               |

Sheet  
2





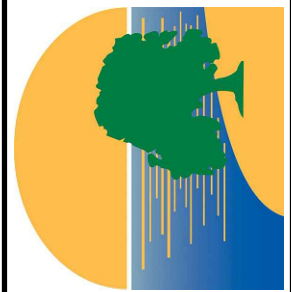




| INVERTER TRIP SETTINGS  |                            |                             |
|-------------------------|----------------------------|-----------------------------|
| DEVICE                  | PICKUP RANGE               | DEFAULT CLEARING TIME (SEC) |
| UNDER FREQUENCY 2 (81U) | ≤57 Hz                     | 0.16                        |
| UNDER FREQUENCY 1 (81U) | ≤59.5 HZ                   | 300                         |
| OVER FREQUENCY 1 (81O)  | 60.5 Hz ≤ f < 62.0 HZ      | 300                         |
| OVER FREQUENCY 2 (81O)  | ≥ 62 Hz                    | 0.16                        |
| UNDER VOLTAGE (27)      | ≤ 50% OF NOMINAL           | 1.1                         |
| UNDER VOLTAGE (27)      | 50% < V ≤ 88% OF NOMINAL   | 2                           |
| OVER VOLTAGE (59)       | 110% ≤ V < 120% OF NOMINAL | 2                           |
| OVER VOLTAGE (59)       | ≤ 120% OF NOMINAL          | 0.16                        |

| SYSTEM DETAILS       |                                 |
|----------------------|---------------------------------|
| INVERTER(S):         | CPS SCA60KTL-DO/US-480          |
| INVERTER QUANTITY:   | 2                               |
| SYSTEM PV SIZE (DC): | 132.6 KW                        |
| SYSTEM SIZE (AC):    | 120.0 KW                        |
| DC/AC RATIO:         | 1.10                            |
| PV MODULE TYPE:      | TRINA TSM-DEG19C.20<br>550W     |
| MODULE QUANTITY:     | 241                             |
| STRING COUNT:        | 11                              |
| RACKING:             | FLUSH MOUNT & FIXED<br>TILT 10° |
| SITE LATITUDE        | 38.68101°                       |
| SITE LONGITUDE       | -77.35316°                      |

This drawing, its contents, and each component of this drawing are the property of and proprietary to ARM Group LLC and shall not be reproduced or used in any manner except for the purpose identified on the Title Block, and only by or on behalf of this client for the identified project unless otherwise authorized by the express, written consent of ARM Group LLC.

[illegible]

|          |     |                      |
|----------|-----|----------------------|
| designed | NJ  | N/A                  |
| checked  | BW  | date 2023/12/06      |
| drawn    | ARM | project no. 23010749 |

|                            |                                                            |                                                       |
|----------------------------|------------------------------------------------------------|-------------------------------------------------------|
| <b>SINGLE LINE DIAGRAM</b> | <b>OWENS OPERATIONS BUILDING<br/>PRINCE WILLIAM COUNTY</b> | <b>3 COUNTY COMPLEX COURT<br/>WOODBIDGE, VA 22192</b> |
|----------------------------|------------------------------------------------------------|-------------------------------------------------------|









**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 22, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the Dr. A.J. Ferlazzo Building  
15941 Donald Curtis Drive in Woodbridge, Virginia  
**a+ei file # 23.059-10**

Dear Tim:

On 8/8/23, I visited Prince William County's building located at 15941 Donald Curtis Drive in Woodbridge, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the western side of Donald Curtis Drive, as seen in Figures 1 and 2. Directions referenced in this report are based on the front of the building in Figure 3 facing nominally east, toward Donald Curtis Drive. The roof is nominally flat. It is understood that the solar collection system will be installed on the roof, using a ballasted frame system.

The roof is framed with hot-rolled, wide-flanged steel beams and open-web steel joists. The depths of the steel roof joists include ten (10) inches, twelve (12) inches, twenty-two (22) inches and twenty-five (25) inches. The hot-rolled wide-flange steel beams range include eight (8) inches, ten (10) inches, twelve (12) inches and fourteen (14) inches. The steel girders that frame the roof of the gymnasium (seen in Figure 20) are thirty-four (34) inches deep. The purlins that are supported by these girders are hot-rolled eight (8)-inch deep, wide-flange steel beams.

The roof beams in the gymnasium and the adjacent sections of the building, seen in Figures 3, 5, 11, 12, 13 and 20, support composite, steel-framed, cementitious roof decking. This decking spans up to eight (8) feet in the gymnasium and no greater than seven (7) feet, six (6) inches in other parts of the southern section of the building.

The roof joists of the norther building areas support type B, 22-gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet between joists.

The two types of decking described above support foam insulation board and a spray-on overlay roof, as seen in Figures 5, 6, 7, 8, 9, 10, 11, 12 and 13.

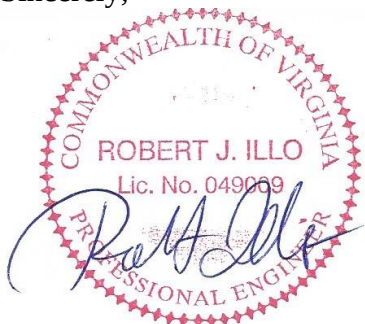
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat, main roof areas described above.
2. The panels will be mounted at an angle to the plane of the roof.
3. The panels will be mounted on a framework that is held to the roof with ballast blocks.
4. The panels, combined with ballast and frame mounting system, will impose approximately six (8) pounds per square foot onto the portion of the roof directly under the panels.
5. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
6. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
7. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of a roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer





Figure 1

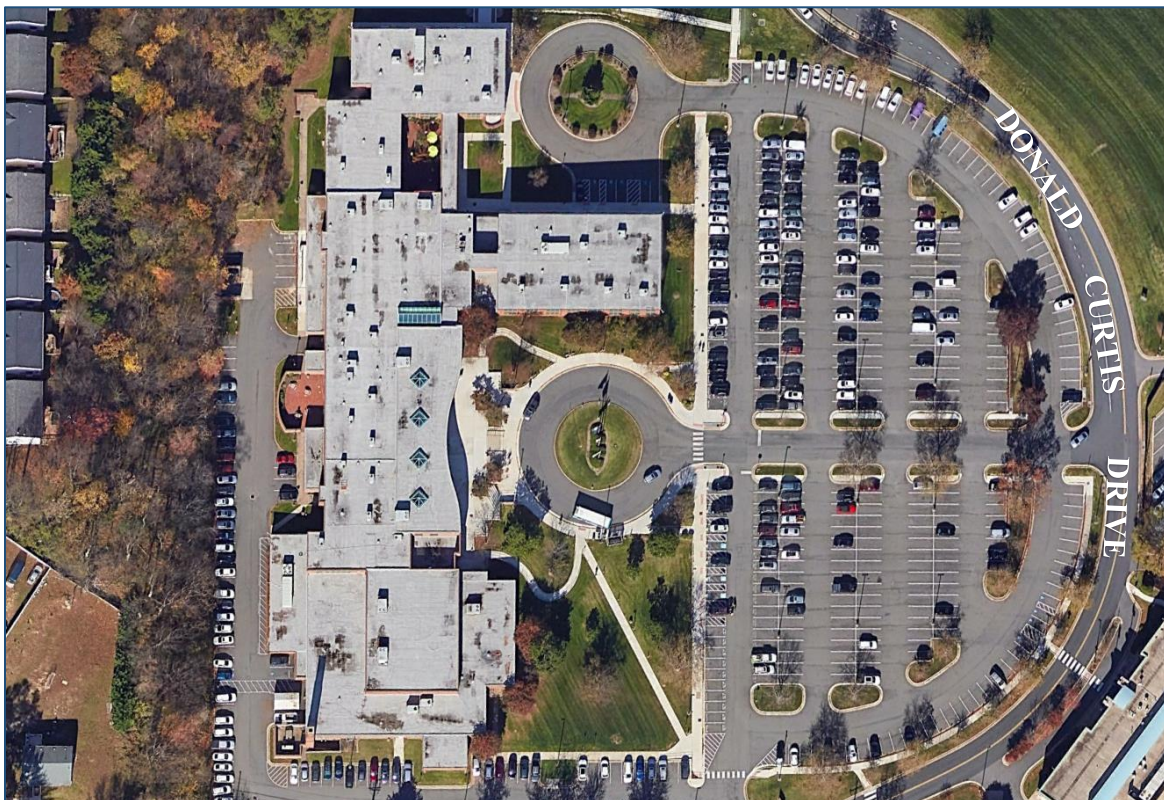


Figure 2





Figure 3



Figure 4





Figure 5



Figure 6



Figure 7



Figure 8





Figure 9



Figure 10





Figure 11



Figure 12





Figure 13



Figure 14



Figure 15



Figure 16





Figure 17

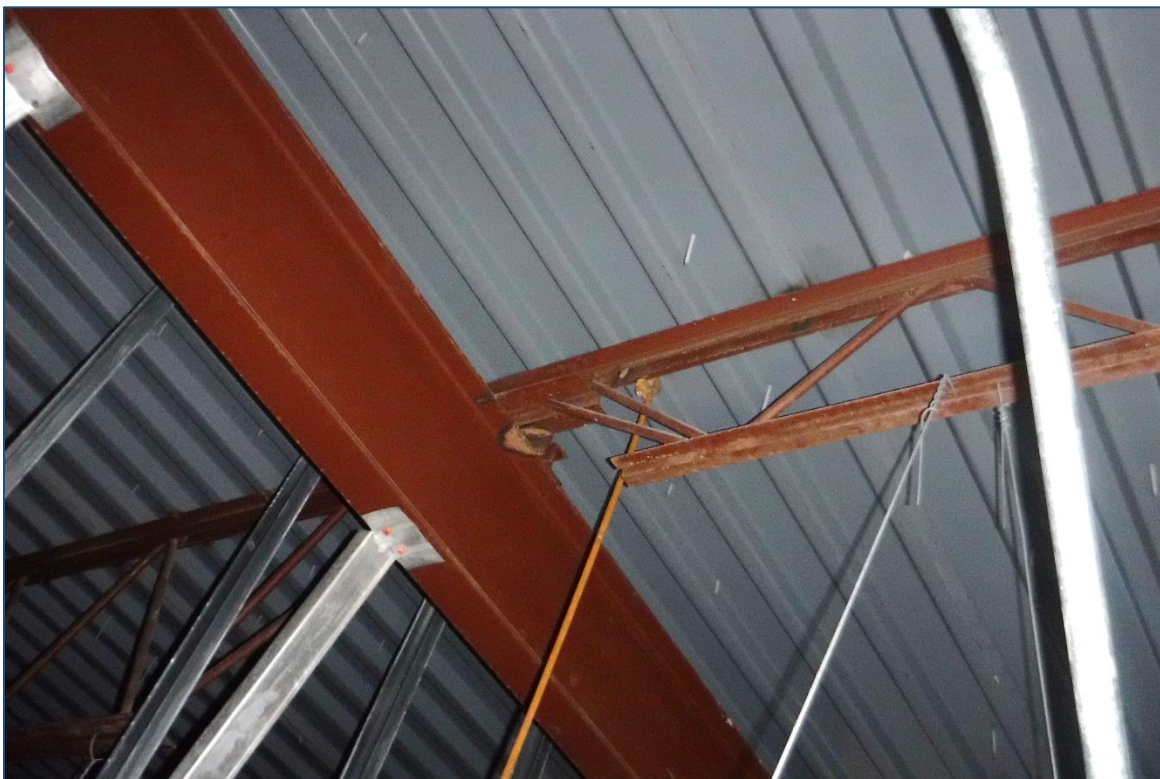


Figure 18





Figure 19

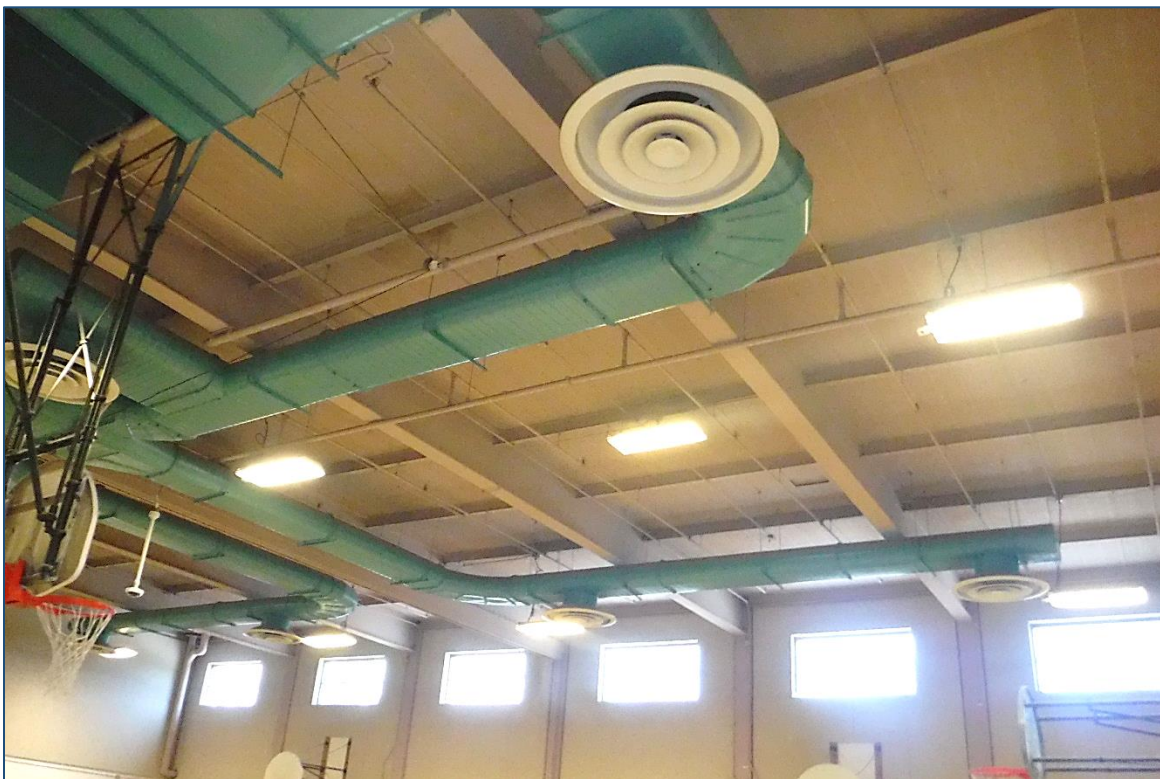


Figure 20





**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

November 10, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the Adult Detention Center  
9320 Lee Avenue in Manassas, Virginia  
**a+ei file # 23.059-4**

Dear Tim:

On 8/7/23, I visited Prince William County's Adult Detention Center located at 9320 Lee Avenue in Manassas, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the southern side of Mosby Street and to the west of Peabody Street, as seen in Figure 1. Directions referenced in this report are based on the face of Section A with the building number, seen in Figure 3, facing nominally south, toward the Judicial Center and toward Church Street. Accordingly, the entry to Section C, seen in Figure 16 is facing north toward Mosby Street. The roofs are nominally flat. It is understood that the solar collection system will be installed on the roof, using a ballasted frame system.

Section A, Main Roofs: The lower, main roofs, seen in Figures 2, 4, 5, 6 and 7, are framed with precast, prestressed concrete roof planks and precast, prestressed concrete double-T roof joist-and-deck units. The western lower, main roof seen in Figure 6 is not suitable for the support of solar panels because of the volume and weight of roof-top HVAC equipment.

The eastern, lower, main roof can be seen in Figures 2 and 7, located to the north of the penthouse. The majority of this section of roof is constructed of hollow-core, precast, prestressed concrete roof planks oriented east to west. The south-western corner (approximately 800 square feet) of this section of roof is constructed of solid-core, precast, prestressed concrete roof planks, oriented north to south. The hollow-core

planks are sixteen (16) inches deep and have a 2-inch-thick concrete topping, creating a total depth of eighteen (18) inches. These hollow-core planks span up to thirty-three (33) feet. The solid-core concrete planks in the south-western corner are six (6) inches deep and span approximately twenty (20) feet.

The southern lower, main roof can be seen in Figures 2 and 4, on the south side of the penthouse. This section of roof is constructed of precast, prestressed concrete double-T roof deck with two integral roof joists, oriented north to south. These double-T's are thirty-two (32) inches deep and span approximately forty (40) feet.

