DESCRIPTION.
This work shall consist of furnishing and installing an integrated Solar Panel Power Supply System at the locations indicated in the contract documents and directions of the Engineer. In this Special Specification, the Solar Panel Power Supply System is located within the Ice Detection Stations or Icing Condition Warning Sign field location as specified in the plans. The Solar Panel Power Supply System shall supply power service for the field equipment where the utility power service is not available. The Solar Panel Power Supply System shall contain all of the components described in the material specification and shall be configured as indicated on the plans.

MATERIALS.
The Solar Panel Power Supply System shall employ solar, battery backed power for the assigned field equipment specified in the plans. The capacity of the solar panels, collector and battery, shall be sized by the contractor to ensure a minimum of 10 days of autonomy between charge cycles due to inclement weather. All equipment, including battery, regulator, and desulfanator, shall be installed in a suitably sized NEMA 3R enclosure for roadside mounting.

The specific components used in the construction of the Solar Panel Power Supply System shall meet, at a minimum, the requirements of the following subsections included under section 700, MATERIAL DETAILS.

- Castings, Forgings and Metals 715
- Traffic Signals 724

The Solar Panel Power Supply System shall be designed to operate continuously under ambient temperature conditions from -40°C (-40°F) to + 70°C (+160°F) for up to 24 hours per day with 10 days of battery backup and shall generally consist of the following:

1. One 123-125 watt solar panels with a mounting bracket for affixing the solar panel to the top of a 4½ NPS O.D.
2. Panel Pedestal pole. The mounting bracket shall be a slip-fitter type design to slip over the top of the pole.
3. Four 100 ampere-hour, 12 VDC sealed gel cell lead acid batteries.
4. One Automatic Sequencing Charger (ASC) and monitoring unit.
5. One toggle-type power switch for emergency shutoff.
6. One suitable size NEMA 3R weatherproof lockable cabinet with a brushed aluminum finish. The cabinet shall house the batteries, charger, solar panel controller and 300 mm free space available for ITS field interface equipment as specified in the plans. The cabinet shall be equipped with mounting brackets to house the electronics, toggle switch and batteries, and shall be furnished with mounting hardware to mount it to a 4½ NPS O. D. pedestal pole.
ITEM 680. 8229 03 M – SOLAR PANEL POWER SUPPLY SYSTEM

7. External conduit, wiring cable and conductors (as recommended by the company supplying the system) between the following:
   a. Solar panel to cabinet back panel.
   b. Batteries to cabinet back panel.
   c. Wiring between components in NEMA 3R cabinet.

The equipment installation shall include pre-setting of the equipment, solar panel direction optimization, and configuration of hardware components which shall allow automatic operation. The Contractor shall provide a fully operational assembly with all cabling and terminations matched to support the selected components.

The Contractor shall furnish, install, and test the Solar Panel Power Supply System, and ensure it meets the following specifications:

a) Solar Panels

**Electrical Characteristics**
- Maximum Power (Pmax) 125W
- Warranted minimum power 119W
- Voltage at Pmax (Vmp) 17.6V
- Current at Pmax (Imp) 7.1A
- Short circuit current (Isc) 7.54A
- Open circuit voltage (Voc) 22.1V
- Temperature coefficient of Isc (0.065±0.015)%/K
- Temperature coefficient of Voc -(80±10)mV/K
- Temperature coefficient of Pmax -(0.5±0.05)%/K
- NOCT (Air 20ºC; Sun 0.8kW/m2; wind speed 1m/s) 47±2ºC
- Maximum series fuse rating 15A (BP 3125S) / 20A (BP 3125U)
- Maximum system voltage 1000V (IEC 61215 rating)
- Maximum system voltage 1000V (TÜV Rheinland rating)

**Mechanical Characteristics**
- Dimensions – (Length: 1510mm, Width: 674mm, Depth: 50mm ) ± 5%
- Weight - 12.0 ± 5% kg
- Solar Cells - 36 cells (157mm x 157mm) in a 4x9 matrix connected in series
- Output Cables - RHW AWG# 12 (4mm2) cable with polarized weatherproof DC rated Multi-contact connectors; asymmetrical lengths - 900mm (-) and 800mm (+)
- Diodes - IntegraBus™ technology includes Schottky by-pass diodes integrated into the printed circuit board bus.
- Construction - Front: High-transmission 3mm (1/8th inch) tempered glass; Back: Tedlar; Encapsulant: EVA.
ITEM 680. 8229 03 M – SOLAR PANEL POWER SUPPLY SYSTEM

- Frame - Clear anodized aluminum alloy type 6063T6 Universal frame; Color: silver.
- The Electrical and Mechanical characteristics can have a variation of ± 5% by approval of the Engineer.

