LIST OF DRAWINGS

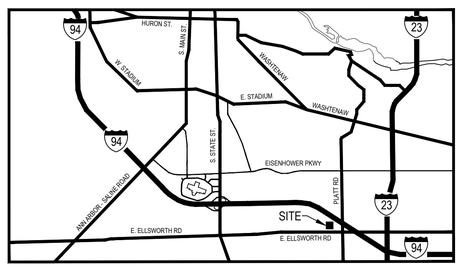
NUM	TITLE	REV	DATE: 3-22-2024	11-13-2024	11-22-2024	1-10-2025
			ISSUED: 50% REVIEW	INTERCONNECT	90% REVIEW	BID REVIEW
	GENERAL					
G001	COVER SHEET		o		o	
G002	GENERAL NOTES & SYMBOLS		o		o	
	CIVIL					
C101	SITE PLAN		o		o	o
C102	CONSTRUCTION PLAN		o		o	o
	ELECTRICAL					
E101	ELECTRICAL SITE PLAN		o	o	o	o
E102	AC POWER PLAN		o	o	o	o
E103	DC POWER PLAN				o	o
E104	GROUNDING PLAN				o	o
E201	ELEVATIONS & SECTIONS - CANOPY				o	o
E202	ELEVATIONS & PLAN DETAILS - SERVICE RACK				o	o
E501	ELECTRICAL DETAILS				o	o
E601	ONE-LINE DIAGRAM			o	o	o
E701	LABELS AND PLACARDS				o	o
E702	SPECIFICATIONS				o	o
E801	DATA SHEETS				o	o
E802	DATA SHEETS				o	o

NOVA PROJECT #23-11-1168
50.0 kW AC, 1000 V DC (MAX.), 49.1 kW DC SOLAR PHOTOVOLTAIC SYSTEM

BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

NOVA PROJECT MANAGER: JEFF ECKHOUT



N

SITE LOCATION MAP

NO SCALE

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Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	JE
11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

BICENTENNIAL PARK
2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

COVER SHEET

PROJECT NUMBER: 23-11-1168-PRK

DRAWN BY	SHEET NUMBER
GAK	G001
SCALE: NONE	
SHEET SIZE: 22x34	

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Bicentennial Park\Drawings\23111168-PRK-G001.dwg Date: Jan 10 2025; 8:43AM User: george kachadoorian

STANDARD METHODS OF NOTATION

SHEET KEY NOTES (TAGS)

ITEM DESIGNATION
(E601 WIRE AND CONDUIT SCHEDULE)

REVISION / ADDENDUM TAG

DETAIL NUMBER
(ELEVATION TAG)
SHEET WHERE FOUND

DETAIL NUMBER
(SECTION CUT TAG)
SHEET WHERE FOUND

DETAIL NUMBER
SHEET WHERE FOUND

(BUBBLE DETAIL)

ENLARGEMENT AREA

DETAIL NUMBER / NAME
(DRAWING TITLE & IDENTIFICATION)
SHEET WHERE FOUND / SCALE

SPOT ELEVATION

MATCH LINE

CENTER LINE

LIGHT LINE INDICATES EXISTING WORK

HEAVY LINE INDICATES NEW WORK

DASHED LINE INDICATES DEMOLITION

UNDERGROUND CONDUIT AND WIRING

GRAPHIC SCALE

NORTH ARROW

NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.

LINES & WIRES

WIRING & CONDUITS

WIRING UNDERGROUND

GROUND WIRE

CONDUIT DOWN

CONDUIT UP

GAS LINE

SILT FENCE

CHAIN LINK FENCE

DETAIL SYMBOLS

PV STRING DESIGNATION

MODULE

SWITCHGEAR

INVERTER

PANEL BOARD

DISCONNECT

METER

TRANSFORMER

CT CABINET

COMBINER

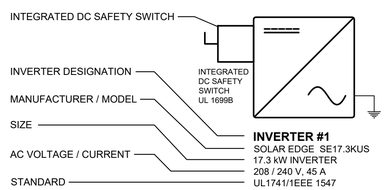
DUPLEX RECEPTACLE

EV CHARGING STATION

EV CHARGING ONLY (PARKING SPACE)

COPPER CLAD GROUND ROD

INVERTER ANNOTATION (EXAMPLE)



PV ARRAY ANNOTATION PLAN

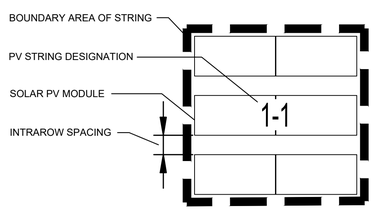


DIAGRAM SYMBOLS

PV STRING DESIGNATION

MODULE (ONE - LINE DIAGRAM)

OPTIMIZER

RAPID SHUTDOWN

PANELBOARD (PB) W/ MAIN BREAKER

DISCONNECT

FUSED DISCONNECT

DISCONNECT SWITCH

TRANSFORMER

FUSE

CIRCUIT BREAKER

CURRENT TRANSFORMER (CTs)

POTENTIAL TRANSFORMER (PTs)

BUS BAR

WYE TRANSFORMER CIRCUIT CONNECTION

DELTA TRANSFORMER CIRCUIT CONNECTION

GROUND

INVERTER

DISCONNECT

METER

COMBINER

SURGE PROTECTIVE DEVICE (SPD)

DUPLEX RECEPTACLE

GFCI DUPLEX RECEPTACLE

GFCI WITH IN USE COVER
OUTDOOR RATED WEATHER RESISTANT

EV CHARGING STATION

UTILITY POLE TO GRID

CIRCUIT HOMERUN W/ STRING IDENTIFIER

AREA DIVIDER LINE (E601 ONE-LINE DIAGRAM)

ABBREVIATION LIST

ABBREVIATION	DESCRIPTION
A	AMPERES
A.F.F.	ABOVE FINISH FLOOR
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CT	CURRENT TRANSFORMER
DEMO	DEMOLITION
DIM	DIMENSION
DISC	DISCONNECT
DP	DISTRIBUTION PANEL
DWG	DRAWING
ELEC	ELECTRICAL
EM / EMER	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
EVCS	ELECTRIC VEHICLE CHARGING STATION
EWC	ELECTRIC WATER COOLER / DRINKING FOUNTAIN
EX / EXIST	EXISTING
FLR	FLOOR
G / GRD / EG	GROUND
GFCI / GFI	GROUND FAULT CIRCUIT INTERRUPTER
HP	HORSEPOWER
HV	HIGH VOLTAGE
HZ	HERTZ
INV	INVERTER
IG	ISOLATED GROUND
JB	JUNCTION BOX
kV	KILOVOLT
kVA	KILOVOLT- AMPERES
kW	KILOWATT
kWH	KILOWATT - HOURS
LTG	LIGHTING
LP	LIGHTING PANEL
MAX	MAXIMUM
MPPT	MAXIMUM POWER POINT TRACKING
MDP	MAIN DISTRIBUTION PANEL
MECH	MECHANICAL
MIN	MINIMUM
MISC	MISCELLANEOUS
MTD	MOUNTED
NEC	NATIONAL ELECTRICAL CODE
N/A	NOT APPLICABLE
NIC	NOT IN CONTRACT
N/L	NIGHT LIGHT
NTS	NOT TO SCALE
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
PNL	PANEL
P	POLE
PH	PHASE
PV	PHOTOVOLTAIC
PT	POTENTIAL TRANSFORMER
PDP	POWER DISTRIBUTION PANEL
RSD	RAPID SHUTDOWN DEVICE
RECEPT	RECEPTACLE
REQ'D	REQUIRED
RSC	RIGID STEEL CONDUIT
SW	SWITCH
SWBD	SWITCH BOARD
SWGR	SWITCH GEAR
TELCOM	TELECOMMUNICATIONS
TP	TAMPERPROOF
TYP	TYPICAL
U.O.N.	UNLESS OTHERWISE NOTED
V	VOLTS
V.I.F.	VERIFY IN FIELD
W	WATTS
WP	WEATHERPROOF
XFMR	TRANSFORMER

STANDARD MOUNTING HEIGHTS

DESCRIPTION	HEIGHT
PANELBOARD	6'-0" A.F.F. TO TOP OF BOX
RECEPTACLE OUTLET	16" A.F.F. TO BOTTOM OF BOX. (MIN.) 48" A.F.F. TO TOP OF BOX (MAX.)
CONDUIT IN TRENCH	18" BELOW GRADE - TO TOP OF CONDIUT (MIN.)

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1-10-2025	BID REVIEW	JE

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CERTIFICATION

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RGM	

CITY OF ANN ARBOR
SOLAR FACILITIES

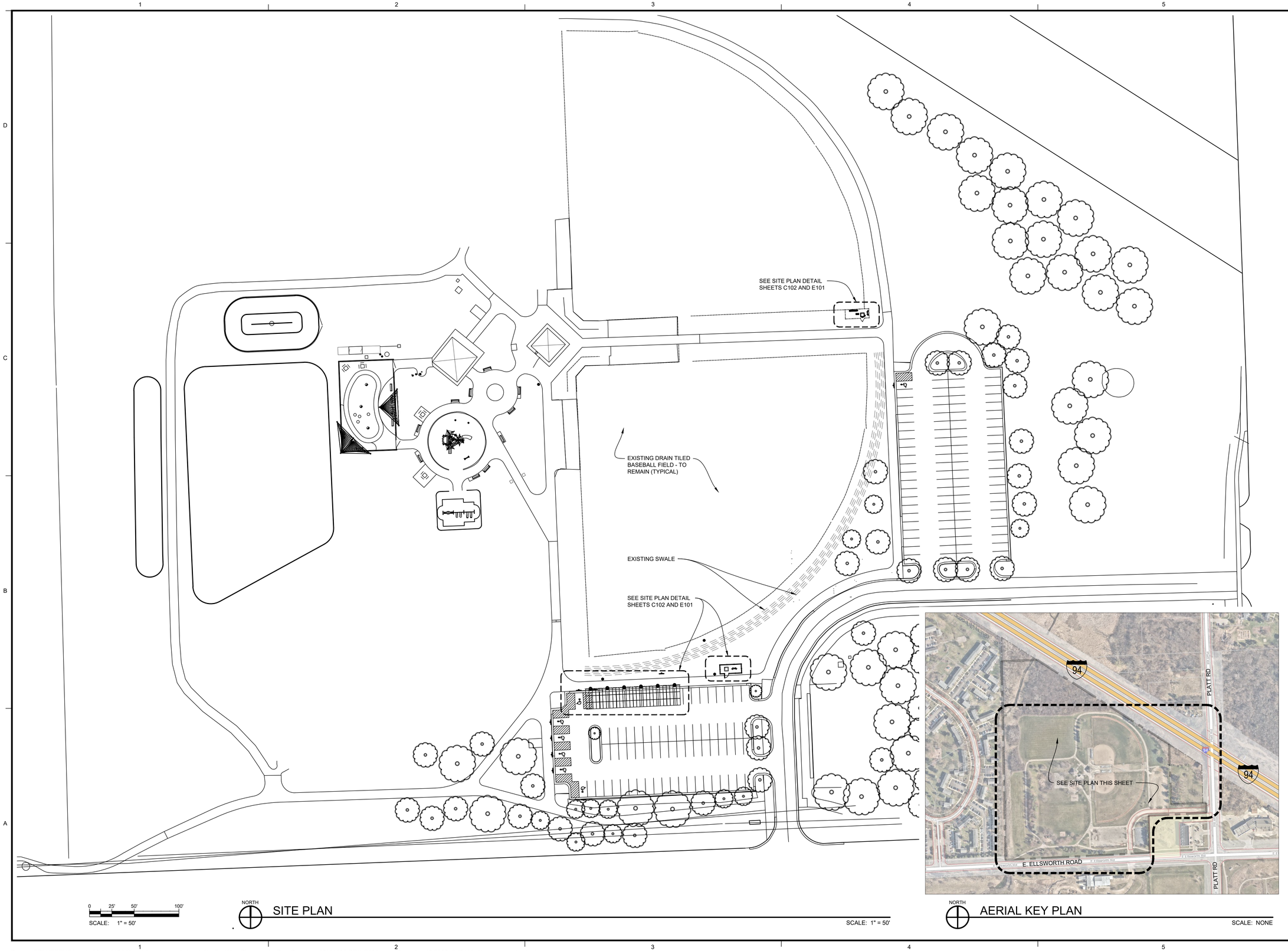
BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

GENERAL NOTES
& SYMBOLS

PROJECT NUMBER	23-11-1168-PRK
DRAWN BY	GAK, BD
SCALE	NONE
SHEET SIZE	22x34
SHEET NUMBER	G002



0 25' 50' 100'
SCALE: 1" = 50'

NORTH

SITE PLAN

SCALE: 1" = 50'

NORTH

AERIAL KEY PLAN

SCALE: NONE

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SOLAR FACILITIES

BICENTENNIAL PARK

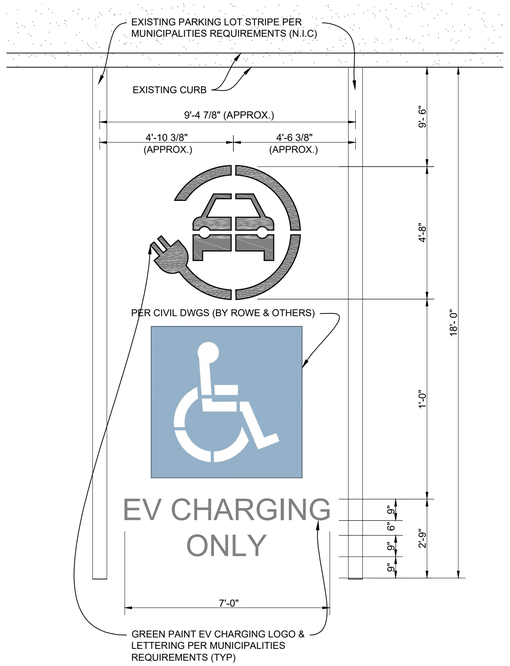
2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

SITE PLAN

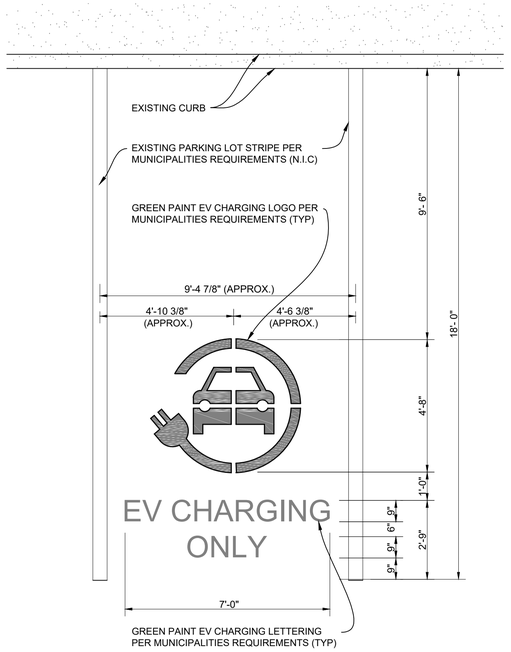
PROJECT NUMBER	23-11-1168-PRK
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	C101

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Bicentennial Park\Drawings\23111168-PRK-C101.dwg Date: Jan 10 2025; 8:48AM User: george kachadoorian



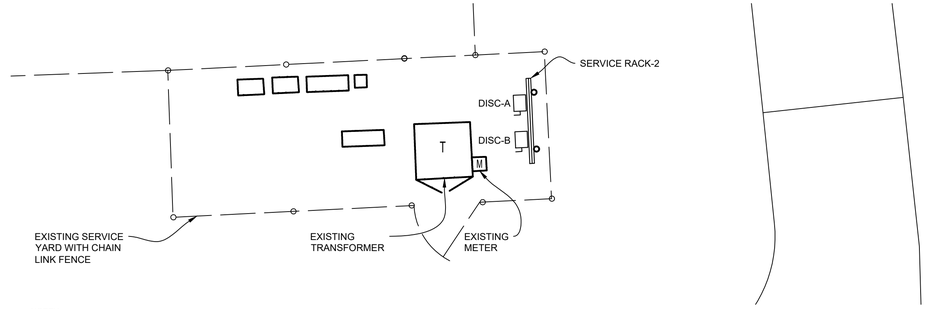
2 C102 BF EV PARKING SPACE DETAIL

SCALE : 3/8" = 1 - 0"



1 C102 EV PARKING SPACE DETAIL

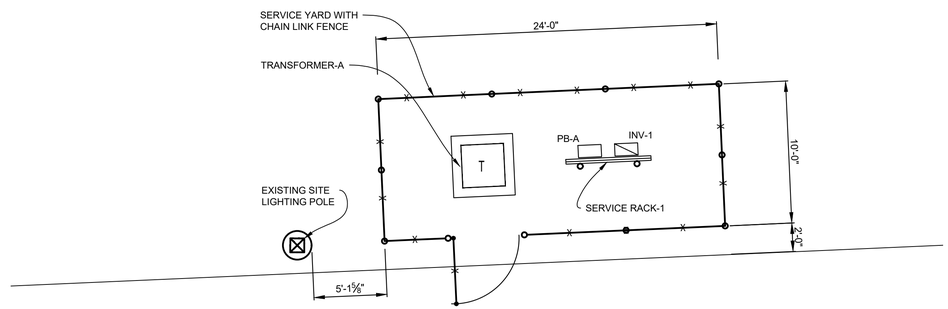
SCALE : 3/8" = 1 - 0"



NORTH

CONSTRUCTION PLAN - AT EXISTING SERVICE YARD

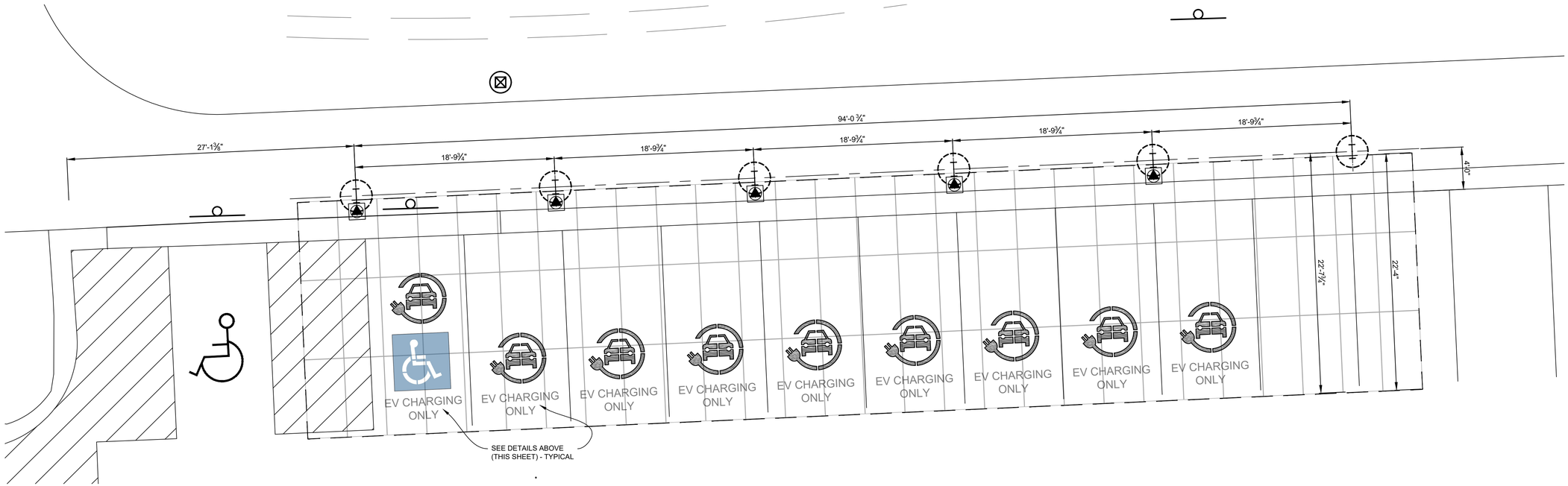
SCALE: 3/16" = 1'-0"



NORTH

CONSTRUCTION PLAN - AT SERVICE YARD

SCALE: 3/16" = 1'-0"



NORTH

CONSTRUCTION PLAN - AT CANOPY

SCALE: 3/16" = 1'-0"

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11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

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CITY OF ANN ARBOR
SOLAR FACILITIES

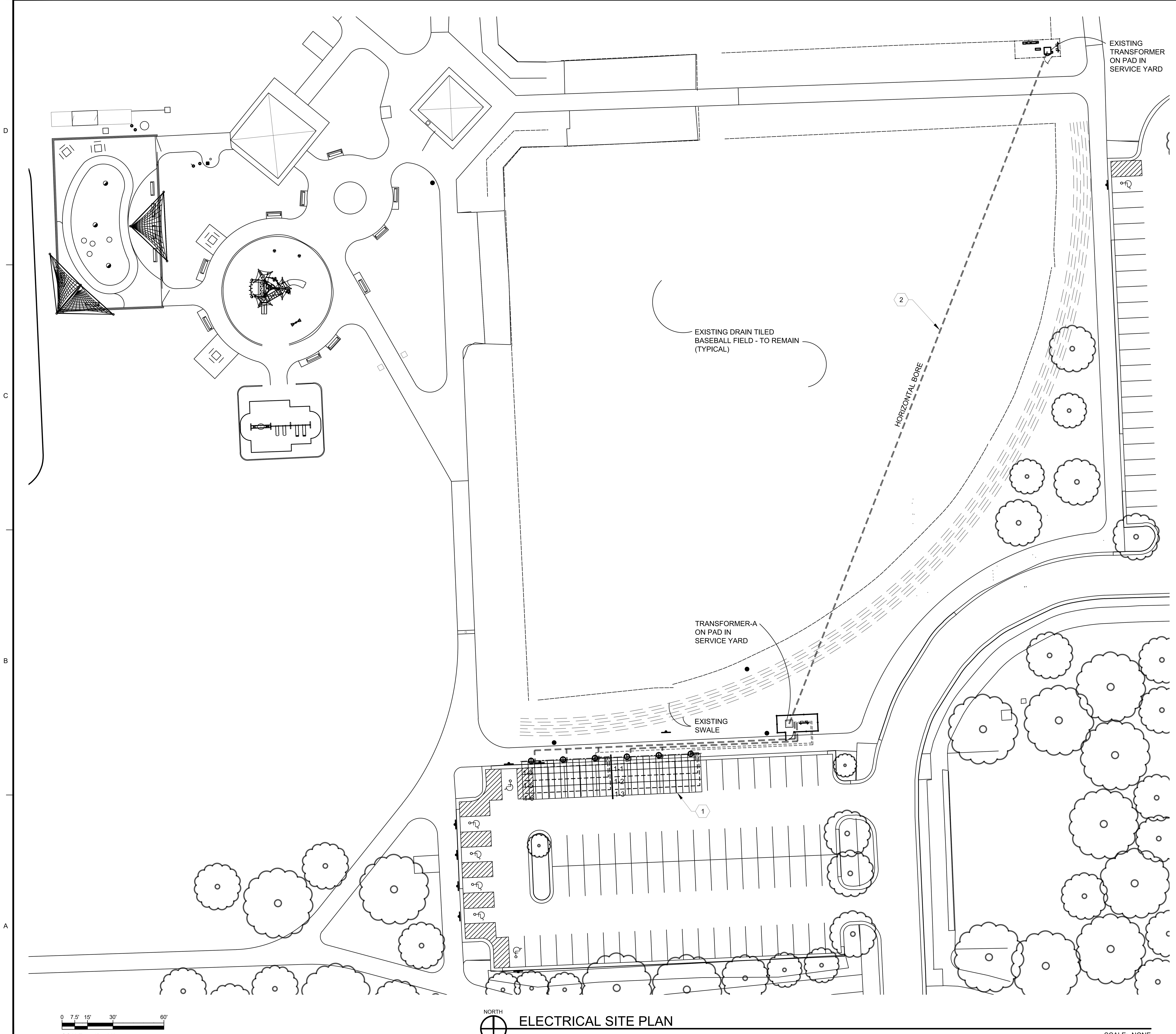
BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

CONSTRUCTION PLAN

PROJECT NUMBER	
23-11-1168-PRK	
DRAWN BY: GAK	SHEET NUMBER: C102
SCALE: AS NOTED	
SHEET SIZE: 22x34	



ELECTRICAL SITE PLAN

SCALE: NONE

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), ALL BUILDING CODES AND ALL APPICABLE CODES AND STANDARDS.
2. FIELD ADJUST ARRAY LAYOUT BASED ON SITE OBSTRUCTIONS.
3. SITE PLAN BASED ON INFORMATION PROVIDED BY OWNER.
4. CONDUIT FILL TO BE LESS THAT 40%
5. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
6. REFER TO SHEET E501 FOR TRENCH DETAIL.
7. CONTRACTOR TO FIELD VERIFY THAT ALL LISTED GROUNDING ELECTRODES ARE PRESENT AND PROPERLY TERMINATED ON SITE.
8. CONTRACTOR TO VERIFY THAT ALL CIRCUIT BREAKERS ARE SUITABLE FOR BACKFEED.

SHEET KEY NOTES

1. 50 kW AC CANOPY PV SOLAR ARRAY, WITH 5 DUAL PORT EV CHARGERS
2. FIELD ADJUST HORIZONTAL BORE BASED ON UNDERGROUND UTILITIES AND OBSTRUCTIONS

PV SYSTEM DESCRIPTION

ARRAY TYPE :	SOLAR PV CANOPY
AZIMUTH :	177.45 DEGREES
TILT:	7 DEGREES

LEGEND

1-1 (STRING #, INVERTER #)	PV STRING DESIGNATION
	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
T	TRANSFORMER
	EV CHARGING STATION
	AC WIRING
	AC WIRING UNDERGROUND
	DC WIRING UNDERGROUND
	DC POWER
	CHAIN LINK FENCE

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DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	JE
11-13-2024	INTERCONNECT	JE
11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

REVISED

NO.	DATE	DESCRIPTION	APPVD.

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CITY OF ANN ARBOR
SOLAR FACILITIES

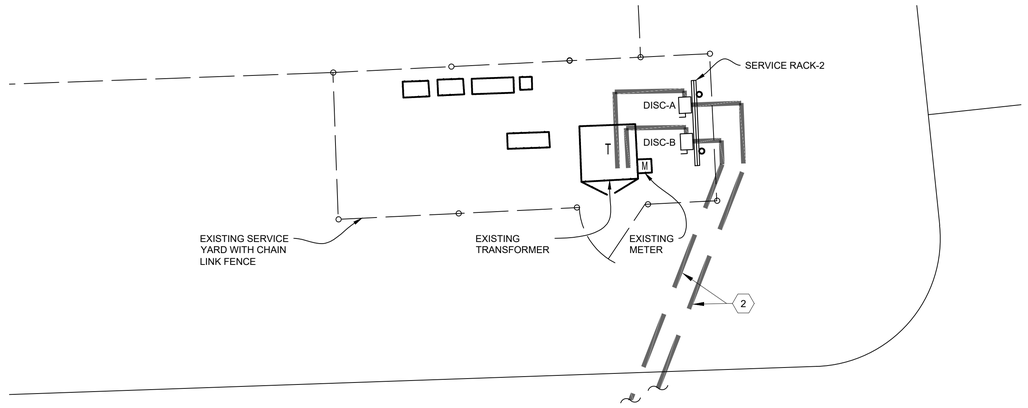
BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

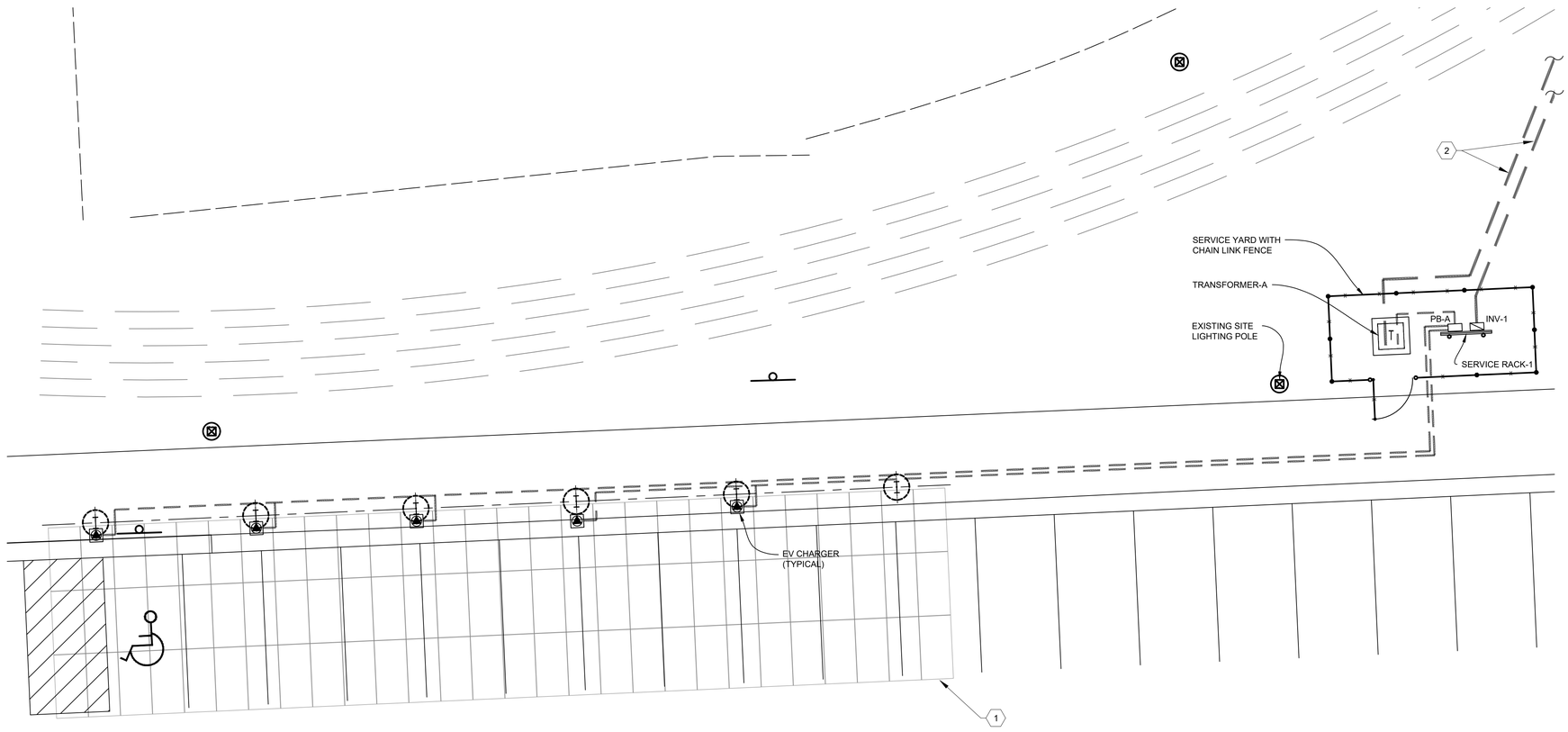
ELECTRICAL SITE PLAN

PROJECT NUMBER: 23-11-1168-PRK
DRAWN BY: GAK
SCALE: AS NOTED
SHEET SIZE: 22x34
SHEET NUMBER: E101



2 E102 AC POWER PLAN - CANOPIES

SCALE: NONE



1 E102 AC POWER PLAN - GROUND MOUNT PV ARRAY

SCALE: NONE

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), ALL BUILDING CODES AND ALL APPICABLE CODES AND STANDARDS.
2. FIELD ADJUST ARRAY LAYOUT BASED ON SITE OBSTRUCTIONS.
3. SITE PLAN BASED ON INFORMATION PROVIDED BY OWNER.
4. CONDUIT FILL TO BE LESS THAT 40%
5. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
6. REFER TO SHEET E501 FOR TRENCH DETAIL.
7. CONTRACTOR TO FIELD VERIFY THAT ALL LISTED GROUNDING ELECTRODES ARE PRESENT AND PROPERLY TERMINATED ON SITE.
8. CONTRACTOR TO VERIFY THAT ALL CIRCUIT BREAKERS ARE SUITABLE FOR BACKFEED.

SHEET KEY NOTES

1. 50 kW AC CANOPY PV SOLAR ARRAY, WITH 5 DUAL PORT EV CHARGERS
2. FIELD ADJUST HORIZONTAL BORE BASED ON UNDERGROUND UTILITIES AND OBSTRUCTIONS

PV SYSTEM DESCRIPTION

ARRAY TYPE :	SOLAR PV CANOPY
AZIMUTH :	177.45 DEGREES
TILT:	7 DEGREES

LEGEND

- INVERTER
- DISCONNECT
- METER
- TRANSFORMER
- EV CHARGING STATION
- AC WIRING
- AC WIRE UNDERGROUND
- CHAIN LINK FENCE

NORTH

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DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	
11-13-2024	INTERCONNECT	
11-22-2024	90% REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

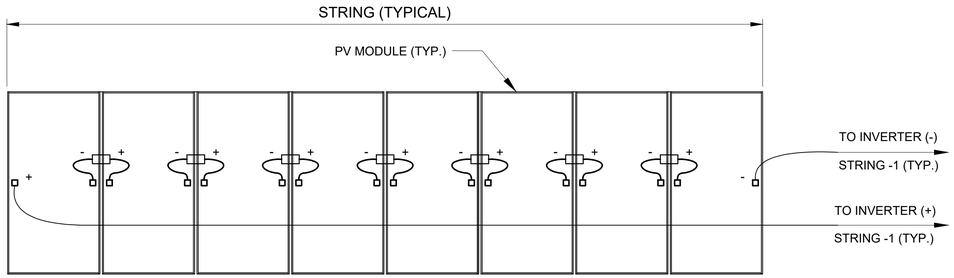
BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

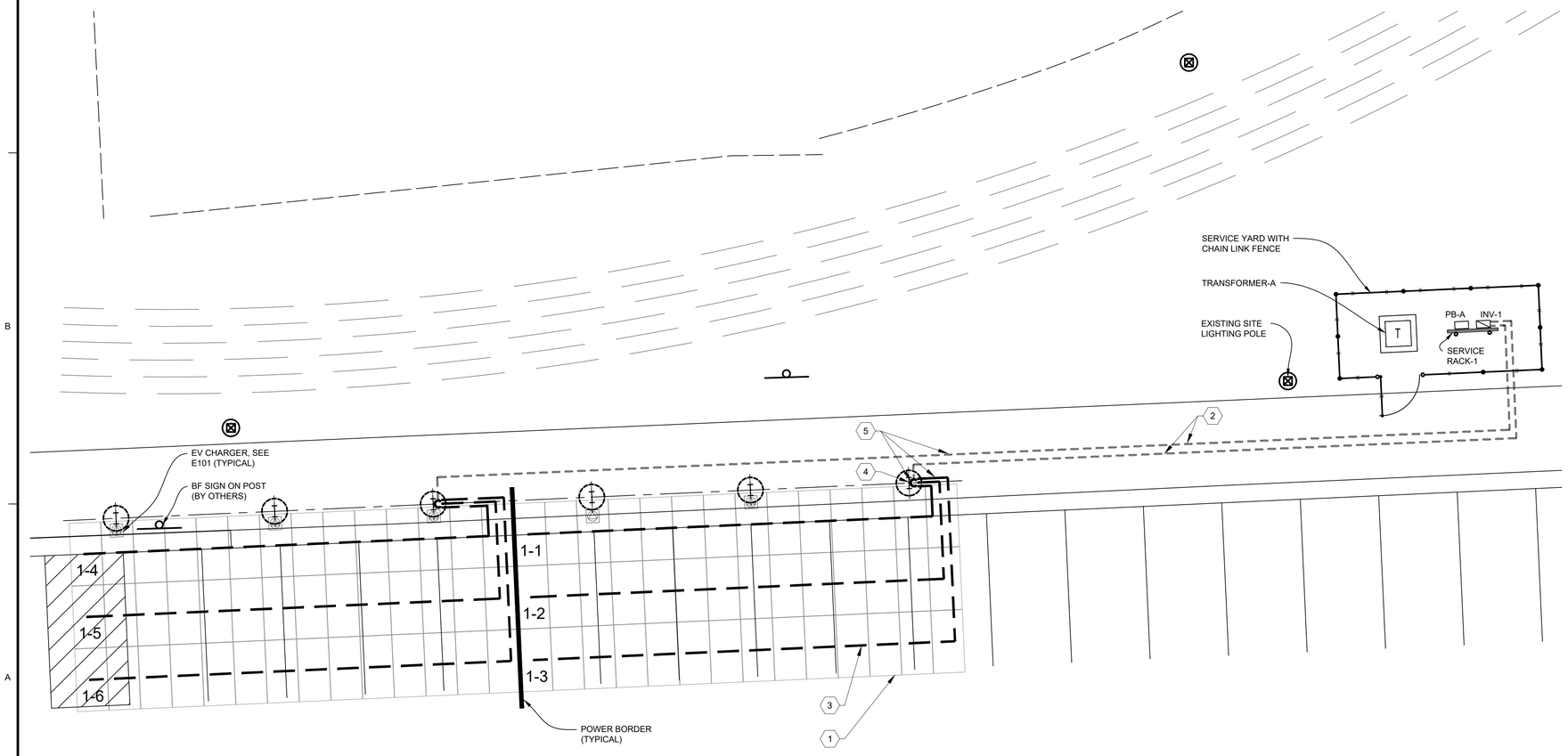
AC POWER PLAN

PROJECT NUMBER	23-11-1168-PRK
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E102



2 E103 PV STRING WIRING DIAGRAM - CANOPY

SCALE: NONE



1 E103 DC POWER PLAN - GROUND MOUNT PV ARRAY

SCALE: NONE

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), ALL BUILDING CODES AND ALL APPICABLE CODES AND STANDARDS.
2. FIELD ADJUST ARRAY LAYOUT BASED ON SITE OBSTRUCTIONS.
3. SITE PLAN BASED ON INFORMATION PROVIDED BY OWNER.
4. CONDUIT FILL TO BE LESS THAT 40%
5. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
6. REFER TO SHEET E501 FOR TRENCH DETAIL.
7. CONTRACTOR TO FIELD VERIFY THAT ALL LISTED GROUNDING ELECTRODES ARE PRESENT AND PROPERLY TERMINATED ON SITE.
8. CONTRACTOR TO VERIFY THAT ALL CIRCUIT BREAKERS ARE SUITABLE FOR BACKFEED.

SHEET KEY NOTES

1. 49.1 kW DC CANOPY PV SOLAR ARRAY, WITH 5 DUAL PORT (AC) EV CHARGERS
2. FIELD ADJUST HORIZONTAL BORE BASED ON UNDERGROUND UTILITIES AND OBSTRUCTIONS
3. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR EQUAL.
4. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT (WALL) AND CONDUIT SUPPORT DETAILS (ROOF) ON SHEET E501.
5. SEE CONDUIT AND WIRE SIZE CHART ON SHEET E601.

PV SYSTEM DESCRIPTION

ARRAY TYPE :	SOLAR PV CANOPY
AZIMUTH :	177.45 DEGREES
TILT:	7 DEGREES

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
+ ~	INVERTER
D	DISCONNECT
M	METER
T	TRANSFORMER
CT	CT CABINET
	DC POWER
	DC WIRING UNDERGROUND
X X	CHAIN LINK FENCE

NORTH

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1-10-2025	BID REVIEW	JE

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CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

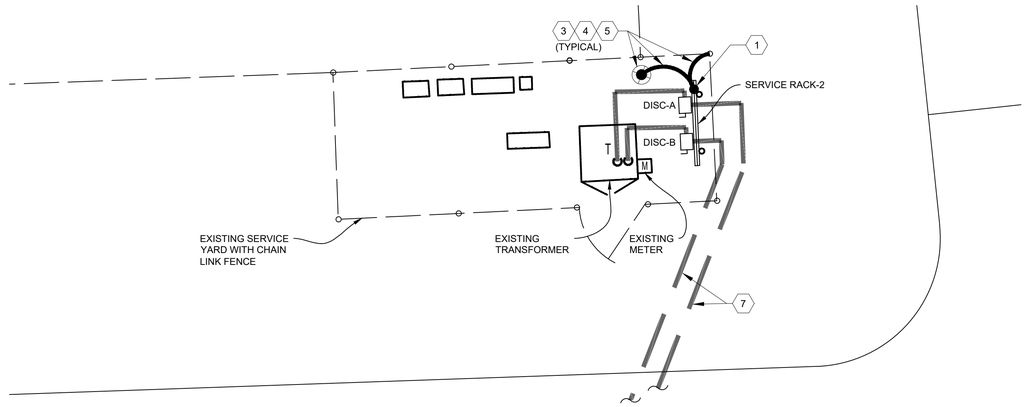
BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

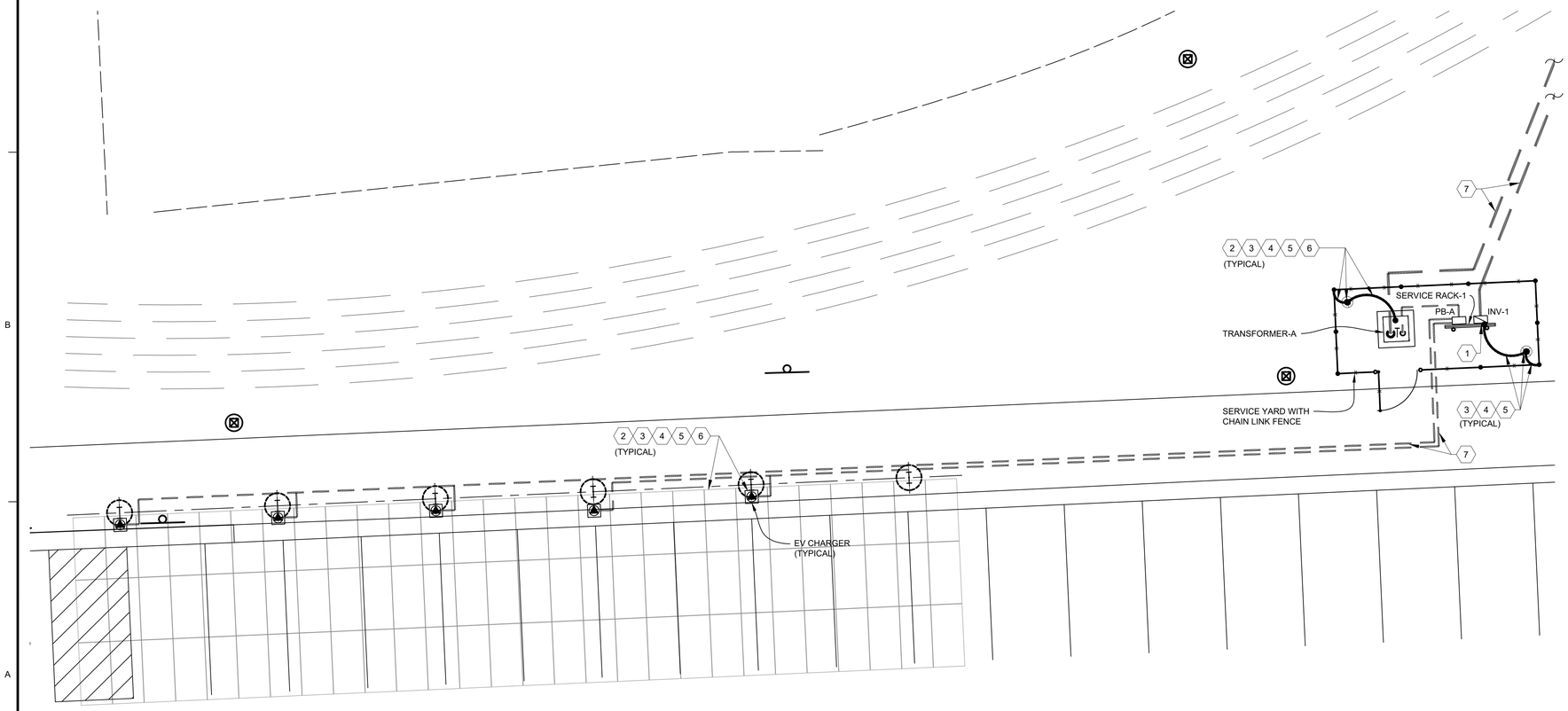
DC POWER PLAN

PROJECT NUMBER	23-11-1168-PRK
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E103



2 E104 GROUNDING PLAN - AT EXISTING SERVICE YARD

SCALE: NONE



1 E104 GROUNDING PLAN - GROUND MOUNT PV ARRAY

SCALE: NONE

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2017 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. GROUNDING SHALL COMPLY WITH CURRENT MICHIGAN ELECTRICAL CODE REQUIREMENTS.
3. ALL EXPOSED METAL SURFACES SHALL BE GROUNDED WITH EQUIPMENT GROUNDING CONDUCTORS.
4. SEE SHEET E501 FOR GROUND DETAILS
5. PV GROUNDING SHALL COMPLY WITH NEC 690.47

SHEET KEY NOTES

1. RACKING SYSTEM SHALL BE BONDED TO THE GROUNDING ELECTRODE SYSTEM.
2. GROUND EACH PV MODULE PER MANUFACTURES INSTRUCTION.
3. GROUND RODS TO BE 5/8" X 8'-0" LONG COPPER CLAD STEEL.
4. ALL GROUNDING CONNECTIONS TO STRUCTURAL FRAME AND NON-CURRENT CARRYING SUPPORTS TO BE MADE USING UL APPROVED GROUNDING CONNECTORS RATED FOR DIRECT BURIAL.
5. #6 BARE COPPER WIRE.
6. CANOPY GROUNDING PER CANOPY MANUFACTURERS SPECIFICATIONS. SEE SEE DETAIL SHEET E501.
7. SEE CONDUIT AND WIRE SIZE CHART ON SHEET E601

PV SYSTEM DESCRIPTION

ARRAY TYPE :	SOLAR PV CANOPY
AZIMUTH :	177.45 DEGREES
TILT:	7 DEGREES

LEGEND

- COPPER CLAD GROUND ROD
- INVERTER
- DISCONNECT
- METER
- TRANSFORMER
- PANEL BOARD
- EV CHARGING STATION
- CONDUIT UNDERGROUND
- GROUND WIRE
- CHAIN LINK FENCE

3 WORKING DAYS
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11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

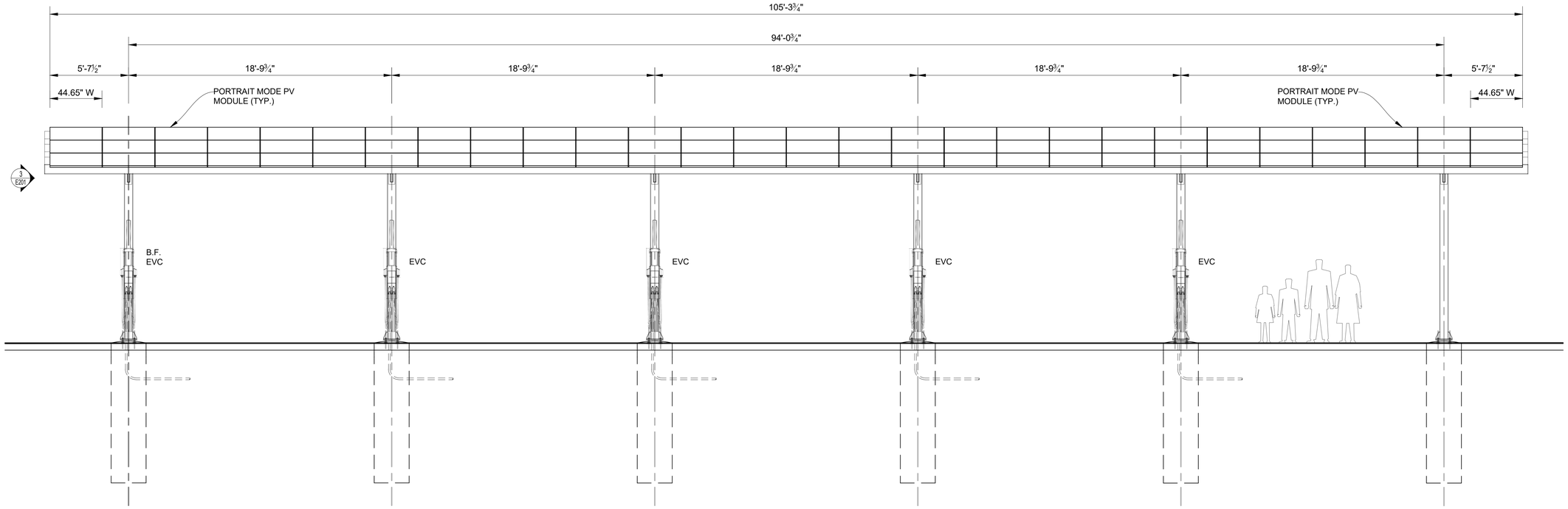
BICENTENNIAL PARK
2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