Section A, Penthouse Roof: The penthouse roof, seen in Figures 2, 5 and 8, is framed with steel girders, oriented east-to-west. These girders support open-web, steel joists. These roof joists are oriented north to south. The main penthouse joists are twenty-four (24) inches deep with 5-inch deep seats and are fabricated with steel angle chords and steel angle webs. These joists span approximately thirty-nine (39) feet, six (6) inches. The joists in the eastern section of the penthouse are fourteen (14) inches deep with 2-1/2-inch seats and are fabricated with steel angle chords and steel bar webs. These joists span approximately twenty (20) feet.

The penthouse roof joists described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet, three (3) inches between joists.

Roofing System: The structure and deck of the roof of Section A support foam insulation board overlaid with elastomeric membrane roofing that is held down with precast concrete pavers on the edges and smooth, river stones in the field of the roofs, as seen in Figures 4, 5, 6 and 7.

Section B, Roof: The roof of Section B (exclusive of the office area in the former sally port) is seen in Figures 1, 9, 10, 11 and 12. This roof is framed with precast, prestressed concrete planks. The concrete roof planks are eight (8) inches deep and forty-eight (48) inches wide. The concrete roof planks span approximately twenty (20) feet. The concrete roof planks serve as the decking that supports the roofing system.

The roof of the office area, located in the former sally port, is framed with steel beams which support open-web, steel joists, as seen in Figures 13 and 14, coated in fire-resistant cover. These steel roof joists are twenty (20) inches deep with two and one-half (2.5)-inch deep seats and are fabricated with steel angle chords and steel angle webs. These joists span approximately twenty-four (24) feet between steel beams.

The steel roof joists described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than sixty (60) inches between joists.

Roofing system for Section B: The concrete planks and steel roof decking of Section B support foam insulation board with single-ply membrane roofing with no ballast.

Section C, Main Roofs: The roof of Section C is seen in Figures 1, and 15. Figure 16 shows the façade of Section C that faces north, toward Mosby Street. The main roof of Section C are framed with precast, prestressed concrete planks and precast, prestressed double-T beam/ slabs. The concrete roof planks are ten (10) inches deep and forty-eight (48) inches wide. The concrete roof planks span approximately twenty (20) feet. The double-T's are thirty-six (36) inches deep and twelve (12) feet wide. The double-T's span no greater than sixty-five (65) feet. The concrete roof planks and double-T's serve as the decking that supports the roofing system.

Section C, Penthouse Roof: The penthouse of Section C is located to the south, as seen in Figure 15. The penthouse roof is framed with steel roof joists, oriented north to south. The steel roof joists on the east bay are twenty (20) inches deep with two and one-half (2.5)-inch deep seats and are fabricated with steel angle chords and steel webs. The steel roof joists on the remaining bays of the penthouse are twenty-four (24) inches deep with two and one-half (2.5)-inch deep seats and are fabricated with steel angle chords and steel webs. The joists of the penthouse roof span no greater than twenty-four (24) feet.

The steel roof joists described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than sixty-five (65) inches between joists.

Roofing system for Section C: The concrete and steel roof decking of Section C support foam insulation board with single-ply membrane roofing with no ballast.

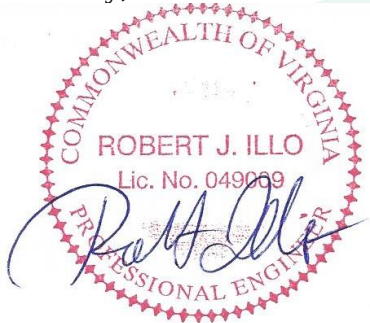
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the sections of the roof described above.
2. The panels will be mounted at an angle to the plane of the roof.
3. The panels will be mounted on a framework that is held to the roof with ballast blocks.
4. The panels, combined with ballast and frame mounting system, will impose approximately eight (8) pounds per square foot onto the portion of the roof directly under the panels.
5. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
6. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
7. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of a section of roof that is more than 30-inches from grade or from a lower, adjacent section of roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer



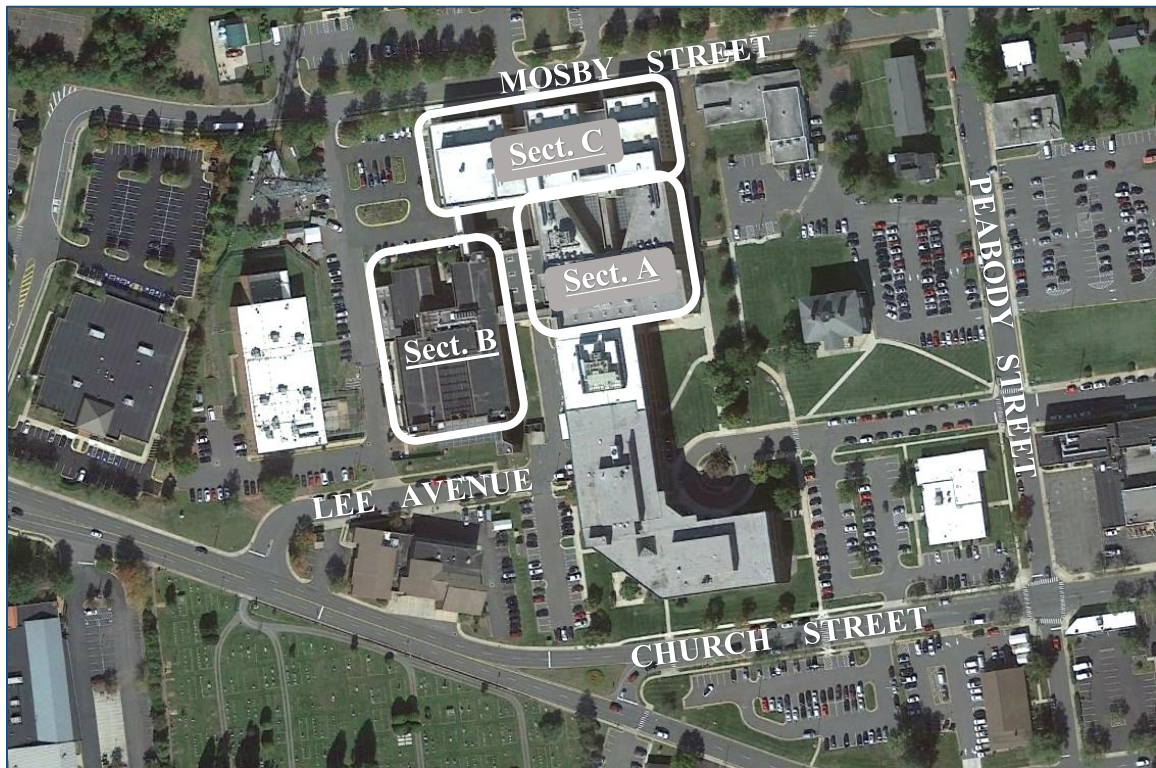


Figure 1

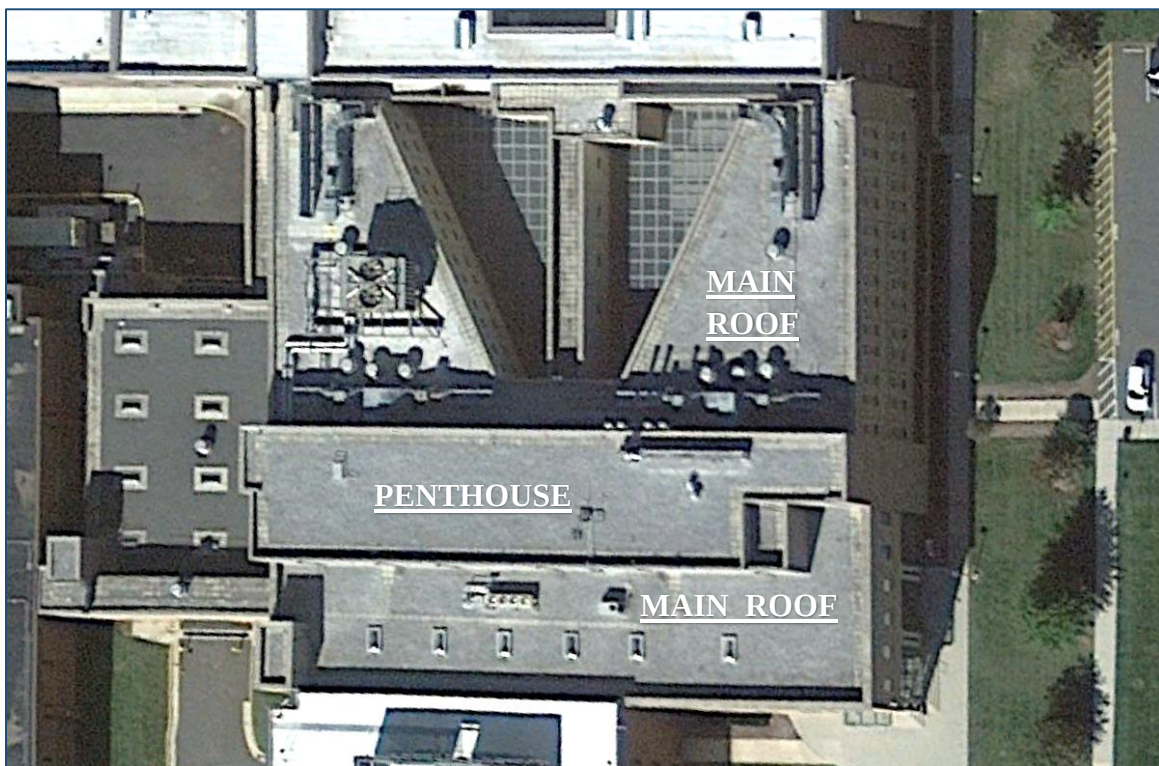


Figure 2: Section A





Figure 3



Figure 4



Figure 5



Figure 6





Figure 7



Figure 8



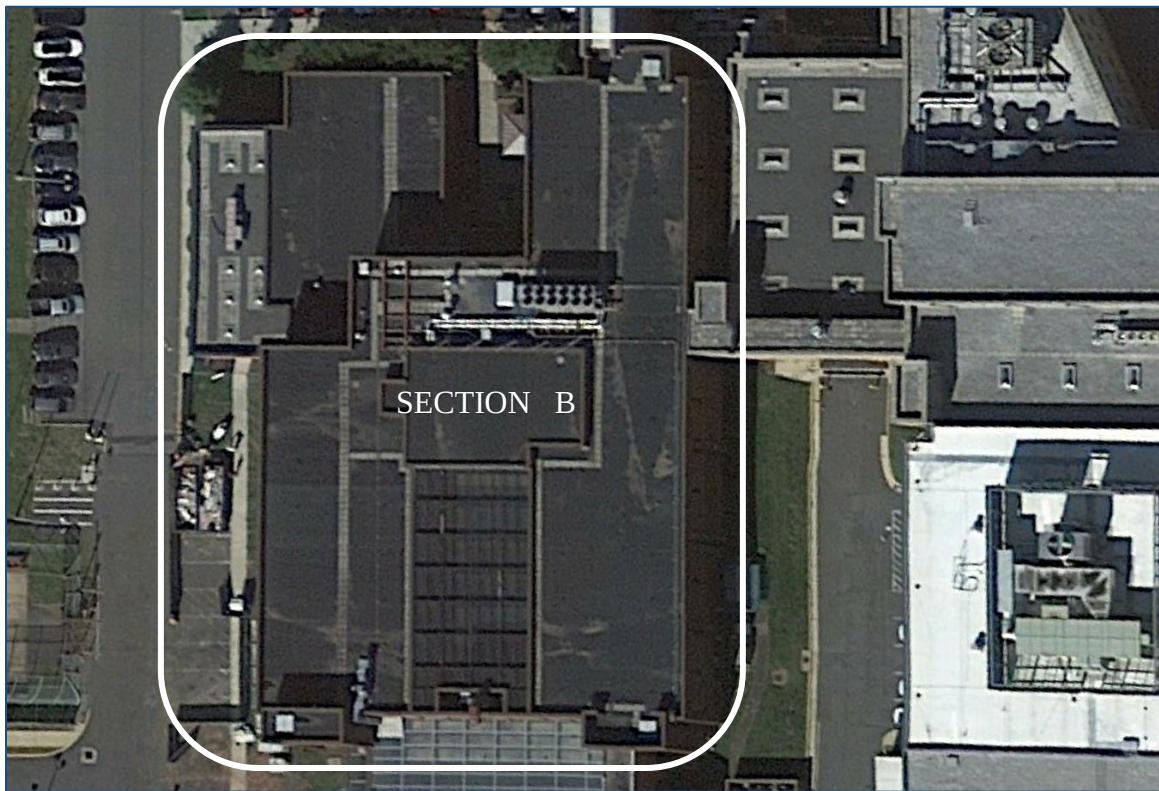


Figure 9: Section B



Figure 10

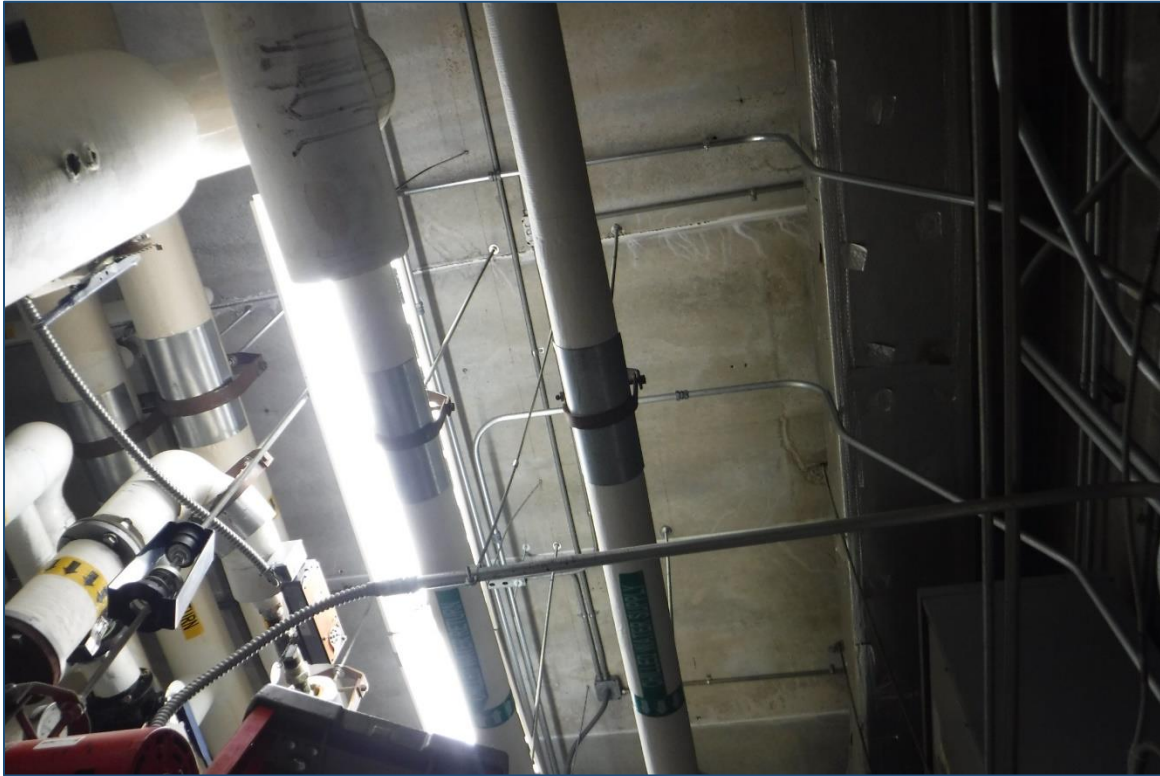


Figure 11



Figure 12





Figure 13



Figure 14

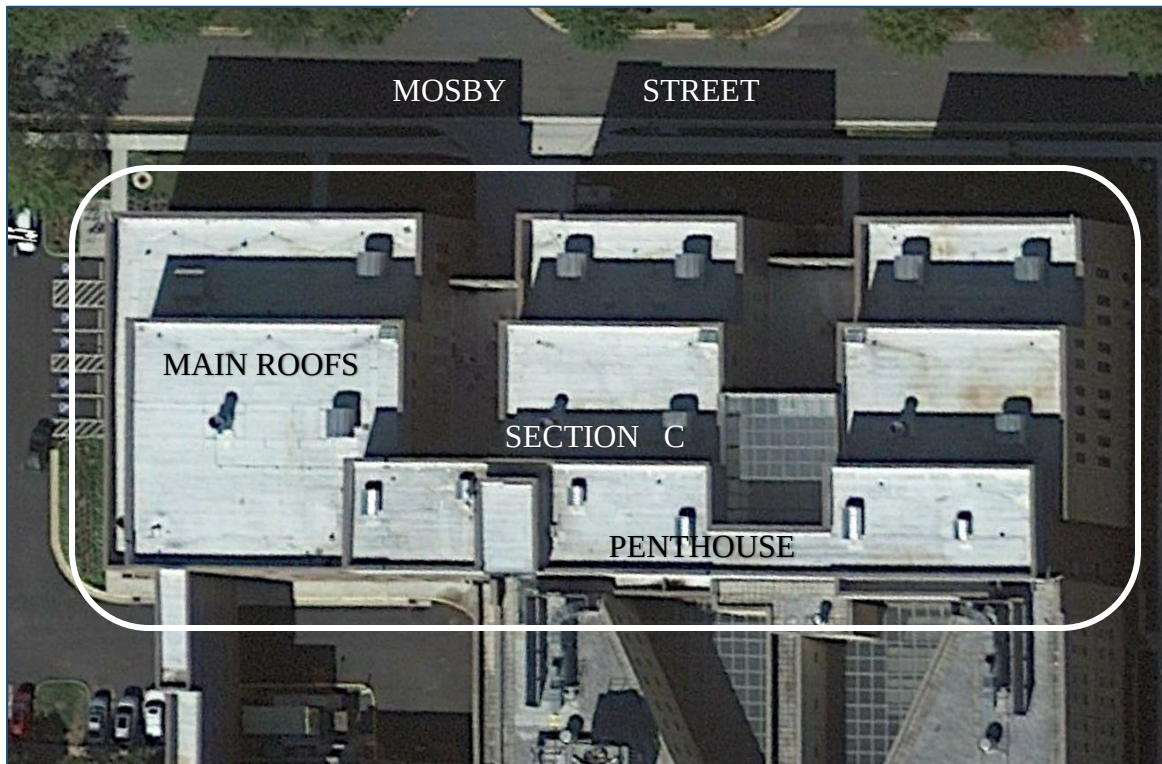


Figure 15: Section C



Figure 16





**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 18, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at Bull Run Library  
8051 Ashton Avenue in Manassas, Virginia  
**a+ei file # 23.059-2**

