1.1.1 PROJECT NOTES:

1.1.2 THIS PHOTOVOLTAIC (PV) SYSTEM SHALL COMPLY WITH THE NATIONAL ELECTRIC CODE (NEC) ARTICLE, ALL MANUFACTURERS’ LISTING AND INSTALLATION INSTRUCTIONS, AND THE RELEVANT CODES AS SPECIFIED BY THE AUTHORITY HAVING JURISDICTION’S (AHJ) APPLICABLE CODES.

1.1.3 THE UTILITY INTERCONNECTION APPLICATION MUST BE APPROVED AND PV SYSTEM INSPECTED PRIOR TO PARALLEL OPERATION.

1.1.4 GROUND FAULT DETECTION AND INTERRUPTION (GFDI) DEVICE IS INTEGRATED WITH THE MICROINVERTER IN ACCORDANCE WITH NEC 690.5(A).

1.1.5 ALL PV SYSTEM COMPONENTS; MODULES, UTILITY-INTERACTIVE INVERTERS, AND SOURCE CIRCUIT COMBINER BOXES ARE IDENTIFIED AND LISTED FOR USE IN PHOTOVOLTAIC SYSTEMS AS REQUIRED BY NEC 690.4 & NEC 690.60:

- PV MODULES: UL1703, IEC61730, AND IEC61215, AND NFPA 70 CLASS C
- INVERTERS: UL 1741 CERTIFIED, IEEE 1547, 929, 519
- COMBINER BOX(ES): UL 1703 OR UL 1741 ACCESSORY

1.1.6 MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC. IF UNAVAILABLE, MAX DC VOLTAGE CALCULATED ACCORDING TO NEC 690.7.

1.1.7 ALL INVERTERS, PHOTOVOLTAIC MODULES, PHOTOVOLTAIC PANELS, AND SOURCE CIRCUIT COMBINES INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER 690.4 (D). SHALL BE INSTALLED ACCORDING TO ANY INSTRUCTIONS FROM LISTING OR LABELING [NEC 110.3].

1.1.8 ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE. IF EXPOSED TO SUNLIGHT, IT SHALL BE UV RESISTANT. ALL PLAQUES AND SIGNAGE WILL BE INSTALLED AS REQUIRED BY THENEC AND AHJ.

1.2.1 SCOPE OF WORK:

1.2.2 PRIME CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND SPECIFICATIONS OF THE GRID-TIED PHOTOVOLTAIC SYSTEM RETROFIT. PRIME CONTRACTOR WILL BE RESPONSIBLE FOR COLLECTING EXISTING ONSITE REQUIREMENTS TO DESIGN, SPECIFY, AND INSTALL THE EXTERIOR ROOF-MOUNTED PORTION OF THE PHOTOVOLTAIC SYSTEMS DETAILED IN THIS DOCUMENT.

1.3.1 WORK INCLUDES:

1.3.2 PV ROOF ATTACHMENTS - ECOLIBRIUM ECOX

1.3.3 PV RACKING SYSTEM INSTALLATION - RAILLESS

1.3.4 PV MODULE AND INVERTER INSTALLATION - Heliene 60M-320/ ENPHASE M250-60-2LL-S22 (-ZC) (-NA) (240V)

1.3.5 PV EQUIPMENT GROUNDING

1.3.6 PV SYSTEM WIRING TO A ROOF-MOUNTED JUNCTION BOX

1.3.7 PV LOAD CENTERS (IF INCLUDED)

1.3.8 PV METERING/MONITORING (IF INCLUDED)

1.3.9 PV DISCONNECTS

1.3.10 PV GROUNDING ELECTRODE & BONDING TO (E) GEC

1.3.11 PV FINAL COMMISSIONING

1.3.12 (E) ELECTRICAL EQUIPMENT RETROFIT FOR PV

1.3.13 SIGNAGE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE
EXEMPT FROM ADDITIONAL FASTENING [NEC 705.12 (D)(5)].