GROUNDING PLAN

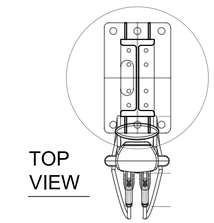
PROJECT NUMBER	23-11-1168-PRK
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E104

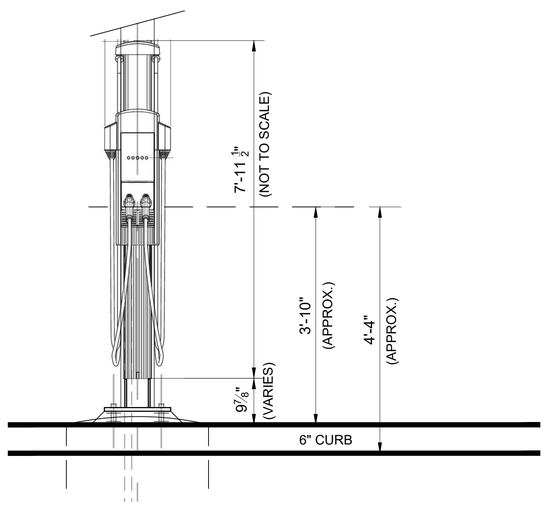
Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Bicentennial Park\Drawings\23111168-PRK-E104.dwg Date: Jan 10 2025; 9:38AM User: george kachadoorian



1 E201 SOLAR PV CANOPY SOUTH ELEVATION - FRONT VIEW

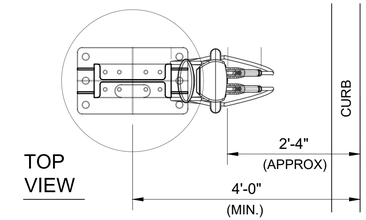
SCALE: 1/4"= 1'-0"

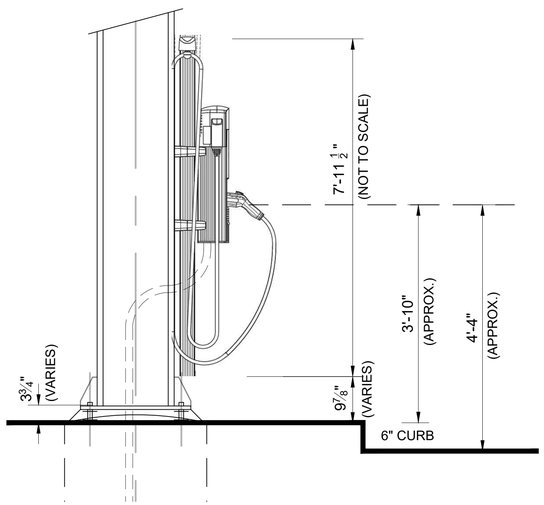




4 E201 EVC FRONT ELEVATION

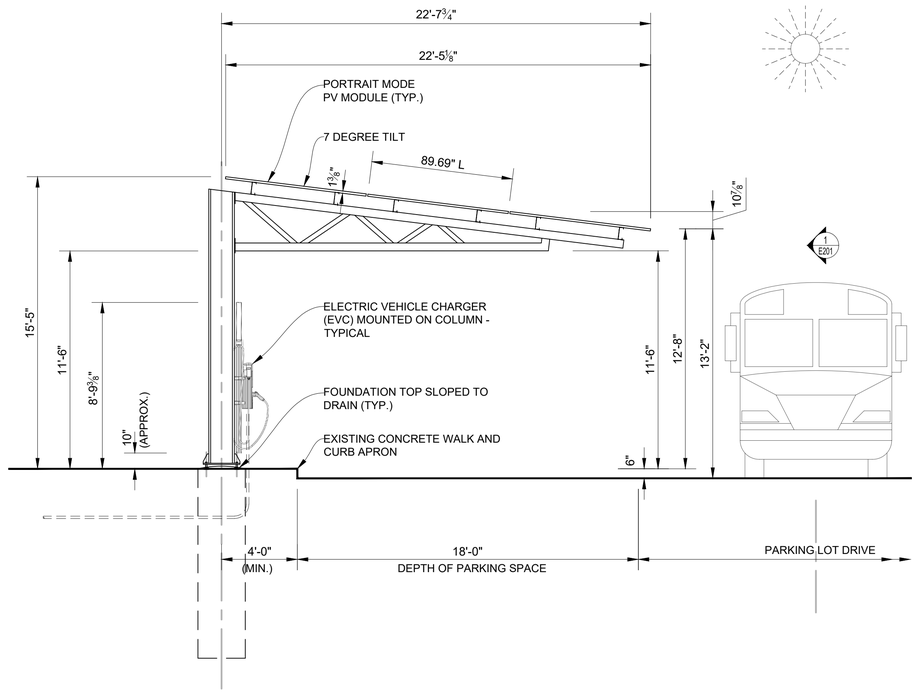
SCALE: 3/4"= 1'-0"





3 E201 EVC SIDE ELEVATION

SCALE: 3/4"= 1'-0"



2 E201 SOLAR PV CANOPY WEST ELEVATION - SIDE VIEW

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

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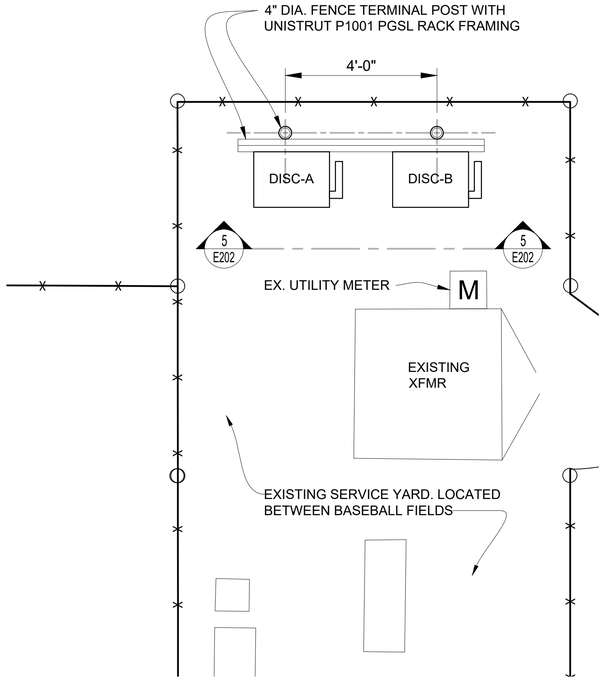
49.1 kW DC SOLAR ARRAY

ELEVATIONS & SECTIONS AT CANOPY

PROJECT NUMBER 23-11-1168-PRK

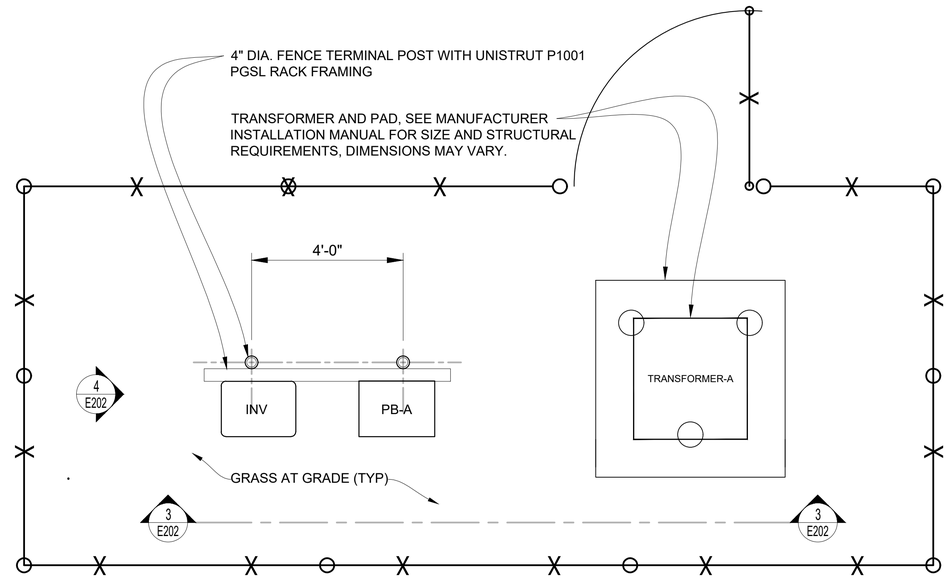
DRAWN BY	SHEET NUMBER
GAK	E201
SCALE: AS NOTED	
SHEET SIZE: 22x34	

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Bicentennial Park\Drawings\23111168-PRK-E201.dwg Date: Jan 10 2025; 10:31AM User: george kachadoorian



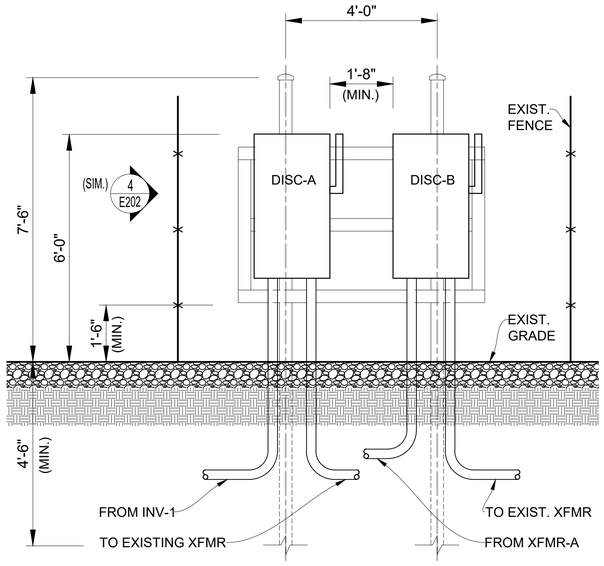
NORTH 2 E201 PLAN DETAIL - SERVICE RACK-2

SCALE: 1/2"= 1'-0"



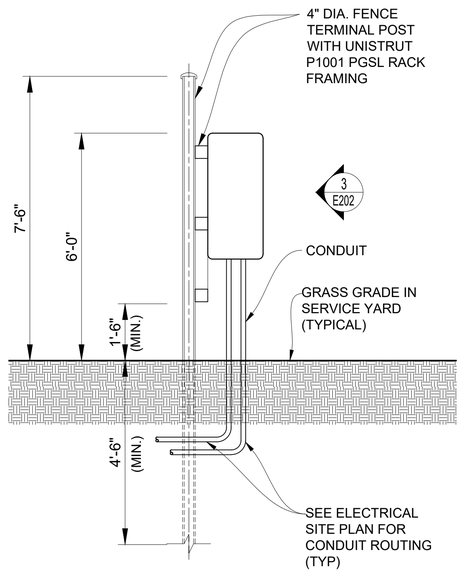
NORTH 1 E201 PLAN DETAIL - SERVICE RACK-1 (NEAR CANOPY)

SCALE: 1/2"= 1'-0"



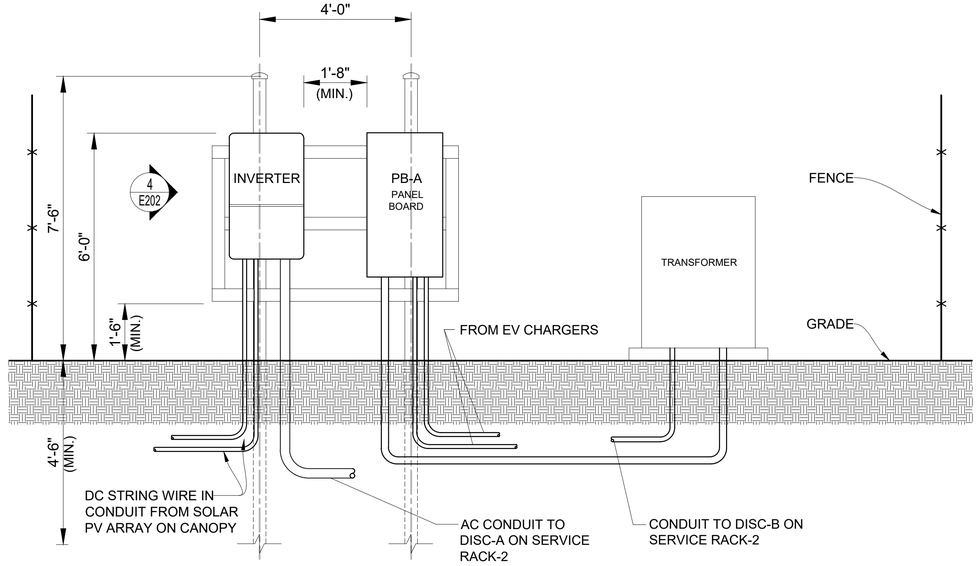
5 E201 ELEVATION - SERVICE RACK-2

SCALE: 1/2"= 1'-0"



4 E201 SIDE ELEV. - SERVICE RACK-1

SCALE: 1/2"= 1'-0"



3 E201 ELEVATION - SERVICE RACK-1 (NEAR CANOPY)

SCALE: 1/2"= 1'-0"

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ANN ARBOR, MI 48108

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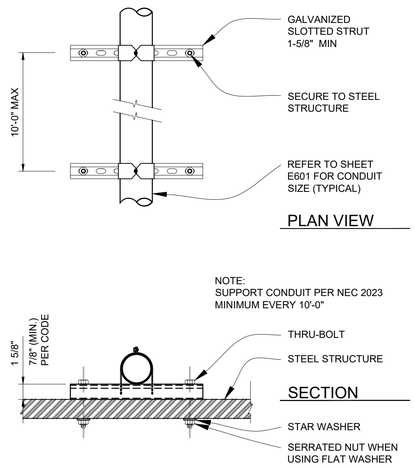
49.1 kW DC SOLAR ARRAY

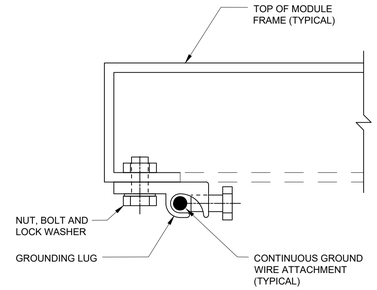
ELEVATIONS & PLAN DETAILS AT SERVICE RACK

PROJECT NUMBER	
23-11-1168-PRK	
DRAWN BY: GAK	SHEET NUMBER: E202
SCALE: AS NOTED	
SHEET SIZE: 22x34	

4 E501 POINT OF INTERCONNECT - (P.O.I.)
EXISTING SERVICE YARD - SIDE VIEW
SCALE: NONE

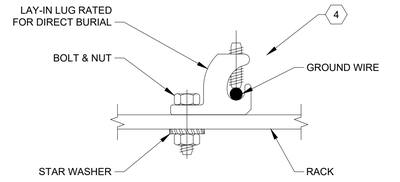


3 E501 DETAIL - SECURING CONDUIT TO STEEL
SCALE: NONE

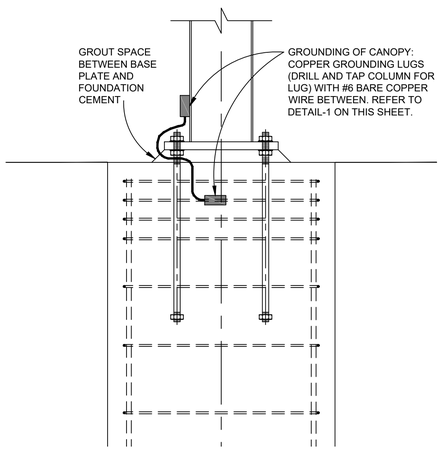


2 E501 MODULE GROUNDING LUG DETAIL
SCALE: NONE

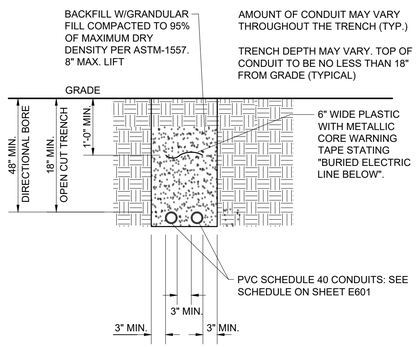
RACK	LUG	HARDWARE
GALVANIZED STEEL	COPPER	GALVANIZED STEEL
ALUMINUM	STAINLESS OR TIN-PLATED COPPER	STAINLESS STEEL
STAINLESS STEEL	COPPER, STAINLESS OR TIN-PLATED COPPER	STAINLESS STEEL



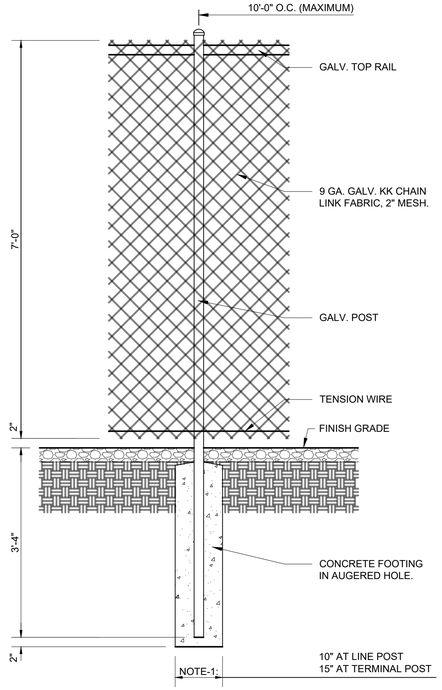
1 E501 GROUNDING DETAIL
SCALE: NONE



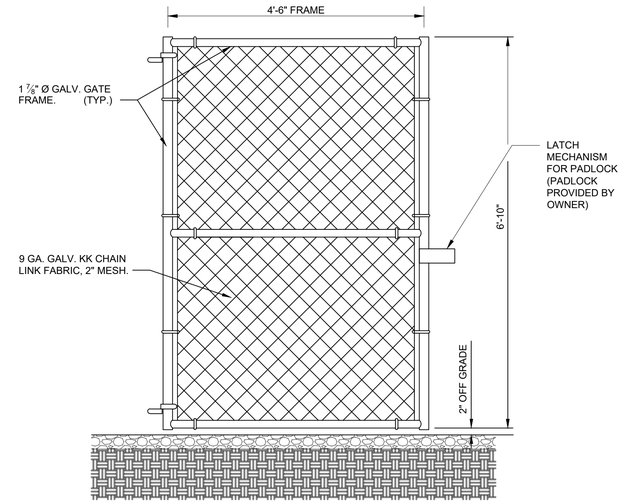
8 E501 GROUNDING @ COLUMN
SCALE: NONE



7 E501 TRENCH DETAIL - UNDERGROUND
SCALE: NONE



6 E501 FENCE DETAIL
SCALE: 3/4" = 1'-0"



NOTE-2
TERMINAL POSTS INCLUDE END, CORNER AND PULL POSTS.

NOTE-3
ALL FASTENERS MUST BE GALVANIZED OR BETTER.

5 E501 GATE DETAIL
SCALE: 3/4" = 1'-0"

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ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

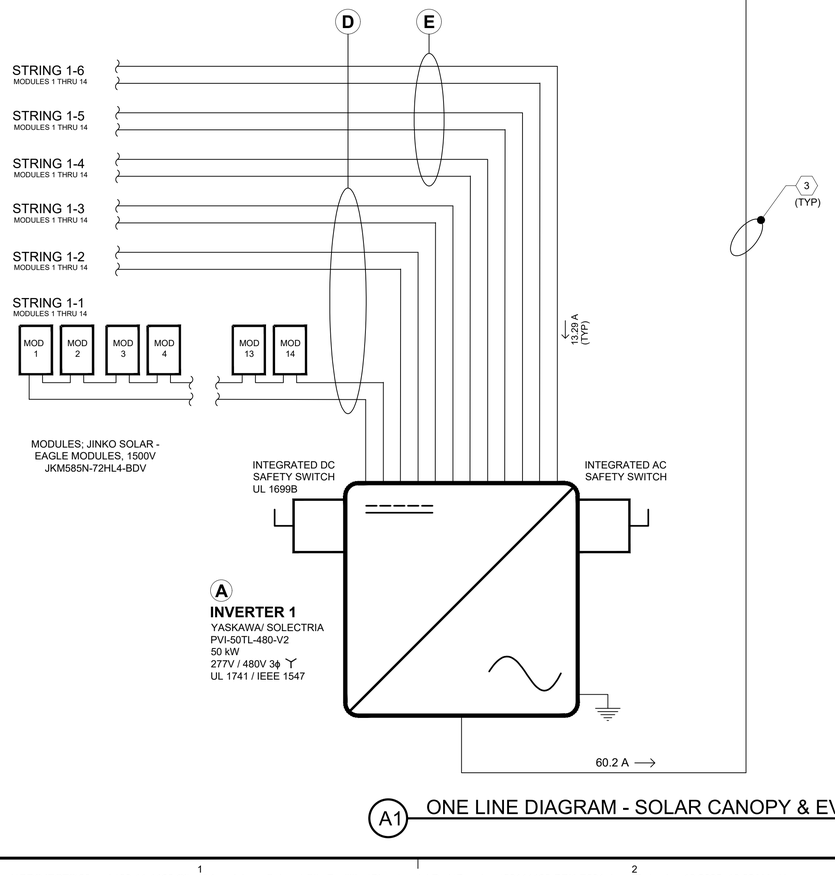
ELECTRICAL DETAILS

PROJECT NUMBER
23-11-1168-PRK

DRAWN BY	SHEET NUMBER
GAK	E501
SCALE: AS NOTED	
SHEET SIZE: 22x34	

CONDUIT AND WIRE SIZE CHART

Item	Description	Label	Route	Conduit	Wire (CU)	Neutral / Ground (CU)
A	Inverter - 50kW, 277/480V and DC Combiner Box	INV-1				
B	Disconnect - 277/480 V, 100A, NEMA 3R, W/80A RK-5 Fuses	DISC-A	A-B	1" HDPE	(3) #3 THWN-2	(2) #8 THWN-2
C	Existing 500KVA Transformer (Load Side Connection)	EXISTING XMFR	B-C	1" PVC	(3) #3 THWN-2	(2) #8 THWN-2
						Ground (CU)
D	DC Home Runs Inverter 1	1-1 to 1-3	D-A	1-1/4" PVC	(6) - #10 PV Wire 2000V	(1) - #6 USE-2
E	DC Home Runs Inverter 2	1-4 to 1-6	E-A	1-1/4" PVC	(6) - #10 PV Wire 2000V	(1) - #6 USE-2
C	Existing 500KVA Transformer (Load Side Connection)	EXISTING XMFR				
F	Disconnect - 277/480V, 200A, NEMA 3R, W/125A RK-5 Fuses	DISC-B	C-F	2" PVC	(4) 1/0 THWN-2	(1) #6THWN-2
G	Transformer- 277/480V WYE to 120/208V WYE 75KVA NEMA 3R	XMFR-A	F-G	2" HDPE	(4) 1/0 THWN-2	(1) #6 THWN-2
H	Panelboard- 120/208V, 400A, 3P, NEMA 3R W/250A Main Breaker	PB-A	G-H	2 1/2" PVC	(4) 300 KCMIL THWN-2	(1) #4 THWN-2
I	Chargepoint CT4000, 120/208V, 1P, Dual Port EV Charger	EVCS - 1 & 2	H-I	1" PVC	(4) - #8 THWN-2	(1) #8 THWN-2
J	Chargepoint CT4000, 120/208V, 1P, Dual Port EV Charger	EVCS - 3 & 4	H-J	1" PVC	(4) - #8 THWN-2	(1) #8 THWN-2
K	Chargepoint CT4000, 120/208V, 1P, Dual Port EV Charger	EVCS - 5 & 6	H-K	1" PVC	(4) - #8 THWN-2	(1) #8 THWN-2
L	Chargepoint CT4000, 120/208V, 1P, Dual Port EV Charger	EVCS - 7 & 8	H-L	1" PVC	(4) - #8 THWN-2	(1) #8 THWN-2
M	Chargepoint CT4000, 120/208V, 1P, Dual Port EV Charger	EVCS - 9 & 10	H-M	1" PVC	(4) - #8 THWN-2	(1) #8 THWN-2



A1 ONE LINE DIAGRAM - SOLAR CANOPY & EV CHARGERS

SCALE: N.T.S.

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), ALL BUILDING CODES AND ALL APPICABLE CODES AND STANDARDS.
2. THE INVERTER INCLUDES RESIDUAL CURRENT DETECTION GFCI. AS PART OF THE DC GROUND FAULT DETECTION METHOD REQUIRED BY UL 1741.
3. DC CONDUCTORS SHALL BE DERATED PER SECTION 310.15.
4. SOLECTRIA INVERTER ARE CERTIFIED UL1699B FOR ARC FAULT PROTECTION PER SECTION 690.11
5. INVERTER INCLUDES ANTI-ISLANDING PROTECTION COMPLIANT WITH UL1741 AND IEEE 1547 PER NEC 690.
6. PHOTOVOLTAIC SYSTEM LABELS SHALL BE INSTALLED PER NEC 2023.

SHEET KEY NOTES

1. AC GROUNDING CONNECTION TO EXISTING TRANSFORMER PROVIDES CONNECTION TO BUILDING GROUNDING ELECTRODE SYSTEM. GROUNDING CONDUCTORS AND BONDING JUMPERS TO BE INSTALLED TO COMPLY WITH ARTICLE 250.
2. NEW LOAD SIDE AC CONNECTION POWER PRODUCTION CONDUCTORS MUST MEET NEC 690, AND 705.12 FOR SERVICE DISCONNECTING MEANS AND OVERCURRENT PROTECTION.
3. REFER TO CHART ON E-601 FOR CONDUIT AND WIRE SIZES.
4. INSTALL PLACARD SHOWING LOCATIONS OF DISCONNECT AND SOLAR ARRAY.
5. MAIN BREAKER SIZED FOR 10 EV CHARGERS.
6. CONDUCTORS SIZED FOR 75 KVA TRANSFORMER FULL LOAD

PV SYSTEM DESCRIPTION

FOR TOTAL SYSTEM:

PV MODULE MODEL:	JINKO SOLAR, JKM585N-72HL4-BDV (585 W)
PV MODULE SIZE:	89.69" L X 44.65" W X 1.38" D
NUMBER OF MODULES:	84
PV MODULE P_{MAX}:	585 W
INVERTERS : (1)	YASKAWA/ SOLECTRIA PVI-50TL-480
NO. OF STRINGS PER INVERTER	INV #1 (6 STRINGS)
DC TO AC RATIO:	.98
NUMBER OF STRINGS:	6
TOTAL NAMEPLATE SIZE:	49.1 kW DC 50.0 kW AC

NOTE: PV SYSTEM IS 1000 V DC (MAX.)

LEGEND

- DISCONNECT SWITCH
- GROUND
- 1-1 PV STRING DESIGNATION (1-1 = STRING # / INVERTER #)

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DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	JE
11-13-2024	INTERCONNECT	JE
11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

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CERTIFICATION

DESIGNED BY: RGM
CHECKED BY:

CITY OF ANN ARBOR
SOLAR FACILITIES

BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

ONE LINE DIAGRAM

PROJECT NUMBER: 23-11-1168-PRK
DRAWN BY: GAK
SCALE:
SHEET SIZE: 22x34
SHEET NUMBER: E601

PHOTOVOLTAIC SYSTEM DISCONNECT

LABEL 1

EACH PV STSTEM DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HA□ARD

DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGI□ED IN THE OPEN POSITION

LABEL 2

THE UTILITY METERING CABINET, EACH INVERTER, EACH DC AND AC DISCONNECTING MEANS □SWITCHES AND BREAKERS□MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HA□ARD

IF GROUND FAULT IS INDICATED ALL NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGI□ED

LABEL 3

□□□T□V□□TAI□ □□□TEM D□ DI□□□NNE□T

MA□ SYSTEM DC VOLTAGE		1000 V
SHORT CIRCUIT DC CURRENT	50kW INV.	163.2 A

LABEL 4

INVERTER DC DISCONNECT MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

□□□T□V□□TAI□ □□□TEM A□ □□INT □□ INTER□□NNE□TI□N

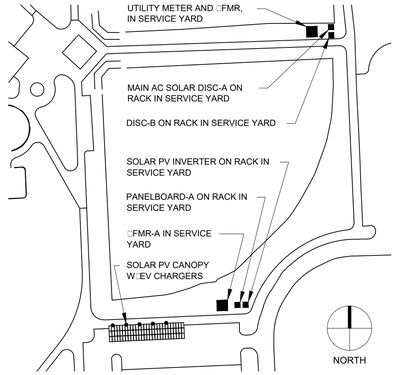
RATED AC OUTPUT CURRENT	60.2 A
NOMINAL OPERATING AC VOLTAGE	480 VAC

LABEL 5

INTERACTIVE SYSTEM POINT OF INTERCONNECTION MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

CAUTION

POWER TO THIS FACILITY IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS AS SHOWN:



LABEL 6

INSTALL MAP PLACARD AS PER UTILITY RE□UIREMENTS, SIGNAGE SHALL BE RED BACKGROUND WITH WHITE ENGRAVED LETTERS: □CAUTION ¾", POWER TO...¾"□ CALL OUTS ⅜"□

THIS LABEL TO BE INSTALLED ON BOTH FENCED IN ELECTRICAL SERVICE YARDS.

WARNING

DUAL POWER SUPPLY

SOURCES UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

LABEL □

E□UIPMENT BACK FED FROM PHOTOVOLTAIC SYSTEMS MUST BE LABELED WITH THIS PLACARD INCLUDING BOTH 480 V. DISCONNECTS AND PRIMARY SWITCH AT SUBSTATION

PHOTOVOLTAIC SOLAR BREAKER

LABEL 8

DO NOT RELOCATETHIS OVERCURRENT DEVICE

LABEL 9

WARNING

THIS E□UIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICE SHALL NOT E□CEED AMPACITY OF BUSSBAR

LABEL 10

AC DISCONNECT

LABEL 11

EACH AC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

DC DISCONNECT

LABEL 12

EACH DC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

DANGER

HIGH VOLTAGE
NO
TRESPASSING

LABEL 15

LABEL SI□E 14" □10". FIELD INSIDE OVAL RED AND OUTSIDE OVAL BLACK .

THIS LABEL TO BE INSTALLED ON BOTH FENCED IN ELECTRICAL SERVICE YARDS. USE STAINLESS STEEL HARDWARE.

CAUTION

PV OUTPUT CIRCUIT

LABEL 13

CAUTION

INVERTER OUTPUT CIRCUIT

LABEL 14

CAUTION SOLAR CIRCUIT

LABEL 16

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No□, MI 483□5

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1-10-2025	BID REVIEW	JE

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49.1 kW DC SOLAR ARRAY

LABELS AND PLACARDS

PROJECT NUMBER 23-11-1168-PRK

DRAWN BY GAK

SCALE

SHEET SI□E 22□34

SHEET NUMBER E□01

1. BASIC ELECTRICAL REQUIREMENTS

A. FURNISH AND INSTALL THE MATERIAL, EQUIPMENT AND SYSTEMS COMPLETE AS SPECIFIED AND/OR INDICATED ON THE DRAWINGS.

B. COMPLY WITH THE 2023 NATIONAL ELECTRICAL CODE (NEC) AND ALL APPLICABLE MUNICIPAL, STATE, LOCAL CODES.

C. OBTAIN ALL APPLICABLE PERMITS INCLUDING BUILDING AND ELECTRICAL, LICENSES AND INSPECTIONS AS REQUIRED.

D. ALL MATERIALS AND EQUIPMENT SHALL BE LISTED AND LABELED BY UL OR OTHER NATIONALLY RECOGNIZED TESTING LABORATORY.

E. SUBMIT SHOP DRAWINGS, WIRING DIAGRAMS, SPECIFICATIONS, OPERATING DATA, AND/OR CATALOG CUTS FOR ALL EQUIPMENT.

F. FOLLOW QUALITY ASSURANCE PROJECT PLAN (QAPP), STARTUP AND COMMISSIONING PROTOCOL.

G. UPON COMPLETION OF THE ELECTRICAL INSTALLATION, THE CONTRACTOR SHALL DELIVER TO NOVA ONE (1) SET OF PRINTS OF AS-BUILT CONTRACT DRAWINGS SHOWING ALL ADDITIONS AND CHANGES DURING THE INSTALLATION. THESE DRAWINGS SHALL BE SUITABLE FOR USE IN PREPARATION OF RECORD DRAWINGS.

2. BASIC ELECTRICAL MATERIALS AND METHODS.

A. RACEWAYS

INSTALL ALL WIRING IN CONDUIT EXCEPT AS OTHERWISE INDICATED. MINIMUM CONDUIT SIZE TO BE ¾". CONDUIT SHALL BE RIGID GALVANIZED STEEL ABOVE GROUND AND WHERE USED AS ELBOWS AND STUB-UPS UNDERGROUND. ELECTRICAL METALLIC TUBING (EMT) MAY BE INSTALLED ABOVE GROUND WHERE NOT SUBJECT TO DAMAGE. UNDERGROUND CONDUIT SHALL BE SCHEDULE 40 PVC. INSTALL CONDUITS PARALLEL AND PERPENDICULAR TO WALLS AND OTHER SURFACES. CLEAN, CAP, AND PROVIDE A PULL STRING IN EACH CONDUIT TO BE LEFT EMPTY.

B. BOXES

JUNCTION BOXES AND PULL BOXES SHALL BE STAMPED STEEL OR CAST ALUMINUM, UL LISTED FOR THE APPLICATION.

C. DISCONNECT SWITCHES

UNLESS OTHERWISE INDICATED, DISCONNECT SWITCHES USED INDOORS SHALL HAVE A NEMA 12 ENCLOSURE AND DISCONNECT SWITCHES USED OUTDOORS SHALL HAVE A NEMA 3R ENCLOSURE. DISCONNECT SWITCHES SHALL BE PAD LOCKABLE IN THE OPEN POSITION.

D. GROUNDING

PROVIDE GROUNDING OF THE ENTIRE ELECTRICAL SYSTEM IN ACCORDANCE WITH NEC ARTICLE 250.

PROVIDE EQUIPMENT GROUNDING CONDUCTORS IN ALL BRANCH CIRCUITS AND ALL FEEDERS.

GROUNDING CONDUCTORS SHALL BE CLASS B STRANDED COPPER, GREEN INSULATED. TERMINATE EACH END USING A SUITABLE LISTED CONNECTOR.

BOND PV MODULES AS SHOWN ON THE DRAWINGS. CONNECT BONDING PIGTAILS TO MODULES PER MANUFACTURER'S INSTRUCTIONS. WHERE USED LUGS SHALL BE UL LISTED FOR DIRECT BURIAL.

GROUNDING ELECTRODES (GROUND RODS) SHALL BE COPPER-CLAD STEEL, MINIMUM 5/8" DIAMETER AND 8 FT. LONG.

BOND TOGETHER METAL STRUCTURES PER NEC 250.110.

E. WIRE AND CABLE

1) WIRE FOR AC CIRCUITS SHALL BE RATED 90 DEGREES C WET OR DRY AND SHALL BE STRANDED COPPER WIRES, TYPE THHN/THWN-2 AND RATED 600V.

2) WIRE FOR MEDIUM VOLTAGE SHALL BE 1C-15kV CLASS.

3) WIRE FOR DC CIRCUITS SHALL BE RATED 90 DEGREES C WET OR DRY AND SHALL BE STRANDED COPPER. ALL DC WIRING NOT IN RACEWAY SHALL BE INSULATED TYPE USE-2 OR PV RATED TO 2000V.

4) DC EQUIPMENT GROUNDING CONDUCTOR SHALL BE MINIMUM OF #6 AWG COPPER AND BE MECHANICALLY ATTACHED TO EACH PV RACKING STRUCTURE UNLESS OTHERWISE NOTED.

5) NO SPLICES SHALL BE MADE EXCEPT WITHIN BOXES UL LISTED FOR THE PURPOSE.

F. SENSORS AND SENSOR WIRING

1) FURNISH AND INSTALL PYRANOMETERS, TEMPERATURE SENSORS, ETC. AS REQUIRED AND AS SHOWN ON DRAWINGS. ALL WIRING USED FOR CONTROLS AND MONITORING SHALL BE APPROVED BY NOVA.

3. DATA AND COMMUNICATIONS SYSTEMS

A. ALL DATA AND COMMUNICATIONS WIRING (INCLUDING CELL MODEMS) SHALL BE COORDINATED WITH THE CITY OF ANN ARBOR AND INSTALLED BY ELECTRICAL CONTRACTOR OR AS DIRECTED BY NOVA.

4. IDENTIFICATION AND LABELS

A. ALL WIRES SHALL BE LABELED AT EACH END.

B. ALL EQUIPMENT MUST BE LABELED PER NEC ARTICLE 690 AND SHEET E-701.

C. PROVIDE LABEL ON EACH PIECE OF EQUIPMENT, SUCH AS INVERTER, COMBINER BOXES, DISCONNECT SWITCHES, ETC. THE LABEL SHALL IDENTIFY THE EQUIPMENT BY THE NAME USED ON THE DRAWINGS, SUCH AS INVERTERS, COMBINER BOXES, DISCONNECT SWITCHES.

5. PV SYSTEM EQUIPMENT

A. PV MODULES:

1) JINKO SOLAR (EAGLE) JKM585N-72HL4-BDV (585W)

a. MAX POWER OUTPUT: Pmax = 585W AT STC

b. VOLTAGE AT MAX POWER: Vmp = 44.02V

c. OPEN CIRCUIT VOLTAGE: Voc = 52.70V

d. CURRENT AT MAX POWER: I mpp = 13.29A

e. SHORT CIRCUIT CURRENT: I sc = 14.01A

2) MODULES PER STRING = 14

3) STRINGS PER INVERTER = 6

4) NUMBER OF STRINGS = 6

5) No. OF MODULES = 84

6) NEG LEAD LENGTH (LANDSCAPE) = 55.12"

7) POS LEAD LENGTH (LANDSCAPE) = 55.12"

B. TOTAL ARRAY:

1) DC NAMEPLATE RATING: (84 x 585) = 49.14 kW

C. RACKING SYSTEM:

1) GENMOUNTS SOLAR RACKING SYSTEM / SINCLAIR DESIGN & ENGINEERING SOLAR CARPORT SYSTEM

2) MODULES TILTED 7 DEGREES

D. INVERTER

1) YASKAWA SOLECTRIA SOLAR PVI-50TL-480

2) NUMBER OF INVERTERS = 1

3) MEETS IEEE-1547, RULE 21, RULE 14 (HI)

4) UL LISTED TO UL-1741, UL-1741 SA, UL-1699B. CSA 2.22

5) NOMINAL INPUT VOLTAGE DC+ TO DC- = 330 TO 1000 VDC RANGE (EACH)

6) MAXIMUM INPUT VOLTAGE DC+ TO DC- = 1000 VDC (EACH)

7) MAX INPUT CURRENT: 108A

8) NOMINAL OUTPUT VOLTAGE: 277 / 480 VAC

9) CONTINUOUS CURRENT OUTPUT: 60.2A

10) MAX CONTINUOUS OUTPUT POWER: 50kW

6. INSTALLATION

A.

1) STORE MODULES IN MANUFACTURER'S PACKAGING UNTIL READY TO INSTALL.

2) PREPARE SURFACE AND INSTALL PER MANUFACTURER'S RECOMMENDATIONS.

3) ATTACH MODULE GROUNDING TERMINAL TO GROUNDING SYSTEM PER DRAWINGS.

7. ELECTRIC VEHICLE CHARGERS (EVC)

A. EVC's:

1) SEE SHEET E802 FOR EVC SPECIFICATIONS

2) INSTALL EVC PER MANUFACTURERS INSTALLATION MANUAL

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

www.novaconsultants.com

ISSUED

DATE	DESCRIPTION	APPVD.
11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

ELECTRICAL SPECIFICATIONS

PROJECT NUMBER 23-11-1168-PRK

DRAWN BY GAK | SHEET NUMBER E702

SCALE

SHEET SIZE 22x34

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Bicentennial Park\Drawings\23111168-PRK-E702.dwg Date: Jan 10 2025; 12:45PM User: george kachadoorian

SOLECTRIA®
PVI-50TL-480 / PVI-60TL-480

3-PHASE TRANSFORMERLESS
COMMERCIAL STRING INVERTERS

Yaskawa Solectria Solar's PVI 50TL-480 and PVI 60TL-480 are transformerless 3-phase inverters, ideal for rooftops, carports and ground-mount PV systems

FEATURES

- Wirebox models with built-in SunSpec compliant transmitters for Module-Level Rapid Shutdown for simple, safe NEC compliance
- UL Listed as PV Rapid Shutdown Systems with APsmart, Northern Electric Power (NEP), and Tigo Energy
- Dual rated listing allows selection of either 50/60 kVA (factory default) or 55/66 kVA (allowing full rated power down to ±0.91 PF)
- Integrated UL-listed Arc-Fault protection
- 15 - 90° mounting angle allows low-profile rooftop installations
- 3 MPPTs with 5 fused inputs each for PV array flexibility
- Industry-leading DC/AC ratios of 1.8 (50TL) and 1.5 (60TL)
- Integrated AC and DC disconnects
- Remote firmware upgrades and diagnostics
- NEMA 4X outdoor rated enclosure, with proven performance
- Certified to IEEE 1547-2018 and UL 1741SB
- Compatible with Bifacial PV Modules

OPTIONS

- Shade cover
- DC fuse bypass
- Web-based monitoring

The PVI-50TL-480 and PVI-60TL-480 come standard with AC and DC disconnects, three MPPTs, and a wiring box with 15 fuse positions.

For rooftop PV systems, both Module-Level Rapid shutdown (MLRSD) wirebox models provide PV Rapid Shutdown System (PVRSS) compliance and include a built-in SunSpec compliant powerline communication transmitter.

One wirebox model is Tigo Enhanced for rapid shutdown and the other two wirebox models are compatible with APsmart or NEP rapid shutdown devices.

Yaskawa Solectria Solar's family of PVI-50/60TL-480 inverters, including standard wireboxes and the rapid-shutdown ready wirebox models, provides flexibility and convenience unmatched in the industry.

Standard Wirebox

- 20A fuses, both polarities
- No built-in PVRSS transmitter

Module-Level Rapid Shutdown Wireboxes

- 20A fuses; positive polarity only
- Built-in PVRSS transmitter
- 3 models for compatibility with APsmart, NEP and Tigo module-level rapid shutdown devices

Tigo Enhanced · APsmart ALTENERGY POWER · NEP NORTHERN ELECTRIC

YASKAWA SOLECTRIA SOLAR

Yaskawa Solectria Solar 1-978-683-9700 | Email: sales@solectria.com | solectria.com
Document No. FL_PVI50601TL.01 | 02/15/2023 |

PVI 50TL-480 / PVI 60TL-480 TECHNICAL DATA

SPECIFICATIONS

Inverter Model		PVI-50TL-480	PVI-60TL-480
DC Input	Maximum PV Power	90 kW (33 kW per MPPT)	90 kW (33 kW per MPPT)
	Maximum Input Voltage	1000 VDC	1000 VDC
	Dc Voltage Ranges: Operating/Max. Power (MPPT)	200-950 VDC / 480-850 VDC	200-950 VDC / 540-850 VDC
	Start-up DC Input Voltage/Power	330 V / 80 W	330 V / 80 W
	Number of MPPT Trackers/Inputs	3 Trackers / 5 Fused-inputs each	3 Trackers / 5 Fused-inputs each
	Maximum Available PV Current (Isc x 1.25)	204 A (68 A per MPPT)	204 A (68 A per MPPT)
	Maximum Operating Input Current (clipping point)	108 A (36 A per MPPT)	114 A (38 A per MPPT)
	DC Surge Protections	Type II MOV, 2800 V_{oc}, 20 kA I_{sc} (8/20 us)	
AC Output	Rated AC Real Power/Apparent Power/Output Current	50 kW / 50 kVA / 60.2 A	60 kW 60kVA / 72.2 A
	Overhead Mode: Real Power/Apparent Power/Output Current	50 kW / 55 kVA / 66.2 A	60 kW / 66 kVA / 79.4 A
	Nominal Output Voltage/Range	480 VAC / -12% to +10%	480 VAC / -12% to +10%
	Nominal Output Frequency/Range	60 Hz / 57-63 Hz	60 Hz / 57-63 Hz
	Power Factor	Unity, >0.99 (Adjustable 0.8 leading to 0.8 lagging)	Unity, >0.99 (Adjustable 0.8 leading to 0.8 lagging)
	Fault Current Contribution (1 Cycle RMS)	64.1 A	64.1 A
	Total Harmonic Distortion (THD) @ Rated Load	< 3%	< 3%
	Grid Connection Type	3-Ph/PE/N (neutral conductor optional)	3-Ph/PE/N (neutral conductor optional)
	Maximum OCPD Device	110 A	125 A
	AC Surge Protection	Type II MOV, 1240 V_{oc}, 15 kA I_{sc} (8/20 us)	
Efficiency	Peak Efficiency	98.8%	98.8%
	CEC Efficiency	98.5%	98.5%
	Tare Loss	< 1 W	< 1 W
Environment	Ambient Temperature Range	-22°F to +140°F (-30°C to +60°C); Derating occurs over +113°F (+45°C)	
	Storage Temperature Range	No low temp minimum to +158°F (+70°C)	
	Relative Humidity (non-condensing)	0-100%	
	Operating Altitude	13,123 ft (4,000 m) Derating occurs from 9,842.5 ft (3,000 m)	
Communications	Modbus Protocol	Proprietary / SunSpec	
	SolrenView Web-Based Monitoring Service	Optional	
	Revenue Grade Metering	Optional, External	
	Communication Interface	RS-485 Modbus RTU	
	Remote Firmware Upgrades	Ethernet Network Card required	
	Remote Diagnostics	Ethernet Network Card required	
Safety	Certifications and Standards	IEEE 1547-2018, UL 1741-SB, UL 1741SA-2016, UL1699B, UL1998, CSA-C22.2 No. 107.1-01, FCC Part 15 (Subpart B, Class A)	
	Selectable Grid Standards	IEEE 1547, CA Rule 21, ISO-NE, HECO	
	Smart Grid Features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-VAr, Freq-Watt, Volt-Watt, Watt-VAr	
Warranty	Standard Limited Warranty	10 Years	
Mechanical	Acoustic Noise Rating	< 60 dBA @ 1 m and 25°C	
	AC/DC Disconnect	Standard, fully-integrated, load break rated	
	Mounting Angle*	15° - 90° from horizontal	
	Weight	Inverter: 125.5 lbs (56 kg); Wiring Box: 33 lbs (15 kg)	
	Enclosure Rating and Finish	NEMA Type 4X; Polyester Powder Coated Aluminum	
	Dimensions (H x W x D)	Power Head: 22.7" x 23.6" x 10.24" (576 mm x 600 mm x 260 mm)	
		Wirebox: 16.7" x 23.6" x 10.24" (424 mm x 600 mm x 260 mm)	
		Overall: 39.4" x 23.6" x 10.24" (1000 mm x 600 mm x 260 mm)	

Wirebox Specifications			
Wirebox	Fused Inputs	15 Fused Positions (5 Positions per MPPT) 20 A Standard (25, 30 A accepted)**	
Wirebox Versions	Standard	PVI-50-60TL-BX-S20 (both polarities fused), No MLRSD transmitter needed	
	APsmart Transmitter Built-in	PVI-50-60TL-WB-APS (only positive polarity fused)	MLRSD compatibility: APsmart RSD-S and RSD-D
	NEP Transmitter Built-in	PVI-50-60TL-WB-NEP (only positive polarity fused)	MLRSD compatibility: NEP PVG-2
	Tigo Transmitter Built-in	PVI-50-60TL-WB-TGO (only positive polarity fused)	MLRSD compatibility: Tigo TS4-A-F (ver 6.7+) and TS4-A-2F

* Shade cover accessory required for installation of 75° or less
** Yaskawa Solectria Solar does not supply optional fuses sizes

IT'S PERSONAL

YASKAWA SOLECTRIA SOLAR

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SDE · GENMOUNTS SOLAR RACKING SYSTEMS

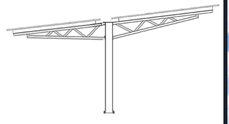
1.2 Megawatt Carport Array
Lawrence Township, NJ 08648

Solar Carport Systems

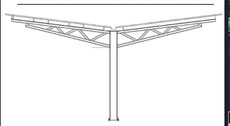
SDE

ENGINEERING MANUFACTURING INSTALLATION

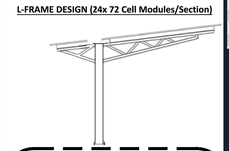
T-FRAME DESIGN (36x 72 Cell Modules/Section)



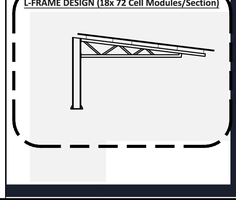
Y-FRAME DESIGN (36x 72 Cell Modules/Section)



L-FRAME DESIGN (24x 72 Cell Modules/Section)



L-FRAME DESIGN (18x 72 Cell Modules/Section)



Application	Parking Area & Sidewalks		
Tilt Angle	7 Degrees	**Modules Per Section**	36
Module Orientation	Portrait	**Ground Clearance**	Site Specific
Wind Load	125 MPH	**Foundation**	Reinforced Concrete
Snow Load	50 PSF	**Purlin Length**	236 Inches
Post Spacing	236 Inches	**Manufacturing**	Made in Michigan, USA

PRODUCT SPECIFICATIONS

All product specifications have been verified through third party engineering firms. For areas with higher wind/snow requirements, additional options are available.
20 - 34 foot section spans are available.