Dear Tim:

On 8/7/23, I visited Prince William County's building located at 8051 Ashton Avenue in Manassas, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the eastern side of Ashton Avenue, as seen in Figure 1. Directions referenced in this report are based on the entry corner of the building seen in Figure 2 being oriented toward the north east. The main roof is nominally flat, as seen in Figures 3, 4 and 5. It is understood that the solar collection system will be installed on the flat roof areas, using a ballasted frame system.

The roof is framed with open-web, steel joists and hot-rolled steel beams, as seen in Figure 6. These roof joists are oriented north to south (approximately parallel to Ashton Avenue) and the steel beams are oriented east to west. The steel joists are supported by hot-rolled steel beams. The steel beams are supported by steel columns.

The depths of the steel joists include fourteen (14) inches, eighteen (18) inches, twenty (20) inches, twenty-two (22) inches, and twenty-four (24) inches. All steel joists are fabricated with 2-1/2-inch-deep seats. The joists are fabricated with steel angle chords and steel web members which include bars and crimped angles. The spans of the steel joists vary from approximately twenty (20) feet to forty (40) feet. The depths of the hot-rolled steel roof beams and girders include twelve (12) inches, fourteen (14) inches, sixteen (16) inches, eighteen (18) inches and twenty-four (24) inches.

The roof joists described above support type B, 22-gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than five (5) feet, six (6) inches between joists. The decking supports foam insulation board and a spray-on overlay roof, as seen in Figures 3, 4 and 5.

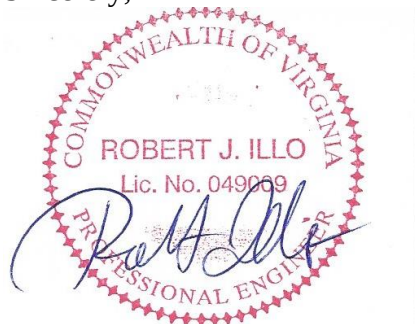
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat, roof areas.
2. It is understood that the spray-on overlay and the underlying roofing system will be removed down to the structural deck and replaced with a single-ply roofing system without ballast.
3. The panels will be mounted at an angle to the plane of the roof.
4. The panels will be mounted on a framework that is held to the roof with ballast blocks.
5. The panels, combined with ballast and frame mounting system, will impose approximately eight (8) pounds per square foot onto the portion of the roof directly under the panels.
6. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
7. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
8. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of the roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer

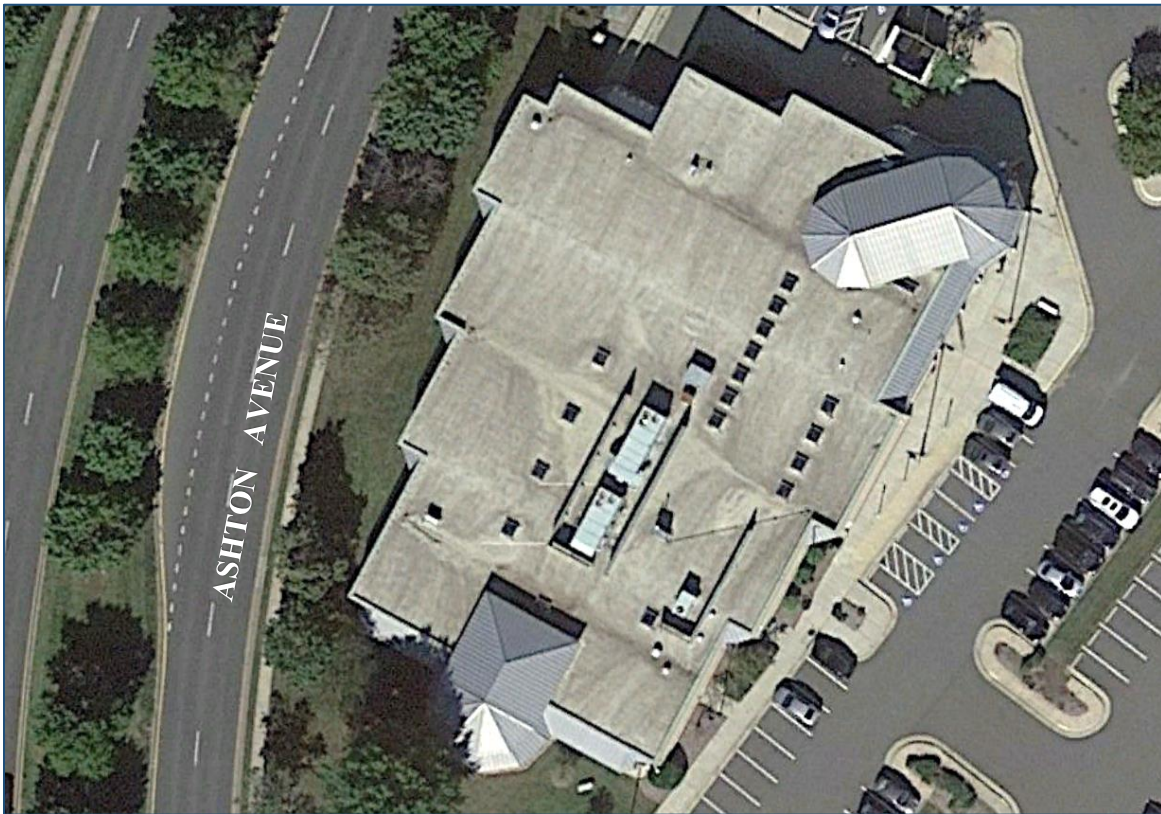


Figure 1



Figure 2





Figure 3



Figure 4





Figure 5

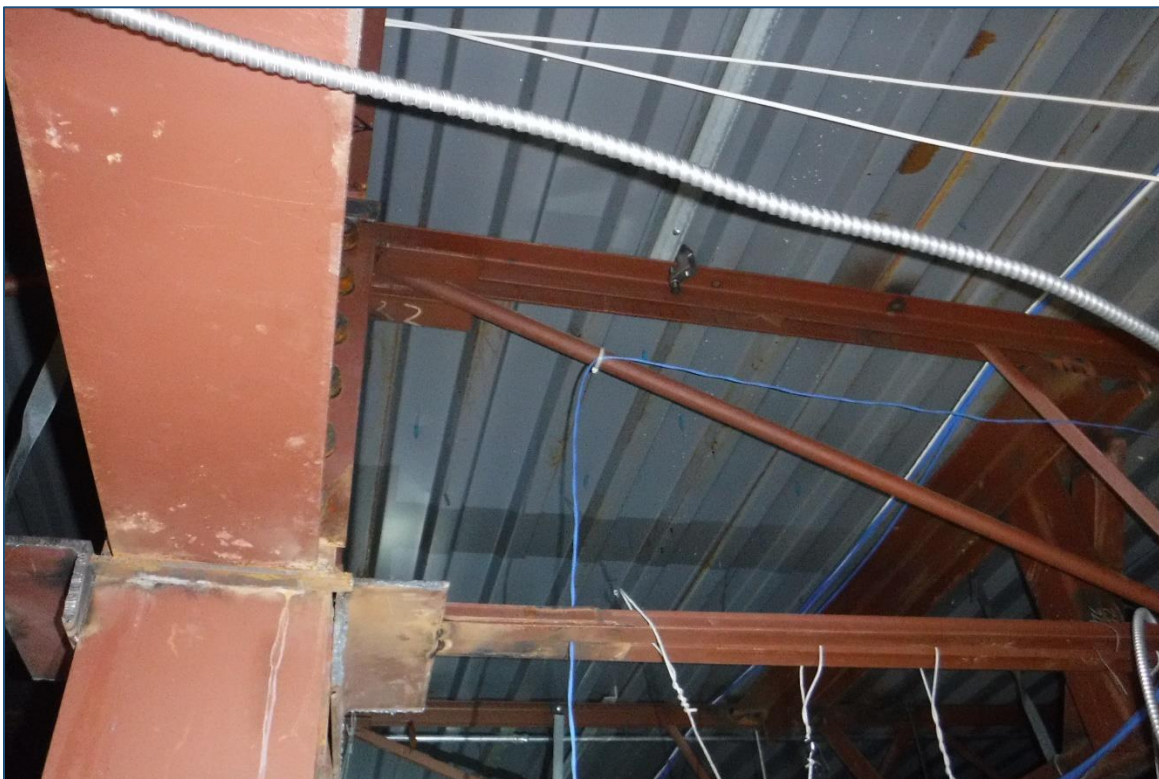


Figure 6



**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 21, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the Central District Police Station  
5036 Davis Ford Road in Woodbridge, Virginia  
**a+ei file # 23.059-6**

Dear Tim:

On 8/8/23, I visited Prince William County's building located at 5036 Davis Ford Road in Woodbridge, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the eastern side of Davis Ford Road. Directions referenced in this report are based on the front of the building in Figure 2 facing nominally west, toward Davis Ford Road. The roof is nominally flat with the exception of the standing seam roofs on the northern and southern stair towers, seen in Figures 1, 3 and 5. It is understood that the solar collection system will be installed on the flat roof, using a ballasted frame system. Additionally, panels may be mounted on a framework that is clamped to the standing seams of the stair-tower roofs.

**Main Roof:** The roof is framed with open-web, steel joists and hot-rolled steel beams, as seen in Figures 7 and 8. These roof joists are oriented east to west. The steel joists are supported by hot-rolled steel beams. The steel beams are supported by steel columns.



The depths of the steel joists include ten (10) inches, fourteen (14) inches and twenty-four (24) inches. All steel joists are fabricated with 2-1/2-inch-deep seats. The joists are fabricated with steel angle chords and steel web members which include bars and angles. The spans of the steel joists vary from approximately nineteen (19) feet to thirty-seven (37) feet. The depths of the hot-rolled steel roof beams and girders include fourteen (14) inches, sixteen (16) inches and eighteen (18) inches.

The roof joists described above support type B, 22-gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet between joists. The decking supports foam insulation board and a modified-bituminous, mineral-surface roll roofing, as seen in Figures 3, 4 and 5.

Stair Tower Roofs: The sloping of the stair towers roofs are framed with open-web steel roof joists, as seen in Figure 6. These joists are ten (10) inches deep and are fabricated with two and one-half (2-1/2) inches deep. The chords of the joists are fabricated with steel angles and the webs of the joists are fabricated from steel bars.

The steel joists of the stair towers described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than four (4) feet between joists. The decking supports standing-seam metal roofing, as seen in Figure 5. The standing seams are approximately one and one-half (1-1/2) inches high and are spaced sixteen (16) inches on center.

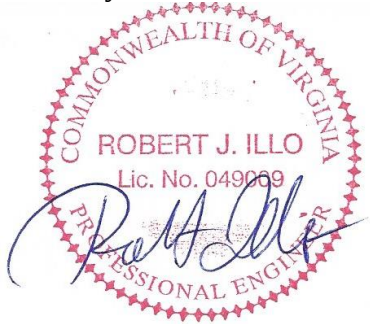
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat, main roof area.
2. The panels will be mounted an angle to the plane of the roof.
3. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
4. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
5. The panels will be supported by rails fastened to the standing-seam roof with S-5 clamps or equivalent.
6. The S-5 clamps will be spaced twenty-four (24) inches on center within eight (8) feet of the edge of the roof and forty-eight (48) inches on center in the center of the roof.
7. Two (2) rails will support each row of panels.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer

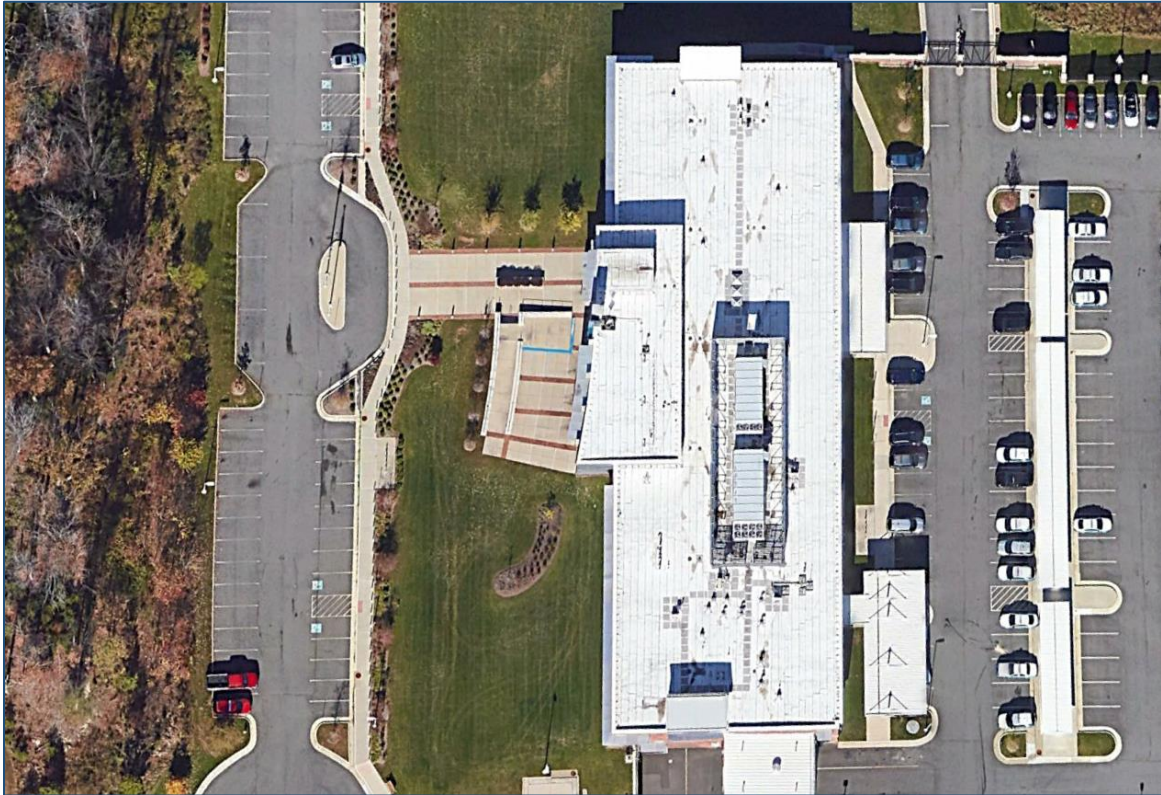


Figure 1



Figure 2





Figure 3



Figure 4



Figure 5



Figure 6





Figure 7

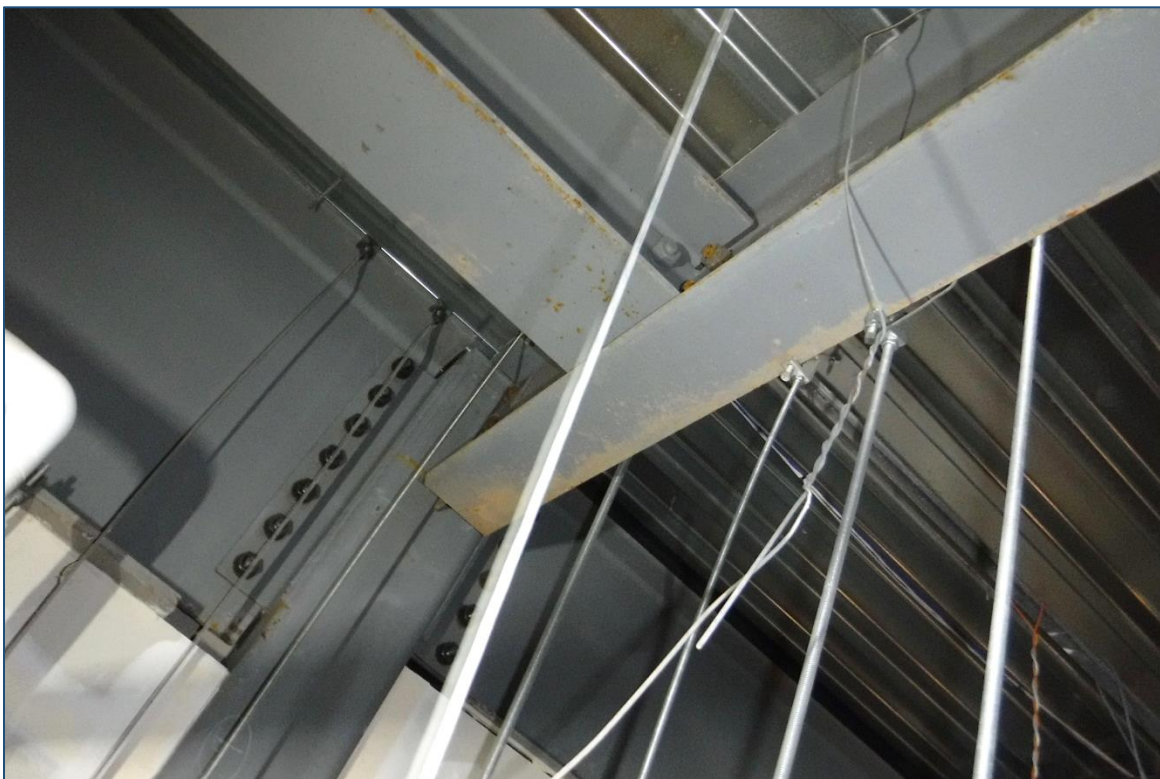


Figure 8





**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 22, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the Chinn Aquatic & Fitness Center  
13025 Chinn Park Drive in Woodbridge, Virginia  
**a+ei file # 23.059-9**

Dear Tim:

On 8/8/23, I visited Prince William County's building located at 13025 Chinn Park Drive in Woodbridge, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the southern side of Chinn Park Drive and east of Prince William Parkway, as seen in Figure 1. Directions referenced in this report are based on the front of the building in Figure 3 facing nominally north, toward Chinn Park Drive. The roof is nominally flat. It is understood that the solar collection system will be installed on the roof, using a ballasted frame system.

The roof is framed with steel beams, hot-rolled steel trusses and open-web steel joists, as seen in Figures 11, 12, 13, 14, 15 and 16.

**Roof Joists and Beams:** The depths of the hot-rolled steel beams include ten (10) inches, fourteen (14) inches, sixteen (16) inches and twenty-one (21) inches. The depths of the open-web steel joists include twelve (12) inches, fourteen (14) inches and twenty-two (22) inches. The open-web steel joists are fabricated with two and one-half (2-1/2)-inch deep seats, steel angle chords and steel webs including angles, straps and bars. These spans of the open-web steel joists range from approximately thirteen (13) feet to thirty-four (34) feet.

The roof joists and beams described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet between joists. The decking supports foam insulation board and EPDM membrane roofing held down with ballast.

Roof Trusses: The steel roof trusses are fabricated from hot-rolled wide-flange steel beams serving as chords and web members. The roof trusses of the main pool can be seen in Figure 14. These trusses are approximately seven (7) feet deep at the bearing end and span approximately ninety-eight feet from north to south. The roof trusses of the wading pool can be seen in Figure 15. These trusses are approximately four (4) feet deep at the least bearing end. The western truss spans thirty-eight (38) feet and the remaining two trusses span forty-five (45) feet from north to south. The roof trusses of the gymnasium can be seen in Figure 16. These trusses are approximately seven (7) feet deep at the bearing end and span approximately ninety feet from north to south. These trusses support ten (10)-inch-deep, hot-rolled wide-flange steel purlins, spaced up to ten (10) feet on center.

The roof trusses and purlins described above support type B, 20 gauge, structural steel decking. The decking is formed with ribs that are three (3) inches deep and spaced six (6) inches on center. The decking spans no more than ten (10) feet between joists. The decking supports foam insulation board and EPDM membrane roofing held down with ballast.

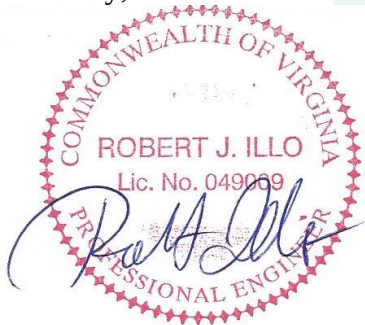
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat roof areas described above.
2. The stone ballast that is currently on the roof membrane will be removed from the roof membrane under the solar panels.
3. The panels will be mounted at an angle to the plane of the roof.
4. The panels will be mounted on a framework that is held to the roof with ballast blocks.
5. The panels, combined with ballast and frame mounting system, will impose approximately eight (8) pounds per square foot onto the portion of the roof directly under the panels.
6. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
7. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
8. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of a section of roof that is more than 30-inches from grade or from a lower, adjacent section of roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer





Figure 1



Figure 2





Figure 3

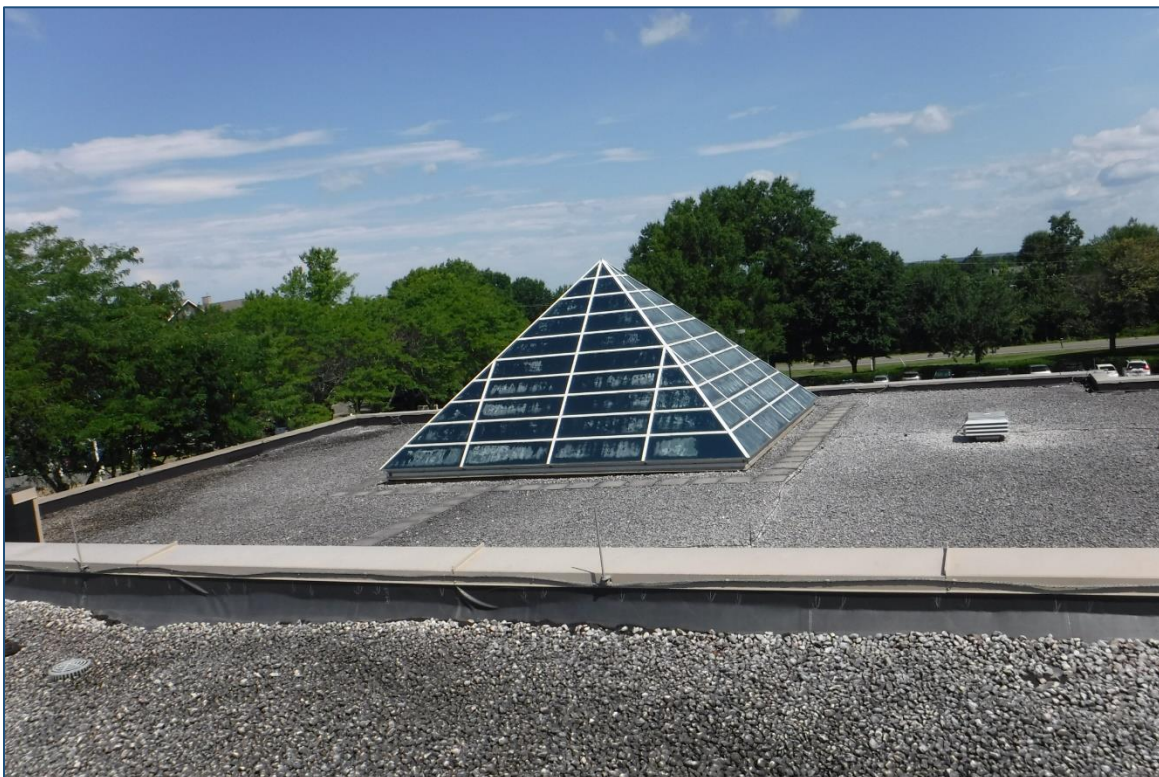


Figure 4





Figure 5



Figure 6





Figure 7



Figure 8





Figure 9



Figure 10



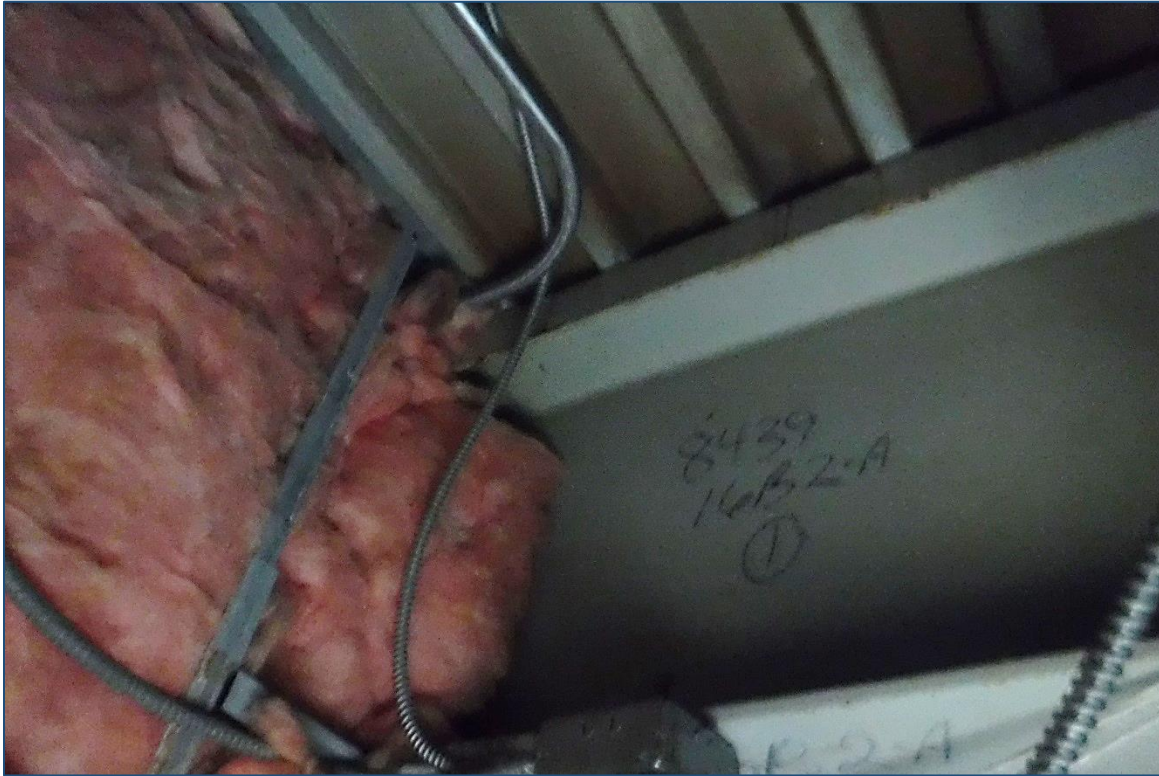


Figure 11



Figure 12





Figure 13

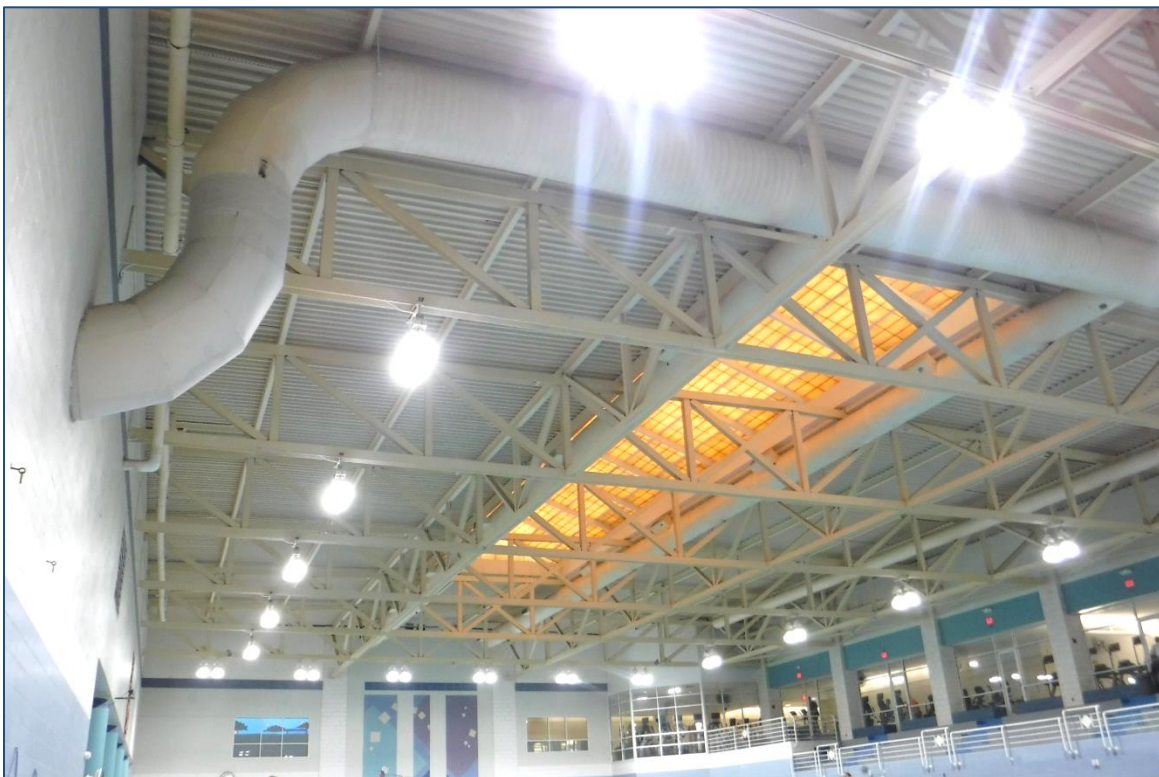


Figure 14





Figure 15

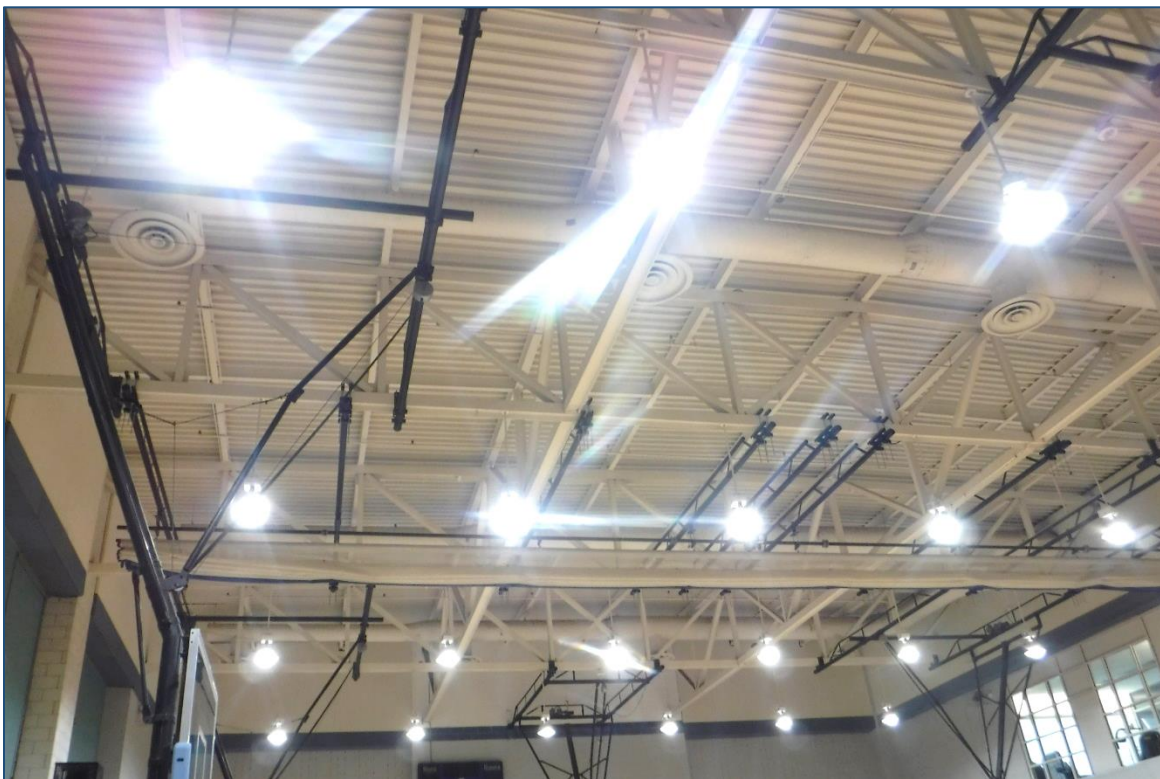


Figure 16



**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 22, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at Development Services Building and Stage  
5 County Complex Court in Woodbridge, Virginia  
**a+ei file # 23.059-7**

Dear Tim:

On 8/8/23, I visited Prince William County's building located at 5 County Complex Court in Woodbridge, Virginia, to examine the physical condition and configuration of the roof of the building and the stage to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the northern side of County Complex Court and Prince William Parkway, as seen in Figure 1. Directions referenced in this report are based on the front of the building seen from the western courtyard in Figure 3 facing nominally west. The roofs of the DSB and the stage are nominally flat. It is understood that the solar collection system will be installed on both of these roofs, using a ballasted frame system.