Quality and Safety
- Module power measurements calibrated to World Radiometric Reference through ESTI (European Solar Test Installation at Ispra, Italy)
- Manufactured in ISO 9001-certified factories; conforms to European Community Directives 89/33/EEC, 73/23/EEC, 93/68/EEC; certified to IEC 61215
- Listed by Underwriter’s Laboratories for electrical and fire safety (Class C fire rating)
- Approved by Factory Mutual Research in NEC Class 1, Division 2, Groups C & D hazardous locations (U)

Qualification Test Parameters
- Temperature cycling range -40ºC to +85ºC for 200 cycles
- Damp heat test 85ºC and 85% relative humidity for 1000h
- Front & rear static load test (eg: wind) 2400 Pa
- Front load test (eg: snow) 5400 Pa
- Hailstone impact test 25mm hail at 23m/s from 1m distance

b) Battery
Battery shall be industrial hardness applications type including Telecommunication applications. Battery shall be sealed, maintenance free, deep cycle, gel lead acid type 12V DC battery. The battery has valve-regulated design with self-discharge rate of less than 1% per month (at 68o F/25o C). The battery shall support the following functions:
- Maintenance-free
- Sealed no leak design
- Higher cranking amps
- Lower self discharge
- Vibration resistance
- Heavy duty, no corrosion terminals
- Dimensions: L (350 mm), W (180 mm), H (30 mm)
- Weight: less than 30 Kg.
ITEM 680. 8229 03 M – SOLAR PANEL POWER SUPPLY SYSTEM

- Nominated Voltage: 12 VDC
- Float Voltage: 13.5 V/Battery (2.25-2.29 V/cell) nominal
- Minimum Float Life: 10 year float life at 25°C (77°F)
- Terminal: FLAG or as approved by the Engineer
- Capacity: min. 27 AH for 20 hour rate
- Minimum Discharge: 340 for 15 Amps output
- All wiring and interconnects use #10AWG wire for less than 10% losses due to voltage drop.
- Non-hazardous cargo for ground, sea and air transportation

c) Panel Controller/Battery Charger

The Panel controller shall provide fully operational control of the battery charging process and solar panel effects. The controller shall support the following functions:

- Prevents the solar panels from damaging a battery by overcharging it too much
- Prevents the batteries from discharging back through the solar panel at night.
- Optimizes the charging of the battery bank
- Uses MPPT (Maximum Power Point Technology) or equivalent as approved by the Engineer.
- Supports 30 Amp 12/24 Volt Rating
- Output Serves as 20 Amp Load Controller or 2 Amp Battery Charger.
- Network interface for coordinates multiple panel controllers and shares Battery Temperature Sensor and remote monitoring display
- Remote Display capability to provide complete charge control and battery system monitoring, to eliminate the need for a separate battery monitor device
- 3-Stage charge control with filtered PWM output and auto/manual equalization or equivalent method, as approved by the Engineer, for improving battery performance and life
- Durable powder coat finish and conformal coated electronics resist corrosion
- Full 24 Month Limited Warranty

Panel Controller Specification:

- Output Current Rating: 30 Amp maximum, automatic 30 Amp current limit
- Nominal Battery Voltage: 12/24VDC
ITEM 680. 8229 03 M – SOLAR PANEL POWER SUPPLY SYSTEM

- Input Voltage: 57VDC maximum
- Power Consumption: less than 1 watt (Power Conversion Efficiency more than 96%)
- Charge Algorithm: 3-stage Bulk/Acceptance/Float (Full charge can be based on net charge current matched to battery amp-hours)
- Float Voltage: 13.4VDC (range 13.2 – 13.8VDC)
- Equalization Voltage: 15.4VDC • automatic or manual operation
- Output Function: Single output field configurable as either: 20 Amp load controller or 2 Amp auxiliary battery charger
- Aux. Battery charge: 2 Amp typical, same charge voltage as primary battery
- Load Control: 20 Amp maximum; ON @ =12.6VDC / OFF @ =11.5VDC
- Temperature Compensation: Optional temperature sensor adjusts charge voltage set points based on measured battery temperature, -5.00 mV/°C/cell correction factor, the temperature sensor range -60 to +80°C
- Communication: Input/Output ammeters 35.0A ±0.50%, capability for multiple Panel controllers to set up and operate as a single machine, share a common battery temperature sensor.
- Remote Monitoring: A twisted pair cable interface with no special communication hardware. RS-232 interface for remote computer control and displaying.