UTILITY-INTERACTIVE INVERTER OUTPUT IS

PHASE B OR L2- RED, OR OTHER CONVENTION IF THREE PHASE

PHASE A OR L1- BLACK

REVISIONS

2.4.5 DC WIRING LIMITED TO MODULE FOOTPRINT. MICROINVERTER WIRING

2.4.6 AC CONDUCTORS COLORED OR MARKED AS FOLLOWS:

2.7.7 SUPPLY SIDE TAP INTERCONNECTION ACCORDING TO NEC 705.12 (A) WITH

2.7.6 FEEDER TAP INTERCONECTION (LOAD SIDE) ACCORDING TO NEC 705.12 (B) WITH

2.5.10 THE GROUNDING ELECTRODE SYSTEM COMPLIES WITH NEC 690.47 AND NEC

2.5.8 GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLORED

2.5.5 EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC

2.5.4 METAL PARTS OF MODULE FRAMES, MODULE RACKING, AND ENCLOSURES

2.2.5 ADDITIONAL AC DISCONNECT(S) SHALL BE PROVIDED WHERE THE INVERTER

2.4.4 VOLTAGE DROP LIMITED TO 1.5%.

2.4.3 CONDUCTORS SIZED ACCORDING TO NEC 690.8, NEC 690.7.

2.4.2 ALL CONDUIT AND WIRE WILL BE LISTED AND APPROVED FOR THEIR PURPOSE.

2.3.2 RACKING SYSTEM & PV ARRAY WILL BE INSTALLED ACCORDING TO

2.3.1 LOCATION OF LABEL ACCORDING TO AHJ.

2.2.7 ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR

2.2.5 ADDITIONAL AC DISCONNECT(S) SHALL BE PROVIDED WHERE THE INVERTER

2.2.4 VOLTAGE DROP OF SYSTEM IS TO BE NOTED AT ALL TIMES.

2.1.5 PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND

2.1.4 GROUNDING CONDUCTORS SHALL BE CONNECTED TO THE PV SYSTEM ACCORDING TO NEC

2.1.3 THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS

2.1.2 A LADDER WILL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA

2.0.1.1 ALL EQUIPMENT LOCATED OUTSIDE OF THE BUILDING OR STRUCTURE.

1.9.1 ALL PARTS OF THE SYSTEM THAT ARE NOT ELECTRICALLY CONNECTED TO THE

1.8.1.1 ANY PRESENT CONDUIT IN PLACE SHALL BE MARKED ORANGE [NEC 110.15].

1.7.1.1 CONDUIT AND LUGS ARE TO BE MARKED ORANGE [NEC 110.15].

1.6.1.1 GROUNDING EARTH CONDUCTOR (GE) WILL BE MARKED GREEN IF #4 AWG OR LARGER [NEC 250.119].

1.5.1.1 SPAN DISTANCE SPECIFIED BY THE RACKING MANUFACTURER.

1.4.1.1 RAPID SHUTDOWN OF ENERGIZED CONDUCTORS BEYOND 10 FT OF PV ARRAY

1.3.1.1 DISCONNECTS TO BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL, BE

1.2.1.1 LOCATION OF LABEL ACCORDING TO AHJ.

1.1.1 ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR
GENERAL NOTES
1. FIELD VERIFY ALL MEASUREMENTS
2. ITEMS BELOW MAY NOT BE ON THIS PAGE

ENGINEER OF RECORD
11.30.2016

DESIGN BY:

PAPER SIZE: 11" x 17" (ANSI B)

CONTRACTOR
LIC. NO.: 
DATE:
CHECKED BY:
REVISIONS

HIC. NO.: 
ELE. NO.: 

ARRAY 1 - 3.64 kW
[N] MODULES
TILT: 20 DEGREES
ROOF PITCH: 4:12
AZIMUTH: 178 DEGREES

ARRAY 2 - 3.64 kW
[N] MODULES
TILT: 35 DEGREES
ROOF PITCH: 8:12
AZIMUTH: 178 DEGREES

ARRAY 3 - 0.28 kW
[N] MODULES
TILT: 35 DEGREES
ROOF PITCH: 8:12
AZIMUTH: 88 DEGREES

ARRAY 4 - 0.28 kW
[N] MODULES
TILT: 35 DEGREES
ROOF PITCH: 8:12
AZIMUTH: 268 DEGREES

A-102.00

ELECTRICAL PLAN
(SHEET 4)

A-102.00
SOLAR ATTACHMENT PLAN

ENGINEER OF RECORD

RESIDENCE

CONTRACTOR

SOLAR ATTACHMENT

AUTRIZED USE OF THIS DRAWING SET WITHOUT WRITTEN PERMISSION FROM CONTRACTOR IS IN VIOLATION OF U.S. COPYRIGHT LAWS AND WILL BE SUBJECT TO CIVIL DAMAGES AND PROSECUTIONS.