**DSB Main Roof:** The main roof of the DSB can be seen in Figures 2, 4, 5 and 6 from above and in Figures 10 and 11 from below. The main roof is framed with hot-rolled steel beams, oriented east-to-west. These steel beams support open-web, steel joists. These roof joists are oriented north to south. The depths of the steel roof joists include ten (10) inches and twenty (20) inches. The joists are fabricated with two and one-half (2-1/2)-inch deep seats, steel angle chords and steel bar web members. The spans of the steel roof joists range from eighteen (18) feet, six (6) inches to thirty-three (33) feet, eight (8) inches. The depths of the hot-rolled steel beams include six (6) inches, ten (10) inches, twelve (12) inches, fourteen (14) inches and sixteen (16) inches. The spans of the hot-rolled steel beams range from approximately twelve (12) feet to thirty-four (34) feet.



The roof joists described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet between joists. The decking supports foam insulation board and a single-ply EPDM membrane roofing.

DSB Central Hall Roof: The elevated roof of the central hall of the DSB can be seen in Figures 2 and 7 from above and in Figures 8 and 9 from below. This roof is framed with two cantilever steel trusses, oriented north to south. Each truss is supported with two columns, as seen in Figure 9. These trusses support hot-rolled steel beams and two cross-trusses. These roof beams and cross-trusses are oriented east to west. The cantilever trusses are forty-two (42) inches deep and are fabricated hot-rolled steel T chords and steel angle webs. These joists span approximately fifty-one (51) feet between columns. The cross-trusses and beams span up to approximately twenty-seven (27) feet. The hot-rolled beams are twelve (12) inches deep.

The roof joists described above support 18-gauge, structural steel box-decking. The decking is formed with steel boxes that are twenty-four (24) inches wide and three (3) inches deep. The decking spans no more than ten (10) feet, seven (7) inches between beams. The box-decking supports foam insulation board and a single-ply EPDM membrane roofing.

Stage Roof: The stage is situated on the northern side of the western courtyard, as seen in Figures 1, 2, and 12. The framing of the stage roof can be seen in Figures 13 and 14. The stage roof is framed with hot-rolled steel beams and girder, supported by steel columns. The girder is located approximately seventeen (17) feet from the southern edge of the roof and is oriented east to west. This girder is thirty-three (33) inches deep. The beams are eighteen (18) inches deep and are oriented north to south. The beams are spaced eight (8) feet, six (6) inches on center. The beams cantilever over the girder and bear on the north wall of the stage as seen in Figures 13 and 14.

The beams support type B, 20 gauge, structural steel decking. The decking is formed with ribs that are three (3) inches deep and spaced six (6) inches on center. The decking spans no more than eight (8) feet, six (6) inches between beams. The decking supports foam insulation board and a single-ply EPDM membrane roofing.

Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

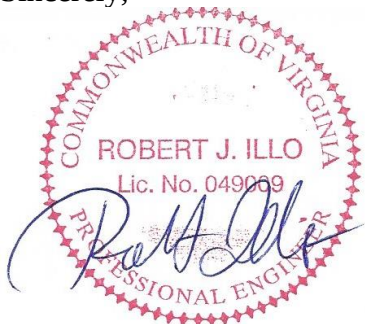
1. The solar panels will be mounted on the flat, main roof areas described above.
2. The panels will be mounted at an angle to the plane of the roof.
3. The panels will be mounted on a framework that is held to the roof with ballast blocks.
4. The panels, combined with ballast and frame mounting system, will impose approximately six (6) pounds per square foot onto the portion of the roof directly under the panels.
5. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.

6. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
7. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of a roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer





Figure 1

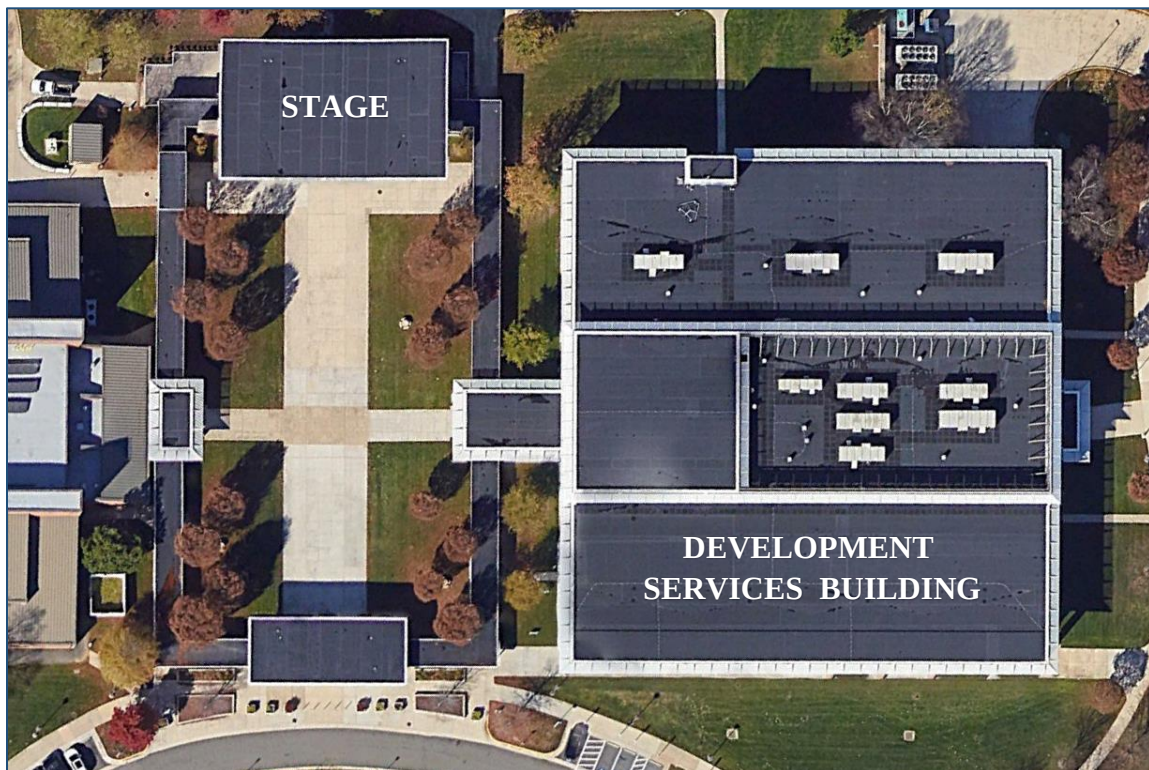


Figure 2





Figure 3



Figure 4



Figure 5



Figure 6





Figure 7

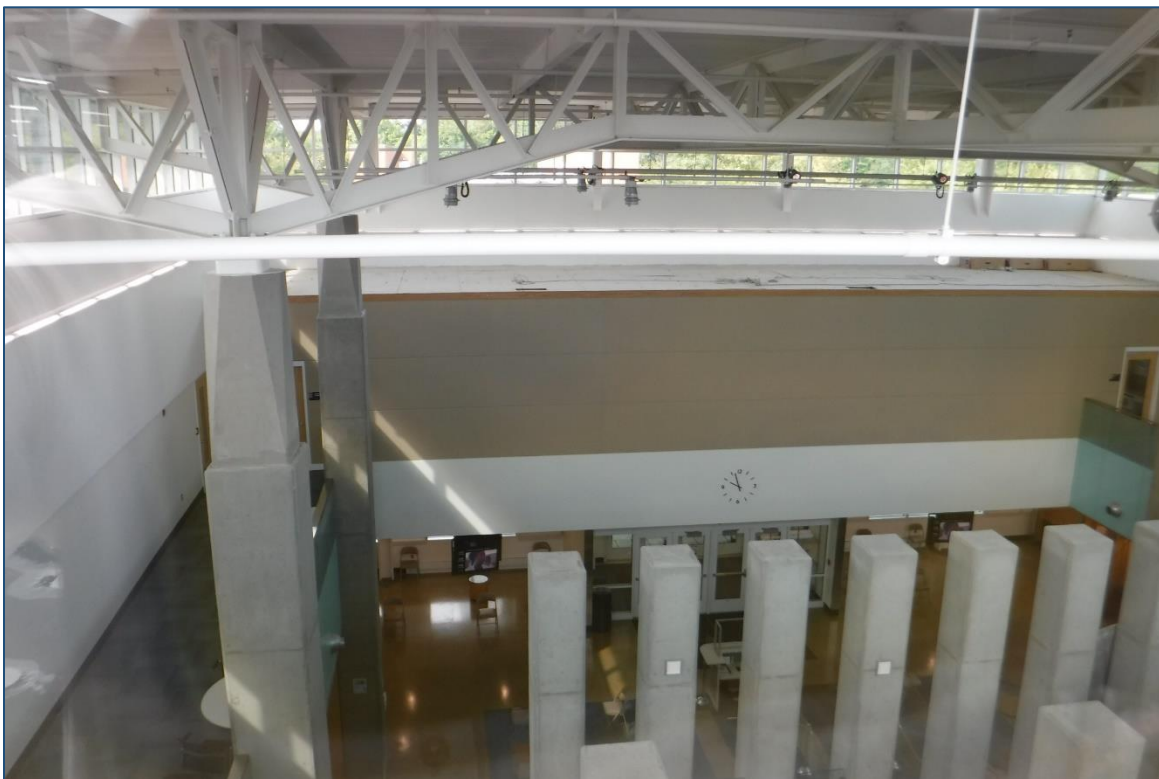


Figure 8





Figure 9



Figure 10



Figure 11



Figure 12





Figure 13



Figure 14





**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 15, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at Fire Station 22  
7500 Century Park Drive in Manassas, Virginia  
**a+ei file # 23.059-1**

Dear Tim:

On 8/7/23, I visited Prince William County's building located at 7500 Century Park Drive in Manassas, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the eastern side of Century Park Drive. Directions referenced in this report are based on the front of the building in Figure 1 facing nominally west, toward Century Park Drive. The roof is nominally flat. It is understood that the solar collection system will be installed on the roof, using a ballasted frame system.

The roof is framed with open-web, steel joists and hot-rolled steel beams, as seen in Figures 8, 9 and 10. These roof joists are oriented east to west in all areas except the southern section of roof. The steel joists which frame the southern roof section are oriented north to south. The steel joists are supported by concrete masonry bearing walls and hot-rolled steel beams. The steel beams are supported by concrete masonry walls and steel columns.

The depths of the steel joists include ten (10) inches, fourteen (14) inches, twenty (20) inches and twenty-six (26) inches. All steel joists are fabricated with 2-1/2-inch-deep seats. The joists are fabricated with steel angle chords and steel web members which include bars and angles. The spans of the steel joists vary from approximately eleven (11) feet to thirty-four (34) feet, four (4) inches. The depths of the hot-rolled steel roof beams and girders include fourteen (14) inches, sixteen (16) inches, eighteen (18) inches and twenty (20) inches.

The roof joists described above support type B, 22-gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet between joists. The decking supports foam insulation board and a single-ply TPO membrane roofing, as seen in Figures 4, 5, 6 and 7.

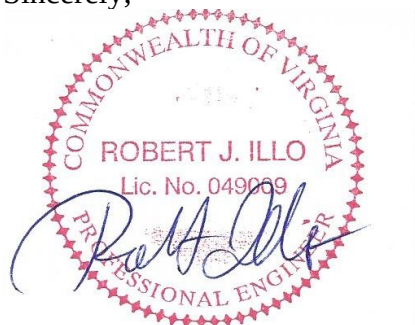
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat, roof areas.
2. The panels will be mounted at an angle to the plane of the roof.
3. The panels will be mounted on a framework that is held to the roof with ballast blocks.
4. The panels, combined with ballast and frame mounting system, will impose approximately eight (8) pounds per square foot onto the portion of the roof directly under the panels.
5. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
6. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
7. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of the roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer

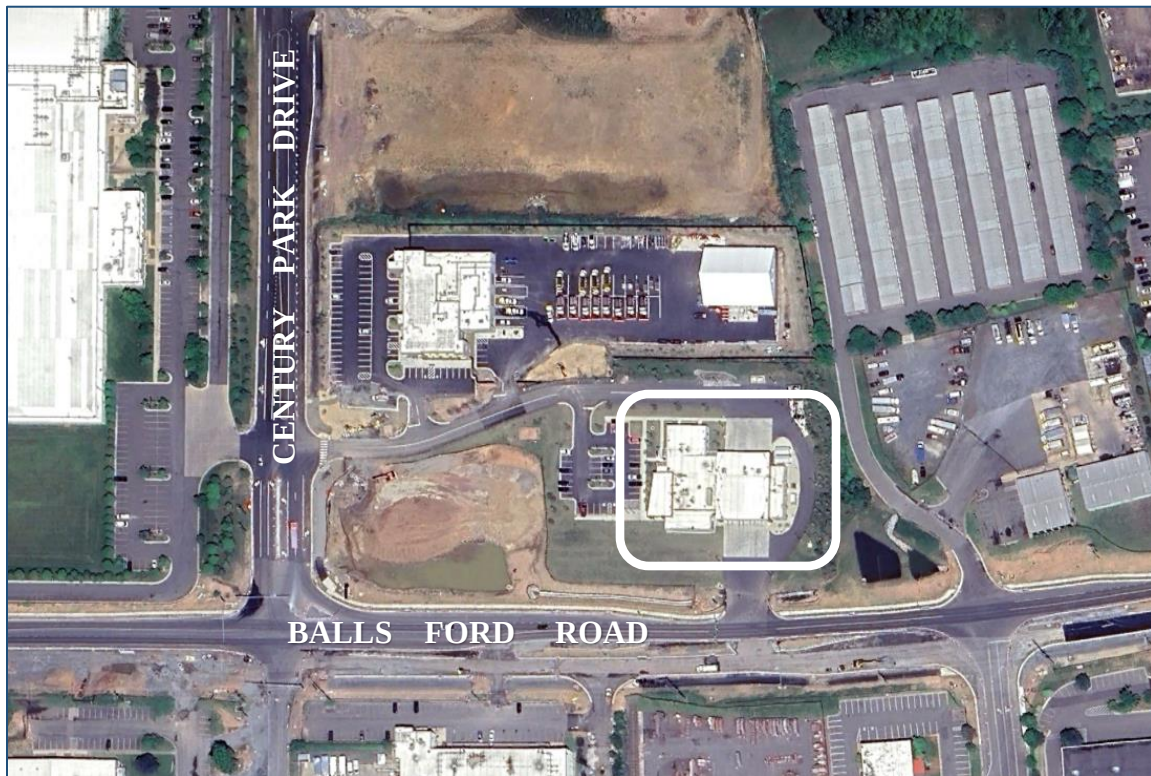


Figure 1



Figure 2





Figure 3



Figure 4



Figure 5



Figure 6





Figure 7

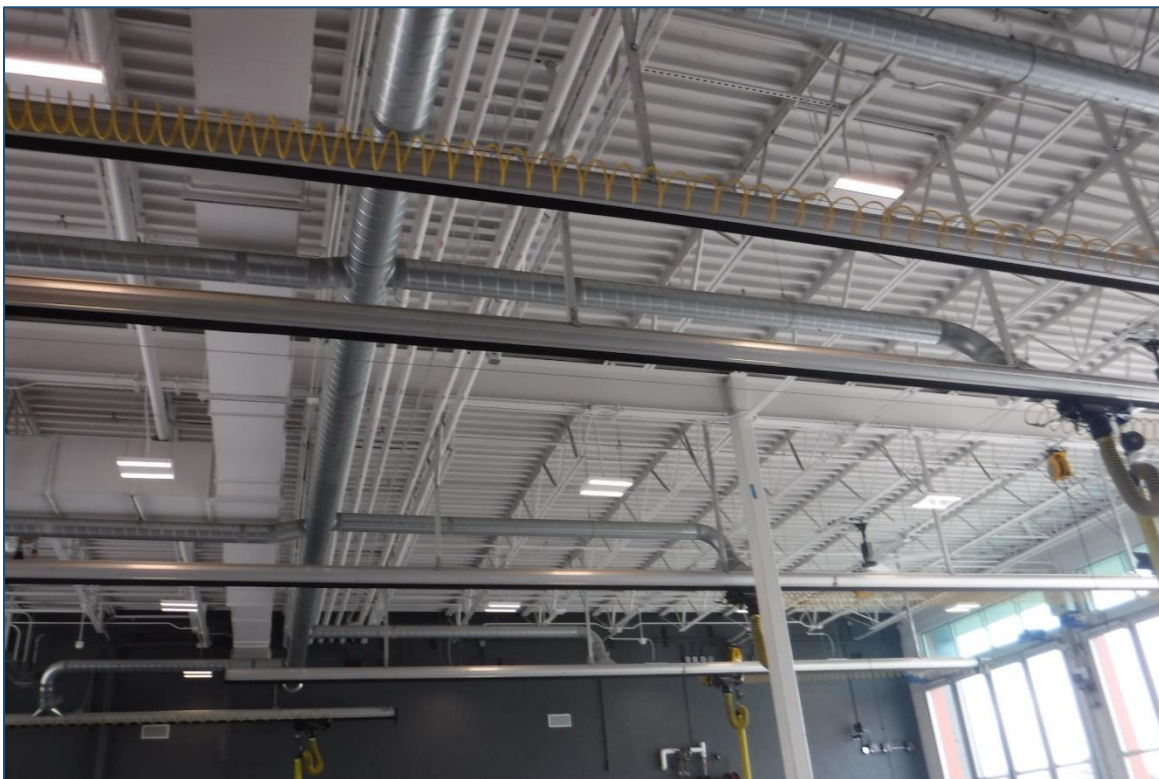


Figure 8



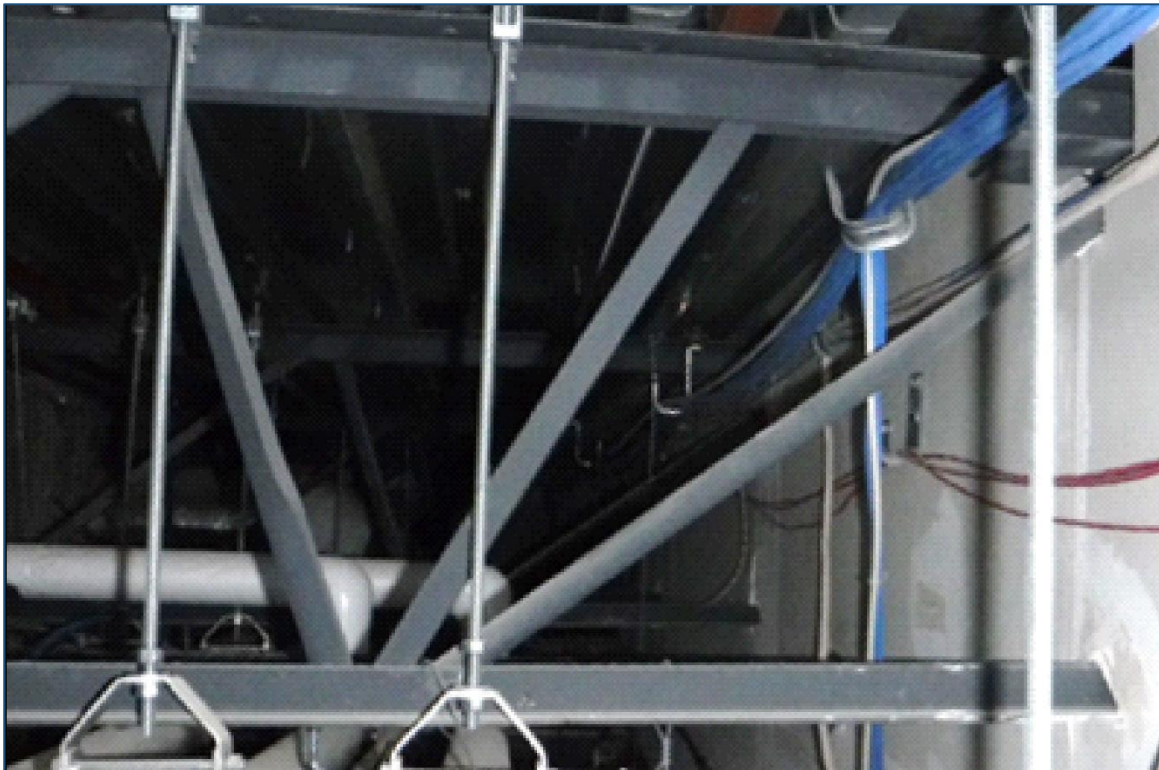


Figure 9

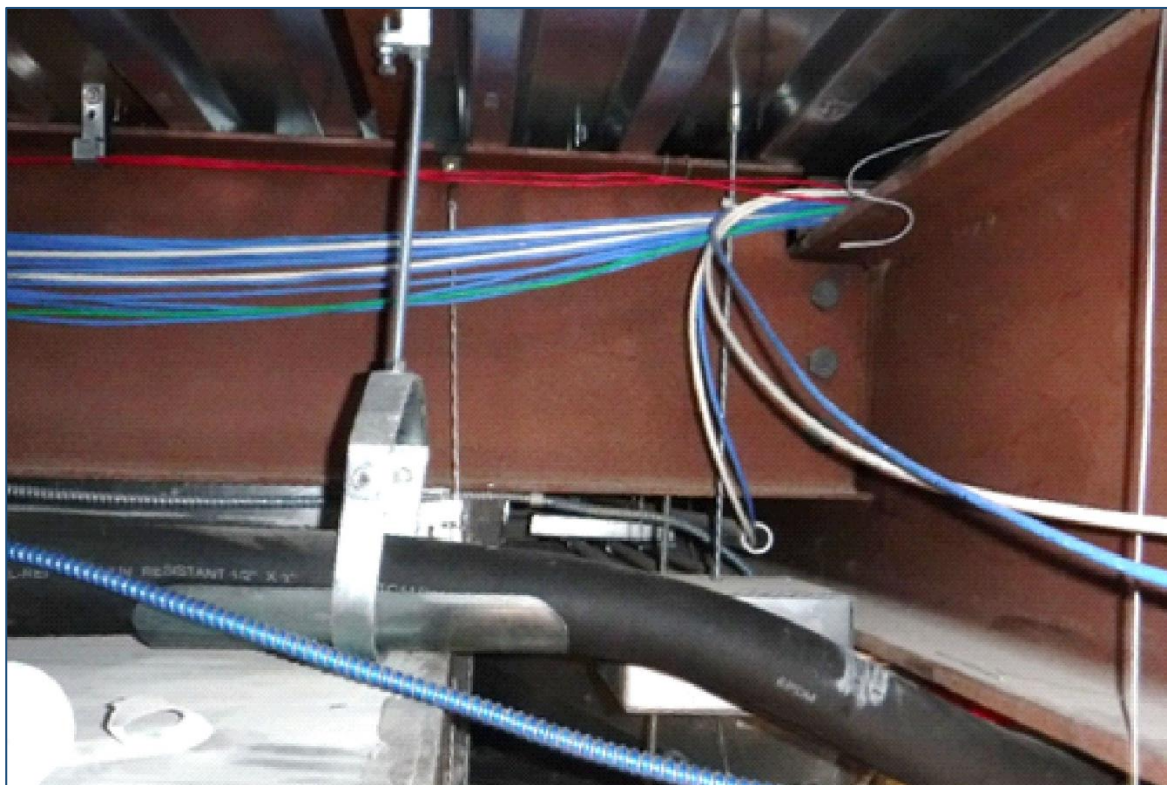


Figure 10



**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: [Rillo@aeiArchitect.com](mailto:Rillo@aeiArchitect.com)

August 21, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the County Judicial Center  
9311 Lee Avenue in Manassas, Virginia  
**a+ei file # 23.059-5**

Dear Tim:

On 8/7/23, I visited Prince William County's building located at 9311 Lee Avenue in Manassas, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the southern side of Mosby Street and to the west of Peabody Street, as seen in Figure 1. Directions referenced in this report are based on the entrance to the building, seen in Figure 3, facing nominally northeast. The roof is nominally flat. It is understood that the solar collection system will be installed on the roof, using a ballasted frame system. Two penthouses are located on the roof, as seen in Figures 2, 4, 5 and 6.

Original Section: The original section of the building is seen with the gray roof, to the south in Figure 2. The roofs of the original section and its two penthouses can be seen in Figures 4, 5, 6, 7, 8, 9 and 10. The roofs of the original section are framed with open-web steel joists, as seen in Figures 7 and 8. The depths of the steel roof joists of the original section include fourteen (14) inches, sixteen (16) inches and eighteen (18) inches. All steel joists are fabricated with 2-1/2-inch-deep seats. The spans of the main roof joists vary from approximately twenty-four (24) feet to thirty-two (32) feet.

The roof joists of the original section described above support type B, 22-gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center in the . The decking spans no more than six (6) feet between joists. The deck supports foam insulation board and a spray-on overlay roof, as seen in Figures 4, 5 and 6.

Northern Section: The northern section is seen with the white roof to the north in Figure 2. The joists of the northern section are fabricated with hot-rolled steel beams, as seen in Figures 11 and 12. The depths of the hot-rolled steel roof beams and girders include fourteen (14) inches, sixteen (16) inches and eighteen (18) inches. The spans of the northern, hot-rolled roof joists vary from approximately twenty-five (25) feet to thirty-six (36) feet.

The roof joists of the northern roof section described above support type 20-gauge, composite structural steel decking with concrete fill. The decking is formed with ribs that are three (3) inches deep and spaced six (6) inches on center in the . The composite decking system spans no more than nine (9) feet between beams. The deck supports insulation board and membrane roofing without ballast.

Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

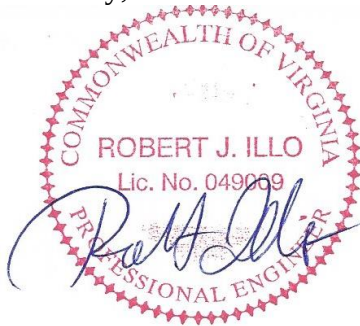
1. The solar panels will be mounted on the flat, roof areas described above.
2. The panels will be mounted at an angle to the plane of the roof.
3. The panels will be mounted on a framework that is held to the roof with ballast blocks.
4. The panels, combined with ballast and frame mounting system, will impose approximately eight (8) pounds per square foot onto the portion of the roof directly under the panels.
5. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
6. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
7. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of a section of roof that is more than 30-inches from grade or from a lower, adjacent section of roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.



Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer

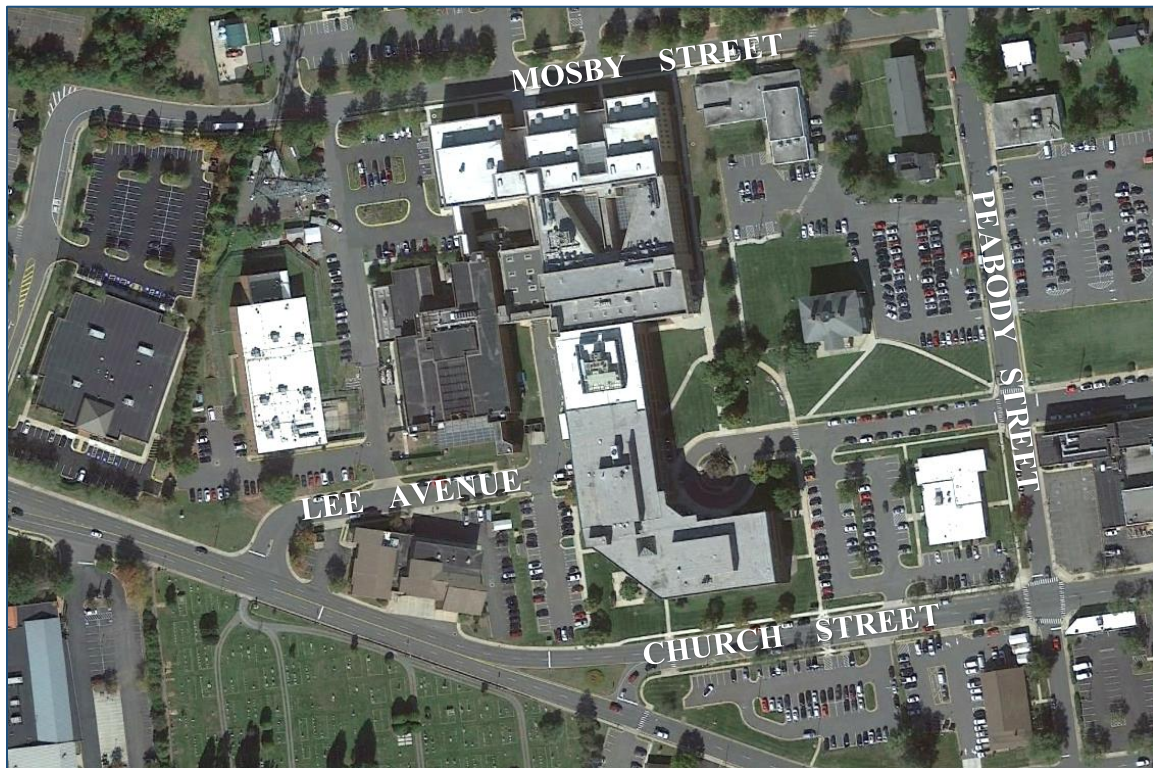


Figure 1

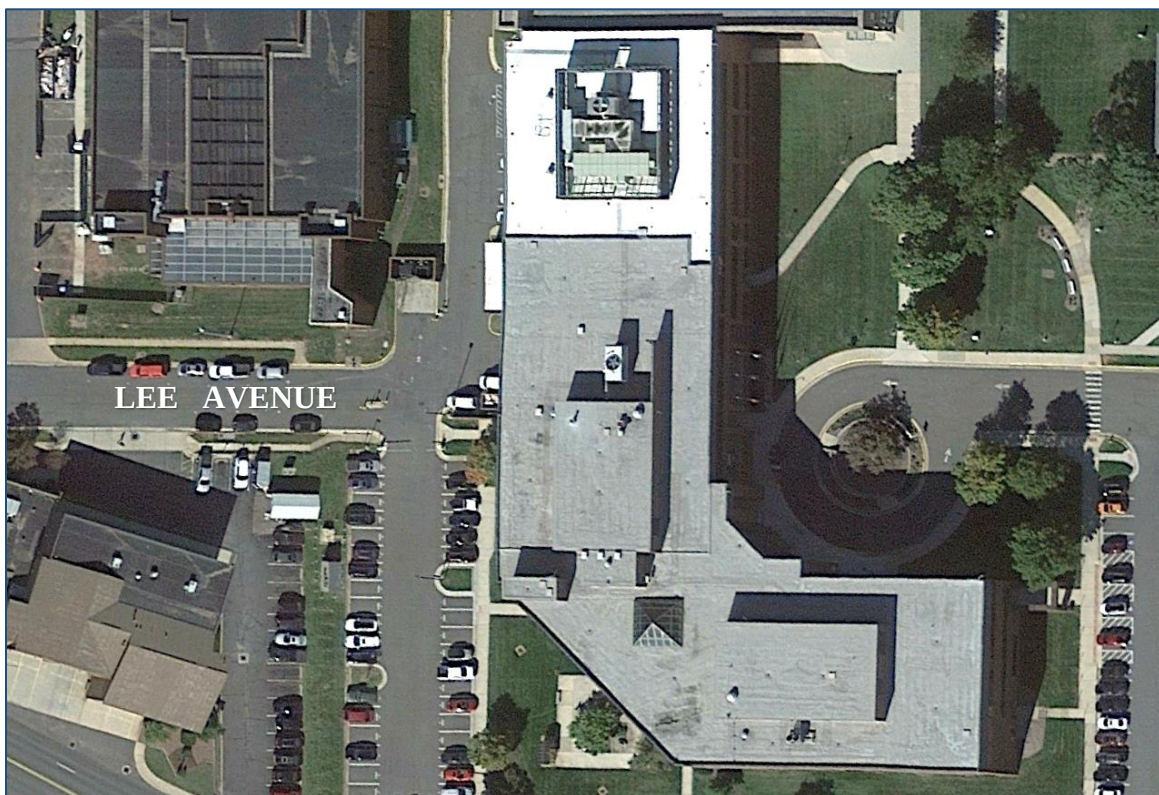


Figure 2





Figure 3



Figure 4





Figure 5



Figure 6



Figure 7



Figure 8





Figure 9



Figure 10





Figure 11

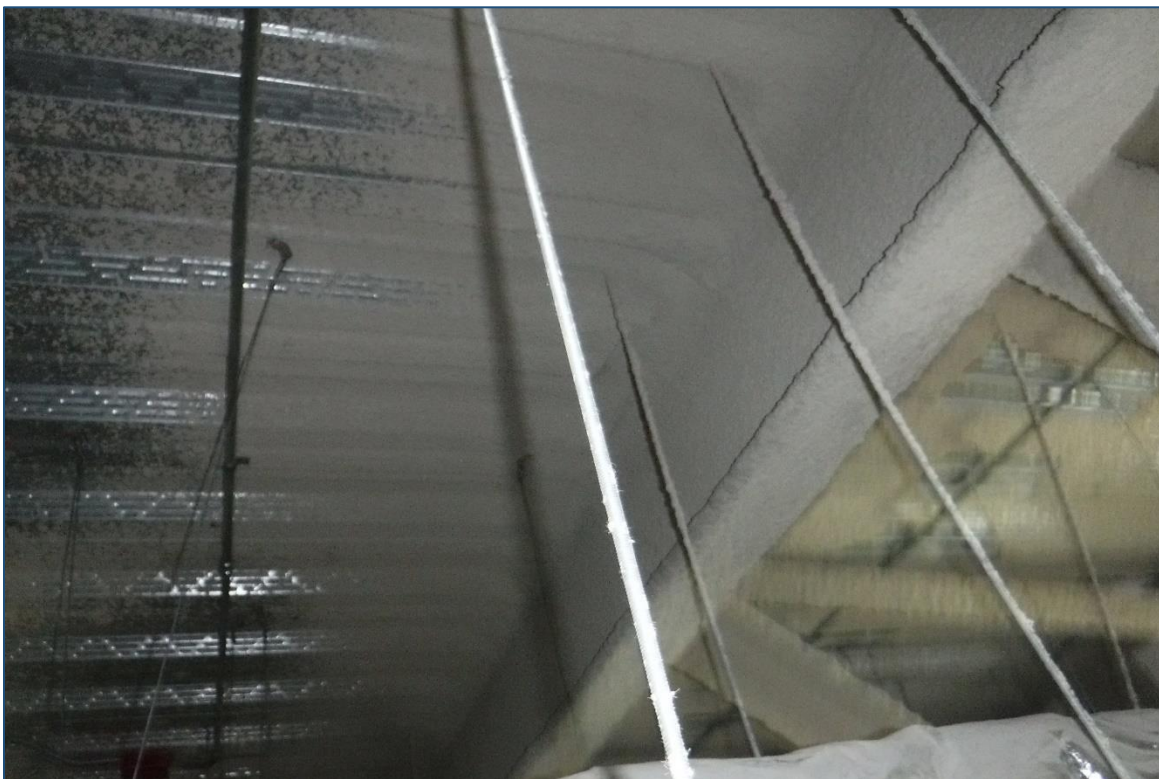


Figure 12



**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

November 10, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the Owens Operations Building  
3 County Complex Court in Woodbridge, Virginia  
**a+ei file # 23.059-8**

Dear Tim:

On 8/8/23, I visited Prince William County's operations building located at 3 County Complex Court in Woodbridge, Virginia, to examine the physical condition and configuration of the roofs of the east and west wings of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the northern side of County Complex Court and Prince William Parkway, as seen in Figure 1. Directions referenced in this report are based on the front of the building seen in Figure 3 facing nominally south, toward County Complex Court. The roofs of both wings are sloped as seen in Figure 2. The central area of the original wing is flat but it is occupied with roof-top HVAC equipment and not suitable for solar panel installation, as seen in Figures 2 and 4. It is understood that the solar collection system will be installed on the sloping roofs, using a frame system that is clamped to the standing seam roofing system.

**Sloping Roofs:** The sloping roofs are framed with cold-formed C10x2 steel rafters, as seen in Figure 6. These rafters are spaced sixteen (16) inches on center. These rafters span no greater than seventeen (17) feet. The rafters are supported by hip rafters, as seen in Figure 6. The hip rafters are fabricated from two (2) C14X2 cold-formed steel channels joined with welds at the flanges, to create a steel box beam.

The cold-formed steel rafters described above support type B, 22 gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than six (6) feet, seven (7) inches between joists. The decking supports standing-seam metal roofing, as seen in Figures 3 and 5. The standing seams are one and three-quarters (1-3/4) inches and spaced sixteen (16) inches on center.

**Flat Roof:** The flat section of roof which supports HVAC equipment can be seen in Figures 2 and 4. This section of roof is framed with steel beams which support open-web, steel joists, as seen in Figures 8, 9, 10, 11 and 12. These roof joists are fourteen (14) inches deep with two and one-half (2.5)-inch deep seats and are fabricated with steel angle chords and steel bar webs. These joists span up to twenty-two (22) feet. These

steel roof joists support type B, 22 gauge, structural steel decking. The steel decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than fifty (50) inches between joists.

**Roofing System:** The structure and deck of the flat roof support foam insulation board overlaid with elastomeric membrane roofing that is held down with precast concrete pavers on the edges and smooth, river stones in the field of the roofs.

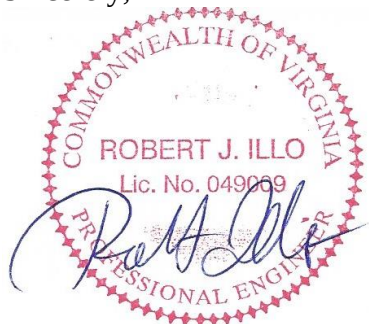
**Understanding of Conditions:** I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat, main roof area.
2. The panels will be mounted an angle to the plane of the roof.
3. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
4. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
5. Standing Seam Roof: The panels on the sloping, standing seam roofs will be supported by rails fastened to the standing-seam roof with S-5 clamps or equivalent.
6. The S-5 clamps will be spaced thirty-two (32) inches on center within six(6) feet of the edge of the roof and forty-eight (48) inches on center in the center of the roof.
7. Two (2) rails will support each row of panels.
8. Flat Roof: The panels on the flat roof will be mounted on a framework that is held to the flat roof with ballast blocks.
9. The panels, combined with ballast and frame mounting system, will impose approximately eight (8) pounds per square foot onto the portion of the roof directly under the panels.