PRICING OVERVIEW

SDE calculated our average cost/watt prices, using 350 - 370 Watt Modules. Prices outlined below includes foundation cages, all required racking components, hardware, and freight.

36 PANEL Y or T FRAME CANOPIES: 30 - 35 CENTS/WATT

24 PANEL L FRAME CANOPIES: 40 - 45 CENTS/WATT

18 PANEL L FRAME CANOPIES: 45 - 50 CENTS/WATT

EAGLE MODULES

THE MOST DEPENDABLE SOLAR PRODUCT

EAGLE® 72 G6B

570-590 WATT • N-TYPE BIFACIAL

Positive power tolerance of 0~+3%

- NYSE-listed since 2010, Bloomberg Tier 1 manufacturer
- Top performance in the strictest 3rd party labs
- Automated manufacturing utilizing artificial intelligence
- Vertically integrated, tight controls on quality
- Premium solar factories in USA, Vietnam, and Malaysia

KEY FEATURES

N-Type Technology
N-type cells offer Jinko's in-house TOPCon technology with better performance and improved reliability.

Multi Busbar Half Cell Technology
Better light trapping and current collection to improve module power output and reliability.

Bifacial Power Gain
N-Type architecture increases bifaciality for higher backside bonus and better lifetime yield.

Low Temperature Coefficient
Best in class temperature coefficient for highest lifetime energy yield in all climates.

Industrial Grade Construction
Fire Type 29 with optimized dual-glass construction and thick frame for highest mechanical load resistance.

Shade Tolerant
Twin array design allows continued performance even with shading by trees or debris.

Protected Against All Environments
Certified to withstand humidity, heat, rain, marine environments, wind, hailstorms, and packed snow.

Warranty
12-year product and 30-year linear power warranty.

- ISO9001:2015 Quality Standards
- ISO14001:2015 Environmental Standards
- IEC61215, IEC61730 certified products
- ISO45001: 2018 Occupational Health & Safety Standards
- UL61730 certified products

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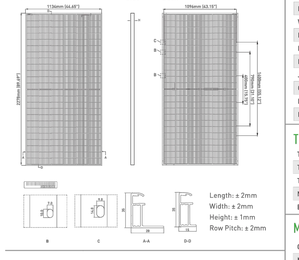
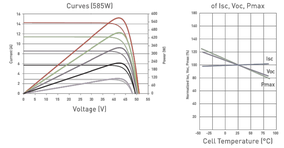
JinkoSolar

ENGINEERING DRAWINGS



ELECTRICAL PERFORMANCE & TEMPERATURE DEPENDENCE



MECHANICAL CHARACTERISTICS

No. of Half Cells	144 (2 x 72)
Dimensions	2278 x 1134 x 35mm (89.69 x 44.65 x 1.38in)
Weight	32kg (70.55lbs)
Front Glass	2.0mm, Anti-Reflection Coating
Back Glass	2.0mm, Heat Strengthened Glass
Frame	Anodized Aluminum Alloy
Junction Box	IP68 Rated
Output Cables	12 AWG, 1400mm (55.12in)
Fire Type	Type 29
Pressure Rating	5400Pa (Snow) & 2400Pa (Wind)

TEMPERATURE CHARACTERISTICS

Temperature Coefficients of Pmax	-0.29%/°C
Temperature Coefficients of Voc	-0.25%/°C
Temperature Coefficients of Isc	0.045%/°C
Nominal Operating Cell Temperature (NOCT)	45±2°C
Bifacial Factor	80±5%

MAXIMUM RATINGS

Operating Temperature (°C)	-40°C~+85°C
Maximum System Voltage	1500VDC
Maximum Series Fuse Rating	30A

PACKAGING CONFIGURATION

(Two pallets = One stack)
31pcs/pallets, 62pcs/stack, 558pcs/40 HQ Container

BIFACIAL OUTPUT-REARSIDE POWER GAIN

5%	Maximum Power (Pmax)	598Wp	604Wp	609Wp	614Wp	620Wp
	Module Efficiency (%)	23.17%	23.37%	23.57%	23.78%	23.98%
15%	Maximum Power (Pmax)	654Wp	661Wp	667Wp	672Wp	679Wp
	Module Efficiency (%)	25.38%	25.60%	25.82%	26.05%	26.27%
25%	Maximum Power (Pmax)	713Wp	719Wp	725Wp	731Wp	738Wp
	Module Efficiency (%)	27.59%	27.83%	28.06%	28.31%	28.55%

WARRANTY

12-year product and 30-year linear power warranty

1st year degradation not to exceed 1%, each subsequent year not to exceed 0.4%, minimum power at year 30 is 87.4% or greater.

ELECTRICAL CHARACTERISTICS

Module Type	JKM570N-72HL4-BDV		JKM575N-72HL4-BDV		JKM580N-72HL4-BDV		JKM585N-72HL4-BDV		JKM590N-72HL4-BDV	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	570Wp	430Wp	575Wp	433Wp	580Wp	437Wp	585Wp	441Wp	590Wp	445Wp
Maximum Power Voltage (Vmp)	43.58V	40.56V	43.73V	40.73V	43.88V	40.89V	44.02V	41.05V	44.17V	41.21V
Maximum Power Current (Imp)	13.08A	10.59A	13.15A	10.64A	13.22A	10.69A	13.29A	10.74A	13.36A	10.79A
Open-circuit Voltage (Voc)	52.10V	49.49V	52.30V	49.68V	52.50V	49.87V	52.70V	50.06V	52.90V	50.25V
Short-circuit Current (Isc)	13.83A	11.16A	13.89A	11.21A	13.95A	11.26A	14.01A	11.31A	14.07A	11.36A
Module Efficiency STC (%)	22.07%		22.26%		22.45%		22.65%		22.84%	

***STC:** ☀ Irradiance 1000W/m² 🌡 Cell Temperature 25°C AM = 1.5
NOCT: ☀ Irradiance 800W/m² 🌡 Ambient Temperature 20°C AM = 1.5 Wind Speed 1m/s

*Power measurement tolerance: ±3%

The company reserves the final right for explanation on any of the information presented hereby. JKM570-590N-72HL4-BDV-F35-F1-US

BUILDING YOUR TRUST IN SOLAR. WWW.JINKOSOLAR.US

JinkoSolar

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

www.novaconsultants.com

ISSUED

DATE	DESCRIPTION	APPVD.
11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
GAK	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER
23-11-1168-PRK

DRAWN BY	SHEET NUMBER
GAK	E801
SCALE: AS NOTED	
SHEET SIZE: 22x34	

CT4000 Level 2 Commercial Charging Station

Specifications and Ordering Information

CT4021

Ordering Information

The order codes below represent specific product configurations. Other product options are available. Please contact ChargePoint Sales for information and order codes.

Specify model number followed by the applicable code(s).
The order code sequence is: **Model-Options**. **Software**, **Services** and **Misc** are ordered as separate line items.

Hardware

Description		Order Code
Model	1830 mm (6 ft) Single Port Bollard Mount	CT4011-GW1
	1830 mm (6 ft) Dual Port Bollard Mount	CT4021-GW1
	1830 mm (6 ft) Single Port Wall Mount	CT4013-GW1
	1830 mm (6 ft) Dual Port Wall Mount	CT4023-GW1
	2440 mm (8 ft) Dual Port Bollard Mount	CT4025-GW1
	2440 mm (8 ft) Dual Port Wall Mount	CT4027-GW1
Included	Integral Modem – North America	-GW1
Misc	Power Management Kit Bollard Concrete Mounting Kit	CT4000-PMGMT
	Bollard Concrete Mounting Kit	CT4001-CCM

*Note: ALL CT4000 stations include Integral Modem -GW1.

Software & Services

Description	Order Code
ChargePoint Commercial Service Plan	CPCLD-COMMERCIAL-*n**
ChargePoint Enterprise Plan	CPCLD-ENTERPRISE-*n**
ChargePoint Assure	CT4000-ASSURE*n**
Station Activation and Configuration	CPSUPPORT-ACTIVE
ChargePoint Station Installation and Validation	CT4000-INSTALLVALID

1-YEAR

Note: All CT4000 stations require a network service plan per port.

*Substitute *n* for desired years (1, 2, 3, 4 or 5 years)

GEN. CONTRACTOR TO VERIFY # OF YEARS WITH CITY, PRIMARY CONTACT; Simi Barr
CHARGEPOINT SALE REPESNATIVE: Ian McGill

General Specifications

Electrical Input

Electrical Input	Single Port (AC Voltage 208 / 240V AC)			Dual Port (AC Voltage 208 / 240V AC)		
	Input Current	Input Power Connection	Required Service Panel Breaker	Input Current	Input Power Connection	Required Service Panel Breaker
Standard	30A	One 40A branch circuit	40A dual pole (non-GFCI type)	30A x 2	Two independent 40A branch circuits	40A dual pole (non-GFCI type) x 2
Standard Power Share	n/a	n/a	n/a	32A	One 40A branch circuit	40A dual pole (non-GFCI type)
Power Select 24A	24A	One 30A branch circuit	30A dual pole (non-GFCI type)	24A x 2	Two independent 30A branch circuits	30A dual pole (non-GFCI type) x 2
Power Select 24A Power Share	n/a	n/a	n/a	24A	One 30A branch circuit	30A dual pole (non-GFCI type)
Power Select 16A	16A	One 20A branch circuit	20A dual pole (non-GFCI type)	16A x 2	Two independent 20A branch circuits	20A dual pole (non-GFCI type)
Power Select 16A Power Share	n/a	n/a	n/a	16A	One 20A branch circuit	20A dual pole (non-GFCI type)
Service Panel GFCI	Do not provide external GFCI as it may conflict with internal GFCI (CCID)					
Wiring – Standard	3-wire (L1, L2, Earth)			5-wire (L1, L1, L2, L2, Earth)		
Wiring – Power Share	n/a			3-wire (L1, L2, Earth)		
Station Power	8 W typical (standby), 15 W maximum (operation)					

Electrical Output

Electrical Output	Single Port (AC Voltage 208 / 240V AC)	Dual Port (AC Voltage 208 / 240V AC)
Standard	7.2 kW (240V AC @ 30A)	7.2 kW (240V AC @ 30A) x 2
Standard Power Share	n/a	7.2 kW (240V AC @ 30A) x 1 or 3.8 kW (240V AC @ 16A) x 2

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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DATE	DESCRIPTION	APPVD.
11-22-2024	90% REVIEW	JE
1-10-2025	BID REVIEW	JE

REVISED

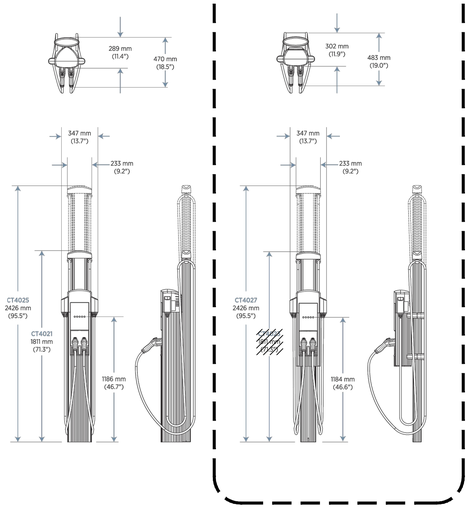
NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

Architectural Drawings (Dimensions)

CT4021 1830 mm (6')
CT4025 2440 mm (8')
Bollard

CT4027 2440 mm (8')
Wall Mount



Power Select 24A	5.8 kW (240V AC @ 24A)	5.8 kW (240V AC @ 24A) x 2
Power Select 24A Power Share	n/a	5.8 kW (240V AC @ 24A) x 1 Or 2.9 kW (240V AC @ 12A) x 2
Power Select 16A	3.8 kW (240V AC @ 16A)	3.8 kW (240V AC @ 16A) x 2
Power Select 16A Power Share	n/a	3.8 kW (240V AC @ 16A) x 1 Or 1.9 kW (240V AC @ 8A) x 2

Functional Interfaces

	Single Port (AC Voltage 208 / 240V AC)	Dual Port (AC Voltage 208 / 240V AC)
Connector Types	SAE J1772™	SAE J1772™ x 2
Cable Length — 1.8 m (6 ft) Cable Management	5.5 m (18 ft)	5.5 m (18 ft) x 2
Cable Length — 2.4 m (8 ft) Cable Management	n/a	7 m (23 ft) x 2
Overhead Cable Management System	Yes	
LCD Display	145 mm (5.7 in) full color, 640 x 480, 30 fps full motion video, active matrix, UV protected	
Card Reader	ISO 15693, ISO 14443, NFC	
Locking Holster	Yes	Yes x 2

Safety and Connectivity Features

Ground Fault Detection	20 mA CCID with auto retry
Open Safety Ground Detection	Continuously monitors presence of safety (green wire) ground connection
Plug-Out Detection	Power terminated per SAE J1772™ specifications
Power Measurement Accuracy	+/- 2% from 2% to full scale (30A)
Power Report/Store Interval	15 minute, aligned to hour. Vehicle to grid connected and responsive to TOU signals
Local Area Network	2.4 GHz WiFi (802.11 b/g/n)
Wide Area Network	LTE Category 4

Safety and Operational Ratings

Station Enclosure Rating	Type 3R per UL 50E
Safety and Compliance	UL and cUL listed; complies with UL 2594, UL 2231-1, UL 2231-2, and NEC Article 625
Station Surge Protection	6 kV @ 3,000A. In geographic areas subject to frequent thunder storms, supplemental surge protection at the service panel is recommended.
EMC Compliance	FCC Part 15 Class A
Operating Temperature	-40°C to 50°C (-40°F to 122°F)
Non-Operating Temperature	-40°C to 60°C (-40°F to 140°F)
Terminal Block Temperature Rating	105°C (221°F)
Operating Humidity	Up to 85% @ 50°C (122°F) non-condensing
Non-Operating Humidity	Up to 95% @ 50°C (122°F) non-condensing
Network	All stations include integral LTE modem and will be automatically configured to operate as gateway or non-gateway as needed

ChargePoint, Inc. reserves the right to alter product offerings and specifications at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document

ChargePoint, Inc.
240 East Hacienda Avenue
Campbell, CA 95008-6617 USA

+1.408.841.4500 or
+1.877.370.3802 US and Canada toll-free

chargepoint.com

Contact Us

Visit chargepoint.com

Call +1.408.705.1992

Email sales@chargepoint.com

Listed by Underwriters Laboratories Inc.

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GAK	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

BICENTENNIAL PARK

2945 E. ELLSWORTH
ANN ARBOR, MI 48108

50.0 kW AC SOLAR ARRAY
49.1 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER	23-11-1168-PRK
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E802

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Bicentennial Park\Drawings\23111168-PRK-E802.dwg Date: Jan 10 2025; 10:53AM User: george kachadoorian

LIST OF DRAWINGS

NUM	TITLE	REV	6-27-2024 INTERCONNECT	6-29-2024 BID REVIEW	7-16-2024 INTERCONNECT REV 1	1-27-2025 ADDENDUM-2
					1	2
	GENERAL					
G001	COVER SHEET		●	●	●	●
G002	GENERAL NOTATION			●		
	CIVIL					
C101	SITE PLAN			●		
C102	CONSTRUCTION PLAN			●		
C103	DEMOLITION PLAN			●		
	ELECTRICAL					
E101	ELECTRICAL SITE PLAN		●	●	●	
E102	AC POWER PLAN			●		
E103	DC POWER PLAN			●		
E104	GROUNDING PLAN			●		●
E105	PV STRING WIRING PLAN			●		●
E401	EQUIPMENT RACK ON ROOF			●		
E501	ELECTRICAL DETAILS			●		●
E601	ONE-LINE DIAGRAM		●	●	●	●
E701	LABELS AND PLACARDS			●		
E702	ELECTRICAL SPECIFICATIONS			●		
E801	DATA SHEETS			●		
E802	DATA SHEETS			●		
E803	DATA SHEETS			●		
E804	DATA SHEETS			●		
E805	DATA SHEETS			●		
	STRUCTURAL					
S-1.0	UNIRAC - ROOF BALLAST LAYOUT(S)			●		
EF2+	UNIRAC - ECOLIBRIUM-ECOFOOT2; MULTI-PAGE REPORT(S)			●		

PROJECT TO BE SUBMITTED AND REVIEWED UNDER THE 2015 MICHIGAN REHABILITATION CODE FOR EXISTING BUILDINGS (MRCEB) SECTION 301.1.2 "WORK AREA COMPLIANCE METHOD" PER SECTION 504.1 LEVEL-2 ALTERATIONS (CH 5-13).

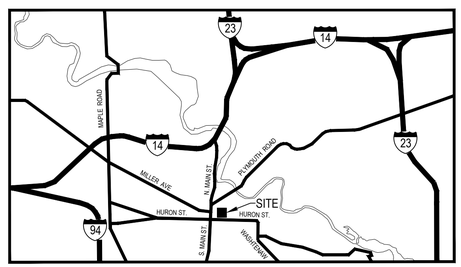
NOVA PROJECT #23-11-1168
110 kW AC, 1000 V DC (MAX.), 135 kW DC SOLAR PHOTOVOLTAIC SYSTEM

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL & JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

NOVA PROJECT MANAGER: JEFF ECKHOUT



N

SITE LOCATION MAP

NO SCALE

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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ISSUED

	DATE	DESCRIPTION	APPVD.
	6-27-2024	INTERCONNECT	
	6-29-2024	BID REVIEW	
1	7-16-2024	INTERCONNECT REV 1	
2	1-27-2025	ADDENDUM-2	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

COVER SHEET

PROJECT NUMBER	
23-11-1168-CH	
DRAWN BY: GAK	SHEET NUMBER: G001
SCALE: NONE	
SHEET SIZE: 22x34	

STANDARD METHODS OF NOTATION

- SHEET KEY NOTES □TAGS□
- ITEM DESIGNATION □E601 WIRE AND CONDUIT SCHEDULE□
- REVISION □ADDENDUM TAG
- DETAIL NUMBER (ELEVATION TAG) SHEET WHERE FOUND — 3 / E402
- DETAIL NUMBER (SECTION CUT TAG) SHEET WHERE FOUND — 5 / E201
- DETAIL NUMBER — 1 / E103 — SHEET WHERE FOUND — (BUBBLE DETAIL) — ENLARGEMENT AREA
- DETAIL NUMBER / NAME (DRAWING TITLE & IDENTIFICATION) SHEET WHERE FOUND / SCALE — 1 / E104 — DET. — SCALE: N.T.S.
- SPOT ELEVATION — 10'-0" A.F.F.
- MATCH LINE — SHEET C102 / SHEET C103
- CENTER LINE
- LIGHT LINE INDICATES E□ISTING WORK
- HEAVY LINE INDICATES NEW WORK
- DASHED LINE INDICATES DEMOLITION
- UNDERGROUND CONDUIT AND WIRING

NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.

STANDARD MOUNTING HEIGHTS

DESCRIPTION	HEIGHT
PANELBOARD	6□0" A.F.F. TO TOP OF BO□
RECEPTACLE OUTLET	16" A.F.F. TO BOTTOM OF BO□. □MIN.□ 48" A.F.F. TO TOP OF BO□ □MA□.□
CONDUIT IN TRENCH	18" BELOW GRADE - TO TOP OF CONDIUT □MIN.□

SITE, ROOF & FLOOR PLAN SYMBOLS

- 1-1 / STRING # / INVERTER # — PV STRING DESIGNATION
- MODULE □SITE & ROOF PLAN□
- SWITCHGEAR
- INV-1 — INVERTER
- PB — PANEL BOARD
- D — DISCONNECT
- M — METER
- T — TRANSFORMER
- CT — CT CABINET
- C — COMBINER
- DUPLE□ RECEPTACLE
- EV CHARGING STATION
- EV CHARGING ONLY □PARKING SPACE□
- COPPER CLAD GROUND ROD
- SILT FENCE
- CHAIN LINK FENCE
- 0 — GRAPHIC SCALE
- NORTH — NORTH ARROW

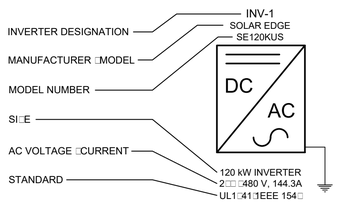
LINES & WIRES

- GAS — GAS LINE
- AC WIRING
- AC WIRING UNDERGROUND
- DC WIRING
- STRING WIRING
- GROUND WIRE
- CONDUIT DOWN
- CONDUIT UP

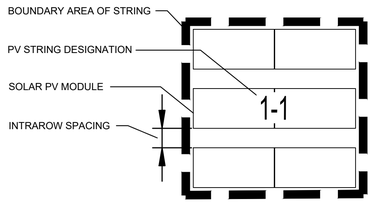
ELECTRICAL DETAIL SYMBOLS

- 1-1 / STRING # / INVERTER # — PV STRING DESIGNATION
- MODULE □PV WIRING PLAN□
- SWITCHGEAR
- INVERTER
- PB — PANEL BOARD
- D — DISCONNECT
- M — METER
- T — TRANSFORMER
- CT — CT CABINET
- C — COMBINER
- DUPLE□ RECEPTACLE
- EV CHARGING STATION
- EV CHARGING ONLY □PARKING SPACE□
- COPPER CLAD GROUND ROD

INVERTER ANNOTATION



PV ARRAY ANNOTATION PLAN



ONE LINE DIAGRAM SYMBOLS □SHEET E601□

- 1-1 / STRING # / INVERTER # — PV STRING DESIGNATION
- MOD 1 (−) (+) — MODULE □ONE - LINE DIAGRAM□
- OPTIMI□ER
- RAPID SHUTDOWN
- PANELBOARD □PB□W□MAIN BREAKER
- DISCONNECT
- FUSED DISCONNECT
- DISCONNECT SWITCH
- TRANSFORMER
- FUSE
- CIRCUIT BREAKER
- CURRENT TRANSFORMER □CTs□
- POTENTIAL TRANSFORMER □PTs□
- BUS BAR
- WYE TRANSFORMER CIRCUIT CONNECTION
- DELTA TRANSFORMER CIRCUIT CONNECTION
- GROUND
- INVERTER
- DISCONNECT
- M — METER
- COMBINER
- SURGE PROTECTIVE DEVICE □SPD□
- DUPLE□ RECEPTACLE
- GFCI DUPLE□ RECEPTACLE
- GFCI WITH IN USE COVER OUTDOOR RATED WEATHER RESISTANT
- EV CHARGING STATION
- UTILITY POLE TO GRID
- STRING 1-1 - (POS.) / STRING 1-1 - (NEG.) — CIRCUIT HOMERUN W□STRING IDENTIFIER
- ROOF / ELEC ROOM — AREA DIVIDER LINE □E601 ONE-LINE DIAGRAM□

ELECTRICAL ABBREVIATION LIST

ABBREVIATION	DESCRIPTION
A	AMPERES
A.F.F.	ABOVE FINISH FLOOR
AU□	AU□ILIARY
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CT	CURRENT TRANSFORMER
DEMO	DEMOLITION
DIM	DIMENSION
DISC	DISCONNECT
DP	DISTRIBUTION PANEL
DWG	DRAWING
ELEC	ELECTRICAL
EM □EMER	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
EVCS	ELECTRIC VEHICLE CHARGING STATION
E□ □E□IST	E□ISTING
FLR	FLOOR
G □GRD □EG	GROUND
GFCI □GFI	GROUND FAULT CIRCUIT INTERRUPTER
HP	HORSEPOWER
HV	HIGH VOLTAGE
H□	HERT□
INV	INVERTER
IG	ISOLATED GROUND
JB	JUNCTION BO□
kV	KILOVOLT
kVA	KILOVOLT- AMPERES
kW	KILOWATT
kWH	KILOWATT - HOURS
MA□	MA□IMUM
MPPT	MA□IMUM POWER POINT TRACKING
MDP	MAIN DISTRIBUTION PANEL
MIN	MINIMUM
MISC	MISCELLANEOUS
MTD	MOUNTED
NEC	NATIONAL ELECTRICAL CODE
N□A	NOT APPLICABLE
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
PNL	PANEL
P	POLE
PH	PHASE
PV	PHOTOVOLTAIC
PT	POTENTIAL TRANSFORMER
PDP	POWER DISTRIBUTION PANEL
RSD	RAPID SHUTDOWN DEVICE
RECEPT	RECEPTACLE
RE□ □D	RE□UIRED
RSC	RIGID STEEL CONDUIT
SW	SWITCH
SWBD	SWITCH BOARD
SWGR	SWITCH GEAR
TELCOM	TELECOMMUNICATIONS
TP	TAMPERPROOF
TYP	TYPICAL
U.O.N.	UNLESS OTHERWISE NOTED
V	VOLTS
V.I.F.	VERIFY IN FIELD
W	WIRE
WP	WEATHERPROOF
□FMR	TRANSFORMER

NOVA Cons□ltants, Inc.
21580 No□ Road
S□ite 300
No□, MI 483□5
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ISSUED

DATE	DESCRIPTION	APPVD.
6-2□-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

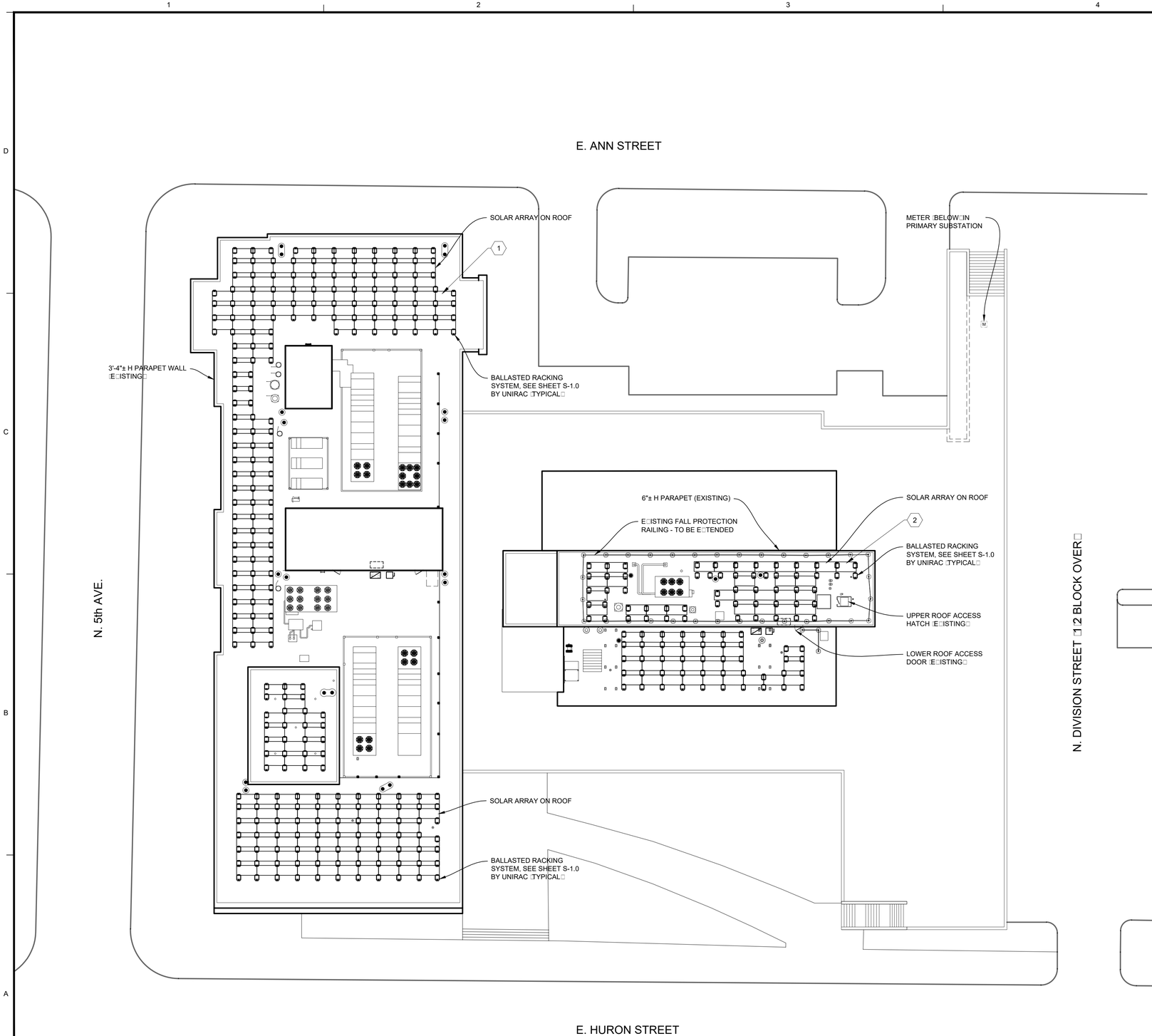
GENERAL NOTATION

PROJECT NUMBER 23-11-1168-CH

DRAWN BY | SHEET NUMBER G002

SCALE

SHEET SI□E 22□34



SITE PLAN

SCALE: 1"=20'

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 80 kW AC, 101.5 kW DC - PV ARRAY (INV-1)
2. 30 kW AC, 33.64 kW DC - PV ARRAY (INV-2)

PV SYSTEM DESCRIPTION

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER

0 5' 10' 20' 40'

SCALE: 1"=20'

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248)-34(-3512
Fax: (248)-34(-4152

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ISSUED

DATE	DESCRIPTION	APPVD.
6-2(-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

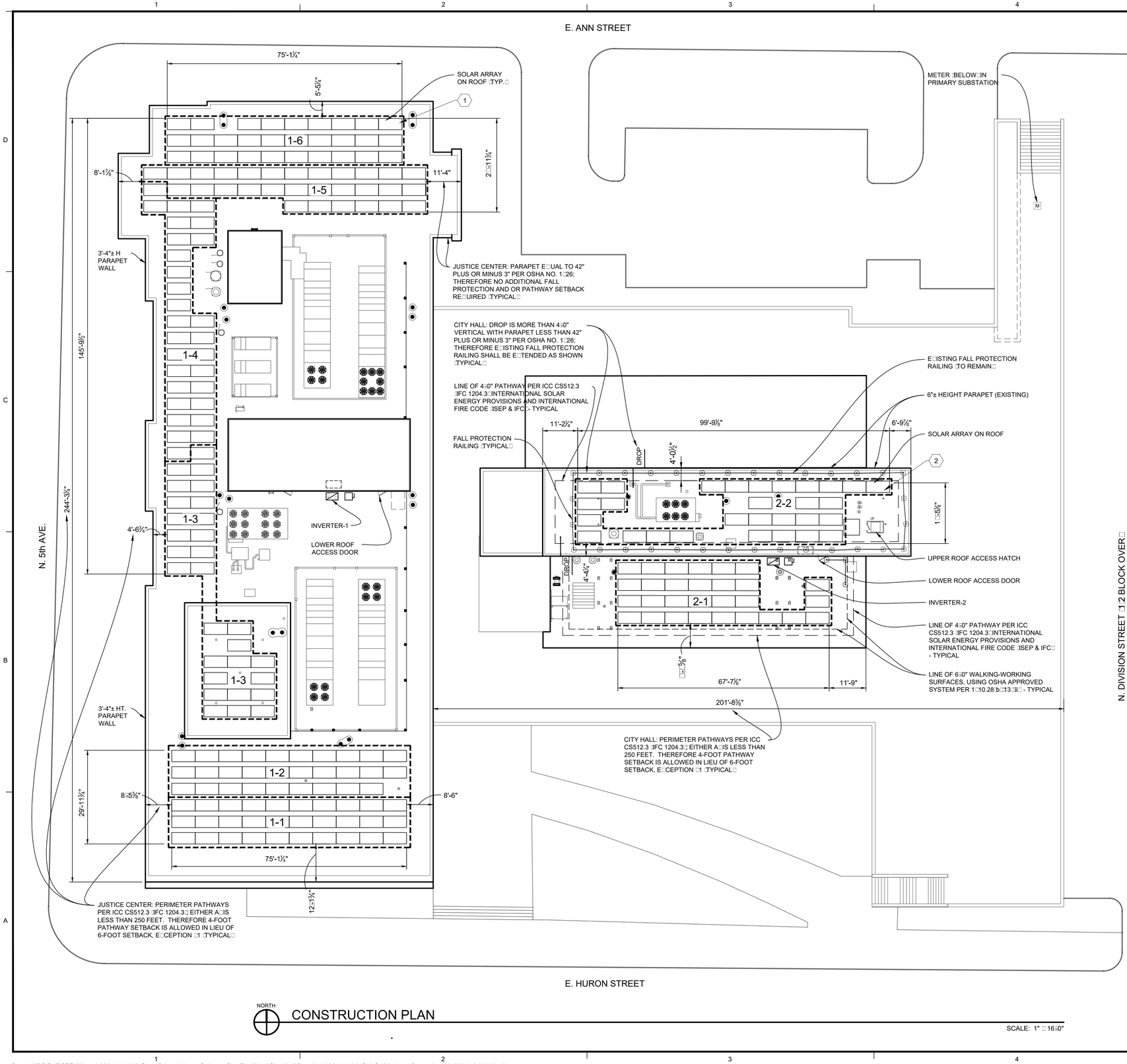
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

SITE PLAN

PROJECT NUMBER	23-11-1168-CH
DRAWN BY	RGM, GAK
SCALE	AS NOTED
SHEET SIZE	22(34
SHEET NUMBER	C101

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\City Hall\Drawings\23111168-CH-C101.dwg Date: Jun 2(2024; (41AM User: george



CONSTRUCTION PLAN

SCALE: 1" = 16'-0"

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC) 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN E)UIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 80 kW AC, 101.5 kW DC - PV ARRAY (INV-1)
2. 30 kW AC, 33.64 kW DC - PV ARRAY (INV-2)

PV SYSTEM DESCRIPTION

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
A)IMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER

SCALE: 1" = 16'

NOVA Cons)tants, Inc.
21580 No) Road
S)te 300
No), MI 483)5
Phone: (248)34)-3512
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www.no)acons)tants.co)

ISSUED

DATE	DESCRIPTION	APPVD.
6-2)-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

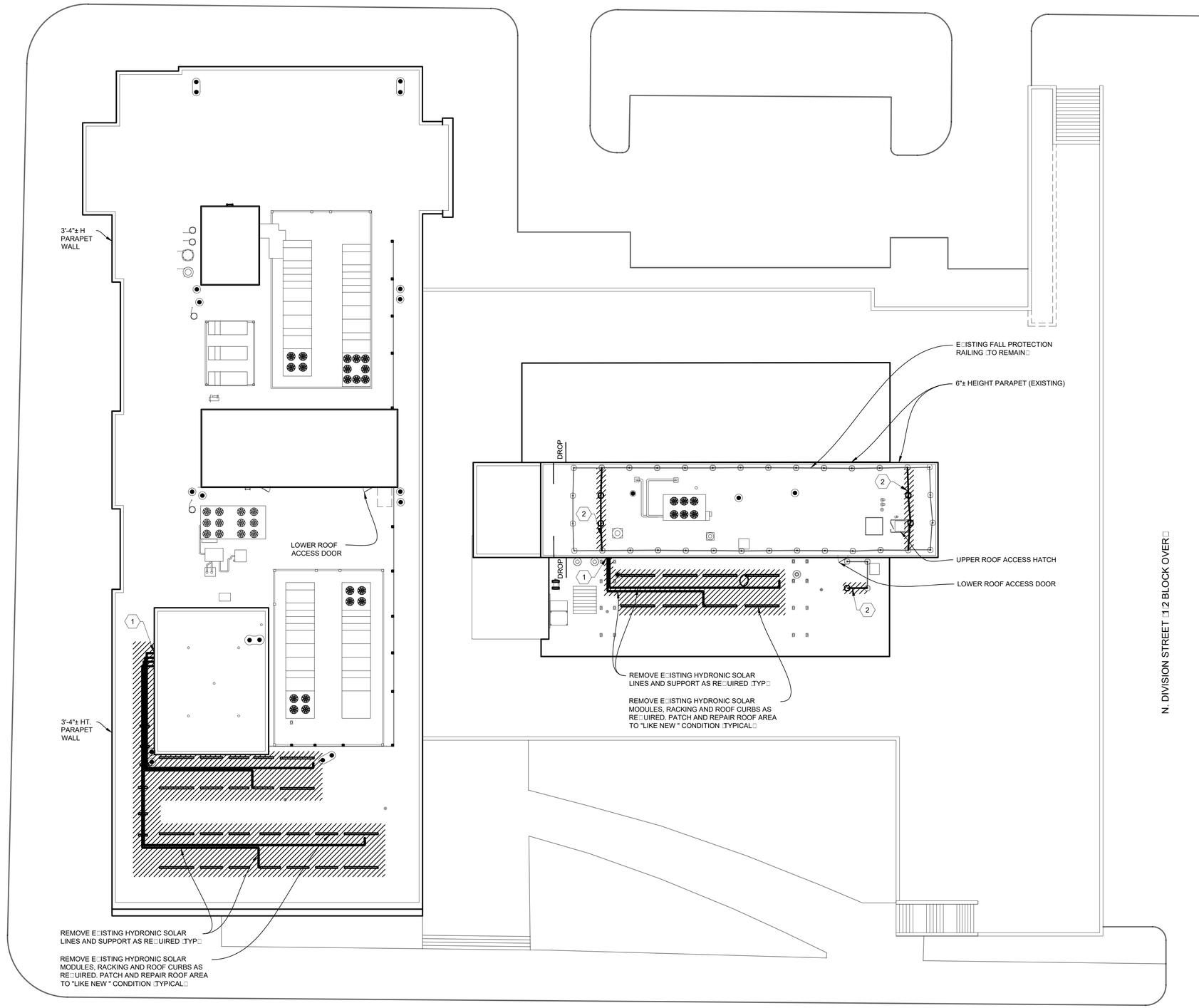
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

CONSTRUCTION PLAN

PROJECT NUMBER: 23-11-1168-CH

DRAWN BY	SHEET NUMBER
RGM, GAK	C102
SCALE: AS NOTED	
SHEET SI)E: 22)34	



NORTH

DEMOLITION PLAN

SCALE: 1" □16□0"

SHEET GENERAL NOTES

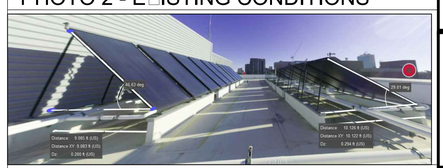
1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE □NEC□ 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.

SHEET KEY NOTES

1. DRAIN, CUT TO STUB AND CAP E□ISTING HYDRONIC SOLAR LINES AS RE□UIRED AND PER CODE □TYPICAL□
2. REMOVE AND RELOCATE E□ISTING FALL PROTECTION AS RE□UIRED

PHOTO 1 - E□ISTING CONDITIONS

PHOTO 2 - E□ISTING CONDITIONS



0 8□ 16□ 32□

SCALE: 1" □16□

NOVA Cons□ltants, Inc.
21580 No□i Road
S□ite 300
No□i, MI 483□5

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DATE	DESCRIPTION	APPVD.
6-2□-2024	BID REVIEW	

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CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

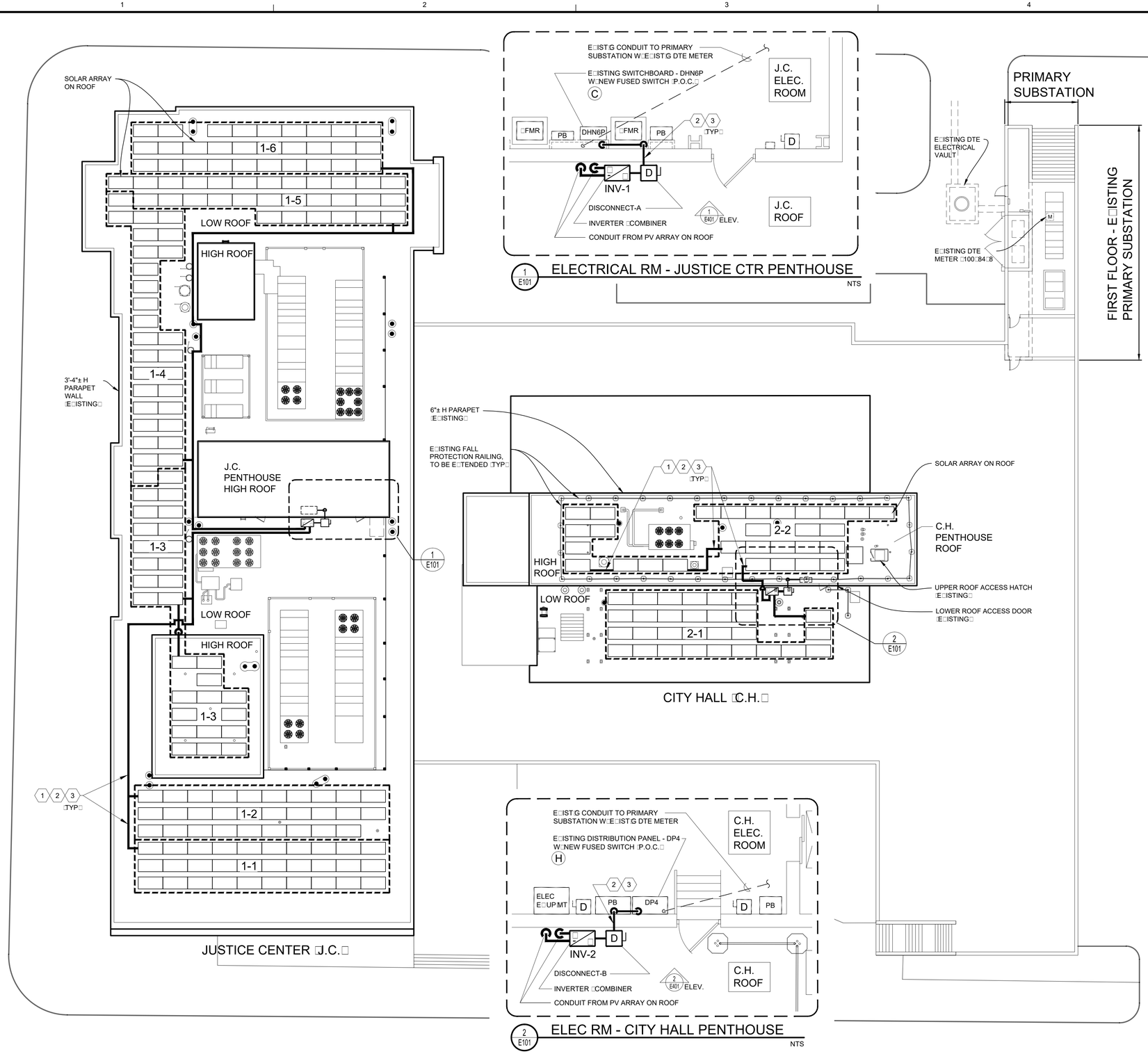
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

DEMONLITION PLAN

PROJECT NUMBER
23-11-1168-CH

DRAWN BY	SHEET NUMBER
RGM, GAK	C103
SCALE: AS NOTED	
SHEET SI□E: 22□34	



SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN E)UIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR E)UAL.
2. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT (WALL) AND CONDUIT SUPPORT DETAILS (ROOF) ON SHEET E501.
3. SEE CONDUIT AND WIRE SI)E CHART ON SHEET E601.

PV SYSTEM DESCRIPTION - GENERAL (1)

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
A)IMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

PV SYSTEM DESCRIPTION - SUMMARY

FOR TOTAL SYSTEM:

PV MODULE MODEL:	JINKO SOLAR, JKM580N-)2HL4-BDV
PV MODULE SI)E:	8)6(" L (44.65" W (1.18" D
NUMBER OF MODULES:	233
PV MODULE PMA)	580 W
OPTIMI)ERS: (120)	SOLAR EDGE S1201)DUAL OPTIMI)ER)
INVERTERS : (2)	1. SOLAR EDGE SE80KUS (80 kW) 2. SOLAR EDGE SE 30 US (30 kW)
NO. OF STRINGS PER INVERTER:	INV (1 (6 STRINGS)
NO. OF STRINGS PER INVERTER:	INV (2 (2 STRINGS)
DC TO AC RATIO:	1.23
NUMBER OF STRINGS:	8
TOTAL NAMEPLATE SI)E:	135.14 kW DC 110.0 kW AC

NOTE: PV SYSTEM IS 1000 V DC (MA).)