Environmental: -40 to 40°C, 10 to 90% RH non-condensing.

CONSTRUCTION DETAILS:
The Contractor shall prepare and submit the Solar Panel Power Supply System shop drawing 30 days prior to the installation of the Solar Panel Power Supply System to the Engineer for review and approval. The shop drawing shall include but not limited to:

- Details of the complete installation of the system and all components to be supplied
- Details of all connections between the Solar Panel Power Supply System components
- Instruction sheets and wiring diagrams for the equipment to be installed.
- The manufacture specifications and catalog cuts and parts lists,
- The Manufacture installation and operation guides.

Particular care shall be given to the interconnection of all of the components and the cabling.

The Engineer reserves the right to inspect and/or factory test any completed assemblies prior to delivery of the material to the project site. Any deviances from these
ITEM 680.8229 03 M – SOLAR PANEL POWER SUPPLY SYSTEM

specifications that are identified during such testing shall be corrected prior to shipment of the assembly to the project site.

The Solar Panel Power Supply System shall be installed in the field location as indicated in the plans. The power output of the Solar Panel Power Supply System shall feed to the specified field equipment as indicated in the plan and direction of the Engineer.

The Solar Panel Power Supply System connections to the field equipment shall be completed using a sufficient length of cable that shall reach the equipment with one meter of slack. The Solar Panel Power Supply System configuration and setup shall be set to assure connection and electric power delivery to the field equipment as indicated in the plan.

The Solar Panel Power Supply System Operational Test shall be performed for each Solar Panel Power Supply System. This test shall be performed during a minimum of 14 days. The testing period shall include a minimum of three days solar panel disconnected from the panel controller. The Solar Panel Power Supply System Operational Test shall verify the Solar Panel Power Supply System is fully operative and can supply specified power without misrepresentation. The Contractor shall provide a Solar Panel Power Supply System Operational Test schedule and Checklist to the Engineer for review and approval prior to the test. The Contractor shall secure the services of a company field advisor for installation and testing of the Solar Panel Power Supply System.

All equipment shall be located and mounted as detailed in the plans and as directed by the Engineer.

All components to be supplied under this specification shall be warranted for a minimum of two years from the conclusion of the Solar Panel Power Supply System Acceptance Test. This warranty shall include repair and/or replacement of all failed components via a factory authorized depot repair service. All items sent to the depot for repair shall be returned within two weeks of the date of receipt at the facility. The depot location shall be in the United States. Repairs shall not require more than two weeks from date of receipt and the provider of the warranty shall be responsible for all return shipping costs. The depot maintainer designated for each component shall be authorized by the original manufacturer to supply this service.

A warranty certificate shall be supplied for each component from the designated depot repair site indicating the start and end dates of the warranty. The certificate shall be supplied at the conclusion of the Solar Panel Power Supply System Acceptance Test or end of the construction of the project which ever come last and shall be for a minimum of two years after that point. The certificate shall name NYSDOT as the recipient of the service. NYSDOT shall have the right to transfer this service to other private parties.
who may be contracted to perform overall maintenance of the facility. The Solar Panel Power Supply System Acceptance Test shall be approved after 6 months of the Solar Panel Power Supply System Operational Test without any failure.

Two copies of all operations and maintenance manuals for each Solar Panel Power Supply shall be delivered for each unit installed.

**METHOD OF MEASUREMENT:**
The Solar Panel Power Supply bid item will be paid for as each completed unit is furnished, along with associated materials, installed, made fully operational, tested, and accepted.

**BASIS OF PAYMENT:**
The unit price for the Solar Panel Power Supply System shall include the cost of furnishing all equipment, materials, testing, documentation, and labor as detailed in the contract documents.

Progress payments will be made in the following percentages of the bid price for each item after each milestone is reached.

- Approval of Shop Drawings - 10%
- Delivery of Assembly to the Job Site - 30%
- Operational Test - 30%
- System Acceptance Test - 30%