**Conclusions:** Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer





Figure 1

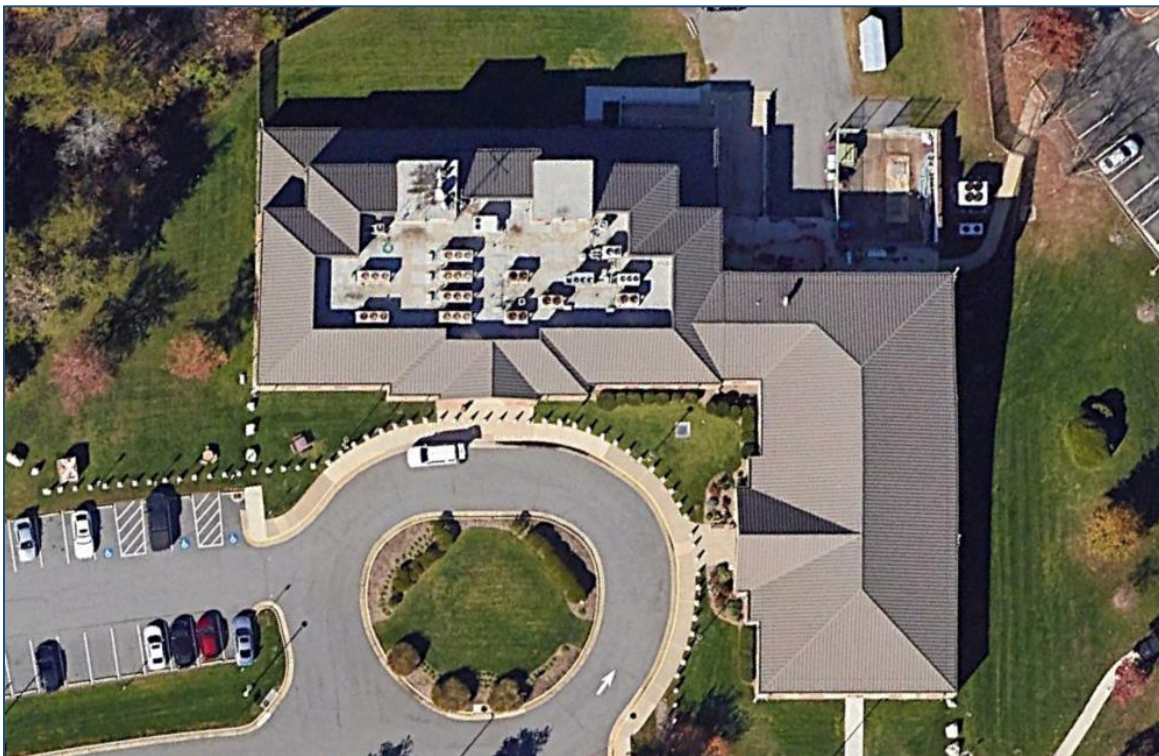


Figure 2





Figure 3



Figure 4



Figure 5

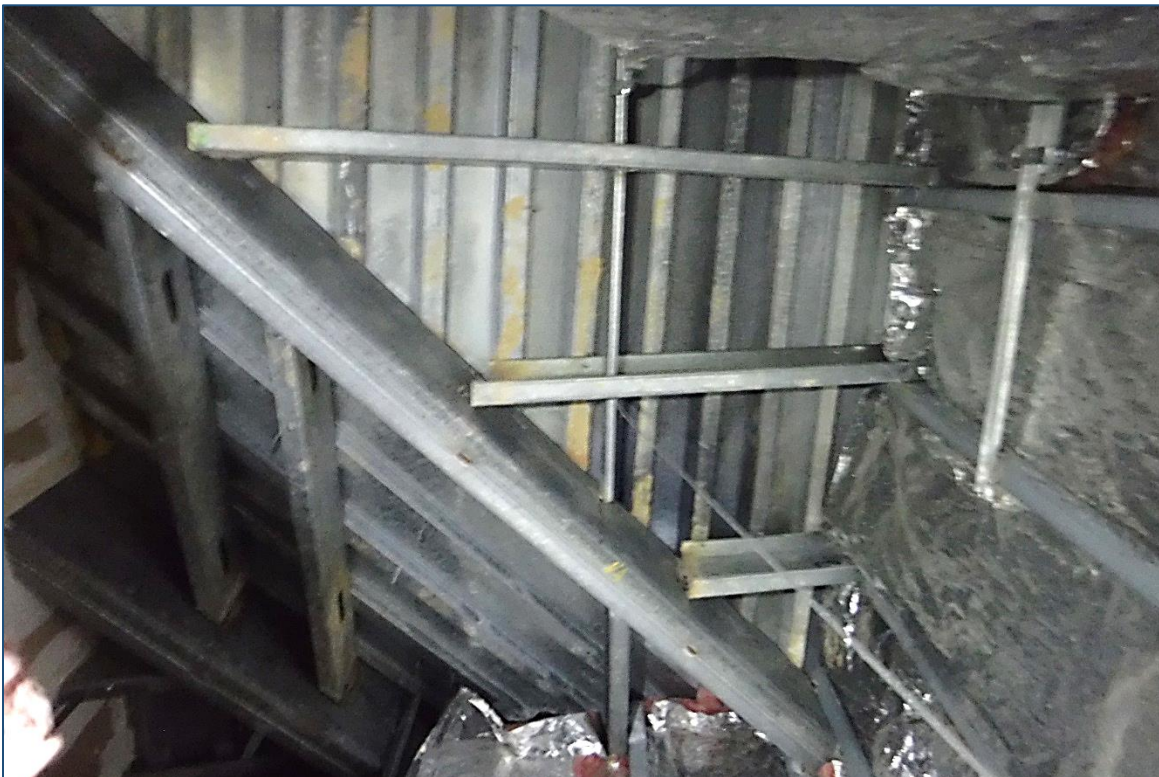


Figure 6





Figure 7

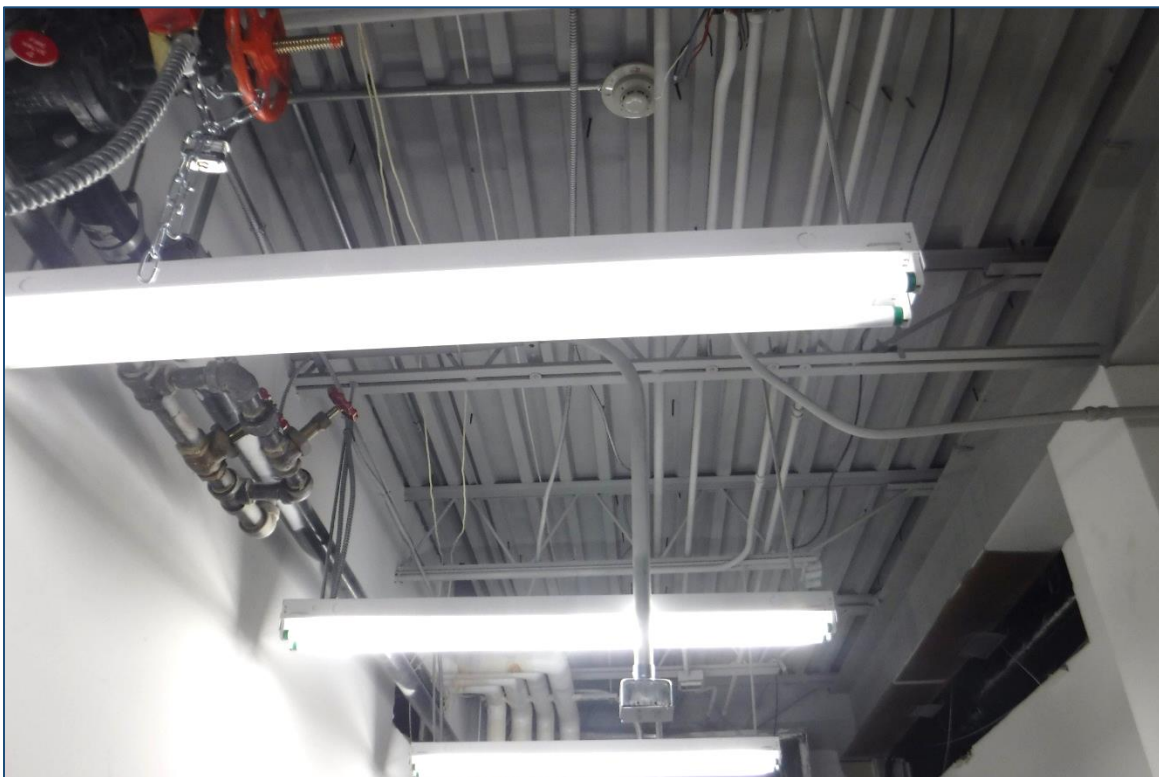


Figure 8



Figure 9



Figure 10



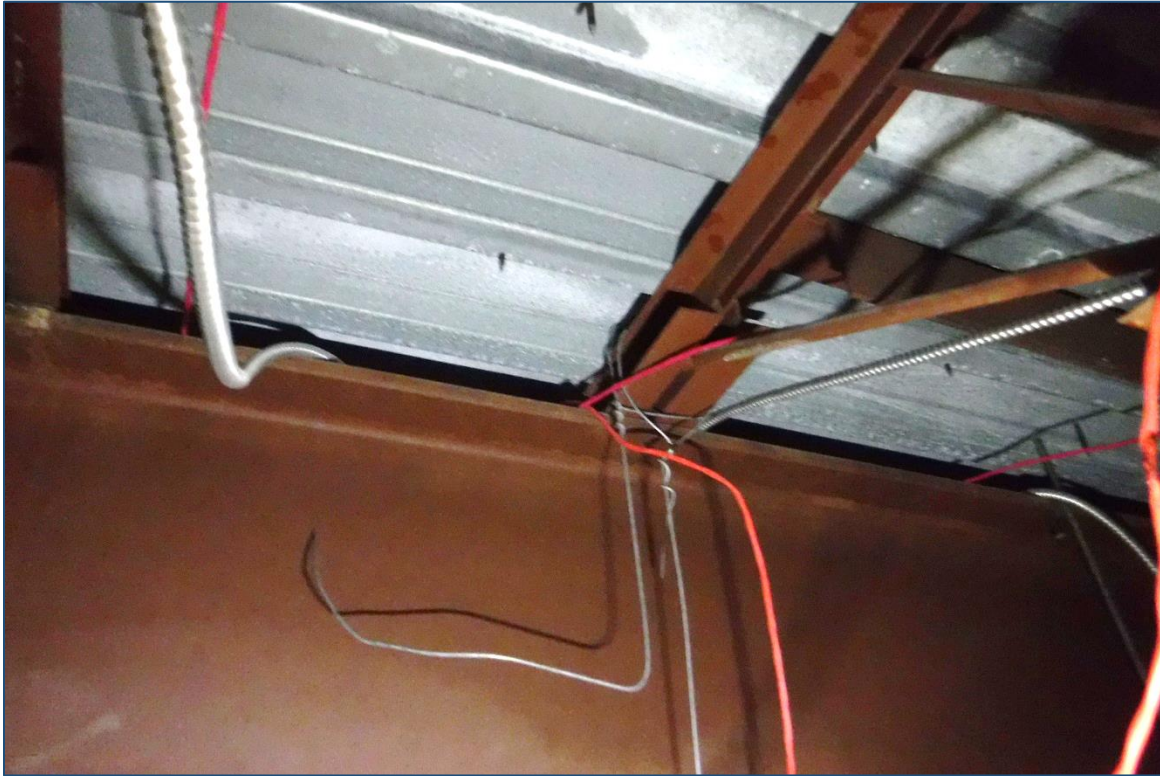


Figure 11

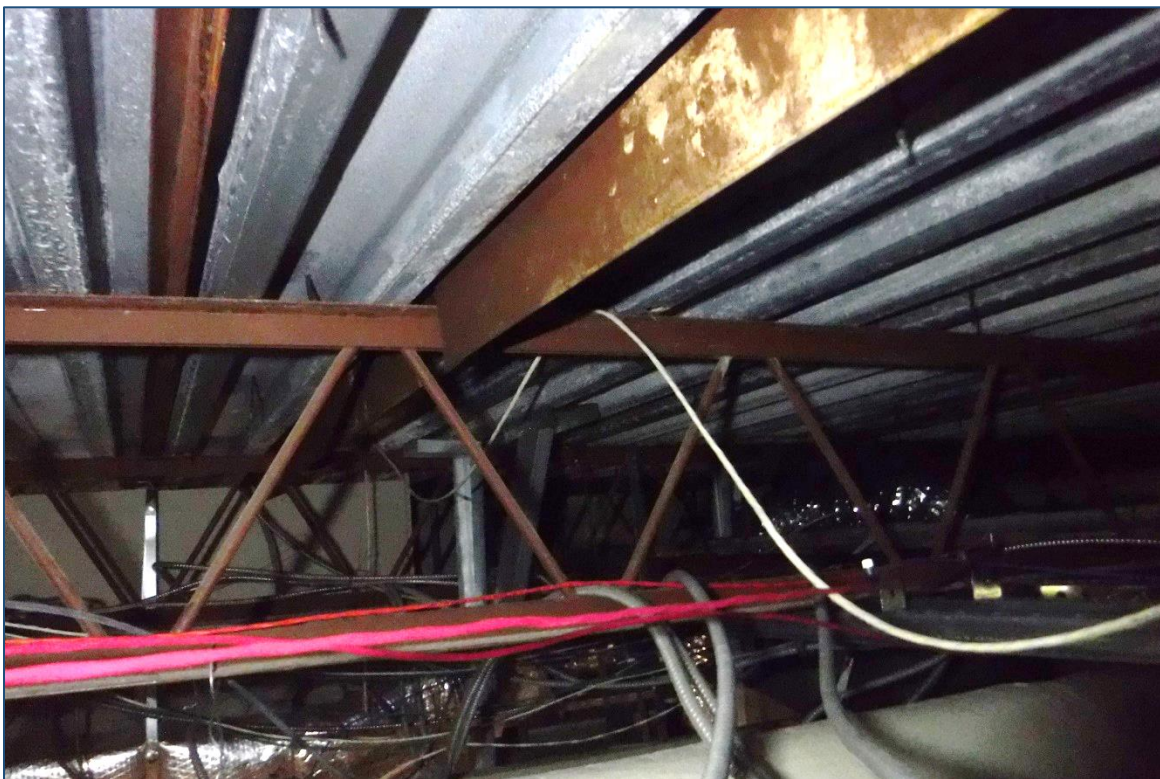


Figure 12





**Robert J. Illo, PE: Structural Engineer**

971 Corvair Road, Lancaster, PA 17601

717-575-1741 email: Rillo@aeiArchitect.com

August 18, 2023

Timothy Williams, Director of Growth  
ARM Group, LLC  
1129 West Governor Road  
Hershey, PA 17033

**RE:** Evaluation of Roof Structure to Support Solar Panels at the Western District Police Station  
8900 Freedom Center Boulevard in Manassas, Virginia  
**a+ei file # 23.059-3**

Dear Tim:

On 8/7/23, I visited Prince William County's building located at 8900 Freedom Center Boulevard in Manassas, Virginia, to examine the physical condition and configuration of the roof of the building to determine the structural capacity of the roof framing under normal live loads, dead loads and the super-imposed load of the solar collection system which you intend to install on the roof. This evaluation is limited to the structural system of the roof and does not include the compatibility of the electrical system with the solar collection system, the capability of the collection system to supply operational power needs, the structural capability of the framework that supports the panels above the roof or any other aspect of the proposed solar collection system.

The building is situated on the southern side of Freedom Center Boulevard, as seen in Figure 1. Directions referenced in this report are based on the front of the building, seen in Figure 3 facing nominally north, toward Freedom Center Boulevard. The roof is nominally flat. It is understood that the solar collection system will be installed on the roof, using a ballasted frame system.

The main, flat roof is framed with open-web, steel joists and hot-rolled steel beams, as seen in Figure 8. These roof joists are oriented north to south or from front to back of the building. The steel joists are supported by concrete masonry bearing walls and hot-rolled steel beams. The steel beams are supported by concrete masonry walls and steel columns.

The depths of the steel joists include twelve (12) inches, sixteen (16) inches, eighteen (18) inches and twenty (20) inches. The steel joists are fabricated with seat depths which vary from 2-1/2 inches to 4-1/4 inches. The joists are fabricated with steel angle chords and steel web members which include bars and angles. The spans of the steel joists vary from approximately twenty (20) feet to thirty (30) feet. The depths of the hot-rolled steel roof beams and girders include ten (10) inches, fourteen (14) inches, sixteen (16) inches, twenty (21) inches and twenty-four (24).

The roof joists described above support type B, 22-gauge, structural steel decking. The decking is formed with ribs that are one and one-half (1-1/2) inches deep and spaced six (6) inches on center. The decking spans no more than five (5) feet between joists. The decking supports foam insulation board and a single-ply TPO membrane roofing, as seen in Figures 2, 4 and 7.

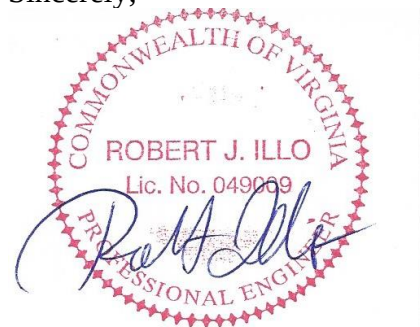
Understanding of Conditions: I have reviewed the materials which you have sent to me, describing the extent and details of the solar collection system which you intend to install on the roof. I understand that the following conditions apply to the installation:

1. The solar panels will be mounted on the flat, main roof area.
2. The panels will be mounted an angle to the plane of the roof.
3. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
4. The installer of the solar panels will seal all penetrations in the roofing material to ensure a weather-tight installation.
5. The panels will be mounted on a framework that is held to the roof with ballast blocks.
6. The panels, combined with ballast and frame mounting system, will impose approximately six (6) pounds per square foot onto the portion of the roof directly under the panels.
7. The installer of the solar panels will provide and install fasteners, and all mounting components above the roof structure to comply with all code-required structural loads.
8. If any components on the roof that require service or any part of a pathway to those components are located within ten (10) feet of an edge of a roof, a guard will be required in accordance with Chapter 10 of the International Building Code (IBC). It is understood that the solar panels do not require service, as they produce power throughout their lifetime without routine maintenance or service.

Conclusions: Based on my review of the materials which you have sent to me, and the understanding of conditions listed above in conjunction with my field inspection and analysis of the roof structure, I can conclude, with a reasonable degree of structural engineering certainty, that the roof structure as constructed and in its current condition is capable of supporting the solar collection panels in conformance to all applicable codes as described above without further modifications.

Thank you for allowing me the opportunity to provide you and your client with my services.

Sincerely,



Robert J. Illo, PE  
Structural Engineer



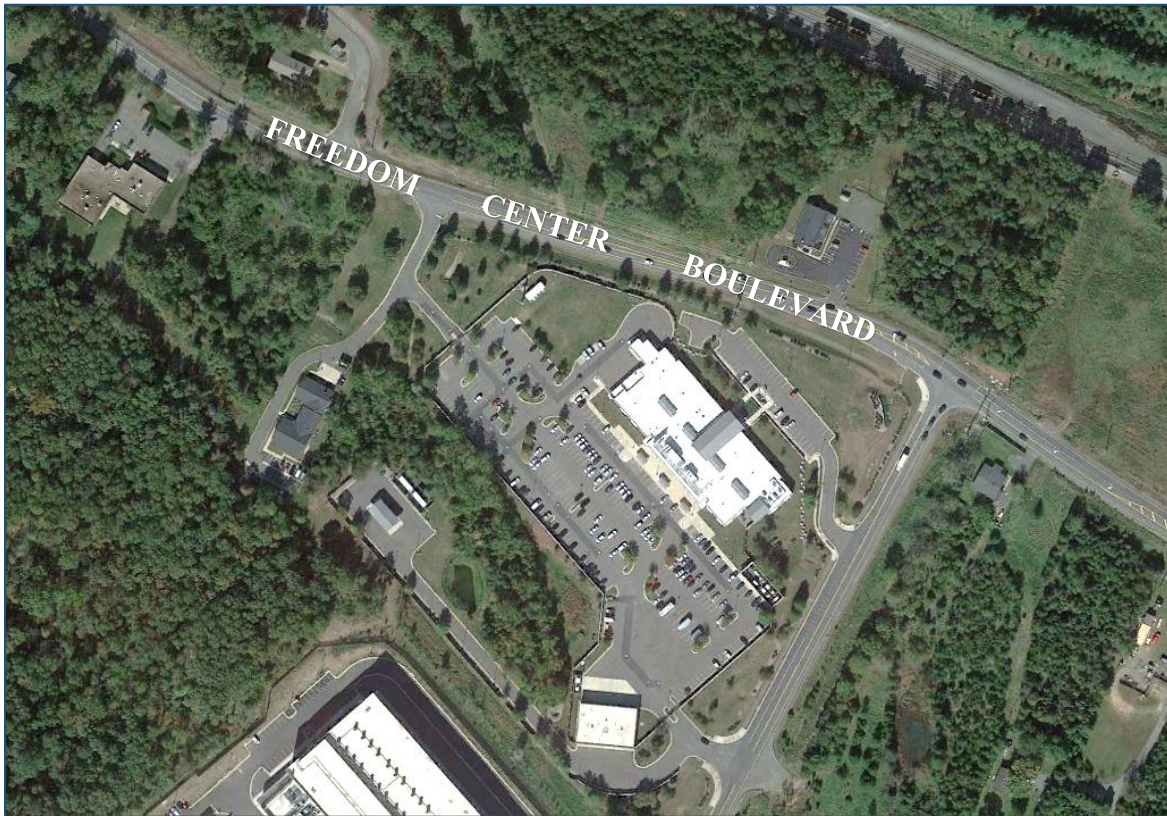


Figure 1

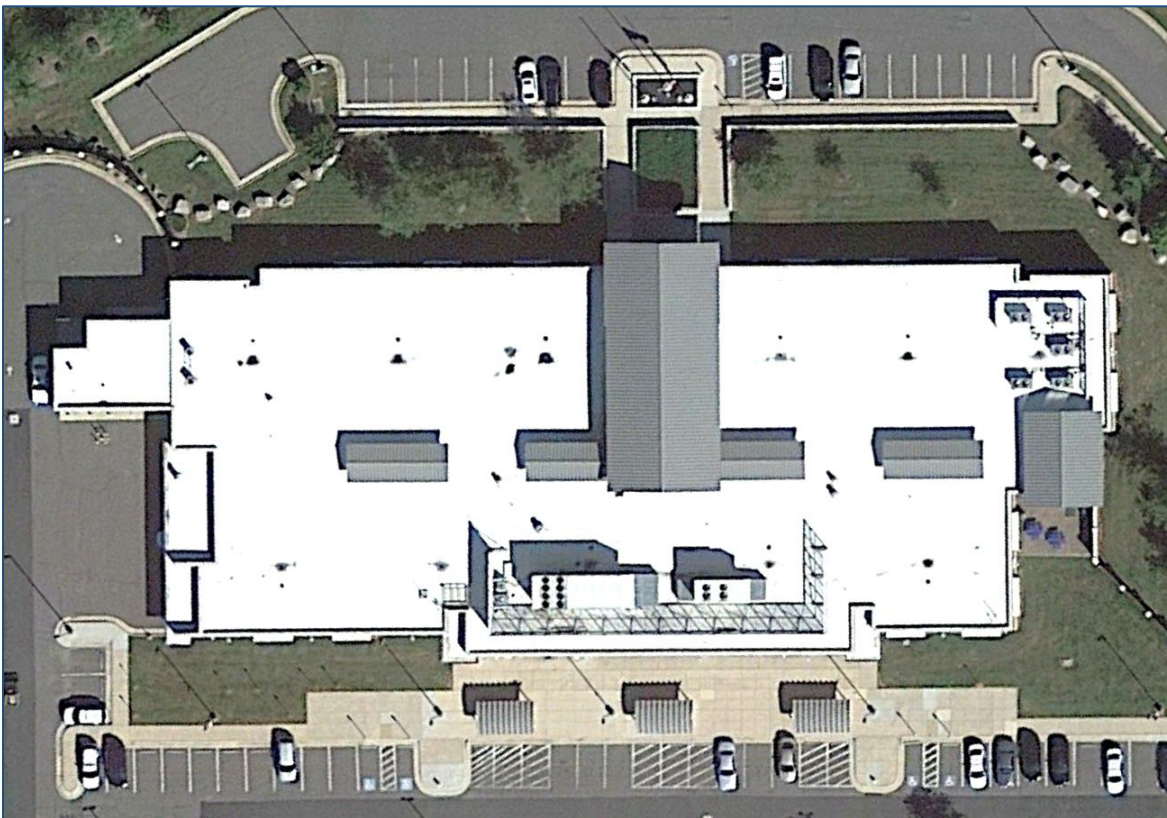


Figure 2





Figure 3



Figure 4



Figure 5



Figure 6





Figure 7



Figure 8