PV SYSTEM DESCRIPTION - SECTION (1)

JUSTICE CENTER : INV-1 (80 kW AC)	1)5 MODULES WITH (0 OPTIMI)ERS DC (101.5 kW DC INV-1 DC TO AC RATIO (1.2)
CITY HALL : INV-2 (30 kW AC)	58 MODULES WITH 30 OPTIMI)ERS DC (33.64 kW DC INV-2 DC TO AC RATIO (1.12

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
( )	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
	AC WIRING CONDUIT
	DC WIRING CONDUIT
(P.O.C.)	POINT OF CONNECTION

0 8) 16) 32)
SCALE: 1" (16)

NOVA Cons)ltants, Inc.
21580 No) Road
S)ite 300
No)i, MI 483)5
Phone: (248)34)-3512
Fa) (248)34)-4152
www.no)acons)ltants.co)

ISSUED

DATE	DESCRIPTION	APPVD.
6-2)-2024	INTERCONNECT	
2-2)-2024	BID REVIEW	
)-16-2024	INTERCONNECT REV 1	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

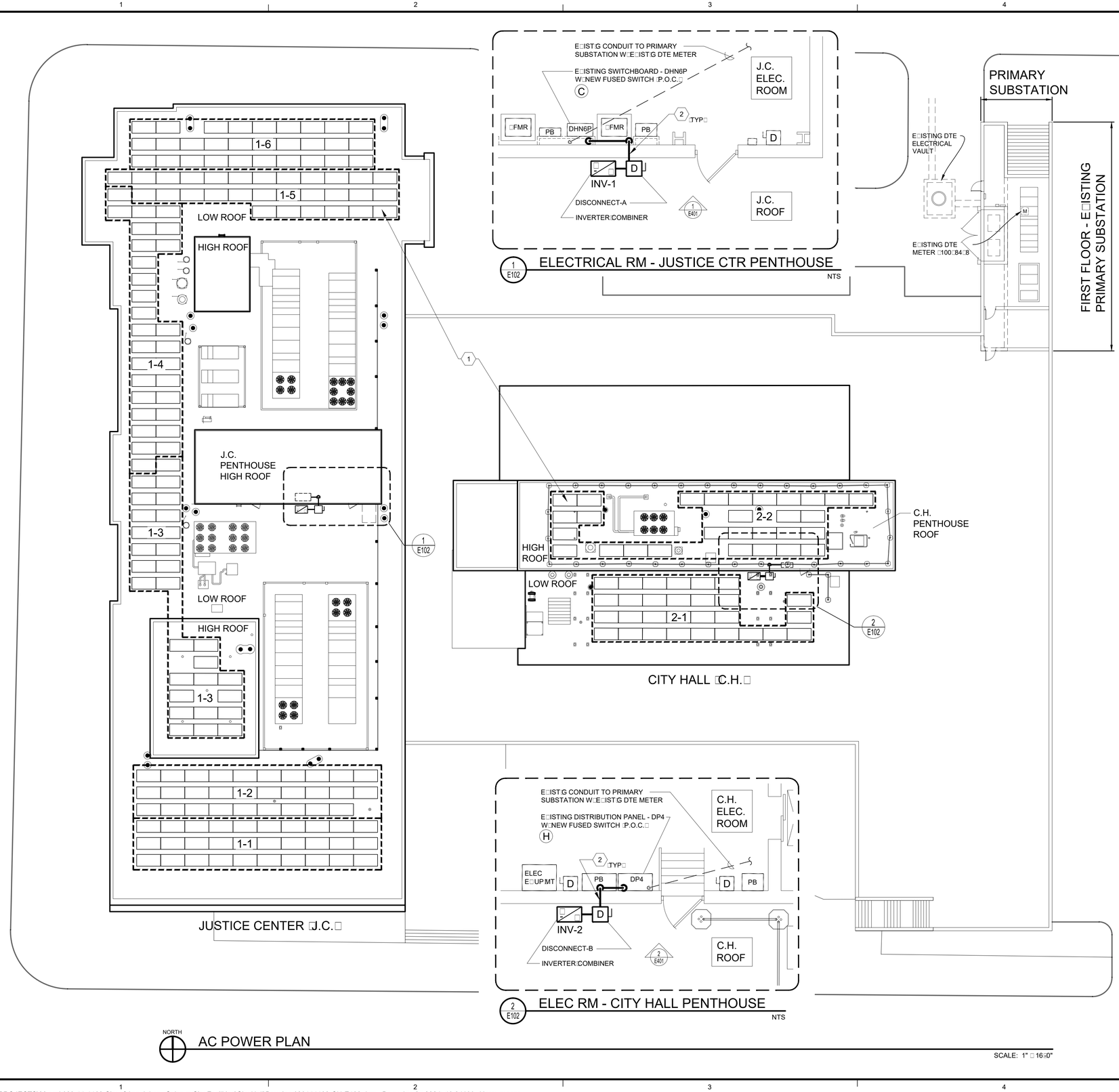
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

ELECTRICAL PLAN

PROJECT NUMBER 23-11-1168-CH

DRAWN BY	SHEET NUMBER
RGM, GAK	E101
SCALE: AS NOTED	
SHEET SI)E: 22)34	



SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE □NEC□ 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN E□UIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 135.14 kW DC SOLAR ARRAY □101.5 kW DC □J.C.□□ 33.64 kW DC □C.H.□□
2. SEE CONDUIT AND WIRE SI□E CHART ON SHEET E601.

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
A□IMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
□ / □	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
	AC WIRING CONDUIT
□P.O.C.□	POINT OF CONNECTION

0 8□ 16□ 32□
SCALE: 1" □ 16□

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No□i, MI 483□5
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ISSUED

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6-2□-2024	BID REVIEW	

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CERTIFICATION

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RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL & JUSTICE CENTER

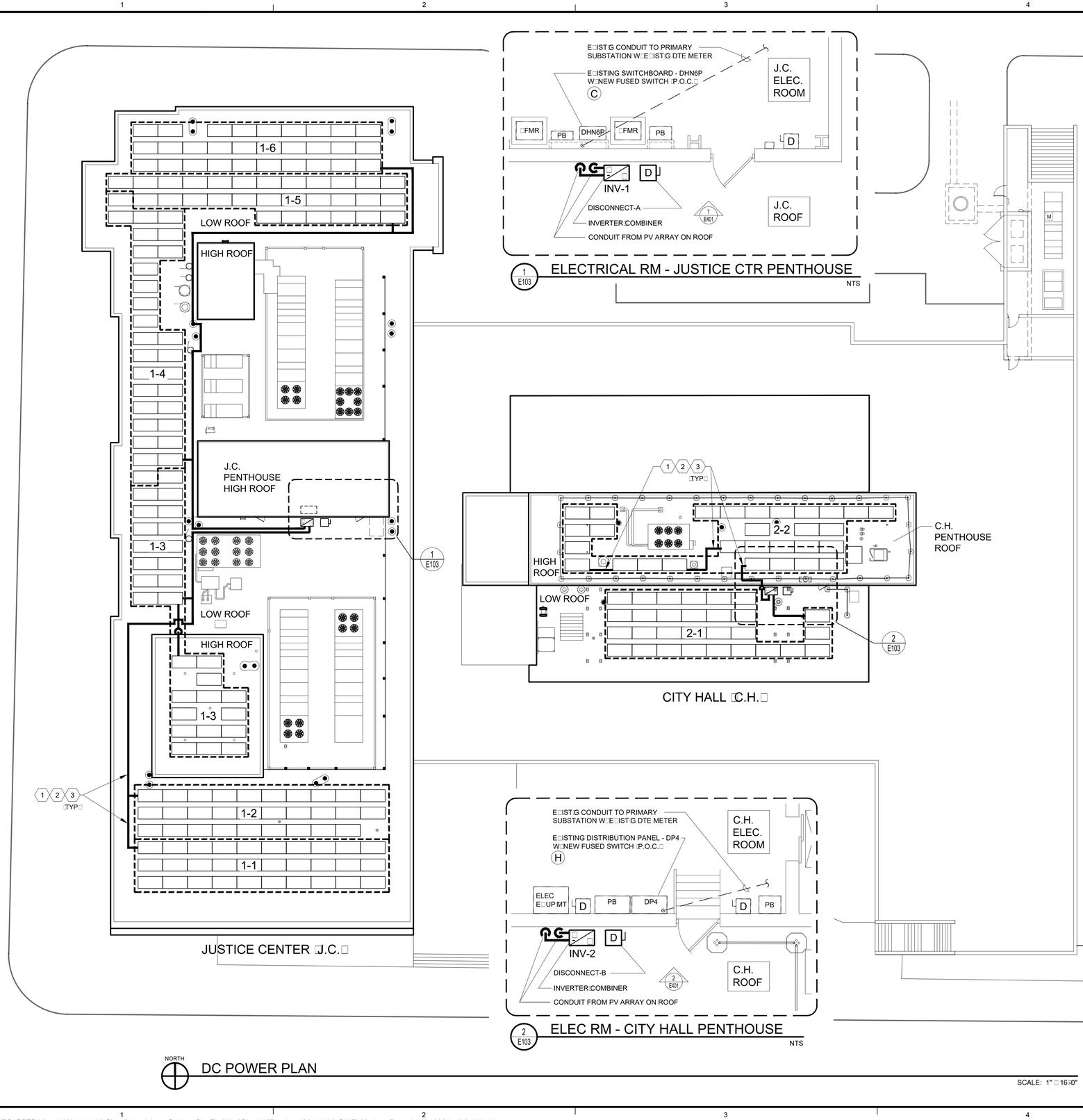
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

AC POWER PLAN

PROJECT NUMBER: 23-11-1168-CH

DRAWN BY	SHEET NUMBER
RGM, GAK	E102
SCALE: AS NOTED	
SHEET SI□E: 22□34	



SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC) 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN E(UIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR E(UAL.
2. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT (WALL) AND CONDUIT SUPPORT DETAILS (ROOF) ON SHEET E501.
3. SEE CONDUIT AND WIRE SI(E CHART ON SHEET E601.

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
A(IMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
(/)	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
———	DC WIRING CONDUIT
(P.O.C.)	POINT OF CONNECTION

0 8(16(32(
SCALE: 1" (16(

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6-2(-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL & JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

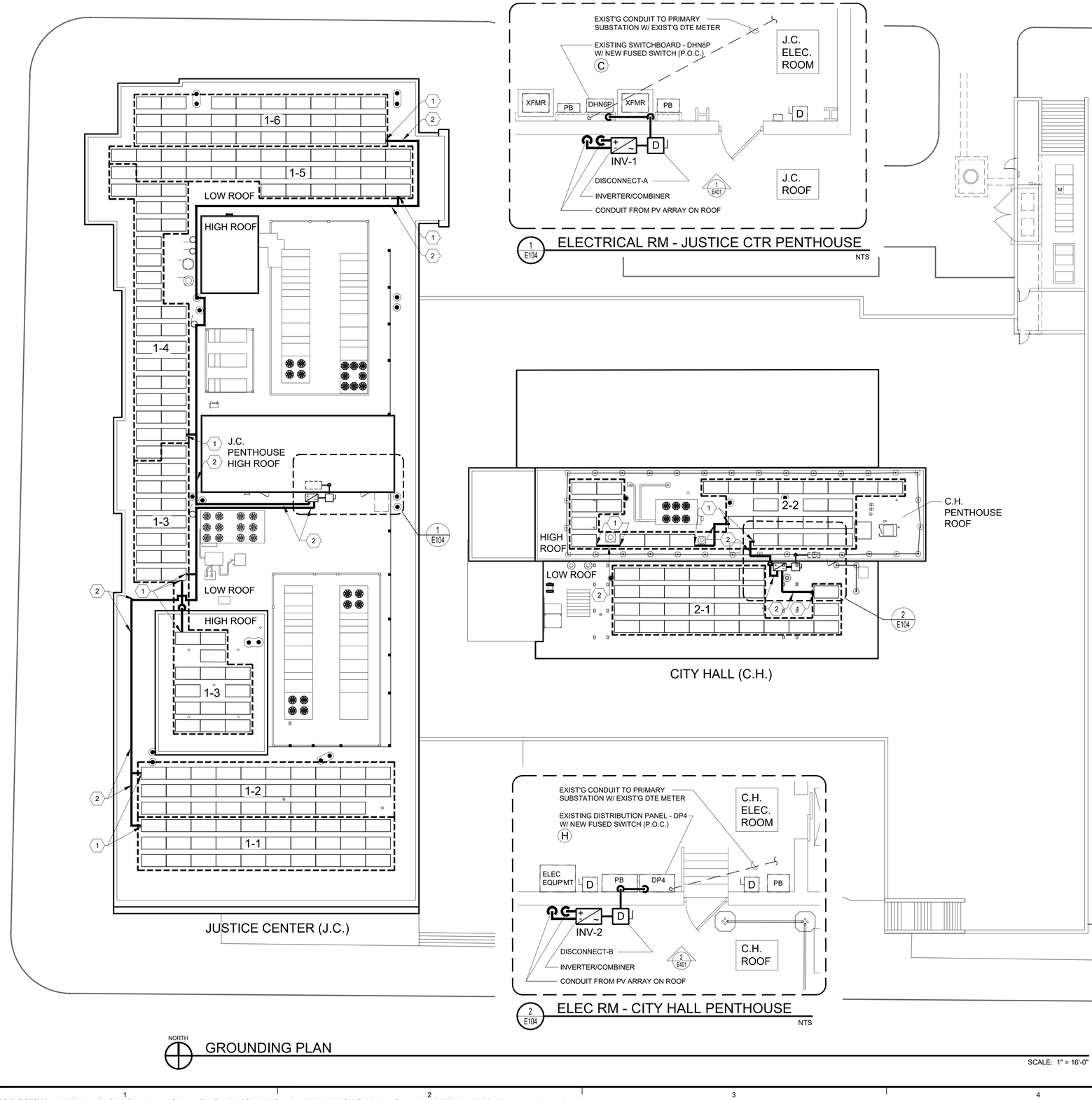
110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

DC POWER PLAN

PROJECT NUMBER: 23-11-1168-CH

DRAWN BY	SHEET NUMBER
RGM, GAK	E103
SCALE: AS NOTED	
SHEET SI(E: 22(34	

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\City Hall\Drawings\23111168-CH-E103.dwg Date: J(n 2(, 2024; 10:2(AM User: george



SHEET GENERAL NOTES

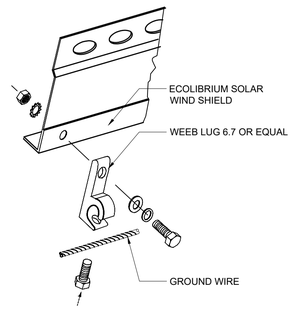
1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS..
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. CONDUIT FILL TO BE LESS THAN 40%.
4. CONTRACTOR TO VERIFY THAT MODULES ARE COMPATABLE WITH RACKING SYSTEM FOR ADEQUATE BONDING AND GROUNDING.
5. CONTRACTOR TO VERIFY WITH RACKING MANUFACTURER THE NUMBER OF GROUNDING LUGS REQUIRED. 1 LUG PER. CONTINUOUS ARRAY, NOT TO EXCEED 150' x 150'.
6. SOLAR PV WIRING METHODS AND WIRING SYSTEMS TO BE INSTALLED GROUNDING COMPLIANT WITH ARTICLE 250 PER NEC 690, PARTS IV AND V.
7. SEE SHEET E501 FOR GROUNDING DETAILS 2

SHEET KEY NOTES

1. INSTALL GROUND LUG PER MANUFACTURER SPECIFICATIONS
2. RACK TO RACK GROUNDING BARE #6 CU. RACK TO INVERTER GROUNDING USE GREEN USE-2 #6 CU

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS



3 E104 GROUNDING LUG DETAIL
SCALE: N.T.S.

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
± ~	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
———	GROUND WIRE
(P.O.C.)	POINT OF CONNECTION

0 8' 16' 32'
SCALE: 1" = 16'

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Novi, MI 48375
Phone: (248) 347-3512
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DATE	DESCRIPTION	APPVD.
6-29-2024	BID REVIEW	
1-27-2025	ADDENDUM-2 2	

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NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

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RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL & JUSTICE CENTER

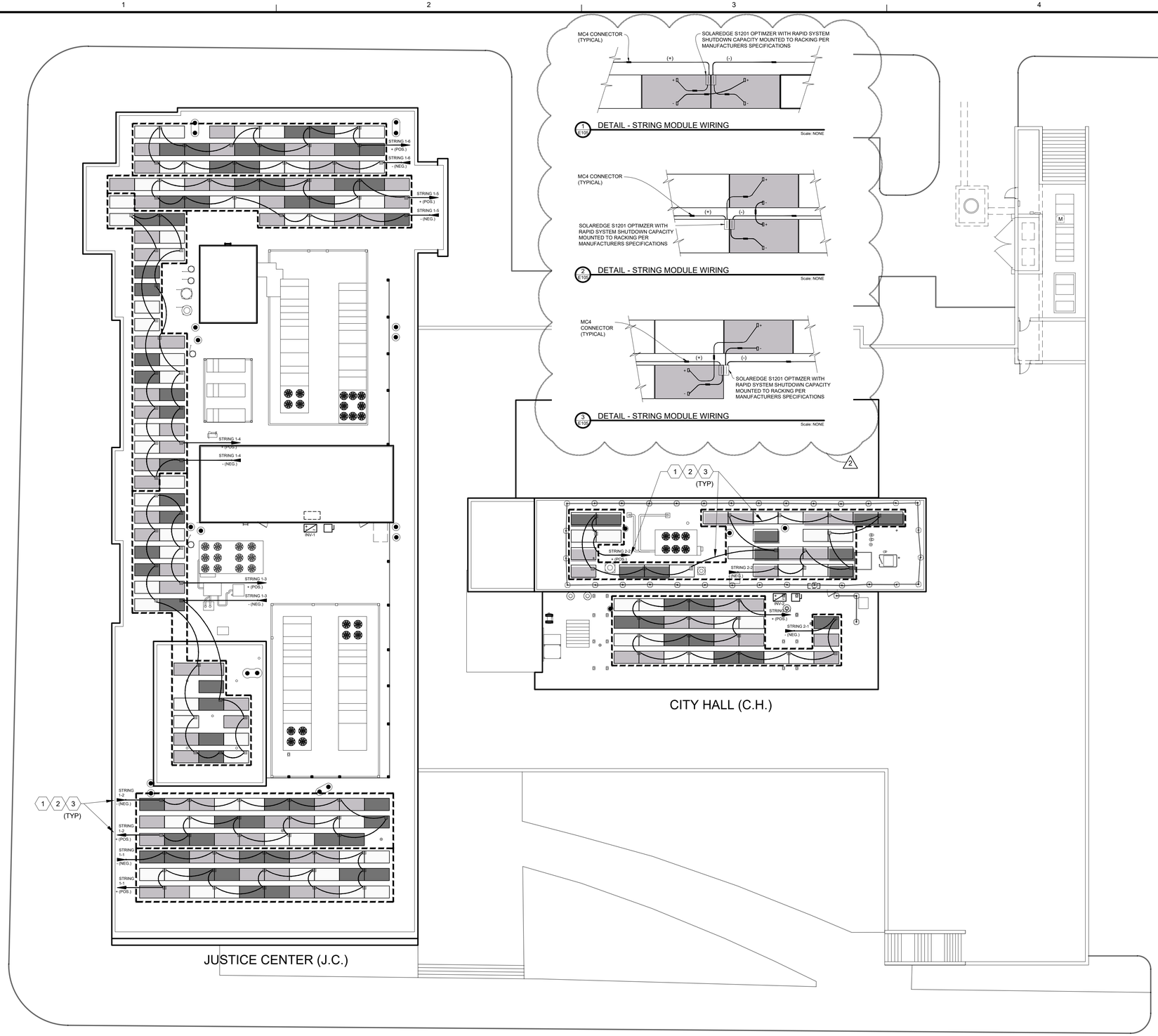
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

GROUNDING PLAN

PROJECT NUMBER 23-11-1168-CH

DRAWN BY	SHEET NUMBER
RGM, GAK	E104
SCALE: AS NOTED	
SHEET SIZE: 22x34	



NORTH

PV WIRING PLAN

SCALE: 1" = 16'-0"

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.
4. PANEL MODULE PAIRS ARE WIRED IN SERIAL. POSITIVE OF FIRST PANEL TO NEGATIVE OF SECOND PANEL WITH REMAINING PANEL FEEDS CONNECTED TO S1201 OPTIMIZERS. 2

SHEET KEY NOTES

1. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR EQUAL.
2. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT (WALL) AND CONDUIT SUPPORT DETAILS (ROOF) ON SHEET E501.
3. SEE CONDUIT AND WIRE SIZE CHART ON SHEET E601.

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

PV SYSTEM DESCRIPTION - ANALYSIS

JUSTICE CENTER : INV-1 (80 kW AC)	175 MODULES WITH 90 OPTIMIZERS DC = 101.5 kW DC INV-1 DC TO AC RATIO = 1.27
CITY HALL : INV-2 (30 kW AC)	58 MODULES WITH 30 OPTIMIZERS DC = 33.64 kW DC INV-2 DC TO AC RATIO = 1.12

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
+ ~	INVERTER
D	DISCONNECT
M	METER
	STRING WIRING

0 8' 16' 32'
SCALE: 1" = 16'

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21580 Novi Road
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DATE	DESCRIPTION	APPVD.
6-29-2024	BID REVIEW	
1-27-2025	ADDENDUM-2 2	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

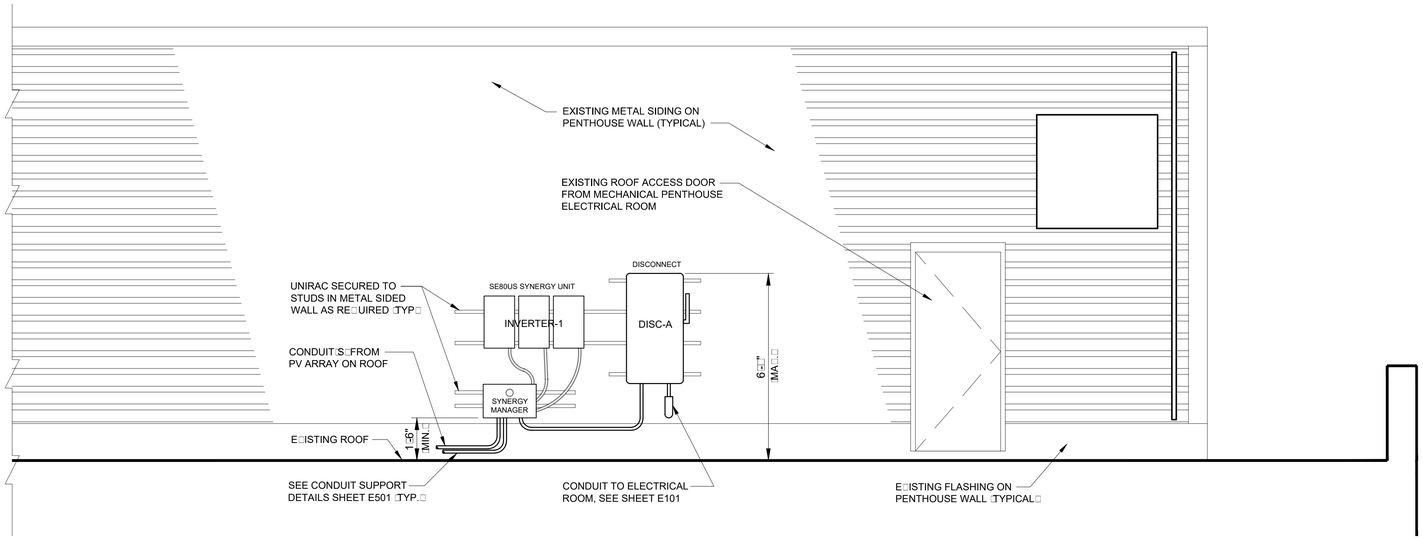
CITY HALL &
JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

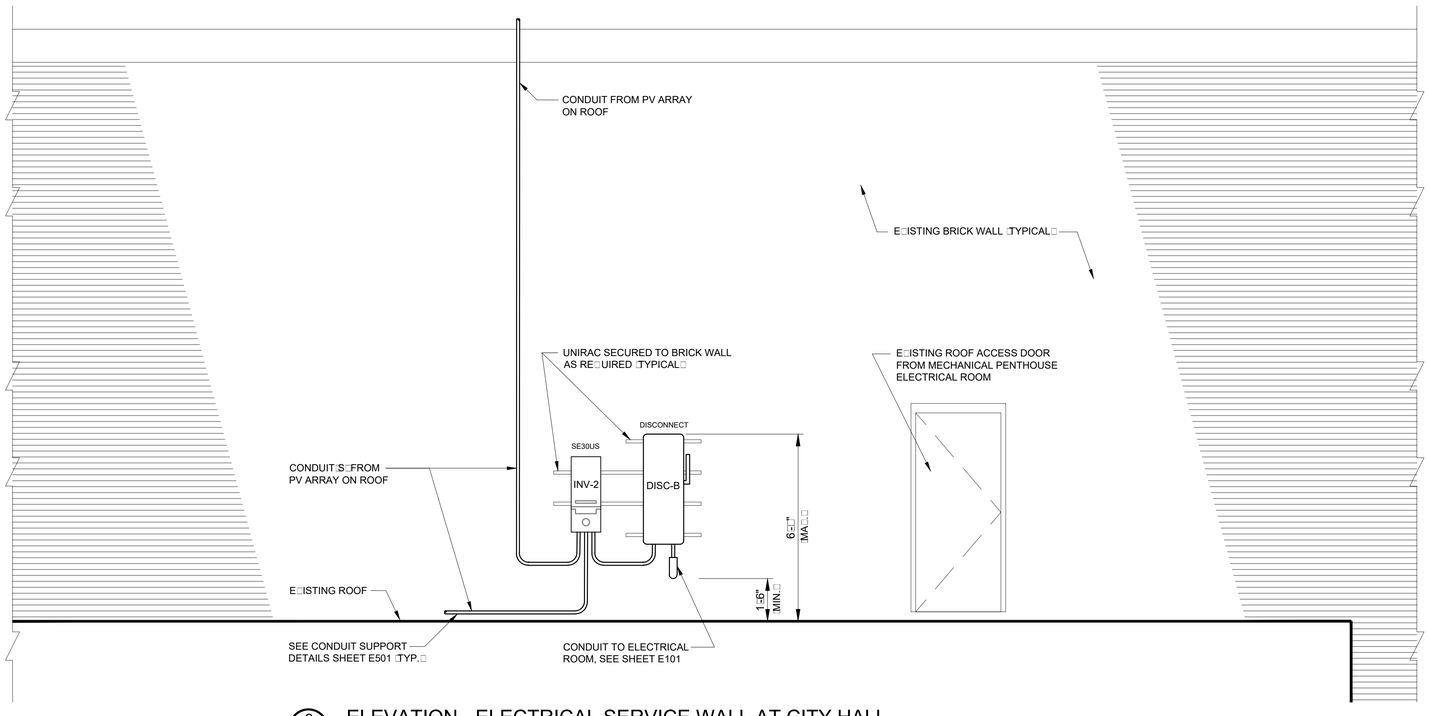
PV WIRING PLAN

PROJECT NUMBER	
23-11-1168-CH	
DRAWN BY: RGM, GAK	SHEET NUMBER: E105
SCALE: AS NOTED	
SHEET SIZE: 22x34	



1 / E401 ELEVATION - ELECTRICAL SERVICE WALL AT JUSTICE CENTER

SCALE: 3/8" = 1'-0"



2 / E401 ELEVATION - ELECTRICAL SERVICE WALL AT CITY HALL

SCALE: 3/8" = 1'-0"

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC) 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. FIELD ADJUST THE ARRAY LAYOUT BASED SITE OBSTRUCTIONS IF NECESSARY.
3. SITE PLAN BASED ON INFORMATION PROVIDED BY OWNER.

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Suite 300
Novi, MI 48375

Phone: (248)-34-3512
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DATE	DESCRIPTION	APPVD.
6-2-2024	BID REVIEW	

REVISED

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RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL & JUSTICE CENTER

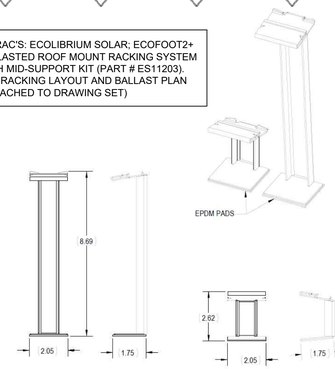
301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

EQUIPMENT RACK ON ROOF

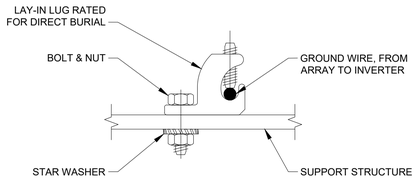
PROJECT NUMBER	
23-11-1168-CH	
DRAWN BY: GAK	SHEET NUMBER: E401
SCALE: AS NOTED	
SHEET SIZE: 22x34	

UNIRAC'S: ECOLIBRIUM SOLAR; ECOFOOT2+ BALLASTED ROOF MOUNT RACKING SYSTEM WITH MID-SUPPORT KIT (PART # ES11203). SEE RACKING LAYOUT AND BALLAST PLAN (ATTACHED TO DRAWING SET)



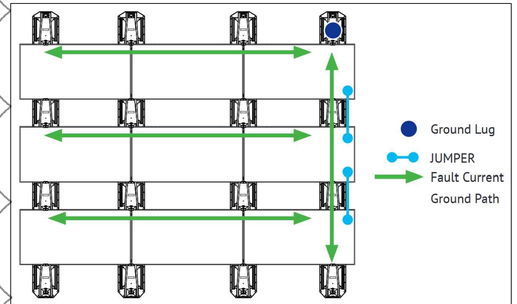
12 E501 MID-SUPPORT KIT

RACK	LUG	HARDWARE
GALVANIZED STEEL	COPPER	GALVANIZED STEEL
ALUMINUM	STAINLESS OR TIN-PLATED COPPER	STAINLESS STEEL
STAINLESS STEEL	COPPER, STAINLESS OR TIN-PLATED COPPER	STAINLESS STEEL



9 E501 GROUNDING DETAIL - MECH. / ELEC.

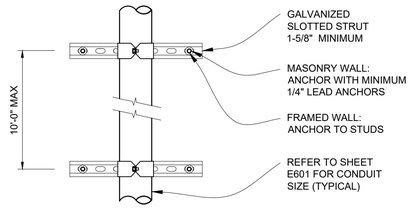
SCALE: NONE



Wind Deflectors carry module-to-module East/West ground bond. Bonding jumpers carry row-to-row North/South ground bond.

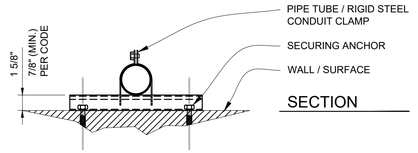
13 E501 MANUFACTURERS GROUNDING PLAN DET.

SCALE: N.T.S.



PLAN VIEW

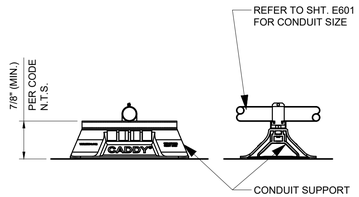
NOTE:
SUPPORT CONDUIT PER NEC 2023
MINIMUM EVERY 10'-0"



SECTION

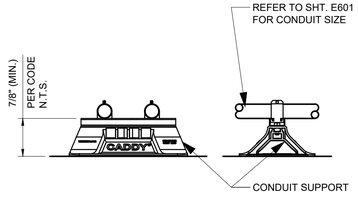
1 E501 VERTICAL CONDUIT SUPPORT - WALL

N.T.S.



2 E501 CONDUIT SUPPORT DETAIL - ROOF

N.T.S.



3 E501 CONDUIT SUPPORT DETAIL - ROOF

N.T.S.

SHEET GENERAL NOTES

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2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. CONDUIT FILL TO BE LESS THAN 40%.

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1-27-2025	ADDENDUM-2	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

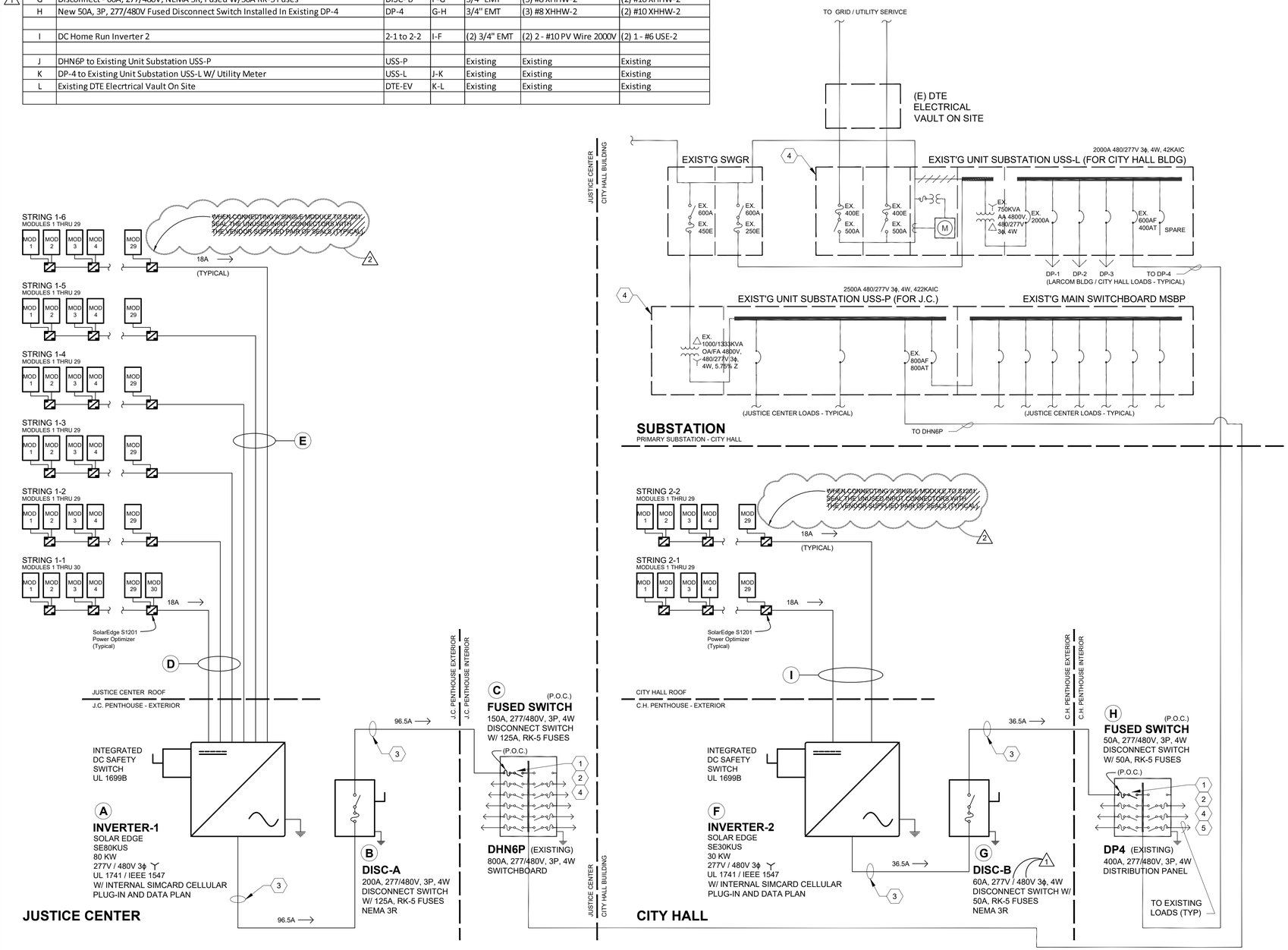
110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

ELECTRICAL DETAILS

PROJECT NUMBER	
23-11-1168-CH	
DRAWN BY: RGM, GAK	SHEET NUMBER: E501
SCALE: AS NOTED	
SHEET SIZE: 22x34	

CONDUIT AND WIRE SIZE CHART

Item	Description	Label	Route	Conduit	Wire (CU)	Neutral/Ground (CU)
	Justice Center					
A	Inverter - 80kW, 277/480V and DC Combiner Box	INV-1				
B	Disconnect - 200A, 3P, 277/480V, NEMA 3R, Fused W/125A RK-5 Fuses	DISC- A	A-B	1 1/4" EMT	(3) #1 XHHW-2	(2) #6 XHHW-2
C	New 277/480V, 3P, 150A Fused Switch Switch Installed In Existing DHN6P W/ 125A RK-	DHN6P	B-C	1 1/4" EMT	(3) #1 XHHW-2	(2) #6 XHHW-2
D	DC Home Runs Inverter 1	1-1 to 1-3	D-A	1 1/4" EMT	(6) - #10 PV Wire 2000V	(1) - #6 USE-2
E	DC Home Runs Inverter 1	1-4 to 1-6	E-A	1 1/4" EMT	(6) - #10 PV Wire 2000V	(1) - #6 USE-2
	City Hall					
F	Inverter - 30kW, 277/480V and DC Combiner Box	INV-2				
G	Disconnect - 60A, 277/480V, NEMA 3R, Fused W/50A RK-5 Fuses	DISC- B	F-G	3/4" EMT	(3) #8 XHHW-2	(2) #10 XHHW-2
H	New 50A, 3P, 277/480V Fused Disconnect Switch Installed In Existing DP-4	DP-4	G-H	3/4" EMT	(3) #8 XHHW-2	(2) #10 XHHW-2
I	DC Home Run Inverter 2	2-1 to 2-2	I-F	(2) 3/4" EMT	(2) 2 - #10 PV Wire 2000V	(2) 1 - #6 USE-2
J	DHN6P to Existing Unit Substation USS-P	USS-P		Existing	Existing	Existing
K	DP-4 to Existing Unit Substation USS-L W/ Utility Meter	USS-L	J-K	Existing	Existing	Existing
L	Existing DTE Elecrtrical Vault On Site	DTE-EV	K-L	Existing	Existing	Existing



A1 ONE LINE DIAGRAM

NO SCALE

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), AND ALL APPLICABLE LOCAL CODES AND STANDARDS.

2. THE INVERTERS INCLUDE RESIDUAL CURRENT DETECTION GFCI AS PART OF THE DC GROUND FAULT DETECTION METHOD REQUIRED BY UL 1741.

3. ARTICLE 310.15(B)(2) EXCEPTION: TYPE XHHW-2 INSULATED CONDUCTORS SHALL NOT BE SUBJECT TO THIS AMPACITY ADJUSTMENT PER 310.15

4. DC CONDUCTORS SHALL BE DERATED PER 310.15

5. SOLAREDGE INVERTERS ARE CERTIFIED UL 1699B FOR ARC FAULT PROTECTION PER SECTION 690.11

6. INVERTER INCLUDES ANTI-ISLANDING PROTECTION COMPLIANT WITH UL 1741 AND IEEE 1547 PER NEC 690.

7.CONTRACTOR TO FIELD VERIFY THAT ALL LISTED GROUNDING ELECTRODES ARE PRESENT AND PROPERLY TERMINATED ON SITE.

8. CONTRACTOR TO VERIFY THAT ALL CIRCUIT BREAKERS ARE SUITABLE FOR BACKFEED

SHEET KEY NOTES

1. AC GROUNDING CONNECTIONS TO DHN6P AND DP4 PROVIDES CONNECTION TO BUILDING GROUNDING ELECTRODE SYSTEM. GROUNDING CONDUCTORS AND BONDING JUMPERS TO BE INSTALLED TO COMPLY WITH ARTICLE 250.

2. NEW LOAD SIDE CONNECTION POWER PRODUCTION CONDUCTORS MUST MEET NEC 690, 705.12, AN UNGROUNDED CONDUCTOR SHALL BE INSTALLED AT THE POINT WHERE THE ELECTRIC POWER PRODUCTION CONDUCTORS ARE CONNECTED TO THE SERVICE.

3. REFER TO CHART ON E-601 FOR CONDUIT AND WIRE SIZES.

4. INSTALL PLACARD SHOWING LOCATIONS OF DISCONNECT AND SOLAR ARRAY.

5. CIRCUIT BREAKERS WITH A CURRENT RATING OF 125 A OR LESS MUST BE MARKED AS SUITABLE FOR 75°C OR 60°/75°C RATED CONDUCTORS. BREAKERS TO BE RATED FOR 25 KAIC OR GREATER.

6. PER NEC 705.28(C)(2), A CONDUCTOR USED SOLELY FOR INSTRUMENTATION, VOLTAGE, DETECTION, OR PHASE DETECTION AND CONNECTED TO A SINGLE-PHASE OR THREE-PHASE INVERTER, SHALL BE PERMITTED TO BE SIZED AT LESS THAN THE AMPACITY OF THE OTHER CURRENT CARRYING CONDUCTORS AND SHALL BE SIZED EQUAL TO OR LARGER THAN THE EQUIPMENT GROUNDING CONDUCTOR.

PV SYSTEM DESCRIPTION - COMBINED SUMMARY

FOR TOTAL SYSTEM:

PV MODULE MODEL:	JINKO SOLAR (EAGLE), JKM580N-72HL4-BDV
PV MODULE SIZE:	89.69" L X 44.65" W X 1.18" D
NUMBER OF MODULES:	233
PV MODULE P_{MAX}:	580 W
OPTIMIZERS: (120)	SOLAR EDGE S1201(DUAL OPTIMIZER)
INVERTERS : (2)	1. SOLAR EDGE SE80KUS (80 kW) 2. SOLAR EDGE SE30KUS (30 kW)
NO. OF STRINGS PER INVERTER:	INV #1 (6 STRINGS)
NO. OF STRINGS PER INVERTER:	INV #2 (2 STRINGS)
DC TO AC RATIO:	1.23
NUMBER OF STRINGS:	8
TOTAL NAMEPLATE SIZE:	135.14 kW DC 110.0 kW AC

NOTE: PV SYSTEM IS 1000 V DC (MAX.)

PV SYSTEM DESCRIPTION - SECTION 1

JUSTICE CENTER : INV-1 (80 kW AC)	175 MODULES W/ 90 OPTIMIZERS (101.5 kW DC) DC TO AC RATIO = 1.27
CITY HALL : INV-2 (30 kW AC)	58 MODULES W/ 30 OPTIMIZERS (33.64 kW DC) DC TO AC RATIO = 1.12

LEGEND

- DISCONNECT SWITCH
- TRANSFORMER
- FUSE
- GROUND
- 1-1 (STRING # / INVERTER #) — PV STRING DESIGNATION
- (P.O.C.) — POINT OF CONNECTION

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

www.novaconsultants.com

ISSUED

DATE	DESCRIPTION	APPVD.
6-27-2024	INTERCONNECT	
6-29-2024	BID REVIEW	
7-16-2024	INTERCONNECT REV 1	
1-27-2025	ADDENDUM-2	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL & JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

ONE LINE DIAGRAM

PROJECT NUMBER
23-11-1168-CH

DRAWN BY: GAK
SCALE:
SHEET SIZE: 22x34
SHEET NUMBER: E601

PHOTOVOLTAIC SYSTEM DISCONNECT

LABEL 1

EACH PV STSTEM DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HA□ARD

DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGI□ED IN THE OPEN POSITION

LABEL 2

THE UTILITY METERING CABINET, EACH INVERTER, EACH DC AND AC DISCONNECTING MEANS □SWITCHES AND BREAKERS□MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HA□ARD

IF GROUND FAULT IS INDICATED ALL NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGI□ED

LABEL 3

PHOTOVOLTAIC SYSTEM DC DISCONNECT

MA□ SYSTEM DC VOLTAGE		1000 V
SHORT CIRCUIT DC CURRENT	80kW INV-1	□6.5 A

LABEL 4A

INVERTER DC DISCONNECT MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

PHOTOVOLTAIC SYSTEM DC DISCONNECT

MA□ SYSTEM DC VOLTAGE		1000 V
SHORT CIRCUIT DC CURRENT	30kW INV-2	45 A

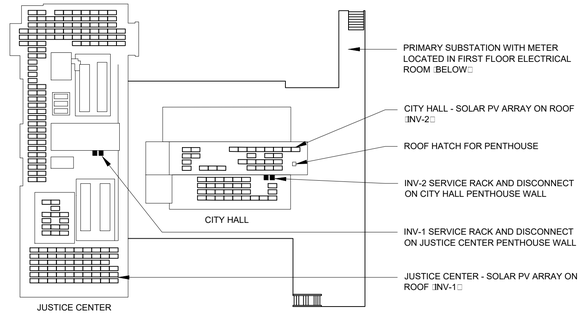
LABEL 4B

INVERTER DC DISCONNECT MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

CAUTION

POWER TO THIS FACILITY IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS AS SHOWN:

NORTH



LABEL 6

INSTALL MAP PLACARD AS PER UTILITY RE□UIREMENTS, SIGNAGE SHALL BE RED BACKGROUND WITH WHITE ENGRAVED LETTERS: □CAUTION ¾", POWER TO...¾"□ CALL OUTS ⅜"□

THIS LABEL TO BE INSTALLED ON DISCONNECT DISC-MAIN□S□

WARNING

DUAL POWER SUPPLY

SOURCES UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

LABEL □

E□UIPMENT BACK FED FROM PHOTOVOLTAIC SYSTEMS MUST BE LABELED WITH THIS PLACARD INCLUDING BOTH 480 V. DISCONNECTS AND PRIMARY SWITCH AT SUBSTATION

PHOTOVOLTAIC SYSTEM AC POINT OF INTERCONNECTION

RATED AC OUTPUT CURRENT	□6.5 A
NOMINAL OPERATING AC VOLTAGE	480 VAC
80kW INV-1	

LABEL 5A

INTERACTIVE SYSTEM POINT OF INTERCONNECTION □DHN6P□ MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

PHOTOVOLTAIC SYSTEM AC POINT OF INTERCONNECTION

RATED AC OUTPUT CURRENT	36.5 A
NOMINAL OPERATING AC VOLTAGE	480 VAC
30kW INV-2	

LABEL 5B

INTERACTIVE SYSTEM POINT OF INTERCONNECTION □DP4□ MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

PHOTOVOLTAIC SOLAR BREAKER

DO NOT RELOCATETHIS OVERCURRENT DEVICE

LABEL 8

LABEL □

WARNING

THIS E□UIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICE SHALL NOT E□CEED AMPACITY OF BUSSBAR

LABEL 10

PHOTOVOLTAIC SYSTEM kWH METER

LABEL 11

AC DISCONNECT

LABEL 12

EACH AC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

DC DISCONNECT

LABEL 13

EACH DC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

CAUTION

PV OUTPUT CIRCUIT

LABEL 14

CAUTION

INVERTER OUTPUT CIRCUIT

LABEL 15

PHOTOVOLTAIC SYSTEM E□UIPPED WITH RAPID SHUTDOWN

LABEL 16

INVERTER AND P.O.I.

DC PHOTOVOLTAIC SOURCE CIRCUIT

LABEL 1□

CAUTION SOLAR CIRCUIT

LABEL 1□

NOVA Cons□ltants, Inc.
21580 No□ Road
S□ite 300
No□, MI 483□5
Phone: □248□34□-3512
Fa□: □248□34□-4152
www.no□acons□ltants.co□

ISSUED

DATE	DESCRIPTION	APPVD.
6-2□-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

LABELS AND PLACARDS

PROJECT NUMBER 23-11-1168-CH

DRAWN BY GAK | SHEET NUMBER E□01

SCALE

SHEET SI□E 22□34

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\City Hall\Drawings\23111168-CH-E□01.dwg Date: J□n 2□2024; 11:14AM User: george

1. BASIC ELECTRICAL RE□UIREMENTS

A. FURNISH AND INSTALL THE MATERIAL, E□UIPMENT AND SYSTEMS COMPLETE AS SPECIFIED AND□OR INDICATED ON THE DRAWINGS.

B. COMPLY WITH THE 2023 NATIONAL ELECTRICAL CODE □NEC□AND ALL APPLICABLE MUNICIPAL, STATE, LOCAL CODES.

C. OBTAIN ALL APPLICABLE PERMITS INCLUDING BUILDING AND ELECTRICAL, LICENSES AND INSPECTIONS AS RE□UIRED.

D. ALL MATERIALS AND E□UIPMENT SHALL BE LISTED AND LABELED BY UL OR OTHER NATIONALLY RECOGNI□ED TESTING LABORATORY.

E. SUBMIT SHOP DRAWINGS, WIRING DIAGRAMS, SPECIFICATIONS, OPERATING DATA, AND□OR CATALOG CUTS FOR ALL E□UIPMENT.

F. FOLLOW □UALITY ASSURANCE PROJECT PLAN □APP□ STARTUP AND COMMISSIONING PROTOCOL.

G. UPON COMPLETION OF THE ELECTRICAL INSTALLATION, THE CONTRACTOR SHALL DELIVER TO NOVA ONE □1□ SET OF PRINTS OF AS-BUILT CONTRACT DRAWINGS SHOWING ALL ADDITIONS AND CHANGES DURING THE INSTALLATION. THESE DRAWINGS SHALL BE SUITABLE FOR USE IN PREPARATION OF RECORD DRAWINGS.

2. BASIC ELECTRICAL MATERIALS AND METHODS.

A. RACEWAYS

INSTALL ALL WIRING IN CONDUIT EXCEPT AS OTHERWISE INDICATED. MINIMUM CONDUIT SIZE TO BE ¾". CONDUIT SHALL BE RIGID GALVANI□ED STEEL ABOVE GROUND AND WHERE USED AS ELBOWS AND STUB-UPS UNDERGROUND. ELECTRICAL METALLIC TUBING □EMT□MAY BE INSTALLED ABOVE GROUND WHERE NOT SUBJECT TO DAMAGE. UNDERGROUND CONDUIT SHALL BE SCHEDULE 40 PVC. INSTALL CONDUITS PARALLEL AND PERPENDICULAR TO WALLS AND OTHER SURFACES. CLEAN, CAP, AND PROVIDE A PULL STRING IN EACH CONDUIT TO BE LEFT EMPTY.

B. BO□ES

JUNCTION BO□ES AND PULL BO□ES SHALL BE STAMPED STEEL OR CAST ALUMINUM, UL LISTED FOR THE APPLICATION.

C. DISCONNECT SWITCHES

UNLESS OTHERWISE INDICATED, DISCONNECT SWITCHES USED INDOORS SHALL HAVE A NEMA 12 ENCLOSURE AND DISCONNECT SWITCHES USED OUTDOORS SHALL HAVE A NEMA 3R ENCLOSURE. DISCONNECT SWITCHES SHALL BE PAD LOCKABLE IN THE OPEN POSITION.

D. GROUNDING

PROVIDE GROUNDING OF THE ENTIRE ELECTRICAL SYSTEM IN ACCORDANCE WITH NEC ARTICLE 250.