DESIGN BY:

PAPER SIZE: 11" x 17" (ANSI B)

NEW PV SYSTEM: 7.84 kWp

APN:

PHONE:

ADDRESS:

SOLAR ATTACHMENT PLAN

FLUSH MOUNTED SOLAR MODULES ATTACHED TO ROOF SURFACE (SEE SHEET S-501 FOR MOUNTING DETAILS)

FLUSH MOUNTED SOLAR MODULES

Sheet 5 of 5

3'-3"

5'-5"

22'-11"

5'-5"
## Bill of Materials

<table>
<thead>
<tr>
<th>Category</th>
<th>Make and Model</th>
<th>QTY</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODULE</strong></td>
<td>Heliene 60M-320</td>
<td>28</td>
<td>PIECES</td>
<td>1</td>
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<tr>
<td></td>
<td>W, 60 CELLS, MONOCRYSTALLINE SILICON</td>
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<tr>
<td><strong>INVERTER</strong></td>
<td>ENPHASE M250-60-2LL-S22-IG</td>
<td>28</td>
<td>PIECES</td>
<td>1</td>
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<tr>
<td></td>
<td>ENPHASE ENGAGE (TM) TRUNK CABLE FOR LANDSCAPE LAYOUT</td>
<td>2</td>
<td>PIECES</td>
<td>1</td>
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<tr>
<td></td>
<td>ENPHASE ENGAGE (TM) BRANCH TERMINATOR</td>
<td>1</td>
<td>PIECE</td>
<td>1</td>
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<td></td>
<td>ENPHASE ENGAGE (TM) WATERTIGHT SEALING CAP</td>
<td>1</td>
<td>BUNDLE</td>
<td>1</td>
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<tr>
<td><strong>WIRING</strong></td>
<td>18 AWG THWN-2, COPPER, WHITE (NEUTRAL)</td>
<td>110 FEET</td>
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<td>18 AWG THWN-2, COPPER, BLACK (LINE 1)</td>
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<td></td>
<td>18 AWG THWN-2, COPPER, RED (LINE 2)</td>
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<td><strong>OCPD</strong></td>
<td>CIRCUIT BREAKER, 20A, 240VAC</td>
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<td>PIECES</td>
<td>1</td>
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<tr>
<td></td>
<td>CIRCUIT BREAKER, 35A, 240VAC</td>
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<td>PIECE</td>
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### Module Specifications

<table>
<thead>
<tr>
<th>REF.</th>
<th>QTY.</th>
<th>MAKE AND MODEL</th>
<th>PMAX PTC</th>
<th>ISC</th>
<th>IMP</th>
<th>VOC</th>
<th>VMP</th>
<th>TEMP. COEFF. OF VOC</th>
<th>FUSE RATING</th>
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</thead>
<tbody>
<tr>
<td>PM1-28</td>
<td>28</td>
<td>Heliene 60M-320</td>
<td>280W</td>
<td>254W</td>
<td>9.43A</td>
<td>8.89A</td>
<td>38.5V</td>
<td>-0.119V/°C (-0.31%/°C)</td>
<td>15A</td>
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### Inverter Specifications

<table>
<thead>
<tr>
<th>REF.</th>
<th>QTY.</th>
<th>MAKE AND MODEL AC VOLTAGE GROUND MAX OCPD RATING</th>
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</thead>
<tbody>
<tr>
<td>I1-28</td>
<td>28</td>
<td>ENPHASE M250-60-2LL-S22 (-ZC) (-NA) (240V) FLOATING</td>
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<tr>
<td></td>
<td></td>
<td>1A</td>
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### Disconnect Specifications

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<tr>
<th>REF.</th>
<th>QTY.</th>
<th>MAKE AND MODEL</th>
<th>RATED CURRENT</th>
<th>MAX RATED VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>1</td>
<td>SQUARE D DU222RB OR EQUIV.</td>
<td>60A</td>
<td>240VAC</td>
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</tbody>
</table>

### OCPD Specifications

<table>
<thead>
<tr>
<th>REF.</th>
<th>QTY.</th>
<th>RATED CURRENT</th>
<th>MAX VOLTAGE</th>
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</thead>
<tbody>
<tr>
<td>CB1-2</td>
<td>2</td>
<td>20A</td>
<td>240V</td>
</tr>
<tr>
<td>CB3</td>
<td>1</td>
<td>35A</td>
<td>240V</td>
</tr>
</tbody>
</table>

### System Summary

- **Branch #1:**
  - Inverters per branch: 15
  - Max AC current: 15A
  - Max AC output power: 3,750W
- **Branch #2:**
  - Inverters per branch: 13
  - Max AC current: 13A
  - Max AC output power: 3,250W