PROVIDE E□UIPMENT GROUNDING CONDUCTORS IN ALL BRANCH CIRCUITS AND ALL FEEDERS.

GROUNDING CONDUCTORS SHALL BE CLASS B STRANDED COPPER, GREEN INSULATED. TERMINATE EACH END USING A SUITABLE LISTED CONNECTOR.

BOND PV MODULES AS SHOWN ON THE DRAWINGS. CONNECT BONDING PIGTAILS TO MODULES PER MANUFACTURER'S INSTRUCTIONS. WHERE USED LUGS SHALL BE UL LISTED FOR DIRECT BURIAL.

GROUNDING ELECTRODES □GROUND RODS□SHALL BE COPPER-CLAD STEEL, MINIMUM 5/8" DIAMETER AND 8 FT. LONG.

BOND TOGETHER METAL STRUCTURES PER NEC 250.110.

E. WIRE AND CABLE

1□ WIRE FOR AC CIRCUITS SHALL BE RATED □0 DEGREES C WET OR DRY AND SHALL BE STRANDED COPPER WIRES, TYPE THHN□THWN-2 AND RATED 600V.

2□ WIRE FOR MEDIUM VOLTAGE SHALL BE 1C-15kV CLASS.

3□ WIRE FOR DC CIRCUITS SHALL BE RATED □0 DEGREES C WET OR DRY AND SHALL BE STRANDED COPPER. ALL DC WIRING NOT IN RACEWAY SHALL BE INSULATED TYPE USE-2 OR PV RATED TO 2000V.

4□ DC E□UIPMENT GROUNDING CONDUCTOR SHALL BE MINIMUM OF □6 AWG COPPER AND BE MECHANICALLY ATTACHED TO EACH PV RACKING STRUCTURE UNLESS OTHERWISE NOTED.

5□ NO SPLICES SHALL BE MADE E□CEPT WITHIN BO□ES UL LISTED FOR THE PURPOSE.

F. SENSORS AND SENSOR WIRING

1□ FURNISH AND INSTALL PYRANOMETERS, TEMPERATURE SENSORS, ETC. AS RE□UIRED AND AS SHOWN ON DRAWINGS. ALL WIRING USED FOR CONTROLS AND MONITORING SHALL BE APPROVED BY NOVA.

3. DATA AND COMMUNICATIONS SYSTEMS

A. ALL DATA AND COMMUNICATIONS WIRING □INCLUDING CELL MODEMS□SHALL BE COORDINATED WITH THE CITY OF ANN ARBOR AND INSTALLED BY ELECTRICAL CONTRACTOR OR AS DIRECTED BY NOVA.

4. IDENTIFICATION AND LABELS

A. ALL WIRES SHALL BE LABELED AT EACH END.

B. ALL E□UIPMENT MUST BE LABELED PER NEC ARTICLE 6□0 AND SHEET E-□01.

C. PROVIDE LABEL ON EACH PIECE OF E□UIPMENT, SUCH AS INVERTER, COMBINER BO□ES, DISCONNECT SWITCHES, ETC. THE LABEL SHALL IDENTIFY THE E□UIPMENT BY THE NAME USED ON THE DRAWINGS, SUCH AS INVERTERS, COMBINER BO□ES, DISCONNECT SWITCHES.

5. PV SYSTEM E□UIPMENT

A. PV MODULES:

1□ JINKO SOLAR □EAGLE□JKM580N-□2HL4-BDV □580W□

a. MA□ POWER OUTPUT: P□ a□□580W AT STC

b. VOLTAGE AT MA□ POWER: V□ p □42.5□V

c. OPEN CIRCUIT VOLTAGE: Voc □51.4□V

d. CURRENT AT MA□ POWER: I □pp □13.62A

e. SHORT CIRCUIT CURRENT: I sc □14.3□A

2□ MODULES PER STRING □ 2□ □TYPICAL□ E□CEPTION STRING 1-1 □30 MODULES

3□ STRINGS PER INVERTER □6 □INV. □1□□2 □INV. □2□

4□ NUMBER OF STRINGS □8

5□ No. OF MODULES □233

6□ NEG LEAD LENGTH □LANDSCAPE□□ 55.12"

□□ POS LEAD LENGTH □LANDSCAPE□□ 55.12"

B. POWER OPTIMI□ER

1□ SOLAREDGE S1201 □DUAL OPTIMI□ER□

2□ INPUT WIRE LENGTH IN FEET

INPUT 1	OUTPUT
5.25□	□□□ 1□38□□□0.32□

3□ RATED INPUT DC POWER □ 1200W

4□ USE WITH 2 MODULES CONNECTED IN PARALLEL

5□ PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM, COMPLIANT WITH NEC 2014, 201□, 2023

C. TOTAL ARRAY:

1□ DC NAMEPLATE RATING: □233 □580□□ 135.14 kW

D. RACKING SYSTEM:

1□ UNIRAC'S ECOLIBRIUM SOLAR, ECOFOOT2□ WITH BALLAST

2□ MODULES TILTED 10 DEGREES

E. INVERTER

1□ SOLAREDGE SE 80K US □SE 30K US

2□ NUMBER OF INVERTERS □ 1 □1

3□ MEETS IEEE-154□, RULE 21, RULE 14 □HI□

4□ UL LISTED TO UL-1□41, UL-1□41 SA, UL-16□□B. CSA 2.22

5□ NOMINAL INPUT VOLTAGE DC□ TO DC- □ 850 VDC □INV-1□□850 VDC □INV-2□

6□ MA□IMUM INPUT VOLTAGE DC□ TO DC- □1000 VDC □EACH□

□□ MA□ INPUT CURRENT: □6.5A □INV-1□□36.25A □INV-2□

8□ NOMINAL OUTPUT VOLTAGE: 2□□480 VAC

□□ CONTINUOUS CURRENT OUTPUT: □6.5A □INV-1□□36.25A □INV-2□

10□MA□ CONTINUOUS OUTPUT POWER: 80kW □INV-1□□30kW □INV-2□

5. INSTALLATION

A.

1□ STORE MODULES IN MANUFACTURER'S PACKAGING UNTIL READY TO INSTALL.

2□ PREPARE SURFACE AND INSTALL PER MANUFACTURER'S RECOMMENDATIONS.

3□ ATTACH MODULE GROUNDING TERMINAL TO GROUNDING SYSTEM PER DRAWINGS.

NOVA Cons□ltants, Inc.
21580 No□i Road
S□te 300
No□i, MI 483□5
Phone: □248□34□-3512
Fa□: □248□34□-4152
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CITY OF ANN ARBOR
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301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

ELECTRICAL
SPECIFICATIONS

PROJECT NUMBER
23-11-1168-CH

DRAWN BY
RGM, GAK

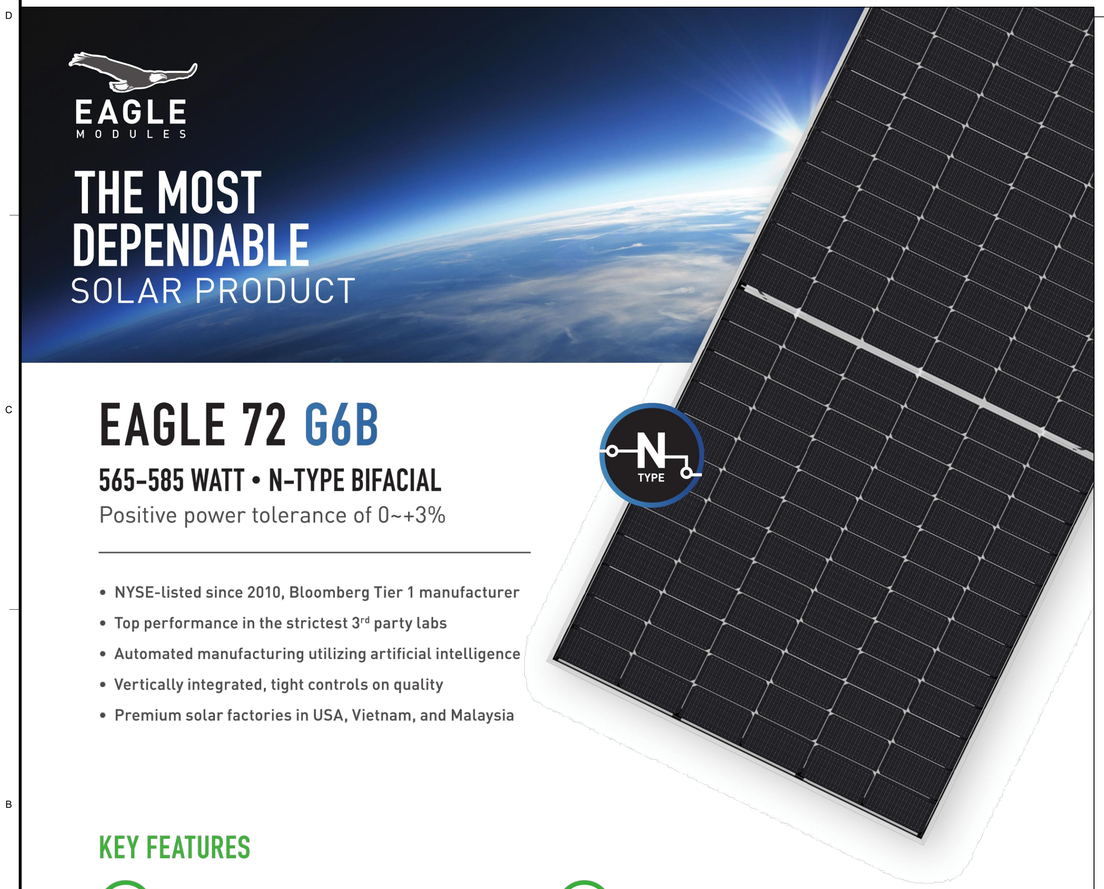
SCALE

SHEET SI□E
22□34

SHEET NUMBER
E□02

EAGLE MODULES

THE MOST DEPENDABLE SOLAR PRODUCT



EAGLE 72 G6B

565-585 WATT • N-TYPE BIFACIAL

Positive power tolerance of 0~+3%

- NYSE-listed since 2010, Bloomberg Tier 1 manufacturer
- Top performance in the strictest 3rd party labs
- Automated manufacturing utilizing artificial intelligence
- Vertically integrated, tight controls on quality
- Premium solar factories in USA, Vietnam, and Malaysia

KEY FEATURES

N-Type Technology
N-type cells offer Jinko's in-house TOPCon technology with better performance and improved reliability.

Multi Busbar Half Cell Technology
Better light trapping and current collection to improve module power output and reliability.

Bifacial Power Gain
N-Type architecture increases bifaciality for higher backside bonus and better lifetime yield.

Low Temperature Coefficient
Best in class temperature coefficient for highest lifetime energy yield in all climates.

Industrial Grade Construction
Fire Type 29 with optimized dual-glass construction and thick frame for highest mechanical load resistance.

Shade Tolerant
Twin array design allows continued performance even with shading by trees or debris.

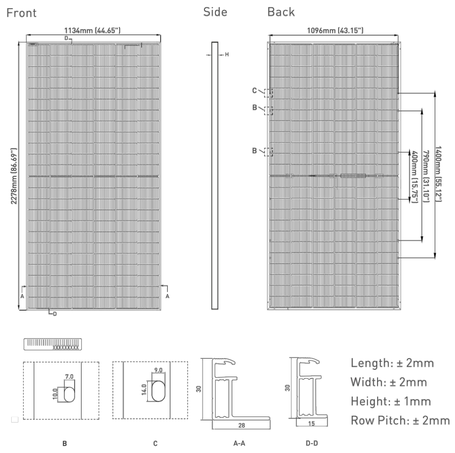
Protected Against All Environments
Certified to withstand humidity, heat, rain, marine environments, wind, hailstorms, and packed snow.

Warranty
12-year product and 30-year linear power warranty.

- ISO9001:2015 Quality Standards
- ISO14001:2015 Environmental Standards
- IEC61215, IEC61730 certified products
- ISO45001: 2018 Occupational Health & Safety Standards
- UL61730 certified products

BUILDING YOUR TRUST IN SOLAR. WWW.JINKOSOLAR.US

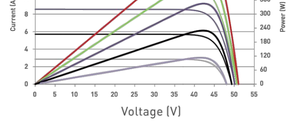
ENGINEERING DRAWINGS



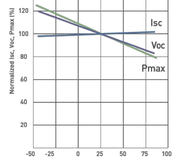
Length: ± 2mm
Width: ± 2mm
Height: ± 1mm
Row Pitch: ± 2mm

ELECTRICAL PERFORMANCE & TEMPERATURE DEPENDENCE

Current-Voltage & Power-Voltage Curves (585W)



Temperature Dependence of Isc, Voc, Pmax



MECHANICAL CHARACTERISTICS

No. of Half Cells	144 (2 x 72)
Dimensions	2278 x 1134 x 30mm (89.69 x 44.65 x 1.18in)
Weight	32kg (70.55lbs)
Front Glass	2.0mm, Anti-Reflection Coating
Back Glass	2.0mm, Heat Strengthened Glass
Frame	Anodized Aluminum Alloy
Junction Box	IP68 Rated
Output Cables	12 AWG, 1400mm (55.12in)
Fire Type	Type 29
Pressure Rating	5400Pa (Snow) & 2400Pa (Wind)

TEMPERATURE CHARACTERISTICS

Temperature Coefficients of Pmax	-0.29%/°C
Temperature Coefficients of Voc	-0.25%/°C
Temperature Coefficients of Isc	0.045%/°C
Nominal Operating Cell Temperature (NOCT)	45±2°C
Bifacial Factor	80±5%

MAXIMUM RATINGS

Operating Temperature (°C)	-40°C~+85°C
Maximum System Voltage	1500VDC
Maximum Series Fuse Rating	30A

PACKAGING CONFIGURATION

(Two pallets = One stack)

36pcs/pallets, 72pcs/stack, 720pcs/40 HQ Container

BIFACIAL OUTPUT-REARSIDE POWER GAIN

5%	Maximum Power (Pmax)	593Wp	599Wp	604Wp	609Wp	614Wp
	Module Efficiency (%)	22.97%	23.17%	23.37%	23.57%	23.78%
15%	Maximum Power (Pmax)	650Wp	656Wp	661Wp	667Wp	673Wp
	Module Efficiency (%)	25.15%	25.37%	25.60%	25.82%	26.05%
25%	Maximum Power (Pmax)	706Wp	713Wp	719Wp	725Wp	731Wp
	Module Efficiency (%)	27.34%	27.58%	27.82%	28.07%	28.31%

WARRANTY

12-year product and 30-year linear power warranty

1st year degradation not to exceed 1%, each subsequent year not to exceed 0.4%, minimum power at year 30 is 87.4% or greater.

ELECTRICAL CHARACTERISTICS

Module Type	JKM565N-72HL4-BDV		JKM570N-72HL4-BDV		JKM575N-72HL4-BDV		JKM580N-72HL4-BDV		JKM585N-72HL4-BDV	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	565Wp	425Wp	570Wp	429Wp	575Wp	432Wp	580Wp	436Wp	585Wp	440Wp
Maximum Power Voltage (Vmp)	42.14V	39.52V	42.29V	39.65V	42.44V	39.78V	42.59V	39.87V	42.74V	40.03V
Maximum Power Current (Imp)	13.41A	10.75A	13.48A	10.81A	13.55A	10.87A	13.62A	10.94A	13.69A	10.99A
Open-circuit Voltage (Voc)	50.87V	48.32V	51.07V	48.51V	51.27V	48.70V	51.47V	48.89V	51.67V	49.08V
Short-circuit Current (Isc)	14.19A	11.46A	14.25A	11.50A	14.31A	11.55A	14.37A	11.60A	14.43A	11.65A
Module Efficiency STC (%)	21.87%		22.07%		22.26%		22.45%		22.65%	

*STC: Irradiance 1000W/m² Cell Temperature 25°C AM = 1.5
NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM = 1.5 Wind Speed 1m/s

*Power measurement tolerance: ±3%

The company reserves the final right for explanation on any of the information presented hereby. JKM565-585N-72HL4-BDV-F2-US

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No□, MI 483□5
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Fa□: □248□34□-4152
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CITY OF ANN ARBOR
SOLAR FACILITIES

CITY HALL &
JUSTICE CENTER

301 E. HURON STREET
ANN ARBOR, MI 48104

110 kW AC SOLAR ARRAY
135 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER 23-11-1168-CH
DRAWN BY GAK
SCALE
SHEET SI□E 22□34
SHEET NUMBER E801

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\City Hall\Drawings\23111168-CH-E801.dwg Date: J□n 2□2024; 11:30AM User: george

Power Optimizer

For North America

S1201

POWER OPTIMIZER

SolarEdge's most advanced, cost-effective Power Optimizer for commercial and large field installations

- **Greater Energy Yields**
  - High efficiency (99.5%) with module-level MPPT, for maximized system energy production and revenue, and fast project ROI
  - Supports high power and bifacial PV modules, and high string current for more power per string.
- **Maximum Protection with Built-In Safety**
  - Designed to automatically reduce high DC voltage to touch-safe levels, upon grid/inverter shutdown, with SafeDC™
  - Includes SolarEdge Sense Connect, allowing continuous monitoring to detect overheating due to installation issues or connector-level wear and tear
- **Lower BoS Costs**
  - Flexible system design enables maximum space utilization and up to 2x longer string lengths, 50% less cables, fuses and combiner boxes
  - Supports connection of two PV modules in series with easy cable management and fast installation times
- **Simpler O&M**
  - Module-level system monitoring enabling pinpointed fault detection and remote, time-saving troubleshooting

solaredge.com

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Power Optimizer

For North America

S1201

	S1201	Units
INPUT		
Rated Input DC Power(1)	1200	W
Absolute Maximum Input Voltage (Voc)	125	Vdc
MPPT Operating Range	12.5 – 105	Vdc
Maximum Short Circuit Current (Isc) of Connected PV Module	15	Adc
Maximum Efficiency	99.5	%
Weighted Efficiency	98.8	%
Overvoltage Category	II	
OUTPUT DURING OPERATION		
Maximum Output Current	18	Adc
Maximum Output Voltage	80	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)		
Safety Output Voltage per Power Optimizer	1	Vdc
STANDARD COMPLIANCE		
Photovoltaic Rapid Shutdown System	Compliant with NEC 2014, 2017, 2020	
EMC	FCC Part15, IEC 61000-6-2, and IEC 61000-6-3	
Safety	IEC62109-1 (class II safety), UL1741, UL3741, CSA C22.2#107.1	
Material	UL94 V-0, UV Resistant	
RoHS	Yes	
Fire Safety	VDE-AR-E 2100-712:2013-05	
INSTALLATION SPECIFICATIONS		
Maximum Allowed System Voltage	1000	Vdc
Dimensions (W x L x H)	129 x 155 x 59 / 5.08 x 6.10 x 2.32	mm / in
Weight	1106 / 2.4	gr / lb
Input Connector	MC4(2)	
Input Wire Length	1.6 / 5.25(3)	m / ft
Output Connector	MC4	
Output Wire Length	(+) 5.3 (-) 0.10 / (+) 17.38, (-) 0.32	m / ft
Operating Temperature Range(4)	-40 to +85 / -40 to +185	°C / °F
Protection Rating	IP68 / NEMA6P	
Relative Humidity	0 – 100	%

(1) Rated power of the module at STC will not exceed the power optimizer Rated Input DC Power. Modules with up to +5% power tolerance are allowed.
(2) For other connector types please contact SolarEdge.
(3) The Sense Connect feature is only enabled on the output cable connectors.
(4) For ambient temperatures above +65°C / +149°F power de-rating is applied.

PV System Design Using a SolarEdge Inverter(5)(6)(7)		208V Grid SE10K	208V Grid SE17.3K*	277/480V Grid SE20K, SE30K	277/480V Grid SE40K*	
Compatible Power Optimizers				S1201		
Minimum String Length	Power Optimizers	8	10	15	15	
	PV Modules	15	19	29	29	
Maximum String Length	Power Optimizers	30	30	30	30	
	PV Modules	60	60	60	60	
Maximum Continuous Power per String		7200	8820	15300	15300	W
Maximum Allowed Connected Power per String(7)		1 string – 8400	1 string – 10020	1 string – 17550	2 strings or less – 17550	W
		2 strings or more – 10600	2 strings or more – 13000	2 strings or more – 23000	3 strings or more – 23000	
Parallel Strings of Different Lengths or Orientations		Yes				
Maximum Difference in Number of Power Optimizers Allowed Between the Shortest and Longest String Connected to the Same Inverter Unit		5 Power Optimizers				

*The same rules apply for Synergy units of equivalent power ratings, that are part of the modular Synergy Technology inverter.
(5) S1201 cannot be mixed with any other Power Optimizers models in the same string.
(6) For each string, a Power Optimizer may be connected to a single PV module if 1) each Power Optimizer is connected to a single PV module or 2) it is the only Power Optimizer connected to a single PV module in the string.
(7) To connect more STC power per string, design your project using SolarEdge Designer.

RoHS

Intertek

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135 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER
23-11-1168-CH

DRAWN BY: GAK
SCALE:
SHEET SI□E: 22□34

SHEET NUMBER
E802

INVERTER - 1

Three Phase Inverter with Synergy Technology

For the 277/480V Grid for North America

SE80KUS / SE100KUS / SE110KUS / SE120KUS

INVERTER

Powered by unique pre-commissioning process for rapid system installation

- Pre-commissioning feature for automated validation of system components and wiring during the site installation process and prior to grid connection
- Easy 2-person installation with lightweight, modular design (each inverter consists of 2 or 3 Synergy units and 1 Synergy Manager)
- Independent operation of each Synergy unit enables higher uptime and easy serviceability
- Built-in thermal sensors detect faulty wiring, ensuring enhanced protection and safety
- Built-in arc fault protection and rapid shutdown
- Built-in PID mitigation for maximized system performance
- Monitored* and field-replaceable surge protection devices, to better withstand surges caused by lightning or other events
- Built-in module-level monitoring with Ethernet or cellular communication for full system visibility

W□INTERNAL SIMCARD CELLULAR PLUG-IN AND DATA PLAN

*Applicable only for DC and AC SPDs

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Three Phase Inverter with Synergy Technology

For the 277/480V Grid for North America

SE80KUS / ~~SE100KUS~~ / ~~SE110KUS~~ / ~~SE120KUS~~

INVERTER - 1

MODEL NUMBER	SE80KUS	SE100KUS	SE110KUS	SE120KUS	
APPLICABLE TO INVERTERS WITH PART NUMBER	SExxK-USx8Ixxxx				UNITS
OUTPUT					
Rated AC Active Output Power	80000	100000	110000	120000	W
Maximum AC Apparent Output Power	80000	100000	120000	120000	VA
AC Output Line Connections	3W + PE, 4W + PE				
Supported Grids	WYE: TN-C, TN-S, TN-C-S, TT, IT; Delta: IT				
AC Output Voltage Minimum-Nominal-Maximum(1) (L-N)	244 – 277 – 305				Vac
AC Output Voltage Minimum-Nominal-Maximum(1) (L-L)	422.5 – 480 – 529				Vac
AC Frequency Min-Nom-Max(1)	59.5 – 60 – 60.5				Hz
Maximum Continuous Output Current (per Phase, PF=1)	96.5	120	144.3		Aac
GFDI Threshold	1				A
Utility Monitoring, Islanding Protection, Configurable Power Factor, Country Configurable Thresholds	Yes				
Total Harmonic Distortion	≤ 3				%
Power Factor Range	+/-0.2 to 1				
INPUT					
Maximum DC Power (Module STC) Inverter / Synergy Unit	140000 / 70000	175000 / 58300	210000 / 70000		W
Transformer-less, Ungrounded	Yes				
Maximum Input Voltage DC+ to DC-	1000				Vdc
Operating Voltage Range	850 – 1000				Vdc
Maximum Input Current	2 x 48.25	3 x 40	3 x 48.25		Adc
Reverse-Polarity Protection	Yes				
Ground-Fault Isolation Detection	167kΩ sensitivity per Synergy Unit(2)				
CEC Weighted Efficiency	98.5				%
Nighttime Power Consumption	< 8	< 12			W
ADDITIONAL FEATURES					
Supported Communication Interfaces(3)	2 x RS485, Ethernet, Wi-Fi (optional), Cellular (optional)				
Smart Energy Management	Export Limitation				
Inverter Commissioning	With the SetApp mobile application using built-in Wi-Fi access point for local connection				
Arc Fault Protection	Built-in, User Configurable (According to UL1699B)				
Photovoltaic Rapid Shutdown System	EC 2014, 2017 and 2020, Built-in				
PID Rectifier	Nighttime, built-in				
RS485 Surge Protection (ports 1+2)	Type II, field replaceable, integrated				
AC, DC Surge Protection	Type II, field replaceable, integrated				
DC Fuses (Single Pole)	25A, integrated				
DC SAFETY SWITCH					
DC Disconnect	Built-in				
STANDARD COMPLIANCE					
Safety	UL1699B, UL1741, UL1741 SA, UL1741 SB, UL1998, CSA C22.2#107.1, Canadian AFCI according to T.I.L. M-07				
Grid Connection Standards	IEEE 1547-2018, Rule 21, Rule 14 (HI)				
Emissions	FCC part 15 class A				

(1) For other regional settings please contact SolarEdge support.
(2) Where permitted by local regulations.
(3) For specifications of the optional communication options, visit the Communication product page or the Resource Library to download the relevant product datasheet.

Three Phase Inverter with Synergy Technology

For the 277/480V Grid for North America

SE80KUS / ~~SE100KUS~~ / ~~SE110KUS~~ / ~~SE120KUS~~

INVERTER - 1

MODEL NUMBER	SE80KUS	SE100KUS	SE110KUS	SE120KUS	
APPLICABLE TO INVERTERS WITH PART NUMBER	SExxK-USx8Ixxxx				UNITS
INSTALLATION SPECIFICATIONS					
Number of Synergy Units per Inverter	2	3			
Ac Max Conduit Size	2 ½"				in
Max AWG Line / PE	4/0 / 1/0				
DC Max Conduit Size	1 x 3"; 2 x 2"				in
DC Input Inverter/ Synergy Unit	8 / 4 pairs; 6-12 AWG	12 / 4 pairs; 6-12 AWG			
	2 pairs / 1 pair, Max 2 AWG; copper or aluminum	3 pairs / 1 pair, Max 2 AWG; copper or aluminum			
Dimensions (H x W x D)	Synergy Unit: 22 x 12.9 x 10.75 / 558 x 328 x 273 Synergy Manager: 14.17 x 22.4 x 11.6 / 360 x 560 x 295				in / mm
Weight	Synergy Unit: 70.4 / 32 Synergy Manager: 39.6 / 18				lb / kg
Operating Temperature Range	-40 to +140 / -40 to +60(4)				°F / °C
Cooling	Fan (user replaceable)				
Noise	< 67				dBA
Protection Rating	NEMA 3R				
Mounting	Brackets provided				

(4) For power de-rating information refer to the Temperature De-rating - Technical Note (North America).

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S□ite 300
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135 kW DC SOLAR ARRAY

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SCALE
SHEET SI□E 22□34
SHEET NUMBER E803

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INVERTER - 2

Three Phase Inverters for the 277/480V Grid

for North America

SE20KUS / SE30KUS / SE33.3KUS

12-20 YEAR WARRANTY

INVERTERS

The best choice for SolarEdge enabled systems

- Quick and easy inverter commissioning directly from a smartphone using the SolarEdge SetApp
- Specifically designed to work with power optimizers
- Superior efficiency (98%)
- Fixed voltage inverter for longer strings
- Integrated Safety Switch
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- Built-in module-level monitoring
- Internet connection through Ethernet or Wireless
- Small, lightweight, and easy to install outdoors or indoors on provided bracket
- Supplied with RS485 Surge Protection Device, to better withstand lightning events

solaredge.com

W□INTERNAL SIMCARD CELLULAR PLUG-IN AND DATA PLAN

solaredge

Three Phase Inverters for the 277/480V Grid(1)

for North America

~~SE20KUS~~ / SE30KUS / ~~SE33.3KUS~~

INVERTER - 2

MODEL NUMBER	SE20KUS	SE30KUS	SE33.3KUS	
APPLICABLE TO INVERTERS WITH PART NUMBER		SEXXK-XXXXXBXX4		
OUTPUT				
Rated AC Power Output	20000	30000	33300	VA
Maximum AC Power Output	20000	30000	33300	VA
Output Line Connections	3 phase, 4-wire / PE (L1-L2-L3-N), TN, TT			
AC Output Voltage Minimum-Nominal-Maximum(2) (L-N)	244-277-305			Vac
AC Output Voltage Minimum-Nominal-Maximum(2) (L-L)	422.5-480-529			Vac
AC Frequency Min-Nom-Max(2)	59.3 - 60 - 60.5			Hz
Maximum Continuous Output Current (per Phase)	24	36.5	40	A
GFDI Threshold	1			A
Utility Monitoring, Islanding Protection, Country Configurable Set Points	Yes			
THD	≤ 3			%
INPUT				
Maximum DC Power (Module STC)	27000	40500	45000	W
Transformer-less, Ungrounded	Yes			
Maximum Input Voltage DC to Gnd	490			Vdc
Maximum Input Voltage DC+ to DC-	1000			Vdc
Nominal Input Voltage DC to Gnd	420			Vdc
Nominal Input Voltage DC+ to DC-	850			Vdc
Maximum Input Current	26.5	39	40	Adc
Maximum Input Short Circuit Current	45			Adc
Reverse-Polarity Protection	Yes			
Ground-Fault Isolation Detection	1MΩ Sensitivity	350kΩ Sensitivity(3)		
CEC Weighted Efficiency	98	98.5		%
Night-time Power Consumption	< 3	< 4		W
ADDITIONAL FEATURES				
Supported Communication Interfaces	RS485, Ethernet, Built-in Cellular (optional)			
Inverter Commissioning	With the SetApp mobile application using built-in access point for local connection			
Rapid Shutdown – NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect(4)			
RS485 Surge Protection Plug-in	Supplied with the inverter			
Smart Energy Management	Export Limitation			
STANDARD COMPLIANCE				
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07			
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (HI)			
Emissions	FCC part15 class B			
INSTALLATION SPECIFICATIONS				
AC output conduit size / AWG range	3/4" minimum / 12-6 AWG	3/4" minimum / 8-4 AWG		
DC input conduit size / AWG range	3/4" minimum / 12-6 AWG			
Number of DC inputs	2 pairs	3 pairs(4)		
Dimensions (H x W x D)	21 x 12.5 x 10.5 / 540 x 315 x 260			in / mm
Dimensions with Safety Switch (H x W x D)	30.5 x 12.5 x 10.5 / 775 x 315 x 260			in / mm
Weight	73.2 / 33.2	93.6 / 42.5		lb / kg
Weight with Safety Switch	79.7 / 36.2	100.3 / 45.5		lb / kg
Cooling	Fans (user replaceable)			
Noise	< 50	< 55		dBA
Operating Temperature Range	-40 to +140 / -40 to +60(5)			°F / °C
Protection Rating	NEMA 3R			

(1) For 120/208V inverters refer to: https://www.solaredge.com/sites/default/files/se-three-phase-us-inverter-208V-setapp-datasheet.pdf
(2) For other regional settings please contact SolarEdge support
(3) Where permitted by local regulations
(4) Field replacement kit for 1 pair of inputs P/N: DCD-3PH-1TBK; Field replacement kit for 3 pairs of fuses and holders P/N: DCD-3PH-6FHK-S1
(5) For power de-rating information refer to: https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf

CE

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SHEET NUMBER E804

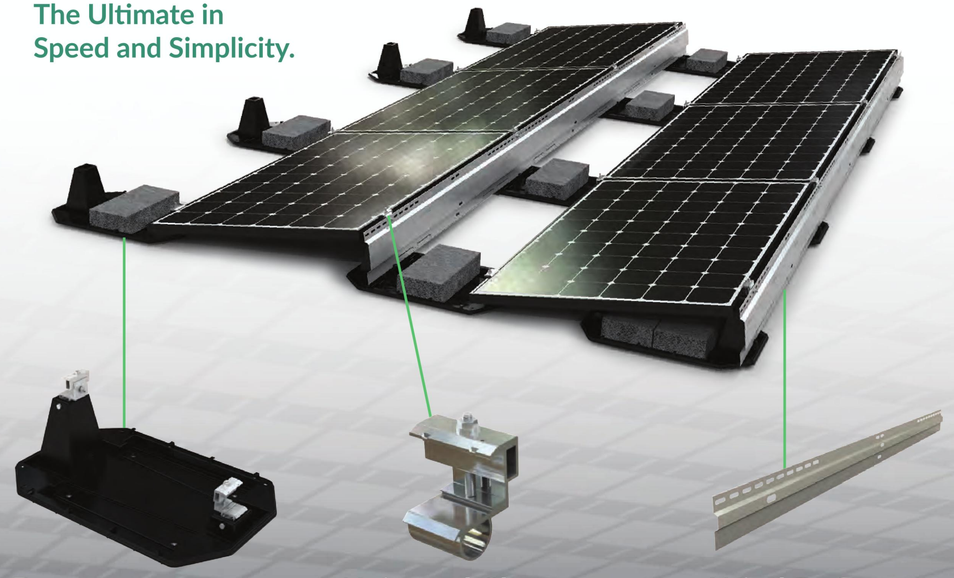
EcoFoot2+®

Ballasted Racking System

Installer-Preferred for Low-Slope Roofs

Three Main Components.

The Ultimate in Speed and Simplicity.



Base

UL-Listed ASA based resin is a durable material commonly used for automotive and construction products. Wire Clips are built-in for easy wire management. Class A fire rated and UL2703 Certified.

Universal Clamp

The preassembled Universal Clamp is ready to go right out of the box. Simply drop the Clamp into the Base. Integrated Bond Pin achieves integrated grounding without the use of grounding washers. Fits 30-50mm module frames with a single component.

Wind Deflector

Corrosion-resistant wind deflector on every module helps minimize uplift, reduce ballast requirements and carries UL2703 validated ground path from modules and racking components.

Ecolibrium Solar

Contact: 740.249.1877 | sales@ecolibriumsolar.com | www.ecolibriumsolar.com

Pure Performance

Unbeatable, Right Out of the Box.

No other racking products install flat roof arrays better than EcoFoot2+ Racking Solution. Installers prefer EcoFoot2+ because it's fast, simple, and durable. The line-up is unbeatable:

- Ready-to-go, preassembled components and simple installation
- No PV panel prep required: bases self-align
- Low-effort roof layout, just two chalk lines required
- No training required, 5-minute learning curve

Commercial

Residential

Design Flexibility

Wire Management Built-In

Master the Most Challenging Rooftop

Stackable Bases fit up to 50kW of Bases delivered on a standard pallet.

System Benefits

- Low part count
- Rapid system deployment
- Preassembled Universal Clamp
- Increased design flexibility
- More ballast capacity
- Simplified logistics
- Ship up to 50kW per pallet

Validation Summary

- Certified to UL2703 Fire Class A for Type I and II modules
- Certified to UL2703
- Grounding and Bonding
- Wind tunnel tested to 150mph
- SEAOC seismic compliant
- CFD and structurally tested
- DNV GL rated at 13.5 panels per installer-hour

Technical Specifications

Dimensions: 26.5"L x 18.25"W x 8.3"H
Typical System Weight: 3.5–6 lbs. per sq. ft.
Module orientation: Landscape/Portrait
Tilt angle: Landscape 10°/Portrait 5°
Module inter-row spacing: 18.9”
Roof pitch: 0° to 7°
Clamping range: 30-50mm
Ballast requirements: 4" x 8" x 16"
Warranty: 25 years
Slip sheets: not required by Ecolibrium Solar.
If required by roofer, use 20"x29" under Base.

Ecolibrium Solar

740-249-1877 | www.ecolibriumsolar.com
507 Richland Avenue, Athens, OH 45701

EcoFoot2+ Sales Sheet v2.1 121919

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21580 Novi Road
Suite 300
Novi, MI 48375
Phone: 248-347-3512
Fax: 248-347-4152
www.novaconsultants.com

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SHEET SIZE 22x34
SHEET NUMBER E805

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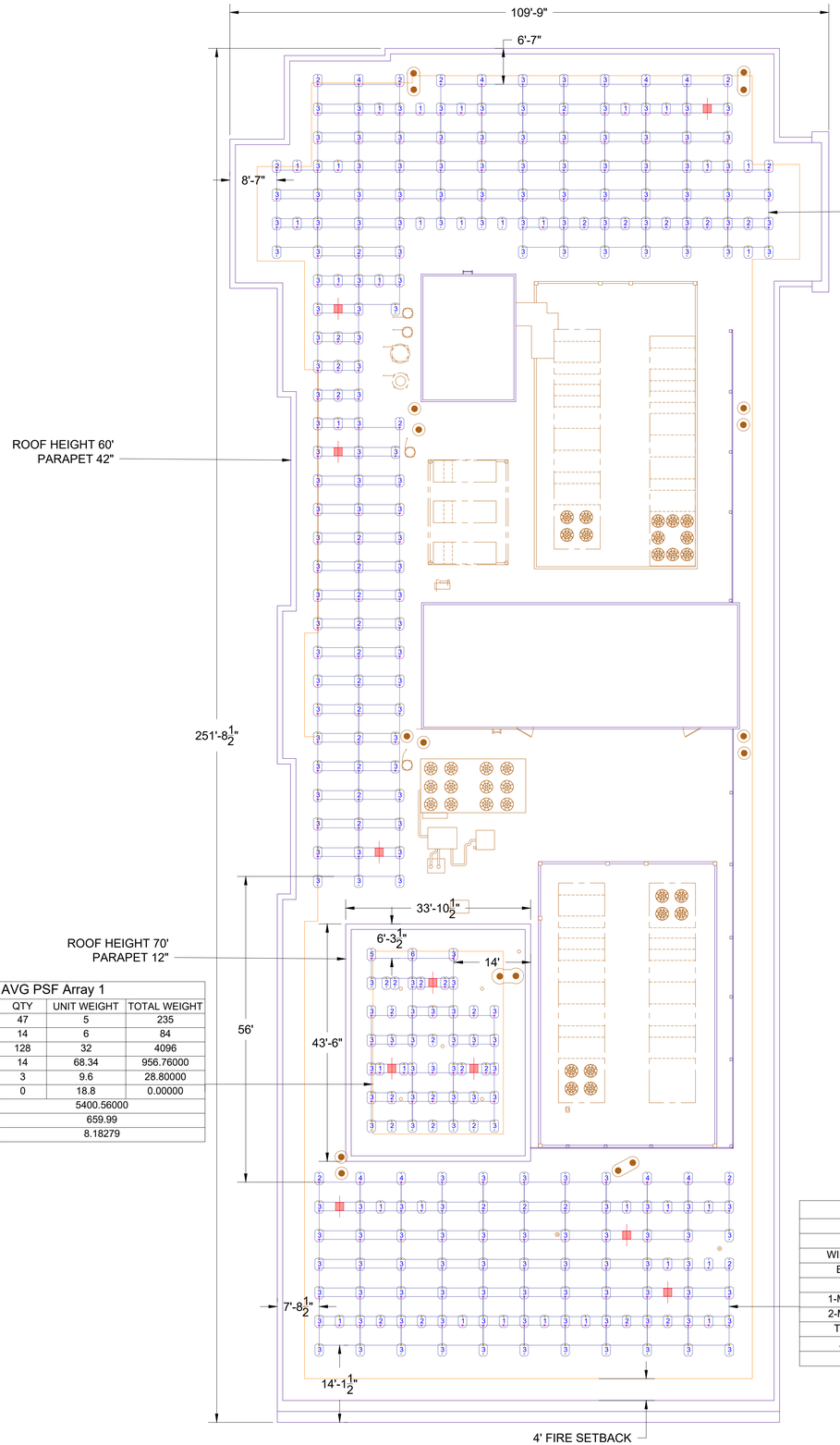
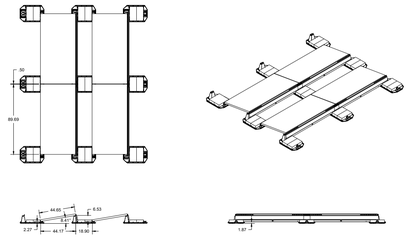


BOM and AVG PSF Array 2			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	172	5	860
WIND DEFLECTORS K	102	6	612
BALLAST BLOCKS	459	32	14688
PANELS	102	68.34	6970.68000
1-MOD ATTACHMENT	4	9.6	38.40000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	23169.08000		
ARRAY AREA(sft)	4416.51		
AVG PSF	5.24602		

BOM and AVG PSF Array 1			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	47	5	235
WIND DEFLECTORS K	14	6	84
BALLAST BLOCKS	128	32	4096
PANELS	14	68.34	956.76000
1-MOD ATTACHMENT	3	9.6	28.80000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	5400.56000		
ARRAY AREA(sft)	659.99		
AVG PSF	8.18279		

BOM and AVG PSF Array 1			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	94	5	470
WIND DEFLECTORS K	59	6	354
BALLAST BLOCKS	250	32	8000
PANELS	59	68.34	4032.06000
1-MOD ATTACHMENT	3	9.6	28.80000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	12884.86000		
ARRAY AREA(sft)	2503.02		
AVG PSF	5.14773		



JINKO SOLAR JKM580N-72HL4-BDV 580W

ECOFOOT2+ LANDSCAPE ELEVATION/ISO VIEWS

SCALE: NTS UNITS: INCHES

MODULE NOTES

-PV MODULE SPECS (W): 580

-PV MODULE QUANTITY: 175

-SYSTEM POWER RATING (STC KWDC): 101.5

-ORIENTATION/TILT (DEGREE): LANDSCAPE/8.41°

BALLAST NOTES

-BALLAST BLOCK: 16"x8"x4" @ 32 LBS

ECOFOOT 2+ (BLOCK PER E2+):

N = BASE WITH NO OF BLOCKS

= 1 MODULE ATTACHMENT

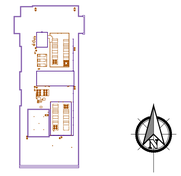
ARRAY OF GREATEST AVERAGE PSF = 8.18

BILL OF MATERIALS

PART NO	NAME	QTY
ES20207	ECOFOOT2+	313
ES10466	UNIVERSAL CLAMP KIT	273
ES20311K	WIND DEFLECTOR	175
ES10970	ECOFOOT MLPE BRACKET	175
ES10378	38" BONDING JUMPER	41
ES11203	MID-SUPPORT KIT	175
310999	FLASHLOC RM	10
ES10843	ROOF TO STRUT	10
ES10844	STRUT TO MODULE	10
ES20501	1 5/8" X 1 5/8" 12 GAUGE STRUT (10')	5
USER SUPPLIED	32 LBS BALLAST BLOCK (SOURCED LOCALLY OR SUPPLIED BY OTHERS)	837
008009P	ILSCO LAY IN LLUG	3

SITE NOTES

BASIC WIND SPEED (MPH)	120
EXPOSURE CATEGORY	B
GROUND SNOW LOAD (PSF)	20
OCCUPANCY CATEGORY	IV
SEISMIC (Ss)	0.094
ROOF HEIGHT (FT)	VARIES
PARAPET HEIGHT (IN)	VARIES
SETBACK TYP. (IN)	48
ROOF SLOPE (DEG)	1.20
ROOFING TYPE	TPO
ASCE7 VERSION	2010
BUILDING CODE	IBC 2015



NO.	REVISION	BY	DATE
0	INITIAL RELEASE	SG	2024-6-7

UNIRAC®
1411 BROADWAY BOULEVARD NE
ALBUQUERQUE, NEW MEXICO, USA, 87102
WWW.UNIRAC.COM

PRODUCED FOR: NOVA CONSULTANTS INC

PROJECT NAME:
JUSTICE CENTER 301 E
HURON ST
ANN ARBOR, MI 48104 48104

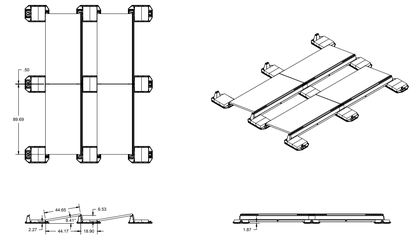
Date: 2024-06-07

Scale: CUSTOM

Drawn By: SG

Sheet: S-1.0

DRAWING INDICATES PLACEMENT OF EQUIPMENT AND BALLAST. PLEASE REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS. INSTALLER IS RESPONSIBLE FOR VERIFICATION OF SITE AND PROJECT SPECIFICS. DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.



JINKO JKM 580N-72HL4-BDV 580W

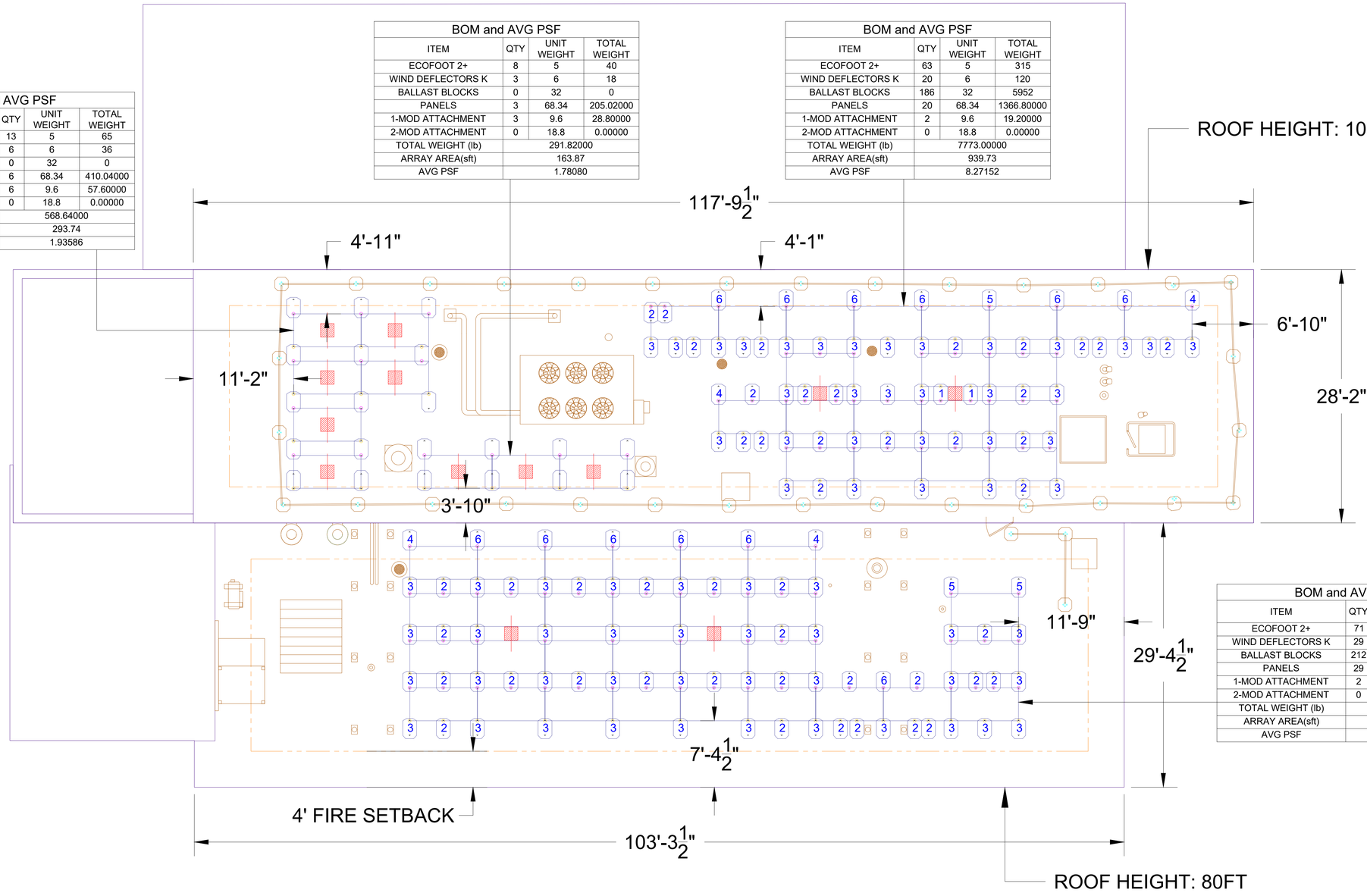
ECOFOOT2+ LANDSCAPE ELEVATION/ISO VIEWS

SCALE: NTS UNITS: INCHES

BOM and AVG PSF			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	13	5	65
WIND DEFLECTORS K	6	6	36
BALLAST BLOCKS	0	32	0
PANELS	6	68.34	410.04000
1-MOD ATTACHMENT	6	9.6	57.60000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	568.64000		
ARRAY AREA(sft)	293.74		
AVG PSF	1.93586		

BOM and AVG PSF			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	8	5	40
WIND DEFLECTORS K	3	6	18
BALLAST BLOCKS	0	32	0
PANELS	3	68.34	205.02000
1-MOD ATTACHMENT	3	9.6	28.80000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	291.82000		
ARRAY AREA(sft)	163.87		
AVG PSF	1.78080		

BOM and AVG PSF			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	63	5	315
WIND DEFLECTORS K	20	6	120
BALLAST BLOCKS	186	32	5952
PANELS	20	68.34	1366.80000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	7773.00000		
ARRAY AREA(sft)	939.73		
AVG PSF	8.27152		



BOM and AVG PSF			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	71	5	355
WIND DEFLECTORS K	29	6	174
BALLAST BLOCKS	212	32	6784
PANELS	29	68.34	1981.86000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)	9314.06000		
ARRAY AREA(sft)	1305.96		
AVG PSF	7.13196		

MODULE NOTES

-PV MODULE SPECS (W): 580

-PV MODULE QUANTITY: 58

-SYSTEM POWER RATING (STC KWDC): 33.64

-ORIENTATION/TILT (DEGREE): LANDSCAPE/8.41°

BALLAST NOTES

-BALLAST BLOCK: 16"x8"x4" @ 32 LBS

ECOFOOT 2+ (BLOCK PER E2+):

= BASE WITH BLOCK COUNT

= 1 MODULE / SEISMIC ATTACHMENT

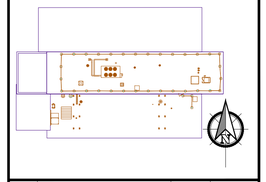
ARRAY OF GREATEST AVERAGE PSF = 8.27

BILL OF MATERIALS

PART NO	NAME	QTY
ES20207	ECOFOOT2+	155
ES10466	UNIVERSAL CLAMP KIT	116
ES20311K	WIND DEFLECTOR	58
ES10970	ECOFOOT MLPE BRACKET	58
ES10378	38" BONDING JUMPER	13
ES11203	MID-SUPPORT KIT	58
310999	FLASHLOC RM	13
ES10843	ROOF TO STRUT	13
ES10844	STRUT TO MODULE	13
ES20501	1 5/8" X 1 5/8" 12 GAUGE STRUT (10')	6
USER SUPPLIED	32 LBS BALLAST BLOCK (SOURCED LOCALLY OR SUPPLIED BY OTHERS)	398
008009P	ILSCO LAY IN LUG	4

SITE NOTES

BASIC WIND SPEED (MPH)	120
EXPOSURE CATEGORY	B
GROUND SNOW LOAD (PSF)	20
OCCUPANCY CATEGORY	IV
SEISMIC (Ss)	0.094
ROOF HEIGHT (FT)	VARIES
PARAPET HEIGHT (IN)	6
SETBACK TYP. (IN)	48
ROOF SLOPE (DEG)	1.20
ROOFING TYPE	OTHER
ASCE7 VERSION	2010
BUILDING CODE	IBC 2015



NO.	REVISION	BY	DATE
0	INITIAL RELEASE	PK	2024-6-4

UNIRAC®
1411 BROADWAY BOULEVARD NE
ALBUQUERQUE, NEW MEXICO, USA, 87102
WWW.UNIRAC.COM

PRODUCED FOR: NOVA CONSULTANTS INC

PROJECT NAME: CITY HALL

301 EAST HURON STREET
ANN ARBOR, MI 48104

Date: 2024-06-05

Scale: CUSTOM

Drawn By: PK

Sheet: S-1.0

DRAWING INDICATES PLACEMENT OF EQUIPMENT AND BALLAST. PLEASE REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS. INSTALLER IS RESPONSIBLE FOR VERIFICATION OF SITE AND PROJECT SPECIFICS. DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

SOLAR PROJECT DESIGN

Prepared For: Nova Consultants Inc
Project Name: Justice Center
Project Address: 301 E Huron St, Ann Arbor, MI 48104
Date: June 7, 2024

SOLUTION OVERVIEW

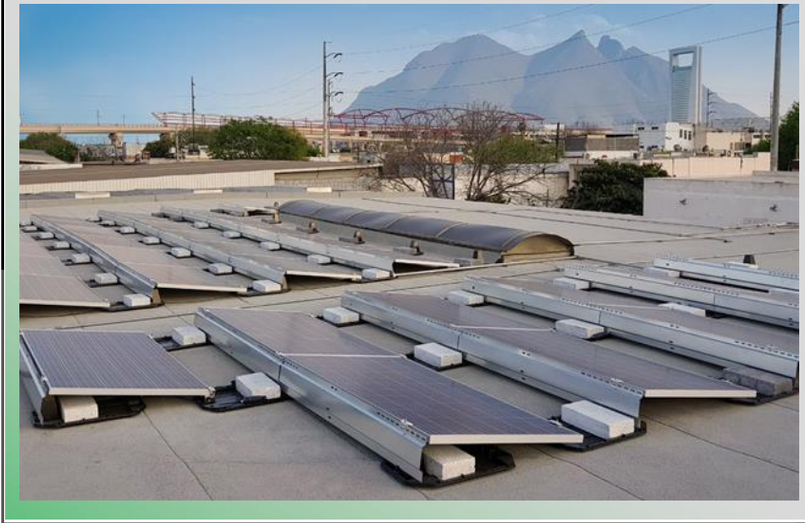
EcoFoot2+ Low-Slope Racking

With 500MW installed, EcoFoot Racking is preferred by installers for fast, simple installation and streamlined logistics. The enclosed provides the layout and system details for a complete solution for your project using this validated and reliable product.

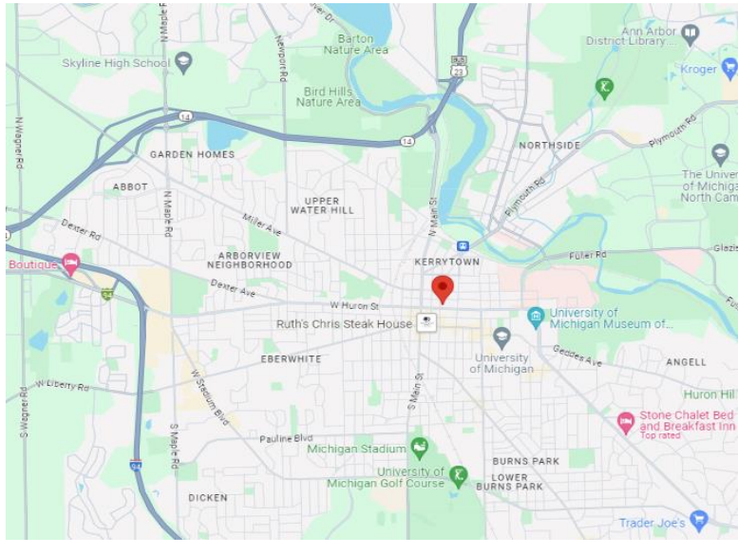
EcoFoot2+ delivers key advantages for a successful, efficient installation.
Faster Installation: Installers complete projects in less time with self-aligning Bases, simple pre-assembled components, five-minute learning curve, and one-tool installation. Install speed is rated at 13.5 modules/installer-hour by DNV-GL.

Low Part Count & Streamlined Logistics: EcoFoot2+ consists of three core components: roof friendly, durable Base with integrated north/south Wire Clips, pre-assembled Clamps, and Wind Deflector to reduce ballast and provide east/west bonding. Stackable Bases fit up to 50kW per pallet, meaning fewer crane lifts and less space used on the job site.

Dedicated Support: Experienced project managers and field technicians support your project from bid to inspection. Project managers ensure you have needed details to obtain a permit and pass inspection. Our field team offers a dedicated phone line and email. On-site training is available.



VICINTY MAP



PROJECT SPECIFICATIONS

SYSTEM INFORMATION	
Total System Size (KW)	93.38
Total Module Quantity	161
Module Orientation	Landscape
EQUIPMENT	
Module Manufacturer	JINKO SOLAR
Module Model	JKM580N-72HL4-BDV
Module Wattage	580
Module Length (in.)	89.69
Module Width (in.)	44.65
Module Weight (lbs)	68.34
BUILDING DATA	
Roof Type	Other
Parapet Height (in)	42
Setback (in)	48
Roof Height (ft)	60
Roof Slope (degrees)	1.20
DESIGN VALUES	
ASCE Version	2010
Basic Windspeed (mph)	120
Wind Exposure Category	B
Occupancy Category	IV
Ground Snow Load (lb/ft^2)	20

DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

CONTRACTOR IS RESPONSIBLE FOR VERIFYING ROOF CAPACITY.
CONTRACTOR IS RESPONSIBLE FOR CONFIRMING ALL DESIGN CRITERIA ARE CORRECT AND APPROPRIATE FOR THE PROJECT SITE.
CONTRACTOR MUST CONFIRM DESIGN MEETS ALL UTILITY AND AHJ REQUIREMENTS.
CONTRACTOR IS RESPONSIBLE FOR VERIFYING THAT BUILDING STRUCTURE AND RELATED CONNECTIONS CAN SUPPORT ALL LOADS IMPOSED BY PV SYSTEM.
REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS AND ADDITIONAL INFORMATION.

Uplift, Sliding and Seismic Calculations

Explanation of EcoFoot System Calculations and Design Procedure

Installer Name:	Nova Consultants Inc
Project Name:	Justice Center
Project Address:	301 E Huron St Ann Arbor, MI 48104
Date Prepared:	6/7/2024

Calculation Explanation Key Sections:

Table Of Figures:

3rd Party Engineering Resources

Rowan, Williams, Davies, & Irwin Inc (RWDI) -- Wind Tunnel Testing Per ASCE 7 / IBC
Maffei Structural Engineering -- Peer Review of Wind Tunnel Testing
Testing Engineers, Inc. -- Friction Testing per ASTM G115
CBC Engineers -- Professional Engineering Review and Certification

Introduction, Site Specifics and Variable Definition

In order to efficiently design EcoFoot2+ and EcoFoot5D ballasted photovoltaic systems, Unirac makes use of a proprietary solar array design aid called "EcoCalcs". Starting with a set of design criteria, shown here in Table 1 below, EcoCalcs utilizes methodologies laid out in the ASCE7 and SEAOC PV1/PV2 documents, and derivative building codes. Actual calculations for this project are included herein, and are accompanied by a step-by-step explanation of Unirac's design process.

The output of EcoCalcs is a comprehensive set of ballast prescriptions, including Image 3 found on Page 6. Ballast prescriptions are applied to a proposed system layout by the Unirac engineering team. Engineering Alliance, Unirac's professional engineering partner, has reviewed and verified EcoCalcs and reviews system designs to ensure that calculations and ballast prescriptions were correctly applied. Upon successful review, Engineering Alliance provides a stamped design review including relevant supporting documentation (this explanation included) and a stamped, approved ballast plan.

Please note: Unirac and Engineering Alliance are not conducting a structural review of the proposed site.

Below, Table 1 and Table 2 list the design criteria and project details for a proposed system in Ann Arbor, MI. These values will be used throughout the remainder of this explanation.

Table 1: System Design Criteria

Product Line	EcoFoot 2+
ASCE7 Version	2010
Ground Elevation (ft)	N/A
Roof Type	Other
Roof Height (ft.)	60
Roof Slope (deg)	1.20
Min Edge Setback (in)	48
Parapet Height (in.)	42
3 Sec. Gust (mph)	120
Occupancy Category	IV
Wind Exposure	B
Snow Load (psf)	20.0
Seismic Data (SS)	0.0940
Soil Site Class	D
Coeff. Of Friction (fn)*	0.37

**req's slip sheets*

Table 2: PV Module Specifics

Module Manufacturer	JINKO SOLAR
Module Model	JKM580N-72HL4-BDV
Module Orientation	Landscape
Module Power (w)	580
Module Length (in)	89.69
Module Width (in)	44.65
Module Weight (lbs.)	68.34

Utilizing the inputs from Tables 1 and 2, the factors in Table 3 are generated for the site. This list of factors is used in various ways to fully define a proposed system according to calculations laid out in the SEAOC and ASCE documents. In the scope of this explanation, factors are used to calculate velocity pressure, qh as defined in ASCE7-05, Section 6.5.10; ASCE7-10, Section 30.3.2; or ASCE7-16 and ASCE7-22, Section 26.10.2, and ultimately the amount of ballast required to offset uplift and drag forces.

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Table 3: Calculation Inputs, Constants, and Variables

Racking Component Weight per Module	15.19	lbs.
Ballast Block Weight	32	lbs.
Asymmetric lift load Ratio (North Row)	1.4	
Asymmetric lift load Ratio (South Row)	1.6	
Ala= Effective Lift Area of PV Module	27.511	ft^2
Ada= Effective Drag Area of PV Module	4.07	ft^2
dLF1= Dead Load of Module and Attributed Racking	83.528	lbs.
Roof Setback Minimum	48	in.
Load Combination Factor for Wind	0.6	
Load Combination Factor for Seismic	0.7	
α (from ASCE7 Table 6-2 or 26.9.1 or 26.11-1)=	7	
zg (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	1200	ft.
zmin (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	30	ft.
z selected (from zmin & inputs)=	60	ft.
Kz= Velocity pressure exposure coefficient at height	0.85	
Kzt= Topographic Factor	1	
Kd= Directionality Factor	0.85	
Ke= Ground Elevation Factor	1	
Wind design load factor	0.6	
Dead Load design load factor	0.6	
qh_wind= Velocity Pressure (0.00256*Kz*Kzt*Ke*Kd*V^2*I)	26.76	psf

An explanation of variables:

Asymmetric Lift Load Ratio: This is a ratio describing the leverage created by EcoFoot base dimensions, module attachment location and location of center of ballast mass. Assessed as a multiplier on top of ballast distribution scheme in Image 4.

dLF1= Dead Load of Module and Attributed Racking: the weight of one module and hardware attributed to that module, not including ballast.

Ala= Effective Lift Area of PV Module: The surface area of a module projected onto the horizontal plane for lift calculations.

Ada= Effective Drag Area of PV Module: The surface area of a module projected onto the horizontal plane for drag calculations.

qh= Velocity Pressure at height "h": Calculation prescribed by ASCE7-05, eq. 6-15, and ASCE7-10, eq. 30.3-1, or ASCE7-16 and ASCE 7-22, eq. 26.10-1 (subscript "h" used here for clarity, ASCE7 utilizes subscript "z").

Wind Tunnel Testing, Uplift and Drag Force Calculations

Wind tunnel testing of the EcoFoot product line to determine GCn values has been conducted by Rowan Williams Davies & Irwin Inc. (RWDI), a nationally recognized boundary-layer wind tunnel test firm. Testing was conducted in accordance with ASCE7-05, section 6.6; and ASCE7-10/16/22, section 31.2. Module-specific GCn data allows for precise application of ballast to prevent uplift. Deviation from prescriptive wind GCn values has been addressed according to SEAOC PV2 via a peer review of the wind tunnel testing and results by Maffei Structural Engineering.

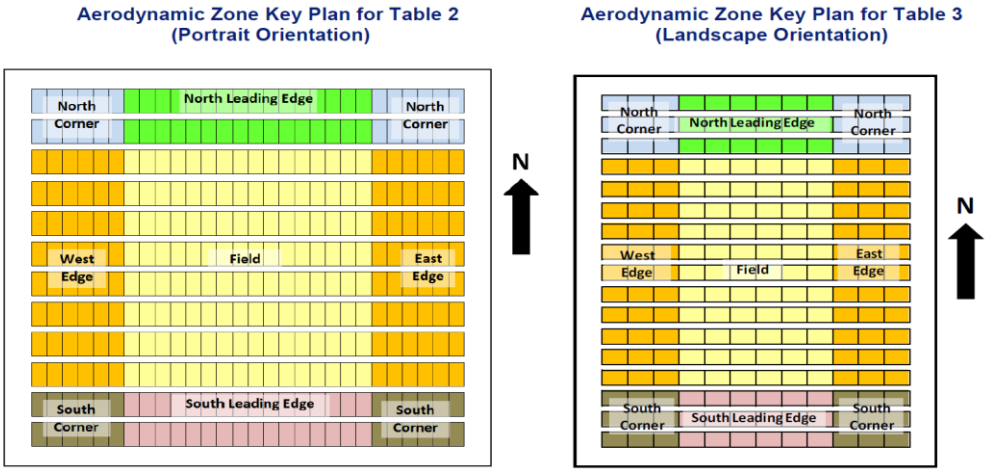
GCn and qh are used to calculate the pressure exerted on each module via the design wind pressure equations (ASCE7-05 – section 6.5.12.4, ASCE7-10 – section 30.4.2, ASCE7-16-30.5.2 and ASCE7-22 – section 30.3.2). Ballast required to offset uplift and drag forces (BWUz) is calculated in accordance with RWDI recoemndations. Detailed calculations for this project are found in Table 4. Resulting required ballast BWUz is displayed graphically in Image 3.

Table 4: Ballast to Resist Uplift Calculations for Project Proposed in Ann Arbor, MI 48104

			Load Sharing Area						
		#col x #rows	2x2	2x3			3x2	3x3	Down (1x1)
North Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.0	-7.9			-7.1	-6.6	17.0
	WLFUz=Uplift wind force =pUz*Ala	lbs.	-248.8	-218.6			-196.0	-180.9	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-99.2	-81.1			-67.5	-58.5	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	165.3	135.1			112.5	97.4	
North Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-7.1	-6.3			-6.0	-5.5	15.6
	WLFUz=Uplift wind force =pUz*Ala	lbs	-196.0	-173.4			-165.9	-150.8	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-67.5	-53.9			-49.4	-40.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	112.5	89.9			82.3	67.3	
E/W Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.0	-6.6			-7.1	-5.5	17.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-248.8	-180.9			-196.0	-150.8	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-99.2	-58.5			-67.5	-40.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	165.3	97.4			112.5	67.3	
Field	pUz=Uplift design wind pressure =qh*GCnUz	psf	-7.1	-6.3			-6.0	-5.5	15.6
	WLFUz=Uplift wind force =pUz*Ala	lbs	-196.0	-173.4			-165.9	-150.8	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-67.5	-53.9			-49.4	-40.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	112.5	89.9			82.3	67.3	
South Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.0	-6.6			-7.7	-5.5	17.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-248.8	-180.9			-211.1	-150.8	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-99.2	-58.5			-76.5	-40.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	165.3	97.4			127.6	67.3	
South Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-8.2	-6.3			-7.1	-5.5	15.6
	WLFUz=Uplift wind force =pUz*Ala	lbs	-226.2	-173.4			-196.0	-150.8	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-85.6	-53.9			-67.5	-40.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	142.7	89.9			112.5	67.3	

The aerodynamic differences among different sub-sections of a large array are handled by various calculation sections (North Corner, North Edge, E/W Edge...) and apply according to the excerpt from the RWDI report shown below in Image 1. The highlighted sections of Table 4 correspond to specific module locations, also shown in Image 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for expanded calculations pertaining to the highlighted sections.

Image 1: Aerodynamic Zones from RWDI Report



To check the amount of drag a given sub-array will experience, the equation in Image 2 is utilized - an excerpt from RWDI's test report. Each sub-array is checked for sliding, proceeding from the smallest to largest or until drag no longer governs total required ballast.

Table 5 lists the calculations used to identify the total required ballast to counteract drag forces and prevent sliding. Friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients. Unless detailed information is available pertaining to the location of the sub-array, the roof's worst case uplift GCp are utilized in calculating drag and required ballast.

Image 2: Ballast to Resist Sliding Equation

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot Ballast_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)^*_{drag} \cdot A_{drag} \cdot \left(\frac{1}{f_n}\right) + |GC_p|^*_{uplift} \cdot A_{uplift} \right] - \alpha_D \cdot M \qquad (lb)$$

Table 5: Ballast to Resist Sliding Calculation

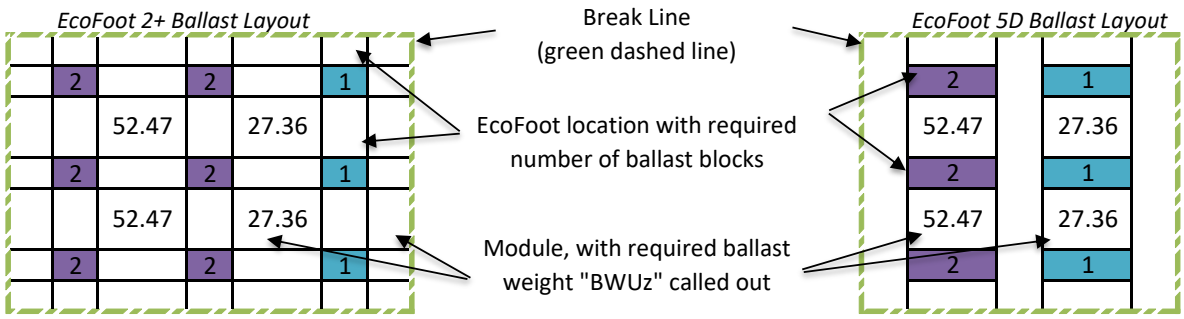
Sub-Array Module Count Total:	16
a_w = Wind Load Combination Factor =	0.6
a_d = Dead Load Combination Factor =	0.6
qz (qh in Table 3)	26.76
M = dLF1 from Table 3 =	83.53
f_n (also see Table 1) =	0.37
A_{uplift} = Ala in Table 3 =	27.51
A_{drag} = Ada in Table 3 =	4.07
$GC_{p\text{-}drag}$	1.42
$GC_{p\text{-}uplift}$	-0.62
Area Reduction Factor =	0.31
$(GCp)^*_{drag}$ =	0.44
$\lvert GCp \rvert^*_{uplift}$ =	0.19
Total Required Ballast Weight (Per Image 2)=	**2989.18**
$W_{ballastblock}$ =	32
Total Required Ballast Blocks:	**94**

Ballast Application to Sheet S-1.0

For easier interpretation, the results calculated in Table 4 are laid out in graphical representations of a solar array, shown in Image 4. Unirac engineers and drafters make use of this graphical layout when applying ballast to a given system design.

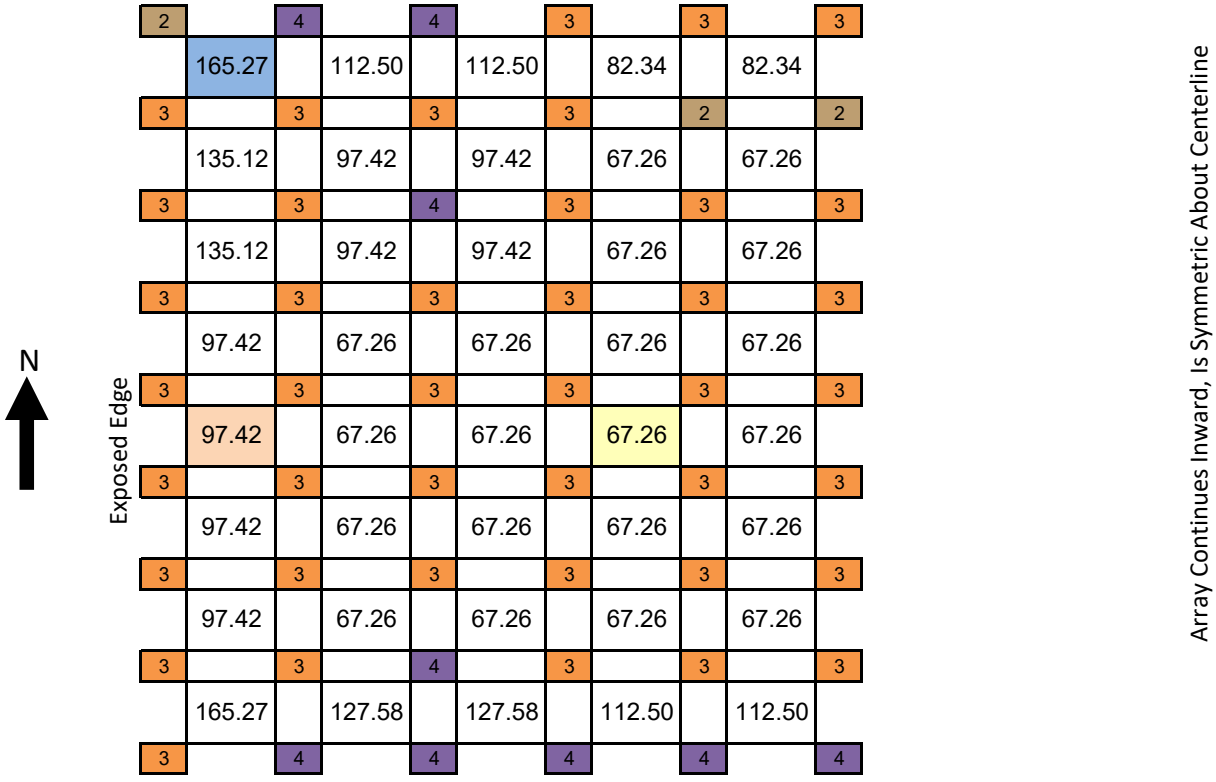
As shown in Image 3, the ballast required to resist lift - BWUz from Table 4 - is listed for each module location in Image 4. A portion of each BWUz value is distributed to each of the connected EcoFoot Bases, also detailed in Image 3 and included in Image 4. The total ballast required at each EcoFoot location is then calculated and rounded up to the next ballast block increment.

Image 3: Example of Module and Ballast Graphical Representation



The ballast prescription array shown in Image 4 is one of many similar arrays created automatically through EcoCalcs in order to address all possible array configurations. The data calculated in Table 4 was ultimately used to assign ballast to the system design in Sheet S-1.0 by Unirac. EcoCalcs and the resulting ballast plan S-1.0 are reviewed by CBC Engineers for correctness and completeness. Once approved, an engineering report including Sheet S-1.0 and any supporting material (this explanation included) are stamped and sealed by a professional engineer registered in the state where the project is proposed.

Image 4: Ballast Prescriptions Produced by Table 4



NOTE: The colored module locations in Image 4 correspond to the same colored areas in Table 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for more detailed calculations.

Detailed Calculations From Table 4

North Corner Module		
GCn Value from RWDI report:	-0.34	
qh value from Table 3:	26.76	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-9.04	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-248.80	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-99.16	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	165.27	lbf

East/West Edge Module		
GCn Value from RWDI report:	-0.25	
qh value from Table 3:	26.76	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-6.58	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-180.95	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-58.45	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	97.42	lbf

Interior Module		
GCn Value from RWDI report:	-0.20	
qh value from Table 3:	26.76	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-5.48	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-150.79	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-40.36	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	67.26	lbf

Max downpoint load calculations

No of Mid supports	1	
Tributary Area to support/bays/base	0.5	of module area
Wind force down (WL)	234 lbs	
Snow load Down (SL)	330.13 lbs	
Total Dead load per Bay (DL)	145.36 lbs	

Load Combinations

DL+ SL	475.49 lbs
DL+0.6WL	285.59 lbs
DL+0.75SL+0.45WL	**498.13 lbs**

SEAOC PV1 - 2012 - Section 4: attached Arrays

Unirac utilizes the unattached design approach to account for seismic force as provided for by Section 16 of the 2016 California Building Code, the Structural Engineering Association of California PV1 Requirements (SEAOC PV1-2012) and ASCE 7. Section 1613.5 defines “Ballasted Photovoltaic System” which also defines "partially attached" systems, and provides guidance for designing arrays that utilize physical anchors and friction to resist seismic forces. SEAOC PV1 or ASCE 7 Chapter 13 defines the calculations required design attached photovoltaic systems, including friction to partially offset seismic forces.

The following explanation walks through calculations outlined in Section 4 - Attached Arrays. The attached approach begins with the project specific design criteria outlined in Table 6. These values reflect site inputs as well as assumptions permitted in the SEAOC PV1-2012 document Section 4 and ASCE 7 chapter 13 .

Table 6: Seismic Design Inputs

Number of blocks per Ecofoot	6.00
Wp=Weight per unit	275.53
Site Class	D
Seismic Design Category	0.00
Ip	1.50
Rp	1.50
'Seismic Calcs (Attached)'!A9	1.00
Fa (Site Class D)	1.6
Sms = Fa x Ss	0.15
Sds = (2/3) x Sms	0.10

Table 7: ASCE7 Inputs

z=height of point of attachment (in.)	1.00
h=structure height compared to base (in.)	1.00
Fp=0.4*ap*Sds*Wp*(1+2*z/h)/(Rp/Ip)	33.15
Fp=1.6*Sds*Ip*Wp	66.30
Fp=0.3*Sds*Ip*Wp	12.43
Fp	33.15
Fp (ASD)	23.21

SEAOC PV1 specifies that “PV support systems that are attached to the roof structure shall be designed to resist the lateral seismic force *Fp* specified in ASCE 7-16/22 Chapter 13.” Although SEAOC PV1 was released prior to ASCE 7-16/22, *Fp* is defined the same way in Chapter 13 of both ASCE verions 7-10, 7-16 and 7-22. Therefore the lateral seismic force analysis applied is valid for both ASCE 7-10, 16 and 22. In utilizing the *Fp* calculations for nominal, minimum, and maximum values laid out in Section 13.3.1, the values in Table 7 are found.

The following is excerpted from SEAOC PV1-2012, Section 4 – Attached Arrays:

“For attached roof-bearing systems, friction is permitted to contribute in combination with the design lateral strength of attachments to resist the lateral force Fp when all of the following conditions are met:

- “The maximum roof slope at the location of the array is less than or equal to 7 degrees (12.3 percent);
- “The height above the roof surface to the center of mass of the solar array is less than the smaller of 36 inches and half the least plan dimension of the supporting base of the array
- “Rp shall not exceed 1.5 unless it is shown that the lateral displacement behavior of attachments is compatible with the simultaneous development of frictional resistance.”

The EcoFoot 2+ and EcoFoot 5D systems have been demonstrated to be in conformance with the above stated stipulations. As such, and in accordance with the remainder of Section 4 – Attached Arrays from SEAOC PV1-2012, the force required to resist movement due to seismic shifting is calculated. Based on the minimum ultimate shear strength of the roof mounting method prescribed for this job, the total lateral load that one attachment may offset is calculated, and by extension the number of modules allowed per attachment point. These values can be found in Table 8.

All friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients, methodology that is in agreement with SEAOC PV2 and Los Angeles, CA stipulations.

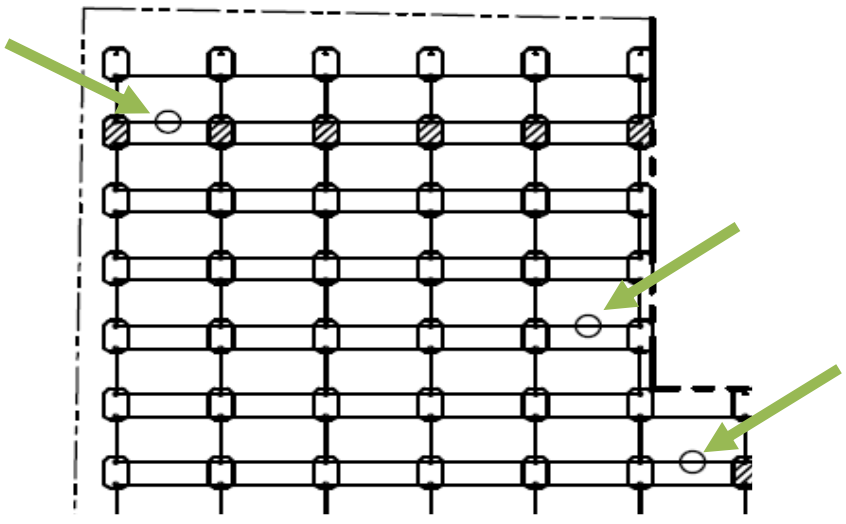
Table 8: Calculation of Physical Attachment Requirements

Friction Coefficient	0.37	*ASTM G115 Tested*
Ff (max friction) = (0.6-0.14*Sds)*(0.7*u)*Wp	41.93	*SEAOC section 4 (ASD), Friction Force*
Excess force per unit	-18.72	*Force to be offset by physical attachments*
Attachment system rating (allowable)	634.91	*ASD design load*
Number of panels per attachment	-33.91	*(if negative, no fasteners are needed)*

This final number of panels per attachment represents the maximum number of modules that any given attachment point may account for in terms of offsetting seismic force Fp. Physical attachments shall be installed per the manufacturer's instructions, and attached to the EcoFoot 2+ or EcoFoot 5D system per the installation instructions provided by Unirac.

On Sheet S-1.0 physical attachments are called out as shown below in Image 5:

Image 5: Example of ballast layout with seismic attachment callouts



SOLAR PROJECT DESIGN

Prepared For: Nova Consultants Inc
Project Name: Justice Center
Project Address: 301 E Huron St, Ann Arbor, MI 48104
Date: June 7, 2024

SOLUTION OVERVIEW

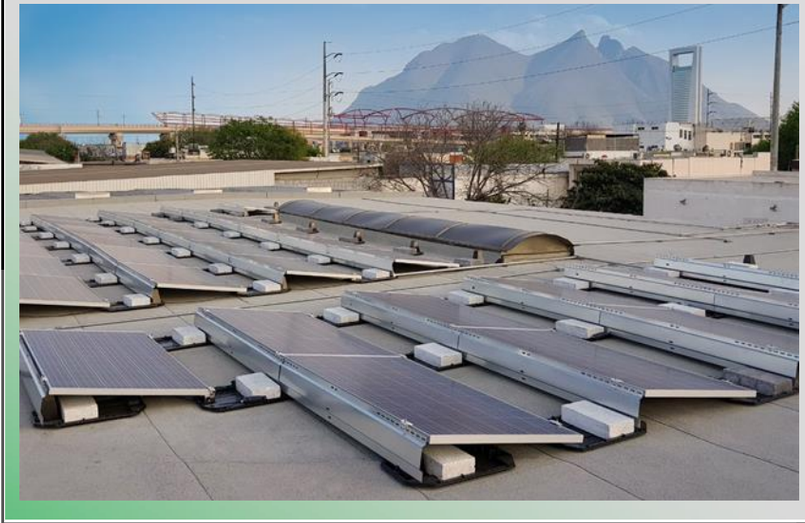
EcoFoot2+ Low-Slope Racking

With 500MW installed, EcoFoot Racking is preferred by installers for fast, simple installation and streamlined logistics. The enclosed provides the layout and system details for a complete solution for your project using this validated and reliable product.

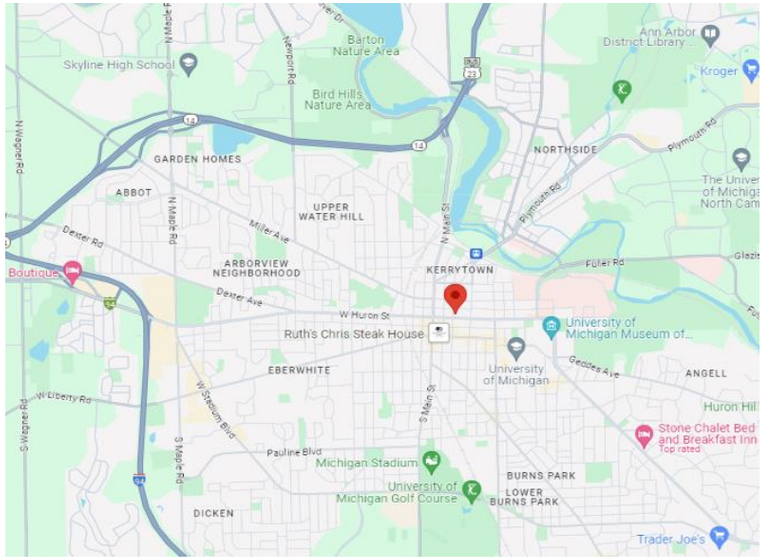
EcoFoot2+ delivers key advantages for a successful, efficient installation.
Faster Installation: Installers complete projects in less time with self-aligning Bases, simple pre-assembled components, five-minute learning curve, and one-tool installation. Install speed is rated at 13.5 modules/installer-hour by DNV-GL.

Low Part Count & Streamlined Logistics: EcoFoot2+ consists of three core components: roof friendly, durable Base with integrated north/south Wire Clips, pre-assembled Clamps, and Wind Deflector to reduce ballast and provide east/west bonding. Stackable Bases fit up to 50kW per pallet, meaning fewer crane lifts and less space used on the job site.

Dedicated Support: Experienced project managers and field technicians support your project from bid to inspection. Project managers ensure you have needed details to obtain a permit and pass inspection. Our field team offers a dedicated phone line and email. On-site training is available.



VICINTY MAP



PROJECT SPECIFICATIONS

SYSTEM INFORMATION	
Total System Size (KW)	8.12
Total Module Quantity	14
Module Orientation	Landscape
EQUIPMENT	
Module Manufacturer	JINKO SOLAR
Module Model	JKM580N-72HL4-BDV
Module Wattage	580
Module Length (in.)	89.69
Module Width (in.)	44.65
Module Weight (lbs)	68.34
BUILDING DATA	
Roof Type	Other
Parapet Height (in)	12
Setback (in)	48
Roof Height (ft)	70
Roof Slope (degrees)	1.20
DESIGN VALUES	
ASCE Version	2010
Basic Windspeed (mph)	120
Wind Exposure Category	B
Occupancy Category	IV
Ground Snow Load (lb/ft^2)	20

DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

CONTRACTOR IS RESPONSIBLE FOR VERIFYING ROOF CAPACITY.
CONTRACTOR IS RESPONSIBLE FOR CONFIRMING ALL DESIGN CRITERIA ARE CORRECT AND APPROPRIATE FOR THE PROJECT SITE.
CONTRACTOR MUST CONFIRM DESIGN MEETS ALL UTILITY AND AHJ REQUIREMENTS.
CONTRACTOR IS RESPONSIBLE FOR VERIFYING THAT BUILDING STRUCTURE AND RELATED CONNECTIONS CAN SUPPORT ALL LOADS IMPOSED BY PV SYSTEM.
REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS AND ADDITIONAL INFORMATION.

Uplift, Sliding and Seismic Calculations

Explanation of EcoFoot System Calculations and Design Procedure

Installer Name:	Nova Consultants Inc
Project Name:	Justice Center
Project Address:	301 E Huron St Ann Arbor, MI 48104
Date Prepared:	6/7/2024

Calculation Explanation Key Sections:

Table Of Figures:

3rd Party Engineering Resources

Rowan, Williams, Davies, & Irwin Inc (RWDI) -- Wind Tunnel Testing Per ASCE 7 / IBC
Maffei Structural Engineering -- Peer Review of Wind Tunnel Testing
Testing Engineers, Inc. -- Friction Testing per ASTM G115
CBC Engineers -- Professional Engineering Review and Certification

Introduction, Site Specifics and Variable Definition

In order to efficiently design EcoFoot2+ and EcoFoot5D ballasted photovoltaic systems, Unirac makes use of a proprietary solar array design aid called “EcoCalcs”. Starting with a set of design criteria, shown here in Table 1 below, EcoCalcs utilizes methodologies laid out in the ASCE7 and SEAOC PV1/PV2 documents, and derivative building codes. Actual calculations for this project are included herein, and are accompanied by a step-by-step explanation of Unirac's design process.

The output of EcoCalcs is a comprehensive set of ballast prescriptions, including Image 3 found on Page 6. Ballast prescriptions are applied to a proposed system layout by the Unirac engineering team. Engineering Alliance, Unirac's professional engineering partner, has reviewed and verified EcoCalcs and reviews system designs to ensure that calculations and ballast prescriptions were correctly applied. Upon successful review, Engineering Alliance provides a stamped design review including relevant supporting documentation (this explanation included) and a stamped, approved ballast plan.

Please note: Unirac and Engineering Alliance are not conducting a structural review of the proposed site.

Below, Table 1 and Table 2 list the design criteria and project details for a proposed system in Ann Arbor, MI. These values will be used throughout the remainder of this explanation.

Table 1: System Design Criteria

Product Line	EcoFoot 2+
ASCE7 Version	2010
Ground Elevation (ft)	N/A
Roof Type	Other
Roof Height (ft.)	70
Roof Slope (deg)	1.20
Min Edge Setback (in)	48
Parapet Height (in.)	12
3 Sec. Gust (mph)	120
Occupancy Category	IV
Wind Exposure	B
Snow Load (psf)	20.0
Seismic Data (SS)	0.0940
Soil Site Class	D
Coeff. Of Friction (fn)*	0.37

**req's slip sheets*

Table 2: PV Module Specifics

Module Manufacturer	JINKO SOLAR
Module Model	JKM580N-72HL4-BDV
Module Orientation	Landscape
Module Power (w)	580
Module Length (in)	89.69
Module Width (in)	44.65
Module Weight (lbs.)	68.34

Utilizing the inputs from Tables 1 and 2, the factors in Table 3 are generated for the site. This list of factors is used in various ways to fully define a proposed system according to calculations laid out in the SEAOC and ASCE documents. In the scope of this explanation, factors are used to calculate velocity pressure, qh as defined in ASCE7-05, Section 6.5.10; ASCE7-10, Section 30.3.2; or ASCE7-16 and ASCE7-22, Section 26.10.2, and ultimately the amount of ballast required to offset uplift and drag forces.

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Table 3: Calculation Inputs, Constants, and Variables

Racking Component Weight per Module	15.19	lbs.
Ballast Block Weight	32	lbs.
Asymmetric lift load Ratio (North Row)	1.4	
Asymmetric lift load Ratio (South Row)	1.6	
Ala= Effective Lift Area of PV Module	27.511	ft^2
Ada= Effective Drag Area of PV Module	4.07	ft^2
dLF1= Dead Load of Module and Attributed Racking	83.528	lbs.
Roof Setback Minimum	48	in.
Load Combination Factor for Wind	0.6	
Load Combination Factor for Seismic	0.7	
α (from ASCE7 Table 6-2 or 26.9.1 or 26.11-1)=	7	
zg (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	1200	ft.
zmin (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	30	ft.
z selected (from zmin & inputs)=	70	ft.
Kz= Velocity pressure exposure coefficient at height	0.89	
Kzt= Topographic Factor	1	
Kd= Directionality Factor	0.85	
Ke= Ground Elevation Factor	1	
Wind design load factor	0.6	
Dead Load design load factor	0.6	
qh_wind= Velocity Pressure (0.00256*Kz*Kzt*Ke*Kd*V^2*I)	27.97	psf

An explanation of variables:

Asymmetric Lift Load Ratio: This is a ratio describing the leverage created by EcoFoot base dimensions, module attachment location and location of center of ballast mass. Assessed as a multiplier on top of ballast distribution scheme in Image 4.

dLF1= Dead Load of Module and Attributed Racking: the weight of one module and hardware attributed to that module, not including ballast.

Ala= Effective Lift Area of PV Module: The surface area of a module projected onto the horizontal plane for lift calculations.

Ada= Effective Drag Area of PV Module: The surface area of a module projected onto the horizontal plane for drag calculations.

qh= Velocity Pressure at height "h": Calculation prescribed by ASCE7-05, eq. 6-15, and ASCE7-10, eq. 30.3-1, or ASCE7-16 and ASCE 7-22, eq. 26.10-1 (subscript "h" used here for clarity, ASCE7 utilizes subscript "z").

Wind Tunnel Testing, Uplift and Drag Force Calculations

Wind tunnel testing of the EcoFoot product line to determine GCn values has been conducted by Rowan Williams Davies & Irwin Inc. (RWDI), a nationally recognized boundary-layer wind tunnel test firm. Testing was conducted in accordance with ASCE7-05, section 6.6; and ASCE7-10/16/22, section 31.2. Module-specific GCn data allows for precise application of ballast to prevent uplift. Deviation from prescriptive wind GCn values has been addressed according to SEAOC PV2 via a peer review of the wind tunnel testing and results by Maffei Structural Engineering.

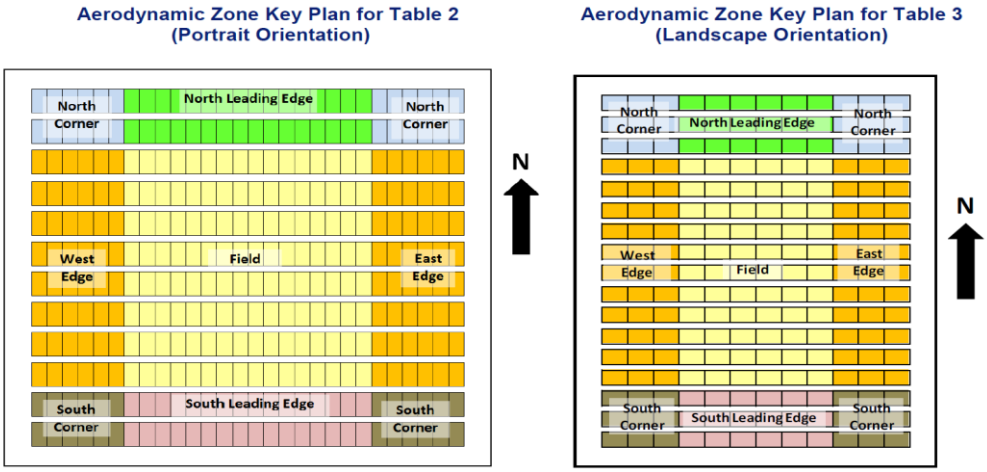
GCn and qh are used to calculate the pressure exerted on each module via the design wind pressure equations (ASCE7-05 – section 6.5.12.4, ASCE7-10 – section 30.4.2, ASCE7-16-30.5.2 and ASCE7-22 – section 30.3.2). Ballast required to offset uplift and drag forces (BWUz) is calculated in accordance with RWDI recoemndations. Detailed calculations for this project are found in Table 4. Resulting required ballast BWUz is displayed graphically in Image 3.

Table 4: Ballast to Resist Uplift Calculations for Project Proposed in Ann Arbor, MI 48104

			Load Sharing Area						
		#col x #rows	2x2	2x3			3x2	3x3	Down (1x1)
North Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.5	-8.3			-7.4	-6.9	17.8
	WLFUz=Uplift wind force =pUz*Ala	lbs.	-260.0	-228.5			-204.9	-189.1	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.9	-87.0			-72.8	-63.3	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	176.5	145.0			121.3	105.6	
North Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-7.4	-6.6			-6.3	-5.7	16.3
	WLFUz=Uplift wind force =pUz*Ala	lbs	-204.9	-181.2			-173.3	-157.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-72.8	-58.6			-53.9	-44.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	121.3	97.7			89.8	74.1	
E/W Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.5	-6.9			-7.4	-5.7	17.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-260.0	-189.1			-204.9	-157.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.9	-63.3			-72.8	-44.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	176.5	105.6			121.3	74.1	
Field	pUz=Uplift design wind pressure =qh*GCnUz	psf	-7.4	-6.6			-6.3	-5.7	16.3
	WLFUz=Uplift wind force =pUz*Ala	lbs	-204.9	-181.2			-173.3	-157.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-72.8	-58.6			-53.9	-44.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	121.3	97.7			89.8	74.1	
South Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.5	-6.9			-8.0	-5.7	17.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-260.0	-189.1			-220.6	-157.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.9	-63.3			-82.2	-44.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	176.5	105.6			137.1	74.1	
South Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-8.6	-6.6			-7.4	-5.7	16.3
	WLFUz=Uplift wind force =pUz*Ala	lbs	-236.4	-181.2			-204.9	-157.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-91.7	-58.6			-72.8	-44.4	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	152.8	97.7			121.3	74.1	

The aerodynamic differences among different sub-sections of a large array are handled by various calculation sections (North Corner, North Edge, E/W Edge...) and apply according to the excerpt from the RWDI report shown below in Image 1. The highlighted sections of Table 4 correspond to specific module locations, also shown in Image 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for expanded calculations pertaining to the highlighted sections.

Image 1: Aerodynamic Zones from RWDI Report



To check the amount of drag a given sub-array will experience, the equation in Image 2 is utilized - an excerpt from RWDI's test report. Each sub-array is checked for sliding, proceeding from the smallest to largest or until drag no longer governs total required ballast.