- **Array STC power:** 7,840W
- **Array PTC power:** 7,109W
- **Max AC current:** 28A
- **Max AC power:** 7,000W
- **Derated (CEC) AC power:** 6,860W

### Design Temperatures

- **ASHRAE EXTREME LOW:**
  - -16°C (3°F), SOURCE: MCGUIRE AFB (KWRI) 40.02°, -74.6°
- **ASHRAE 2% HIGH:**
  - 33°C (91°F), SOURCE: MCGUIRE AFB (KWRI) 40.02°, -74.6°
WARNING: PHOTOVOLTAIC POWER SOURCE INTERACTIVE PHOTOVOLTAIC SYSTEM CONNECTED FROM ROOF MOUNTED SOLAR ARRAYS WITH SAFETY DISCONNECT AS SHOWN! FROM ROOF MOUNTED SOLAR ARRAYS WITH POWER TO THE BUILDING IS ALSO SUPPLIED. CAUTION!

1.1 LABELING REQUIREMENTS BASED ON THE 2014 NATIONAL ELECTRICAL CODE, INTERNATIONAL FIRE CODE 605.11, OSHA STANDARD 1910.145, ANSI Z535
1.2 MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
1.3 LABELS TO BE OF SUFFICIENCY DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
1.4 LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8" AND PERMANENTLY AFFIXED.
1.5 ALERTING WORDS TO BE COLOR CODED. "DANGER" WILL HAVE RED BACKGROUND; "WARNING" WILL HAVE ORANGE BACKGROUND; "CAUTION" WILL HAVE YELLOW BACKGROUND. [ANSI Z535]

PLAQUE AT POINT OF INTERCONNECTION; LABEL, SUCH AS LABEL 5 OR LABEL 6 MUST IDENTIFY PHOTOVOLTAIC SYSTEM [NEC 705.12(D)(4)]
1. Sheet Keynotes

2. Roof Material: Asphalt Shingle

3. Roof Structure: Knee Wall

4. Attachment Type: Ecolibrium Ecox

5. Module Manufacturer: Heliene

6. Module Model: 60M-320

7. Module Length: 5'-5"

8. Module Width: 3'-3"

9. Module Weight: 40.1 LBS.

10. See Sheet A-2 for Dimension(s)

11. Min. Fire Offset: No Fire Code Enforced

12. Rafter Spacing: 16 IN. O.C.

13. Rafter Size: 2X6 Nominal

14. Lag Bolt Diameter: 3/8 IN.

15. Lag Bolt Embedment: 4 IN.

16. Total # of Attachments: 53

17. Total Area: 508.2 SQ. FT.

18. Total Weight: 1122.8 LBS.

19. Weight Per Attachment: 21.18 LBS.

20. Distributed Load: 2.2 PSF.


22. Landscape: 26 IN., Portrait: 33 IN.

23. Standoff Staggering: No

24. Max. Rafter Span: 13 FT.

25. Module Clearance: 3 IN. Min., 6 IN. Max.

26. Field Verify All Measurements

27. General Notes

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Engineer of Record: 11.30.2016
Design By:
### Table: Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage Range (V)</th>
<th>Maximum DC Input (W)</th>
<th>Efficiency</th>
<th>MPPT</th>
<th>Minimum MPPT Voltage (V)</th>
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<tbody>
<tr>
<td>M1</td>
<td>150-180</td>
<td>2000</td>
<td>92%</td>
<td>No</td>
<td>100</td>
</tr>
<tr>
<td>M2</td>
<td>180-220</td>
<td>2500</td>
<td>90%</td>
<td>Yes</td>
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<tr>
<td>M3</td>
<td>220-250</td>
<td>3000</td>
<td>91%</td>
<td>Yes</td>
<td>160</td>
</tr>
</tbody>
</table>

**Optimized Integration with HD-Wave Technology**

- Improved electronic design for reduced energy loss
- Enhanced safety features
- Intuitive user interface for easy setup and operation
- Advanced monitoring capabilities

**Single Phase Inverters**

- Suitable for North America
- Enables smooth transition to renewable energy systems
- Efficient power conversion for various applications

---

**Resource Document**

- Reference:
  - Title: Example Resource
  - Author: Unknown
  - Publication date: [Date]

---

**Contractor**

- Name: [Contractor Name]
- Address: [Address]
- Phone: [Phone Number]

---

**Engineer of Record**

- Name: [Engineer Name]
- Address: [Address]
- Phone: [Phone Number]
Testing & Certification

Benefits of Concrete Loading

Fiber-to-Load Ratio

Installation Features

The strongest Attachment in Solar