Table 5 lists the calculations used to identify the total required ballast to counteract drag forces and prevent sliding. Friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients. Unless detailed information is available pertaining to the location of the sub-array, the roof's worst case uplift GCp are utilized in calculating drag and required ballast.

Image 2: Ballast to Resist Sliding Equation

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot Ballast_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)^*_{drag} \cdot A_{drag} \cdot \left(\frac{1}{f_n}\right) + |GC_p|^*_{uplift} \cdot A_{uplift} \right] - \alpha_D \cdot M \qquad (lb)$$

Table 5: Ballast to Resist Sliding Calculation

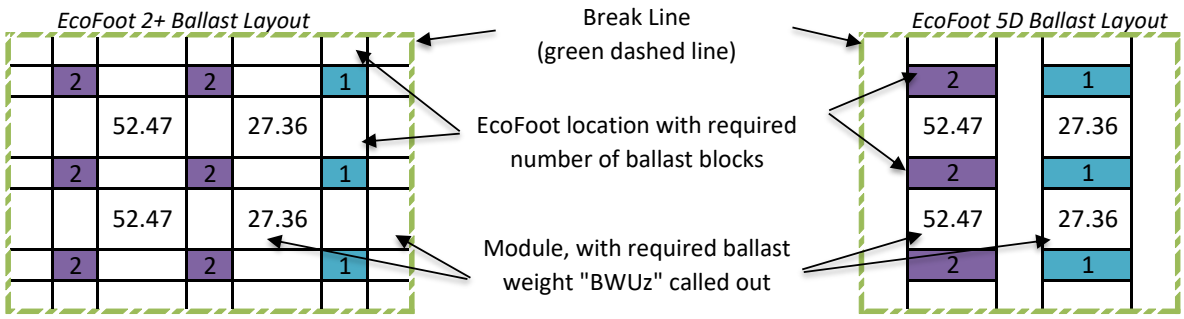
Sub-Array Module Count Total:	16
a_w = Wind Load Combination Factor =	0.6
a_d = Dead Load Combination Factor =	0.6
qz (qh in Table 3)	27.97
M = dLF1 from Table 3 =	83.53
f_n (also see Table 1) =	0.37
A_{uplift} = Ala in Table 3 =	27.51
A_{drag} = Ada in Table 3 =	4.07
$GC_{p\text{-drag}}$	1.42
$GC_{p\text{-uplift}}$	-0.62
Area Reduction Factor =	0.31
$(GCp)^*_{drag}$ =	0.44
$\lvert GCp \rvert^*_{uplift}$ =	0.19
Total Required Ballast Weight (Per Image 2)=	**3183.96**
$W_{ballastblock}$ =	32
Total Required Ballast Blocks:	**100**

Ballast Application to Sheet S-1.0

For easier interpretation, the results calculated in Table 4 are laid out in graphical representations of a solar array, shown in Image 4. Unirac engineers and drafters make use of this graphical layout when applying ballast to a given system design.

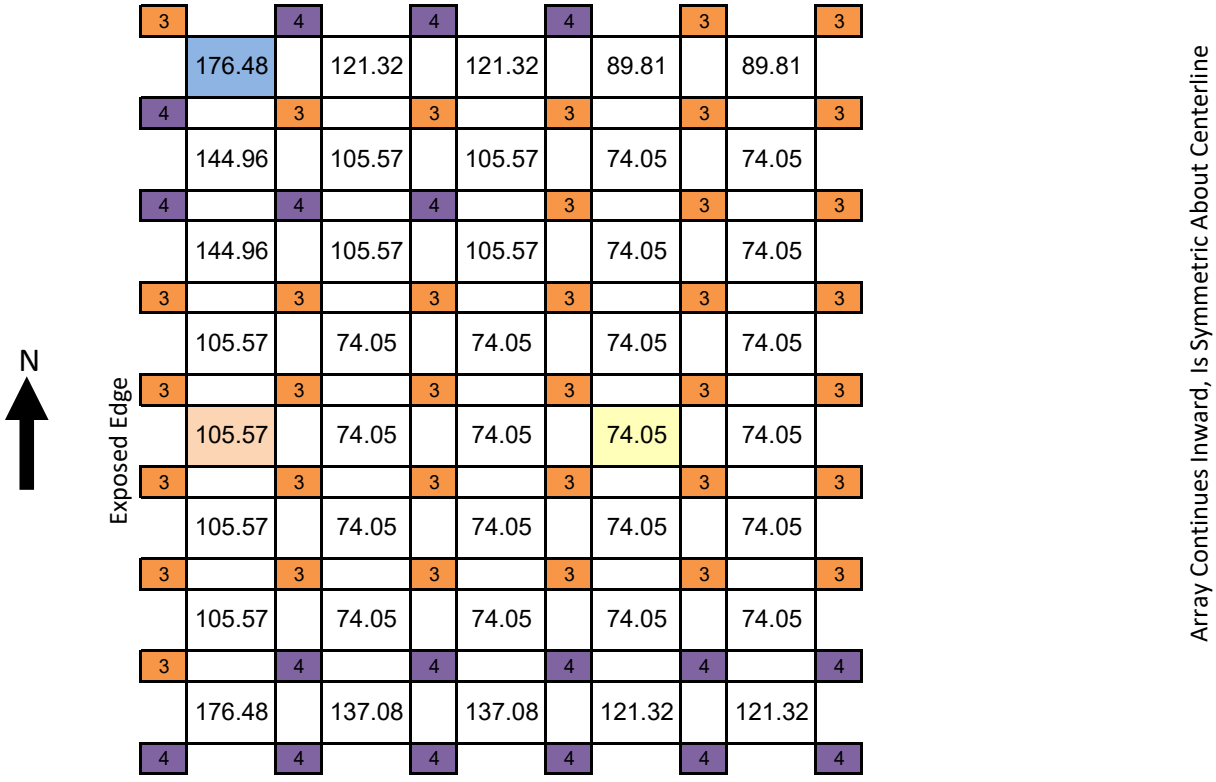
As shown in Image 3, the ballast required to resist lift - BWUz from Table 4 - is listed for each module location in Image 4. A portion of each BWUz value is distributed to each of the connected EcoFoot Bases, also detailed in Image 3 and included in Image 4. The total ballast required at each EcoFoot location is then calculated and rounded up to the next ballast block increment.

Image 3: Example of Module and Ballast Graphical Representation



The ballast prescription array shown in Image 4 is one of many similar arrays created automatically through EcoCalcs in order to address all possible array configurations. The data calculated in Table 4 was ultimately used to assign ballast to the system design in Sheet S-1.0 by Unirac. EcoCalcs and the resulting ballast plan S-1.0 are reviewed by CBC Engineers for correctness and completeness. Once approved, an engineering report including Sheet S-1.0 and any supporting material (this explanation included) are stamped and sealed by a professional engineer registered in the state where the project is proposed.

Image 4: Ballast Prescriptions Produced by Table 4



NOTE: The colored module locations in Image 4 correspond to the same colored areas in Table 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for more detailed calculations.

Detailed Calculations From Table 4

North Corner Module		
GCn Value from RWDI report:	-0.34	
qh value from Table 3:	27.97	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-9.45	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-260.01	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-105.89	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	176.48	lbf

East/West Edge Module		
GCn Value from RWDI report:	-0.25	
qh value from Table 3:	27.97	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-6.87	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-189.10	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-63.34	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	105.57	lbf

Interior Module		
GCn Value from RWDI report:	-0.20	
qh value from Table 3:	27.97	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-5.73	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-157.58	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-44.43	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	74.05	lbf

Max downpoint load calculations

No of Mid supports	1	
Tributary Area to support/bays/base	0.5	of module area
Wind force down (WL)	244 lbs	
Snow load Down (SL)	330.13 lbs	
Total Dead load per Bay (DL)	145.36 lbs	

Load Combinations

DL+ SL	475.49 lbs
DL+0.6WL	291.91 lbs
DL+0.75SL+0.45WL	**502.87 lbs**

unirac.com
1411 Broadway Blvd NE, Albu□uer□ue, NM 87102
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SEAOC PV1 - 2012 - Section 4: attached Arrays

Unirac utilizes the unattached design approach to account for seismic force as provided for by Section 16 of the 2016 California Building Code, the Structural Engineering Association of California PV1 Requirements (SEAOC PV1-2012) and ASCE 7. Section 1613.5 defines “Ballasted Photovoltaic System” which also defines "partially attached" systems, and provides guidance for designing arrays that utilize physical anchors and friction to resist seismic forces. SEAOC PV1 or ASCE 7 Chapter 13 defines the calculations required design attached photovoltaic systems, including friction to partially offset seismic forces.

The following explanation walks through calculations outlined in Section 4 - Attached Arrays. The attached approach begins with the project specific design criteria outlined in Table 6. These values reflect site inputs as well as assumptions permitted in the SEAOC PV1-2012 document Section 4 and ASCE 7 chapter 13 .

Table 6: Seismic Design Inputs

Number of blocks per Ecofoot	6.00
Wp=Weight per unit	275.53
Site Class	D
Seismic Design Category	0.00
Ip	1.50
Rp	1.50
'Seismic Calcs (Attached)'!A9	1.00
Fa (Site Class D)	1.6
Sms = Fa x Ss	0.15
Sds = (2/3) x Sms	0.10

Table 7: ASCE7 Inputs

z=height of point of attachment (in.)	1.00
h=structure height compared to base (in.)	1.00
Fp=0.4*ap*Sds*Wp*(1+2*z/h)/(Rp/Ip)	33.15
Fp=1.6*Sds*Ip*Wp	66.30
Fp=0.3*Sds*Ip*Wp	12.43
Fp	33.15
Fp (ASD)	23.21

SEAOC PV1 specifies that “PV support systems that are attached to the roof structure shall be designed to resist the lateral seismic force *Fp* specified in ASCE 7-16/22 Chapter 13.” Although SEAOC PV1 was released prior to ASCE 7-16/22, *Fp* is defined the same way in Chapter 13 of both ASCE verions 7-10, 7-16 and 7-22. Therefore the lateral seismic force analysis applied is valid for both ASCE 7-10, 16 and 22. In utilizing the *Fp* calculations for nominal, minimum, and maximum values laid out in Section 13.3.1, the values in Table 7 are found.

The following is excerpted from SEAOC PV1-2012, Section 4 – Attached Arrays:

“For attached roof-bearing systems, friction is permitted to contribute in combination with the design lateral strength of attachments to resist the lateral force Fp when all of the following conditions are met:

- “The maximum roof slope at the location of the array is less than or equal to 7 degrees (12.3 percent);
- “The height above the roof surface to the center of mass of the solar array is less than the smaller of 36 inches and half the least plan dimension of the supporting base of the array
- “Rp shall not exceed 1.5 unless it is shown that the lateral displacement behavior of attachments is compatible with the simultaneous development of frictional resistance.”

The EcoFoot 2+ and EcoFoot 5D systems have been demonstrated to be in conformance with the above stated stipulations. As such, and in accordance with the remainder of Section 4 – Attached Arrays from SEAOC PV1-2012, the force required to resist movement due to seismic shifting is calculated. Based on the minimum ultimate shear strength of the roof mounting method prescribed for this job, the total lateral load that one attachment may offset is calculated, and by extension the number of modules allowed per attachment point. These values can be found in Table 8.

All friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients, methodology that is in agreement with SEAOC PV2 and Los Angeles, CA stipulations.

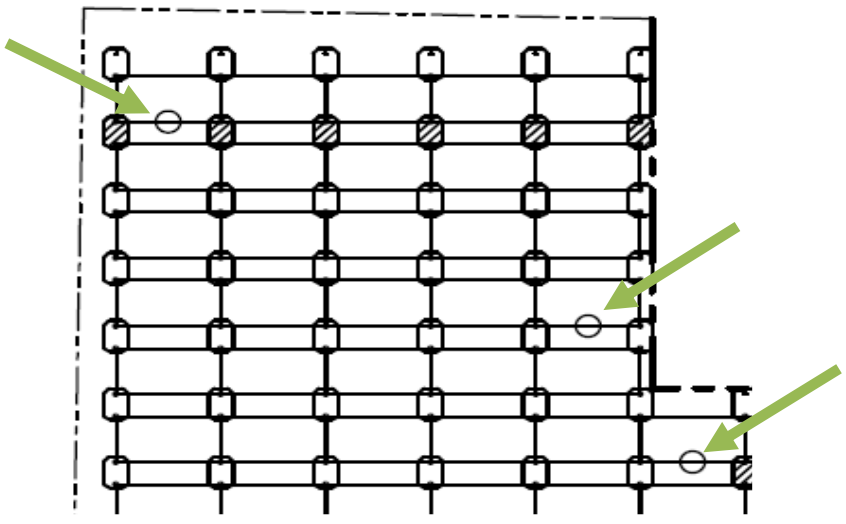
Table 8: Calculation of Physical Attachment Requirements

Friction Coefficient	0.37	*ASTM G115 Tested*
Ff (max friction) = (0.6-0.14*Sds)*(0.7*u)*Wp	41.93	*SEAOC section 4 (ASD), Friction Force*
Excess force per unit	-18.72	*Force to be offset by physical attachments*
Attachment system rating (allowable)	634.91	*ASD design load*
Number of panels per attachment	-33.91	*(if negative, no fasteners are needed)*

This final number of panels per attachment represents the maximum number of modules that any given attachment point may account for in terms of offsetting seismic force Fp. Physical attachments shall be installed per the manufacturer's instructions, and attached to the EcoFoot 2+ or EcoFoot 5D system per the installation instructions provided by Unirac.

On Sheet S-1.0 physical attachments are called out as shown below in Image 5:

Image 5: Example of ballast layout with seismic attachment callouts



SOLAR PROJECT DESIGN

Prepared For: Nova Consultants Inc
Project Name: City Hall
Project Address: 301 East Huron Street, Ann Arbor, MI 48104
Date: June 5, 2024

SOLUTION OVERVIEW

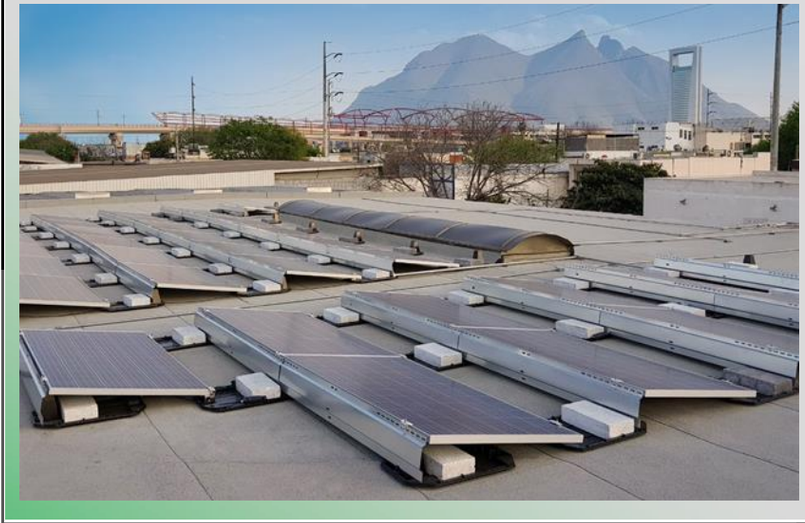
EcoFoot2+ Low-Slope Racking

With 500MW installed, EcoFoot Racking is preferred by installers for fast, simple installation and streamlined logistics. The enclosed provides the layout and system details for a complete solution for your project using this validated and reliable product.

EcoFoot2+ delivers key advantages for a successful, efficient installation.
Faster Installation: Installers complete projects in less time with self-aligning Bases, simple pre-assembled components, five-minute learning curve, and one-tool installation. Install speed is rated at 13.5 modules/installer-hour by DNV-GL.

Low Part Count & Streamlined Logistics: EcoFoot2+ consists of three core components: roof friendly, durable Base with integrated north/south Wire Clips, pre-assembled Clamps, and Wind Deflector to reduce ballast and provide east/west bonding. Stackable Bases fit up to 50kW per pallet, meaning fewer crane lifts and less space used on the job site.

Dedicated Support: Experienced project managers and field technicians support your project from bid to inspection. Project managers ensure you have needed details to obtain a permit and pass inspection. Our field team offers a dedicated phone line and email. On-site training is available.



VICINTY MAP

PROJECT SPECIFICATIONS

SYSTEM INFORMATION	
Total System Size (KW)	16.82
Total Module Quantity	29
Module Orientation	Landscape
EQUIPMENT	
Module Manufacturer	Jinko
Module Model	JKM 580N-72HL4-BDV
Module Wattage	580
Module Length (in.)	89.69
Module Width (in.)	44.65
Module Weight (lbs)	68.34
BUILDING DATA	
Roof Type	Other
Parapet Height (in)	6
Setback (in)	48
Roof Height (ft)	80
Roof Slope (degrees)	1.20
DESIGN VALUES	
ASCE Version	2010
Basic Windspeed (mph)	120
Wind Exposure Category	B
Occupancy Category	IV
Ground Snow Load (lb/ft^2)	20

DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

CONTRACTOR IS RESPONSIBLE FOR VERIFYING ROOF CAPACITY.
CONTRACTOR IS RESPONSIBLE FOR CONFIRMING ALL DESIGN CRITERIA ARE CORRECT AND APPROPRIATE FOR THE PROJECT SITE.
CONTRACTOR MUST CONFIRM DESIGN MEETS ALL UTILITY AND AHJ REQUIREMENTS.
CONTRACTOR IS RESPONSIBLE FOR VERIFYING THAT BUILDING STRUCTURE AND RELATED CONNECTIONS CAN SUPPORT ALL LOADS IMPOSED BY PV SYSTEM.
REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS AND ADDITIONAL INFORMATION.

Uplift, Sliding and Seismic Calculations

Explanation of EcoFoot System Calculations and Design Procedure

Installer Name:	Nova Consultants Inc
Project Name:	City Hall
Project Address:	301 East Huron Street Ann Arbor, MI 48104
Date Prepared:	6/5/2024

Calculation Explanation Key Sections:

Table Of Figures:

3rd Party Engineering Resources

Rowan, Williams, Davies, & Irwin Inc (RWDI) -- Wind Tunnel Testing Per ASCE 7 / IBC
Maffei Structural Engineering -- Peer Review of Wind Tunnel Testing
Testing Engineers, Inc. -- Friction Testing per ASTM G115
CBC Engineers -- Professional Engineering Review and Certification

Introduction, Site Specifics and Variable Definition

In order to efficiently design EcoFoot2+ and EcoFoot5D ballasted photovoltaic systems, Unirac makes use of a proprietary solar array design aid called “EcoCalcs”. Starting with a set of design criteria, shown here in Table 1 below, EcoCalcs utilizes methodologies laid out in the ASCE7 and SEAOC PV1/PV2 documents, and derivative building codes. Actual calculations for this project are included herein, and are accompanied by a step-by-step explanation of Unirac's design process.

The output of EcoCalcs is a comprehensive set of ballast prescriptions, including Image 3 found on Page 6. Ballast prescriptions are applied to a proposed system layout by the Unirac engineering team. Engineering Alliance, Unirac's professional engineering partner, has reviewed and verified EcoCalcs and reviews system designs to ensure that calculations and ballast prescriptions were correctly applied. Upon successful review, Engineering Alliance provides a stamped design review including relevant supporting documentation (this explanation included) and a stamped, approved ballast plan.

Please note: Unirac and Engineering Alliance are not conducting a structural review of the proposed site.

Below, Table 1 and Table 2 list the design criteria and project details for a proposed system in Ann Arbor, MI. These values will be used throughout the remainder of this explanation.

Table 1: System Design Criteria

Product Line	EcoFoot 2+
ASCE7 Version	2010
Ground Elevation (ft)	N/A
Roof Type	Other
Roof Height (ft.)	80
Roof Slope (deg)	1.20
Min Edge Setback (in)	48
Parapet Height (in.)	6
3 Sec. Gust (mph)	120
Occupancy Category	IV
Wind Exposure	B
Snow Load (psf)	20.0
Seismic Data (SS)	0.0940
Soil Site Class	D-Stiff Soil
Coeff. Of Friction (fn)*	0.37

**req's slip sheets*

Table 2: PV Module Specifics

Module Manufacturer	Jinko
Module Model	JKM 580N-72HL4-BDV
Module Orientation	Landscape
Module Power (w)	580
Module Length (in)	89.69
Module Width (in)	44.65
Module Weight (lbs.)	68.34

Utilizing the inputs from Tables 1 and 2, the factors in Table 3 are generated for the site. This list of factors is used in various ways to fully define a proposed system according to calculations laid out in the SEAOC and ASCE documents. In the scope of this explanation, factors are used to calculate velocity pressure, qh as defined in ASCE7-05, Section 6.5.10; ASCE7-10, Section 30.3.2; or ASCE7-16 and ASCE7-22, Section 26.10.2, and ultimately the amount of ballast required to offset uplift and drag forces.

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Table 3: Calculation Inputs, Constants, and Variables

Racking Component Weight per Module	15.19	lbs.
Ballast Block Weight	32	lbs.
Asymmetric lift load Ratio (North Row)	1.4	
Asymmetric lift load Ratio (South Row)	1.6	
Ala= Effective Lift Area of PV Module	27.511	ft^2
Ada= Effective Drag Area of PV Module	4.07	ft^2
dLF1= Dead Load of Module and Attributed Racking	83.528	lbs.
Roof Setback Minimum	48	in.
Load Combination Factor for Wind	0.6	
Load Combination Factor for Seismic	0.7	
α (from ASCE7 Table 6-2 or 26.9.1 or 26.11-1)=	7	
zg (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	1200	ft.
zmin (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	30	ft.
z selected (from zmin & inputs)=	80	ft.
Kz= Velocity pressure exposure coefficient at height	0.93	
Kzt= Topographic Factor	1	
Kd= Directionality Factor	0.85	
Ke= Ground Elevation Factor	1	
Wind design load factor	0.6	
Dead Load design load factor	0.6	
qh_wind= Velocity Pressure (0.00256*Kz*Kzt*Ke*Kd*V^2*I)	29.05	psf

An explanation of variables:

Asymmetric Lift Load Ratio: This is a ratio describing the leverage created by EcoFoot base dimensions, module attachment location and location of center of ballast mass. Assessed as a multiplier on top of ballast distribution scheme in Image 4.

dLF1= Dead Load of Module and Attributed Racking: the weight of one module and hardware attributed to that module, not including ballast.

Ala= Effective Lift Area of PV Module: The surface area of a module projected onto the horizontal plane for lift calculations.

Ada= Effective Drag Area of PV Module: The surface area of a module projected onto the horizontal plane for drag calculations.

qh= Velocity Pressure at height "h": Calculation prescribed by ASCE7-05, eq. 6-15, and ASCE7-10, eq. 30.3-1, or ASCE7-16 and ASCE 7-22, eq. 26.10-1 (subscript "h" used here for clarity, ASCE7 utilizes subscript "z").

Wind Tunnel Testing, Uplift and Drag Force Calculations

Wind tunnel testing of the EcoFoot product line to determine GCn values has been conducted by Rowan Williams Davies & Irwin Inc. (RWDI), a nationally recognized boundary-layer wind tunnel test firm. Testing was conducted in accordance with ASCE7-05, section 6.6; and ASCE7-10/16/22, section 31.2. Module-specific GCn data allows for precise application of ballast to prevent uplift. Deviation from prescriptive wind GCn values has been addressed according to SEAOC PV2 via a peer review of the wind tunnel testing and results by Maffei Structural Engineering.

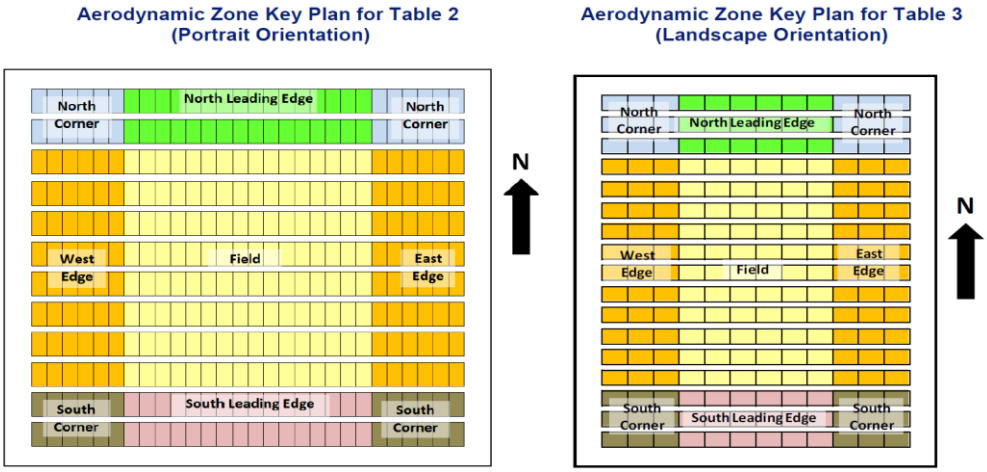
GCn and qh are used to calculate the pressure exerted on each module via the design wind pressure equations (ASCE7-05 – section 6.5.12.4, ASCE7-10 – section 30.4.2, ASCE7-16-30.5.2 and ASCE7-22 – section 30.3.2). Ballast required to offset uplift and drag forces (BWUz) is calculated in accordance with RWDI recoemndations. Detailed calculations for this project are found in Table 4. Resulting required ballast BWUz is displayed graphically in Image 3.

Table 4: Ballast to Resist Uplift Calculations for Project Proposed in Ann Arbor, MI 48104

			Load Sharing Area						
		#col x #rows	2x2	2x3			3x2	3x3	Down (1x1)
North Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.4	-8.4			-7.6	-6.9	23.0
	WLFUz=Uplift wind force =pUz*Ala	lbs.	-259.9	-229.7			-209.3	-189.8	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.8	-87.7			-75.5	-63.8	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	176.4	146.2			125.8	106.3	
North Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-8.6	-7.5			-7.2	-6.1	18.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-235.9	-206.7			-196.9	-168.5	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-91.4	-73.9			-68.0	-51.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	152.4	123.1			113.4	85.0	
E/W Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.4	-7.9			-7.6	-6.8	23.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-259.9	-216.4			-209.3	-186.3	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.8	-79.7			-75.5	-61.6	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	176.4	132.9			125.8	102.7	
Field	pUz=Uplift design wind pressure =qh*GCnUz	psf	-8.6	-7.5			-7.2	-6.1	18.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-235.9	-206.7			-196.9	-168.5	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-91.4	-73.9			-68.0	-51.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	152.4	123.1			113.4	85.0	
South Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.4	-7.9			-7.7	-6.8	23.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-259.9	-216.4			-211.1	-186.3	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.8	-79.7			-76.5	-61.6	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	176.4	132.9			127.6	102.7	
South Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-8.7	-7.5			-7.3	-6.1	18.0
	WLFUz=Uplift wind force =pUz*Ala	lbs	-239.5	-206.7			-200.5	-168.5	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-93.6	-73.9			-70.2	-51.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	156.0	123.1			116.9	85.0	

The aerodynamic differences among different sub-sections of a large array are handled by various calculation sections (North Corner, North Edge, E/W Edge...) and apply according to the excerpt from the RWDI report shown below in Image 1. The highlighted sections of Table 4 correspond to specific module locations, also shown in Image 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for expanded calculations pertaining to the highlighted sections.

Image 1: Aerodynamic Zones from RWDI Report



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To check the amount of drag a given sub-array will experience, the equation in Image 2 is utilized - an excerpt from RWDI's test report. Each sub-array is checked for sliding, proceeding from the smallest to largest or until drag no longer governs total required ballast.

Table 5 lists the calculations used to identify the total required ballast to counteract drag forces and prevent sliding. Friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients. Unless detailed information is available pertaining to the location of the sub-array, the roof's worst case uplift GCp are utilized in calculating drag and required ballast.

Image 2: Ballast to Resist Sliding Equation

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot Ballast_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)^*_{drag} \cdot A_{drag} \cdot \left(\frac{1}{f_n}\right) + |GC_p|^*_{uplift} \cdot A_{uplift} \right] - \alpha_D \cdot M \qquad (lb)$$

Table 5: Ballast to Resist Sliding Calculation

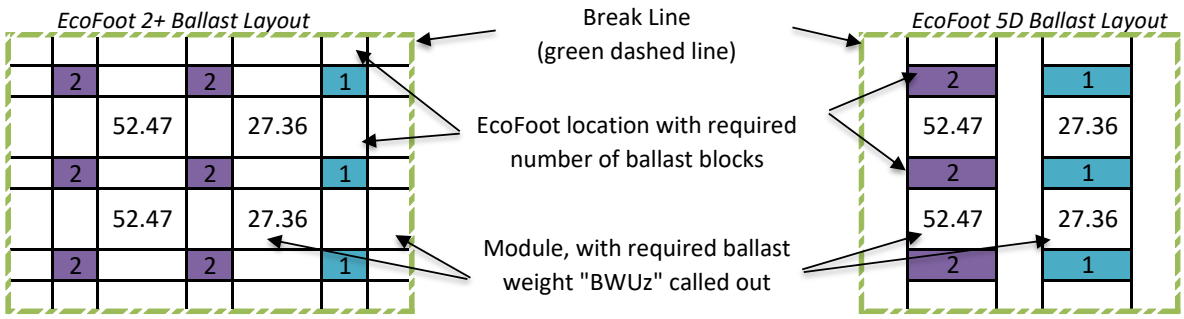
Sub-Array Module Count Total:	16
a_w = Wind Load Combination Factor =	0.6
a_d = Dead Load Combination Factor =	0.6
qz (qh in Table 3)	29.05
M = dLF1 from Table 3 =	83.53
f_n (also see Table 1) =	0.37
A_{uplift} = Ala in Table 3 =	27.51
A_{drag} = Ada in Table 3 =	4.07
$GC_{p\text{-}drag}$	1.65
$GC_{p\text{-}uplift}$	-0.66
Area Reduction Factor =	0.31
$(GCp)^*_{drag}$ =	0.51
$\lvert GCp \rvert^*_{uplift}$ =	0.21
Total Required Ballast Weight (Per Image 2)=	**3920.40**
$W_{ballastblock}$ =	32
Total Required Ballast Blocks:	**123**

Ballast Application to Sheet S-1.0

For easier interpretation, the results calculated in Table 4 are laid out in graphical representations of a solar array, shown in Image 4. Unirac engineers and drafters make use of this graphical layout when applying ballast to a given system design.

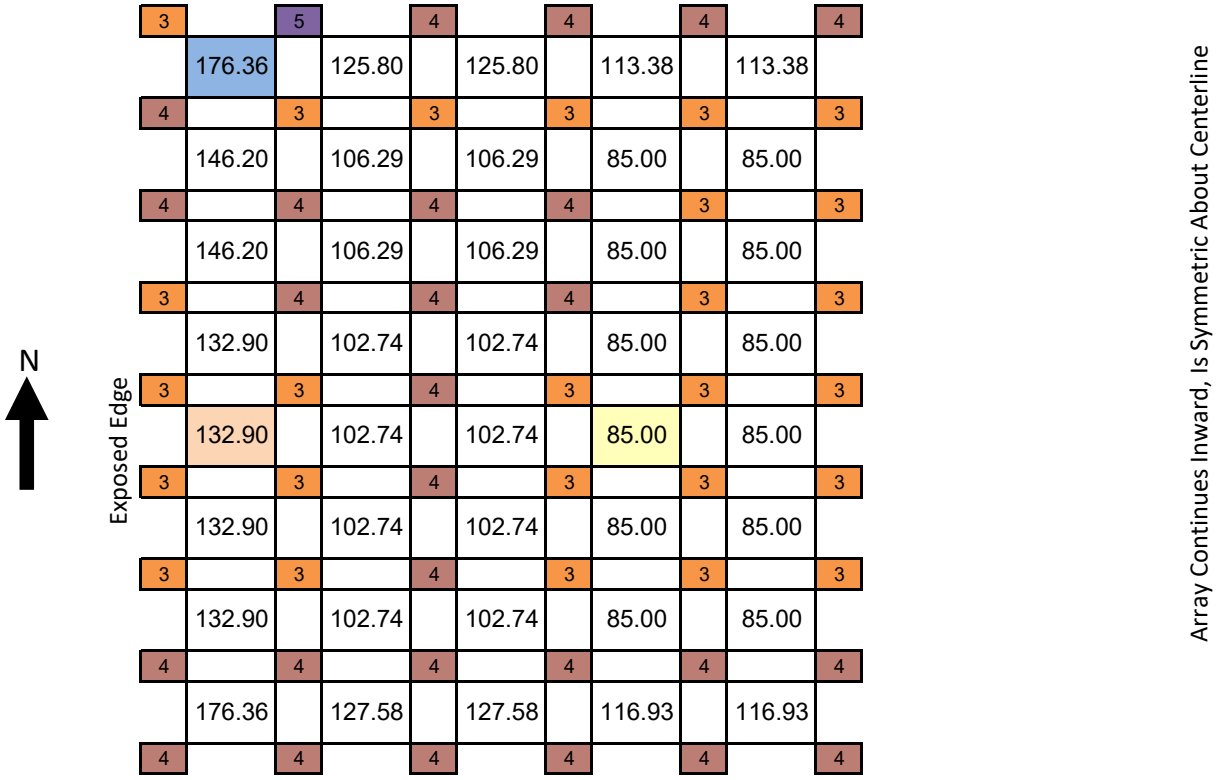
As shown in Image 3, the ballast required to resist lift - BWUz from Table 4 - is listed for each module location in Image 4. A portion of each BWUz value is distributed to each of the connected EcoFoot Bases, also detailed in Image 3 and included in Image 4. The total ballast required at each EcoFoot location is then calculated and rounded up to the next ballast block increment.

Image 3: Example of Module and Ballast Graphical Representation



The ballast prescription array shown in Image 4 is one of many similar arrays created automatically through EcoCalcs in order to address all possible array configurations. The data calculated in Table 4 was ultimately used to assign ballast to the system design in Sheet S-1.0 by Unirac. EcoCalcs and the resulting ballast plan S-1.0 are reviewed by CBC Engineers for correctness and completeness. Once approved, an engineering report including Sheet S-1.0 and any supporting material (this explanation included) are stamped and sealed by a professional engineer registered in the state where the project is proposed.

Image 4: Ballast Prescriptions Produced by Table 4



NOTE: The colored module locations in Image 4 correspond to the same colored areas in Table 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for more detailed calculations.

Detailed Calculations From Table 4

North Corner Module		
GCn Value from RWDI report:	-0.33	
qh value from Table 3:	29.05	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-9.45	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-259.89	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-105.82	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	176.36	lbf

East/West Edge Module		
GCn Value from RWDI report:	-0.27	
qh value from Table 3:	29.05	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-7.87	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-216.43	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-79.74	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	132.90	lbf

Interior Module		
GCn Value from RWDI report:	-0.21	
qh value from Table 3:	29.05	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-6.13	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-168.53	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-51.00	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	85.00	lbf

Max downpoint load calculations

No of Mid supports	1	
Tributary Area to support/bays/base	0.5	of module area
Wind force down (WL)	316 lbs	
Snow load Down (SL)	330.13 lbs	
Total Dead load per Bay (DL)	145.36 lbs	

Load Combinations

DL+ SL	475.49 lbs
DL+0.6WL	334.82 lbs
DL+0.75SL+0.45WL	**535.06 lbs**

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SEAOC PV1 - 2012 - Section 4: attached Arrays

Unirac utilizes the unattached design approach to account for seismic force as provided for by Section 16 of the 2016 California Building Code, the Structural Engineering Association of California PV1 Requirements (SEAOC PV1-2012) and ASCE 7. Section 1613.5 defines “Ballasted Photovoltaic System” which also defines "partially attached" systems, and provides guidance for designing arrays that utilize physical anchors and friction to resist seismic forces. SEAOC PV1 or ASCE 7 Chapter 13 defines the calculations required design attached photovoltaic systems, including friction to partially offset seismic forces.

The following explanation walks through calculations outlined in Section 4 - Attached Arrays. The attached approach begins with the project specific design criteria outlined in Table 6. These values reflect site inputs as well as assumptions permitted in the SEAOC PV1-2012 document Section 4 and ASCE 7 chapter 13 .

Table 6: Seismic Design Inputs

Number of blocks per Ecofoot	6.00
Wp=Weight per unit	275.53
Site Class	D-Stiff Soil
Seismic Design Category	0.00
Ip	1.50
Rp	1.50
'Seismic Calcs (Attached)'!A9	1.00
Fa (Site Class E)	2.5
Sms = Fa x Ss	0.15
Sds = (2/3) x Sms	0.10

Table 7: ASCE7 Inputs

z=height of point of attachment (in.)	1.00
h=structure height compared to base (in.)	1.00
Fp=0.4*ap*Sds*Wp*(1+2*z/h)/(Rp/Ip)	33.15
Fp=1.6*Sds*Ip*Wp	66.30
Fp=0.3*Sds*Ip*Wp	12.43
Fp	33.15
Fp (ASD)	23.21

SEAOC PV1 specifies that “PV support systems that are attached to the roof structure shall be designed to resist the lateral seismic force *Fp* specified in ASCE 7-16/22 Chapter 13.” Although SEAOC PV1 was released prior to ASCE 7-16/22, *Fp* is defined the same way in Chapter 13 of both ASCE verions 7-10, 7-16 and 7-22. Therefore the lateral seismic force analysis applied is valid for both ASCE 7-10, 16 and 22. In utilizing the *Fp* calculations for nominal, minimum, and maximum values laid out in Section 13.3.1, the values in Table 7 are found.

The following is excerpted from SEAOC PV1-2012, Section 4 – Attached Arrays:

“For attached roof-bearing systems, friction is permitted to contribute in combination with the design lateral strength of attachments to resist the lateral force Fp when all of the following conditions are met:

- “The maximum roof slope at the location of the array is less than or equal to 7 degrees (12.3 percent);
- “The height above the roof surface to the center of mass of the solar array is less than the smaller of 36 inches and half the least plan dimension of the supporting base of the array
- “Rp shall not exceed 1.5 unless it is shown that the lateral displacement behavior of attachments is compatible with the simultaneous development of frictional resistance.”

The EcoFoot 2+ and EcoFoot 5D systems have been demonstrated to be in conformance with the above stated stipulations. As such, and in accordance with the remainder of Section 4 – Attached Arrays from SEAOC PV1-2012, the force required to resist movement due to seismic shifting is calculated. Based on the minimum ultimate shear strength of the roof mounting method prescribed for this job, the total lateral load that one attachment may offset is calculated, and by extension the number of modules allowed per attachment point. These values can be found in Table 8.

All friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients, methodology that is in agreement with SEAOC PV2 and Los Angeles, CA stipulations.

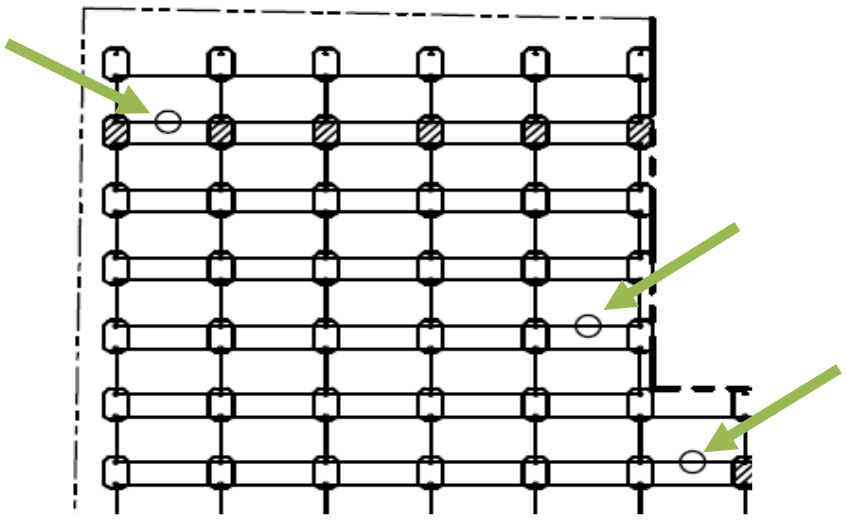
Table 8: Calculation of Physical Attachment Requirements

Friction Coefficient	0.37	*ASTM G115 Tested*
Ff (max friction) = (0.6-0.14*Sds)*(0.7*u)*Wp	41.93	*SEAOC section 4 (ASD), Friction Force*
Excess force per unit	-18.72	*Force to be offset by physical attachments*
Attachment system rating (allowable)	634.91	*ASD design load*
Number of panels per attachment	-33.91	*(if negative, no fasteners are needed)*

This final number of panels per attachment represents the maximum number of modules that any given attachment point may account for in terms of offsetting seismic force Fp. Physical attachments shall be installed per the manufacturer's instructions, and attached to the EcoFoot 2+ or EcoFoot 5D system per the installation instructions provided by Unirac.

On Sheet S-1.0 physical attachments are called out as shown below in Image 5:

Image 5: Example of ballast layout with seismic attachment callouts



SOLAR PROJECT DESIGN

Prepared For: Nova Consultants Inc
Project Name: City Hall
Project Address: 301 East Huron Street, Ann Arbor, MI 48104
Date: June 5, 2024

SOLUTION OVERVIEW

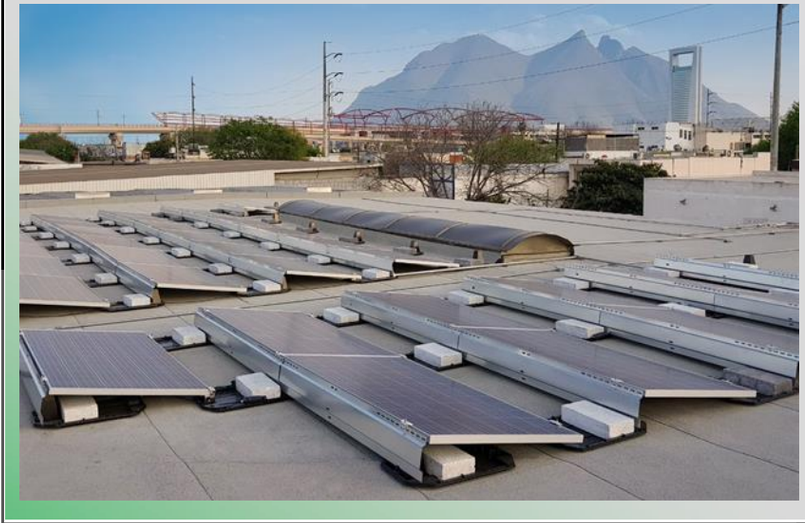
EcoFoot2+ Low-Slope Racking

With 500MW installed, EcoFoot Racking is preferred by installers for fast, simple installation and streamlined logistics. The enclosed provides the layout and system details for a complete solution for your project using this validated and reliable product.

EcoFoot2+ delivers key advantages for a successful, efficient installation.
Faster Installation: Installers complete projects in less time with self-aligning Bases, simple pre-assembled components, five-minute learning curve, and one-tool installation. Install speed is rated at 13.5 modules/installer-hour by DNV-GL.

Low Part Count & Streamlined Logistics: EcoFoot2+ consists of three core components: roof friendly, durable Base with integrated north/south Wire Clips, pre-assembled Clamps, and Wind Deflector to reduce ballast and provide east/west bonding. Stackable Bases fit up to 50kW per pallet, meaning fewer crane lifts and less space used on the job site.

Dedicated Support: Experienced project managers and field technicians support your project from bid to inspection. Project managers ensure you have needed details to obtain a permit and pass inspection. Our field team offers a dedicated phone line and email. On-site training is available.



VICINTY MAP

PROJECT SPECIFICATIONS

SYSTEM INFORMATION	
Total System Size (KW)	16.82
Total Module Quantity	29
Module Orientation	Landscape
EQUIPMENT	
Module Manufacturer	Jinko
Module Model	JKM 580N-72HL4-BDV
Module Wattage	580
Module Length (in.)	89.69
Module Width (in.)	44.65
Module Weight (lbs)	68.34
BUILDING DATA	
Roof Type	Other
Parapet Height (in)	6
Setback (in)	48
Roof Height (ft)	100
Roof Slope (degrees)	1.20
DESIGN VALUES	
ASCE Version	2010
Basic Windspeed (mph)	120
Wind Exposure Category	B
Occupancy Category	IV
Ground Snow Load (lb/ft^2)	20

DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

CONTRACTOR IS RESPONSIBLE FOR VERIFYING ROOF CAPACITY.
CONTRACTOR IS RESPONSIBLE FOR CONFIRMING ALL DESIGN CRITERIA ARE CORRECT AND APPROPRIATE FOR THE PROJECT SITE.
CONTRACTOR MUST CONFIRM DESIGN MEETS ALL UTILITY AND AHJ REQUIREMENTS.
CONTRACTOR IS RESPONSIBLE FOR VERIFYING THAT BUILDING STRUCTURE AND RELATED CONNECTIONS CAN SUPPORT ALL LOADS IMPOSED BY PV SYSTEM.
REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS AND ADDITIONAL INFORMATION.

Uplift, Sliding and Seismic Calculations

Explanation of EcoFoot System Calculations and Design Procedure

Installer Name:	Nova Consultants Inc
Project Name:	City Hall
Project Address:	301 East Huron Street Ann Arbor, MI 48104
Date Prepared:	6/5/2024

Calculation Explanation Key Sections:

Table Of Figures:

3rd Party Engineering Resources

Rowan, Williams, Davies, & Irwin Inc (RWDI) -- Wind Tunnel Testing Per ASCE 7 / IBC
Maffei Structural Engineering -- Peer Review of Wind Tunnel Testing
Testing Engineers, Inc. -- Friction Testing per ASTM G115
CBC Engineers -- Professional Engineering Review and Certification

Introduction, Site Specifics and Variable Definition

In order to efficiently design EcoFoot2+ and EcoFoot5D ballasted photovoltaic systems, Unirac makes use of a proprietary solar array design aid called “EcoCalcs”. Starting with a set of design criteria, shown here in Table 1 below, EcoCalcs utilizes methodologies laid out in the ASCE7 and SEAOC PV1/PV2 documents, and derivative building codes. Actual calculations for this project are included herein, and are accompanied by a step-by-step explanation of Unirac's design process.

The output of EcoCalcs is a comprehensive set of ballast prescriptions, including Image 3 found on Page 6. Ballast prescriptions are applied to a proposed system layout by the Unirac engineering team. Engineering Alliance, Unirac's professional engineering partner, has reviewed and verified EcoCalcs and reviews system designs to ensure that calculations and ballast prescriptions were correctly applied. Upon successful review, Engineering Alliance provides a stamped design review including relevant supporting documentation (this explanation included) and a stamped, approved ballast plan.

Please note: Unirac and Engineering Alliance are not conducting a structural review of the proposed site.

Below, Table 1 and Table 2 list the design criteria and project details for a proposed system in Ann Arbor, MI. These values will be used throughout the remainder of this explanation.

Table 1: System Design Criteria

Product Line	EcoFoot 2+
ASCE7 Version	2010
Ground Elevation (ft)	N/A
Roof Type	Other
Roof Height (ft.)	100
Roof Slope (deg)	1.20
Min Edge Setback (in)	48
Parapet Height (in.)	6
3 Sec. Gust (mph)	120
Occupancy Category	IV
Wind Exposure	B
Snow Load (psf)	20.0
Seismic Data (SS)	0.0940
Soil Site Class	D-Stiff Soil
Coeff. Of Friction (fn)*	0.37

**req's slip sheets*

Table 2: PV Module Specifics

Module Manufacturer	Jinko
Module Model	JKM 580N-72HL4-BDV
Module Orientation	Landscape
Module Power (w)	580
Module Length (in)	89.69
Module Width (in)	44.65
Module Weight (lbs.)	68.34

Utilizing the inputs from Tables 1 and 2, the factors in Table 3 are generated for the site. This list of factors is used in various ways to fully define a proposed system according to calculations laid out in the SEAOC and ASCE documents. In the scope of this explanation, factors are used to calculate velocity pressure, qh as defined in ASCE7-05, Section 6.5.10; ASCE7-10, Section 30.3.2; or ASCE7-16 and ASCE7-22, Section 26.10.2, and ultimately the amount of ballast required to offset uplift and drag forces.

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Table 3: Calculation Inputs, Constants, and Variables

Racking Component Weight per Module	15.19	lbs.
Ballast Block Weight	32	lbs.
Asymmetric lift load Ratio (North Row)	1.4	
Asymmetric lift load Ratio (South Row)	1.6	
Ala= Effective Lift Area of PV Module	27.511	ft^2
Ada= Effective Drag Area of PV Module	4.07	ft^2
dLF1= Dead Load of Module and Attributed Racking	83.528	lbs.
Roof Setback Minimum	48	in.
Load Combination Factor for Wind	0.6	
Load Combination Factor for Seismic	0.7	
α (from ASCE7 Table 6-2 or 26.9.1 or 26.11-1)=	7	
zg (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	1200	ft.
zmin (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	30	ft.
z selected (from zmin & inputs)=	100	ft.
Kz= Velocity pressure exposure coefficient at height	0.99	
Kzt= Topographic Factor	1	
Kd= Directionality Factor	0.85	
Ke= Ground Elevation Factor	1	
Wind design load factor	0.6	
Dead Load design load factor	0.6	
qh_wind= Velocity Pressure (0.00256*Kz*Kzt*Ke*Kd*V^2*I)	30.97	psf

An explanation of variables:

Asymmetric Lift Load Ratio: This is a ratio describing the leverage created by EcoFoot base dimensions, module attachment location and location of center of ballast mass. Assessed as a multiplier on top of ballast distribution scheme in Image 4.

dLF1= Dead Load of Module and Attributed Racking: the weight of one module and hardware attributed to that module, not including ballast.

Ala= Effective Lift Area of PV Module: The surface area of a module projected onto the horizontal plane for lift calculations.

Ada= Effective Drag Area of PV Module: The surface area of a module projected onto the horizontal plane for drag calculations.

qh= Velocity Pressure at height "h": Calculation prescribed by ASCE7-05, eq. 6-15, and ASCE7-10, eq. 30.3-1, or ASCE7-16 and ASCE 7-22, eq. 26.10-1 (subscript "h" used here for clarity, ASCE7 utilizes subscript "z").

Wind Tunnel Testing, Uplift and Drag Force Calculations

Wind tunnel testing of the EcoFoot product line to determine GCn values has been conducted by Rowan Williams Davies & Irwin Inc. (RWDI), a nationally recognized boundary-layer wind tunnel test firm. Testing was conducted in accordance with ASCE7-05, section 6.6; and ASCE7-10/16/22, section 31.2. Module-specific GCn data allows for precise application of ballast to prevent uplift. Deviation from prescriptive wind GCn values has been addressed according to SEAOC PV2 via a peer review of the wind tunnel testing and results by Maffei Structural Engineering.

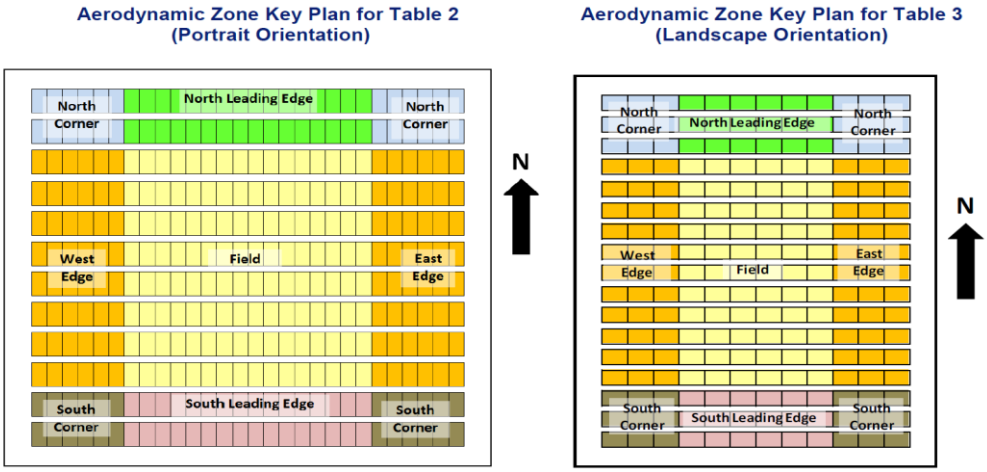
GCn and qh are used to calculate the pressure exerted on each module via the design wind pressure equations (ASCE7-05 – section 6.5.12.4, ASCE7-10 – section 30.4.2, ASCE7-16-30.5.2 and ASCE7-22 – section 30.3.2). Ballast required to offset uplift and drag forces (BWUz) is calculated in accordance with RWDI recoemndations. Detailed calculations for this project are found in Table 4. Resulting required ballast BWUz is displayed graphically in Image 3.

Table 4: Ballast to Resist Uplift Calculations for Project Proposed in Ann Arbor, MI 48104

			Load Sharing Area						
		#col x #rows	2x2	2x3			3x2	3x3	Down (1x1)
North Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-10.2	-9.0			-8.2	-7.5	24.8
	WLFUz=Uplift wind force =pUz*Ala	lbs.	-281.2	-248.6			-226.5	-205.4	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-118.6	-99.0			-85.8	-73.1	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	197.7	165.0			143.0	121.8	
North Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.3	-8.1			-7.7	-6.6	19.4
	WLFUz=Uplift wind force =pUz*Ala	lbs	-255.3	-223.6			-213.0	-182.3	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-103.0	-84.0			-77.7	-59.3	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	171.7	140.1			129.5	98.8	
E/W Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-10.2	-8.5			-8.2	-7.3	24.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-281.2	-234.2			-226.5	-201.5	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-118.6	-90.4			-85.8	-70.8	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	197.7	150.6			143.0	118.0	
Field	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.3	-8.1			-7.7	-6.6	19.4
	WLFUz=Uplift wind force =pUz*Ala	lbs	-255.3	-223.6			-213.0	-182.3	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-103.0	-84.0			-77.7	-59.3	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	171.7	140.1			129.5	98.8	
South Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-10.2	-8.5			-8.3	-7.3	24.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-281.2	-234.2			-228.4	-201.5	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-118.6	-90.4			-86.9	-70.8	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	197.7	150.6			144.9	118.0	
South Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-9.4	-8.1			-7.9	-6.6	19.4
	WLFUz=Uplift wind force =pUz*Ala	lbs	-259.1	-223.6			-216.9	-182.3	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-105.3	-84.0			-80.0	-59.3	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	175.6	140.1			133.4	98.8	

The aerodynamic differences among different sub-sections of a large array are handled by various calculation sections (North Corner, North Edge, E/W Edge...) and apply according to the excerpt from the RWDI report shown below in Image 1. The highlighted sections of Table 4 correspond to specific module locations, also shown in Image 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for expanded calculations pertaining to the highlighted sections.

Image 1: Aerodynamic Zones from RWDI Report



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To check the amount of drag a given sub-array will experience, the equation in Image 2 is utilized - an excerpt from RWDI's test report. Each sub-array is checked for sliding, proceeding from the smallest to largest or until drag no longer governs total required ballast.

Table 5 lists the calculations used to identify the total required ballast to counteract drag forces and prevent sliding. Friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients. Unless detailed information is available pertaining to the location of the sub-array, the roof's worst case uplift GCp are utilized in calculating drag and required ballast.

Image 2: Ballast to Resist Sliding Equation

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot Ballast_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)^*_{drag} \cdot A_{drag} \cdot \left(\frac{1}{f_n}\right) + |GC_p|^*_{uplift} \cdot A_{uplift} \right] - \alpha_D \cdot M \qquad (lb)$$

Table 5: Ballast to Resist Sliding Calculation

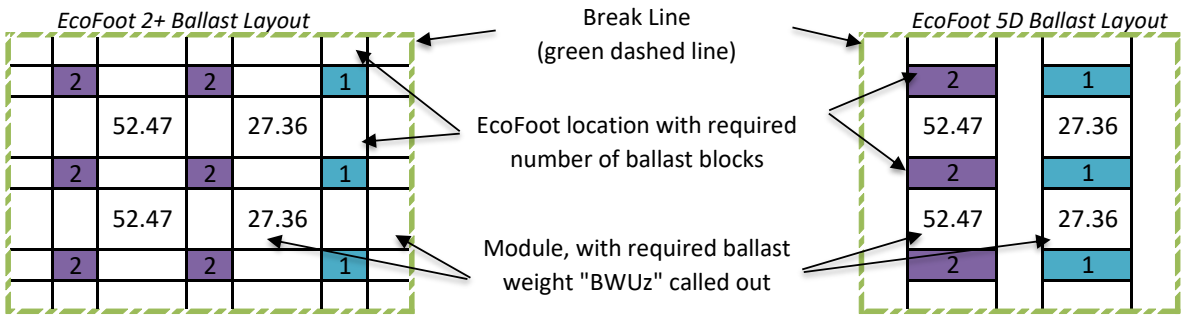
Sub-Array Module Count Total:	16
a_w = Wind Load Combination Factor =	0.6
a_d = Dead Load Combination Factor =	0.6
qz (qh in Table 3)	30.97
M = dLF1 from Table 3 =	83.53
f_n (also see Table 1) =	0.37
A_{uplift} = Ala in Table 3 =	27.51
A_{drag} = Ada in Table 3 =	4.07
$GC_{p\text{-}drag}$	1.67
$GC_{p\text{-}uplift}$	-0.67
Area Reduction Factor =	0.31
$(GCp)^*_{drag}$ =	0.52
$\lvert GCp \rvert^*_{uplift}$ =	0.21
Total Required Ballast Weight (Per Image 2)=	**4351.07**
$W_{ballastblock}$ =	32
Total Required Ballast Blocks:	**136**

Ballast Application to Sheet S-1.0

For easier interpretation, the results calculated in Table 4 are laid out in graphical representations of a solar array, shown in Image 4. Unirac engineers and drafters make use of this graphical layout when applying ballast to a given system design.

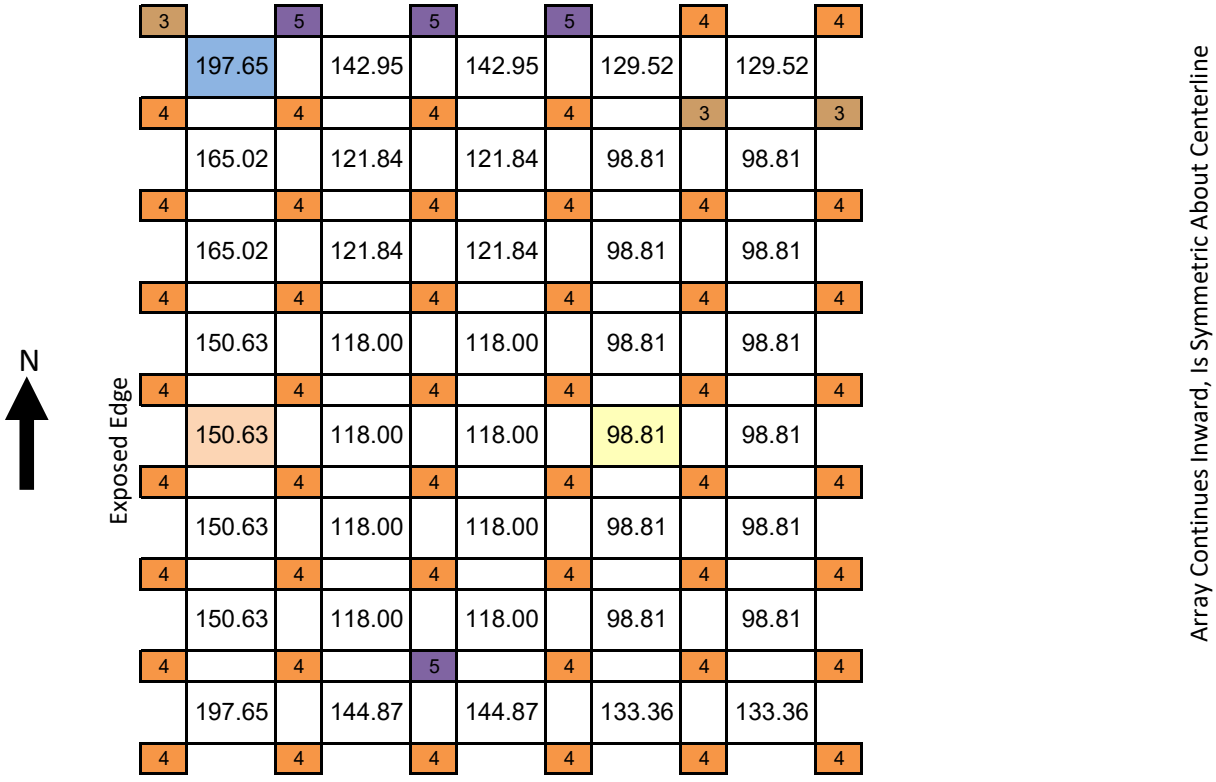
As shown in Image 3, the ballast required to resist lift - BWUz from Table 4 - is listed for each module location in Image 4. A portion of each BWUz value is distributed to each of the connected EcoFoot Bases, also detailed in Image 3 and included in Image 4. The total ballast required at each EcoFoot location is then calculated and rounded up to the next ballast block increment.

Image 3: Example of Module and Ballast Graphical Representation



The ballast prescription array shown in Image 4 is one of many similar arrays created automatically through EcoCalcs in order to address all possible array configurations. The data calculated in Table 4 was ultimately used to assign ballast to the system design in Sheet S-1.0 by Unirac. EcoCalcs and the resulting ballast plan S-1.0 are reviewed by CBC Engineers for correctness and completeness. Once approved, an engineering report including Sheet S-1.0 and any supporting material (this explanation included) are stamped and sealed by a professional engineer registered in the state where the project is proposed.

Image 4: Ballast Prescriptions Produced by Table 4



NOTE: The colored module locations in Image 4 correspond to the same colored areas in Table 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for more detailed calculations.

Detailed Calculations From Table 4

North Corner Module		
GCn Value from RWDI report:	-0.33	
qh value from Table 3:	30.97	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-10.22	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-281.18	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-118.59	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	197.65	lbf

East/West Edge Module		
GCn Value from RWDI report:	-0.27	
qh value from Table 3:	30.97	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-8.51	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-234.16	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-90.38	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	150.63	lbf

Interior Module		
GCn Value from RWDI report:	-0.21	
qh value from Table 3:	30.97	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-6.63	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-182.34	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-59.28	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	98.81	lbf

Max downpoint load calculations

No of Mid supports	1	
Tributary Area to support/bays/base	0.5	of module area
Wind force down (WL)	342 lbs	
Snow load Down (SL)	330.13 lbs	
Total Dead load per Bay (DL)	145.36 lbs	

Load Combinations

DL+ SL	475.49 lbs
DL+0.6WL	350.34 lbs
DL+0.75SL+0.45WL	**546.70 lbs**

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SEAOC PV1 - 2012 - Section 4: attached Arrays

Unirac utilizes the unattached design approach to account for seismic force as provided for by Section 16 of the 2016 California Building Code, the Structural Engineering Association of California PV1 Requirements (SEAOC PV1-2012) and ASCE 7. Section 1613.5 defines “Ballasted Photovoltaic System” which also defines "partially attached" systems, and provides guidance for designing arrays that utilize physical anchors and friction to resist seismic forces. SEAOC PV1 or ASCE 7 Chapter 13 defines the calculations required design attached photovoltaic systems, including friction to partially offset seismic forces.

The following explanation walks through calculations outlined in Section 4 - Attached Arrays. The attached approach begins with the project specific design criteria outlined in Table 6. These values reflect site inputs as well as assumptions permitted in the SEAOC PV1-2012 document Section 4 and ASCE 7 chapter 13 .

Table 6: Seismic Design Inputs

Number of blocks per Ecofoot	6.00
Wp=Weight per unit	275.53
Site Class	D-Stiff Soil
Seismic Design Category	0.00
Ip	1.50
Rp	1.50
'Seismic Calcs (Attached)'!A9	1.00
Fa (Site Class E)	2.5
Sms = Fa x Ss	0.15
Sds = (2/3) x Sms	0.10

Table 7: ASCE7 Inputs

z=height of point of attachment (in.)	1.00
h=structure height compared to base (in.)	1.00
Fp=0.4*ap*Sds*Wp*(1+2*z/h)/(Rp/Ip)	33.15
Fp=1.6*Sds*Ip*Wp	66.30
Fp=0.3*Sds*Ip*Wp	12.43
Fp	33.15
Fp (ASD)	23.21

SEAOC PV1 specifies that “PV support systems that are attached to the roof structure shall be designed to resist the lateral seismic force *Fp* specified in ASCE 7-16/22 Chapter 13.” Although SEAOC PV1 was released prior to ASCE 7-16/22, *Fp* is defined the same way in Chapter 13 of both ASCE verions 7-10, 7-16 and 7-22. Therefore the lateral seismic force analysis applied is valid for both ASCE 7-10, 16 and 22. In utilizing the *Fp* calculations for nominal, minimum, and maximum values laid out in Section 13.3.1, the values in Table 7 are found.

The following is excerpted from SEAOC PV1-2012, Section 4 – Attached Arrays:

“For attached roof-bearing systems, friction is permitted to contribute in combination with the design lateral strength of attachments to resist the lateral force Fp when all of the following conditions are met:

- “The maximum roof slope at the location of the array is less than or equal to 7 degrees (12.3 percent);
- “The height above the roof surface to the center of mass of the solar array is less than the smaller of 36 inches and half the least plan dimension of the supporting base of the array
- “Rp shall not exceed 1.5 unless it is shown that the lateral displacement behavior of attachments is compatible with the simultaneous development of frictional resistance.”

The EcoFoot 2+ and EcoFoot 5D systems have been demonstrated to be in conformance with the above stated stipulations. As such, and in accordance with the remainder of Section 4 – Attached Arrays from SEAOC PV1-2012, the force required to resist movement due to seismic shifting is calculated. Based on the minimum ultimate shear strength of the roof mounting method prescribed for this job, the total lateral load that one attachment may offset is calculated, and by extension the number of modules allowed per attachment point. These values can be found in Table 8.

All friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients, methodology that is in agreement with SEAOC PV2 and Los Angeles, CA stipulations.

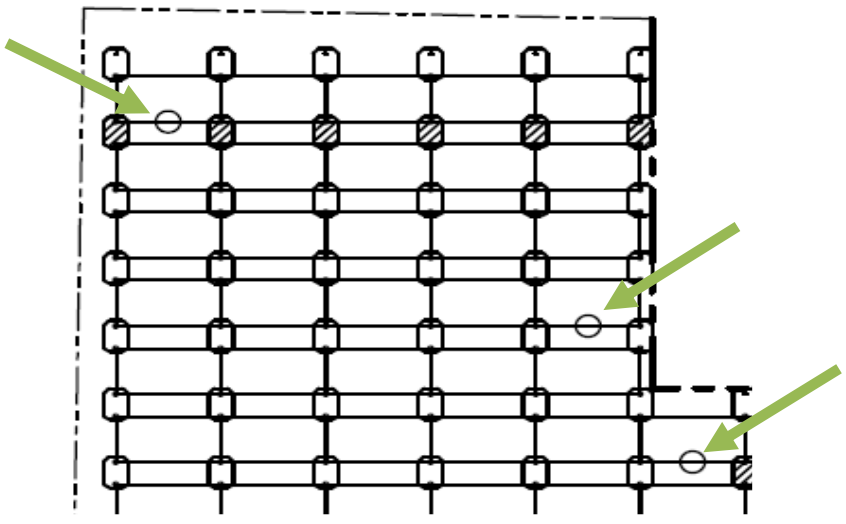
Table 8: Calculation of Physical Attachment Requirements

Friction Coefficient	0.37	*ASTM G115 Tested*
Ff (max friction) = (0.6-0.14*Sds)*(0.7*u)*Wp	41.93	*SEAOC section 4 (ASD), Friction Force*
Excess force per unit	-18.72	*Force to be offset by physical attachments*
Attachment system rating (allowable)	634.91	*ASD design load*
Number of panels per attachment	-33.91	*(if negative, no fasteners are needed)*

This final number of panels per attachment represents the maximum number of modules that any given attachment point may account for in terms of offsetting seismic force Fp. Physical attachments shall be installed per the manufacturer's instructions, and attached to the EcoFoot 2+ or EcoFoot 5D system per the installation instructions provided by Unirac.

On Sheet S-1.0 physical attachments are called out as shown below in Image 5:

Image 5: Example of ballast layout with seismic attachment callouts



LIST OF DRAWINGS

NUM	TITLE	REV	50% REVIEW 3-22-2024	INTERCONNECT 5-8-2024	BID REVIEW 6-28-2024	INTERCONNECT REV. 7-8-2024	ADDENDUM-2 1-27-2025
	GENERAL						
G001	COVER SHEET		●	●	●	●	●
G002	GENERAL NOTES AND SYMBOLS		●		●		
	CIVIL						
C101	SITE PLAN		●		●		
C102	CONSTRUCTION PLAN		●		●		
	ELECTRICAL						
E101	ELECTRICAL SITE PLAN		●	●	●	●	
E102	AC POWER PLAN		●		●		
E103	DC POWER PLAN		●		●		
E104	GROUNDING PLAN				●		●
E105	PV WIRING PLAN		●		●		●
E401	ELECTRICAL EQUIPMENT RACK (ON ROOF)		●		●		
E402	ELECTRICAL EQUIPMENT ELEVATION (GROUND LEVEL)		●		●		
E501	ELECTRICAL DETAILS		●		●		●
E601	ONE-LINE DIAGRAM		●	●	●		●
E701	LABELS AND PLACARDS		●	●	●		
E702	ELECTRICAL SPECIFICATIONS				●		
E801	DATA SHEETS				●		
E802	DATA SHEETS				●		
E803	DATA SHEETS				●		
E804	DATA SHEETS				●		
E805	DATA SHEETS				●		
	STRUCTURAL						
S-1.0	UNIRAC - ROOF BALLAST LAYOUT				●		
EF2+	UNIRAC - ECOLIBRIUM-ECOFOOT2; MULTI-PAGE REPORT				●		

PROJECT TO BE SUBMITTED AND REVIEWED UNDER THE 2015 MICHIGAN REHABILITATION CODE FOR EXISTING BUILDINGS (MRCEB) SECTION 301.1.2 "WORK AREA COMPLIANCE METHOD" PER SECTION 504.1 LEVEL-2 ALTERATIONS (CH 5-13).

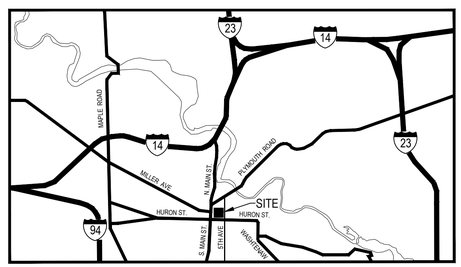
NOVA PROJECT #23-11-1168-FS1
84.6 kW AC, 1000 V DC (MAX.), 96.8 kW DC SOLAR PHOTOVOLTAIC SYSTEM

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

NOVA PROJECT MANAGER: JEFF ECKHOUT



N

SITE LOCATION MAP

NO SCALE

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

www.novaconsultants.com

ISSUED

DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	
5-8-2024	INTERCONNECT	JE
6-28-2024	BID REVIEW	
* 7-8-2024	INTERCONNECT REV.	
2 1-27-2025	ADDENDUM-2	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

COVER SHEET

PROJECT NUMBER	23-11-1168-FS1
DRAWN BY	RGM, GAK, BD
SCALE	NONE
SHEET SIZE	22x34
SHEET NUMBER	G001

STANDARD METHODS OF NOTATION

- SHEET KEY NOTES □TAGS□
- ITEM DESIGNATION □E601 WIRE AND CONDUIT SCHEDULE□
- REVISION □ADDENDUM TAG
- DETAIL NUMBER (ELEVATION TAG) SHEET WHERE FOUND — 3 / E402
- DETAIL NUMBER (SECTION CUT TAG) SHEET WHERE FOUND — 5 / E201
- DETAIL NUMBER — 1 / E103 — SHEET WHERE FOUND — (BUBBLE DETAIL) — ENLARGEMENT AREA
- DETAIL NUMBER / NAME (DRAWING TITLE & IDENTIFICATION) SHEET WHERE FOUND / SCALE — 1 / E104 · DET. · SCALE: N.T.S.
- SPOT ELEVATION — 10'-0" A.F.F.
- MATCH LINE — SHEET C102 / SHEET C103
- CENTER LINE
- LIGHT LINE INDICATES E□ISTING WORK
- HEAVY LINE INDICATES NEW WORK
- DASHED LINE INDICATES DEMOLITION
- UNDERGROUND CONDUIT AND WIRING

NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.

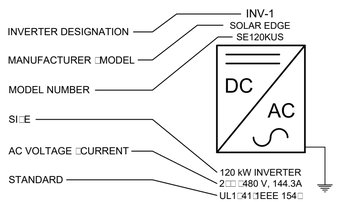
SITE, ROOF □ FLOOR PLAN SYMBOLS

- 1-1 / STRING # / INVERTER # — PV STRING DESIGNATION
- MODULE □SITE □ ROOF PLAN□
- SWITCHGEAR
- INV-1 — INVERTER
- PB — PANEL BOARD
- D — DISCONNECT
- M — METER
- T — TRANSFORMER
- CT — CT CABINET
- C — COMBINER
- DUPLE□ RECEPTACLE
- EV CHARGING STATION
- EV CHARGING ONLY □PARKING SPACE□
- COPPER CLAD GROUND ROD
- SILT FENCE
- CHAIN LINK FENCE
- 0 — GRAPHIC SCALE
- NORTH — NORTH ARROW

ELECTRICAL DETAIL SYMBOLS

- 1-1 / STRING # / INVERTER # — PV STRING DESIGNATION
- MODULE □PV WIRING PLAN□
- SWITCHGEAR
- INVERTER
- PB — PANEL BOARD
- D — DISCONNECT
- M — METER
- T — TRANSFORMER
- CT — CT CABINET
- C — COMBINER
- DUPLE□ RECEPTACLE
- EV CHARGING STATION
- EV CHARGING ONLY □PARKING SPACE□
- COPPER CLAD GROUND ROD

INVERTER ANNOTATION



ONE LINE DIAGRAM SYMBOLS □SHEET E601□

- 1-1 / STRING # / INVERTER # — PV STRING DESIGNATION
- MOD 1 (−) (+) — MODULE □ONE - LINE DIAGRAM□
- OPTIMI□ER
- RAPID SHUTDOWN
- PANELBOARD □PB□W□MAIN BREAKER
- DISCONNECT
- FUSED DISCONNECT
- DISCONNECT SWITCH
- TRANSFORMER
- FUSE
- CIRCUIT BREAKER
- CURRENT TRANSFORMER □CTs□
- POTENTIAL TRANSFORMER □PTs□
- BUS BAR
- WYE TRANSFORMER CIRCUIT CONNECTION
- DELTA TRANSFORMER CIRCUIT CONNECTION
- GROUND
- INVERTER
- DISCONNECT
- METER
- COMBINER
- SURGE PROTECTIVE DEVICE □SPD□
- DUPLE□ RECEPTACLE
- GFCI DUPLE□ RECEPTACLE
- GFCI WITH IN USE COVER OUTDOOR RATED WEATHER RESISTANT
- EV CHARGING STATION
- UTILITY POLE TO GRID
- STRING 1-1 - (POS.) / STRING 1-1 - (NEG.) — CIRCUIT HOMERUN W□STRING IDENTIFIER
- ROOF / ELEC ROOM — AREA DIVIDER LINE □E601 ONE-LINE DIAGRAM□

ELECTRICAL ABBREVIATION LIST

ABBREVIATION	DESCRIPTION
A	AMPERES
A.F.F.	ABOVE FINISH FLOOR
AU□	AU□ILIARY
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CT	CURRENT TRANSFORMER
DEMO	DEMOLITION
DIM	DIMENSION
DISC	DISCONNECT
DP	DISTRIBUTION PANEL
DWG	DRAWING
ELEC	ELECTRICAL
EM □EMER	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
EVCS	ELECTRIC VEHICLE CHARGING STATION
E□ □E□IST	E□ISTING
FLR	FLOOR
G □GRD □EG	GROUND
GFCI □GFI	GROUND FAULT CIRCUIT INTERRUPTER
HP	HORSEPOWER
HV	HIGH VOLTAGE
H□	HERT□
INV	INVERTER
IG	ISOLATED GROUND
JB	JUNCTION BO□
kV	KILOVOLT
kVA	KILOVOLT- AMPERES
kW	KILOWATT
kWH	KILOWATT - HOURS
MA□	MA□IMUM
MPPT	MA□IMUM POWER POINT TRACKING
MDP	MAIN DISTRIBUTION PANEL
MIN	MINIMUM
MISC	MISCELLANEOUS
MTD	MOUNTED
NEC	NATIONAL ELECTRICAL CODE
N□A	NOT APPLICABLE
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
PNL	PANEL
P	POLE
PH	PHASE
PV	PHOTOVOLTAIC
PT	POTENTIAL TRANSFORMER
PDP	POWER DISTRIBUTION PANEL
RSD	RAPID SHUTDOWN DEVICE
RECEPT	RECEPTACLE
RE□ D	RE□UIRED
RSC	RIGID STEEL CONDUIT
SW	SWITCH
SWBD	SWITCH BOARD
SWGR	SWITCH GEAR
TELCOM	TELECOMMUNICATIONS
TP	TAMPERPROOF
TYP	TYPICAL
U.O.N.	UNLESS OTHERWISE NOTED
V	VOLTS
V.I.F.	VERIFY IN FIELD
W	WIRE
WP	WEATHERPROOF
□FMR	TRANSFORMER

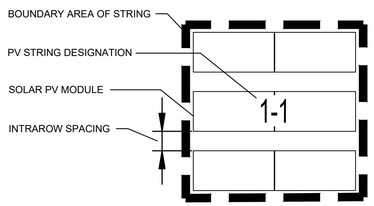
STANDARD MOUNTING HEIGHTS

DESCRIPTION	HEIGHT
PANELBOARD	6□0" A.F.F. TO TOP OF BO□
RECEPTACLE OUTLET	16" A.F.F. TO BOTTOM OF BO□. □MIN.□ 48" A.F.F. TO TOP OF BO□ □MA□.□
CONDUIT IN TRENCH	18" BELOW GRADE - TO TOP OF CONDIUT □MIN.□

LINES □ WIRES

- GAS — GAS — GAS LINE
- AC WIRING
- AC WIRING UNDERGROUND
- DC WIRING
- STRING WIRING
- GROUND WIRE
- CONDUIT DOWN
- CONDUIT UP

PV ARRAY ANNOTATION PLAN



NOVA Cons□ltants, Inc.
21580 No□ Road
S□ite 300
No□, MI 483□5
Phone: □248□34□-3512
Fa□: □248□34□-4152
www.no□acons□ltants.co□

ISSUED

DATE	DESCRIPTION	APPVD.
6-28-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

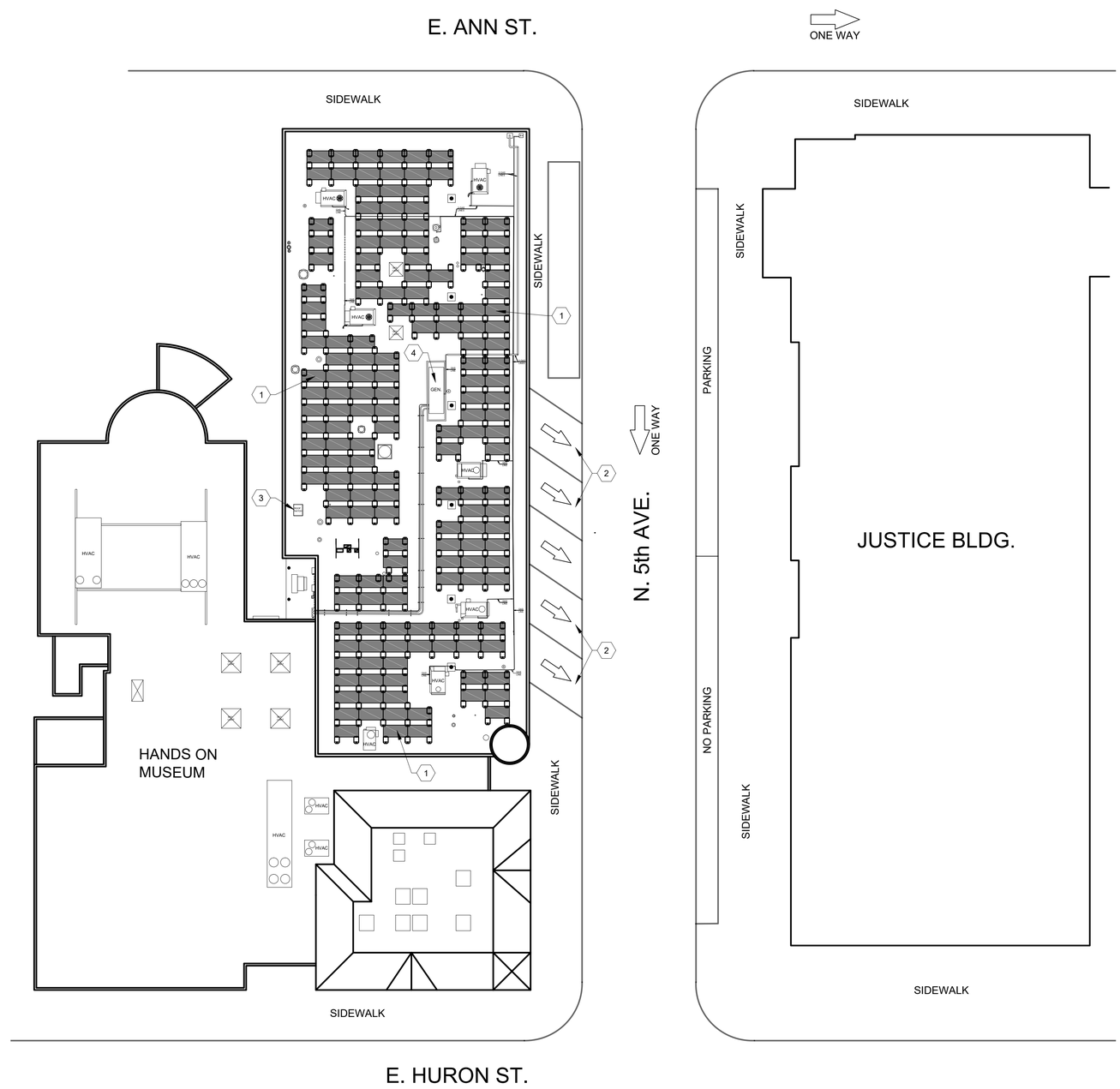
84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

GENERAL NOTATION

PROJECT NUMBER 23-11-1168-FS1

DRAWN BY GAK | SCALE | SHEET SI□E 22□34

SHEET NUMBER G002



NORTH

SITE PLAN

SCALE: 1"=20'

0 5' 10' 20' 40'

SCALE: 1"=20'

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 96.8 kW DC SOLAR ARRAY, 84.6 kW AC SOLAR ARRAY
2. NO PARKING, FIRE LANES (EXISTING)
3. ROOF ACCESS HATCH (EXISTING)
4. EXISTING GENERATOR

PV SYSTEM DESCRIPTION - GENERAL

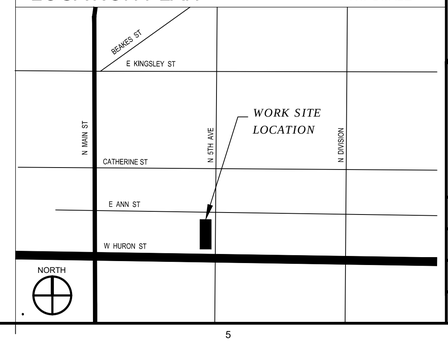
ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER

LOCATION PLAN

NO SCALE



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Suite 300
Novi, MI 48375
Phone: (248)34-3512
Fax: (248)34-4152
www.novaconsultants.com

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DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	
6-28-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

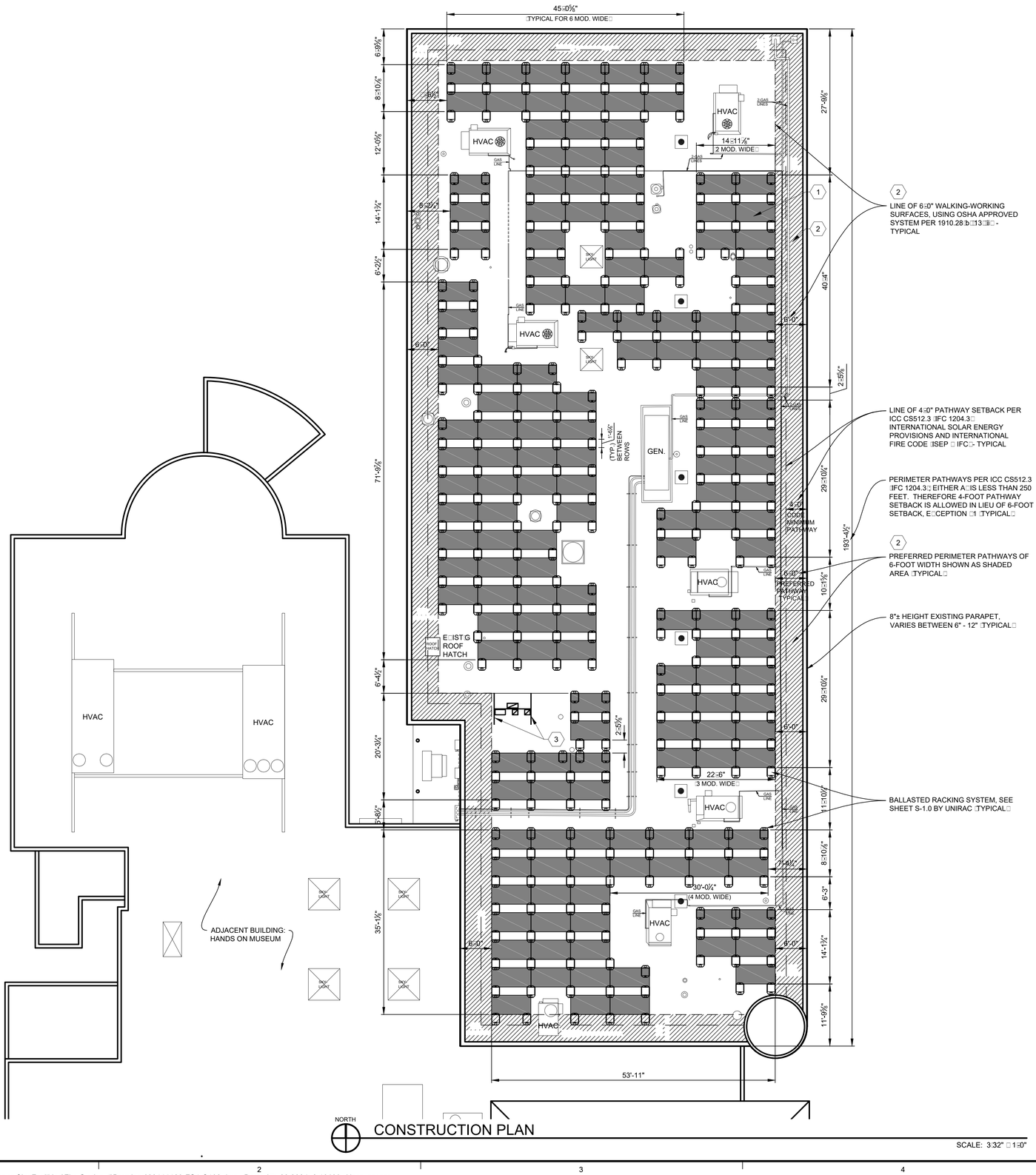
FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

96.8 kW DC SOLAR ARRAY
84.6 kW AC SOLAR ARRAY

SITE PLAN

PROJECT NUMBER	
23-11-1168-FS1	
DRAWN BY: BD, GAK	SHEET NUMBER: C101
SCALE: AS NOTED	
SHEET SIZE: 22x34	



CONSTRUCTION PLAN

SCALE: 3/32" = 1'-0"

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 96.8 kW DC PV ARRAY, 84.6 kW AC PV ARRAY.
2. 6'-0" PREFERRED PERIMETER PATHWAY (4'-0" CODE MIN.)
3. SERVICE RACK WITH INVERTERS AND PB-A.

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

(2) LINE OF 6'-0" WALKING-WORKING SURFACES, USING OSHA APPROVED SYSTEM PER 1910.28(b)(13)(i) - TYPICAL

LINE OF 4'-0" PATHWAY SETBACK PER ICC CS512.3 (IFC 1204.3) INTERNATIONAL SOLAR ENERGY PROVISIONS AND INTERNATIONAL FIRE CODE (SEP) (IFC)- TYPICAL

PERIMETER PATHWAYS PER ICC CS512.3 (IFC 1204.3) EITHER AXIS LESS THAN 250 FEET. THEREFORE 4-FOOT PATHWAY SETBACK IS ALLOWED IN LIEU OF 6-FOOT SETBACK, EXCEPTION #1 (TYPICAL)

(2) PREFERRED PERIMETER PATHWAYS OF 6-FOOT WIDTH SHOWN AS SHADED AREA (TYPICAL)

8"± HEIGHT EXISTING PARAPET, VARIES BETWEEN 6" - 12" (TYPICAL)

BALLASTED RACKING SYSTEM, SEE SHEET S-1.0 BY UNIRAC (TYPICAL)

LEGEND

INVERTER

PB — PANEL BOARD

0 5'-1 1/2" 10'-9" 21'-6"
SCALE: 1" = 3/32"

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248)-34-3512
Fax: (248)-34-4152

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ISSUED

DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	
6-28-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

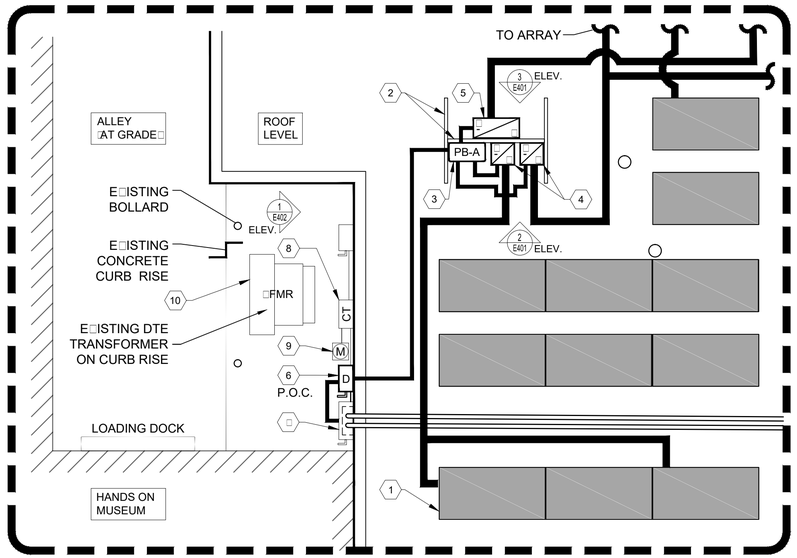
111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

96.8 kW DC SOLAR ARRAY
84.6 kW AC SOLAR ARRAY

CONSTRUCTION PLAN

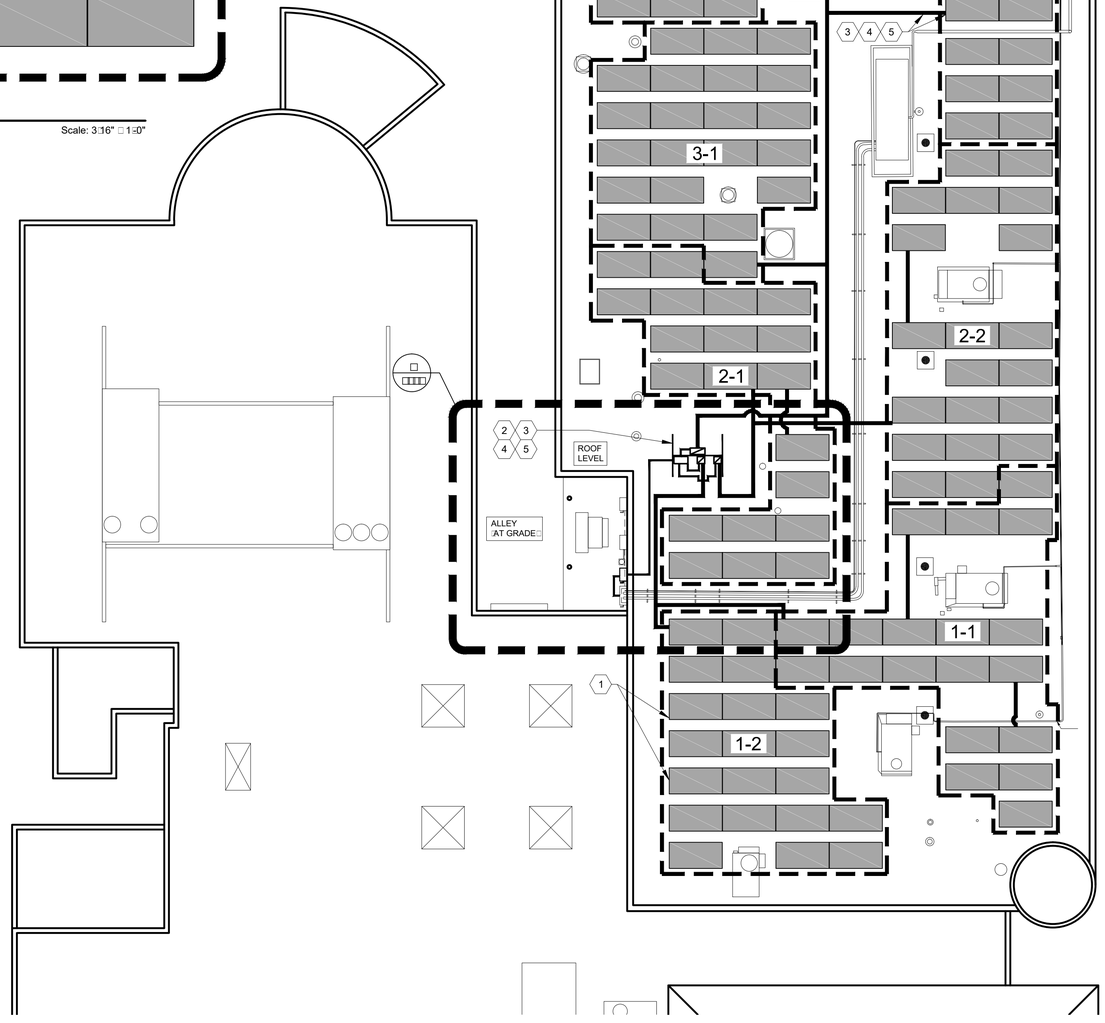
PROJECT NUMBER	23-11-1168-FS1
DRAWN BY	BD, GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	C102

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Fire Station 1\Drawings\23111168-FS1-C102.dwg Date: Jun 28 2024; 8:19AM User: george



PLAN DETAIL - AT EQUIPMENT RACKS

Scale: 3/16" = 1'-0"



NORTH

ELECTRICAL SITE PLAN

SCALE: N.T.S.

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 96.8 kW DC SOLAR ARRAY, 84.6 kW AC SOLAR ARRAY
2. SERVICE RACK (ON ROOF)
3. PB-A, (ON ROOF)
4. (2) 11.3 kW INVERTERS 1 & 2, (ON ROOF)
5. (1) 50 kW INVERTER 3, (ON ROOF)
6. SOLAR PV DISCONNECT-A (P.O.C.), LOCKABLE WITH BLADE STYLE VISIBLE BREAK TO BE INSTALLED WITHIN 5 FEET OF DTE UTILITY METER
7. (E) EXIST. MAIN-1 DISCONNECT
8. EXIST. CT CABINET
9. EXIST. UTILITY METER
10. EXIST. DTE TRANSFORMER
11. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR EQUAL.
12. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT (WALL) AND CONDUIT SUPPORT DETAILS (ROOF) ON SHEET E501.
13. SEE CONDUIT AND WIRE SIZE CHART ON SHEET E601

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (1-1 = STRING #, INVERTER #)	PV STRING DESIGNATION
	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
	AC WIRING CONDUIT
	DC WIRING CONDUIT
(P.O.C.)	POINT OF CONNECTION

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DATE	DESCRIPTION	APPVD.
3-22-2024	50% REVIEW	
5-8-2024	INTERCONNECT	JE
6-28-2024	BID REVIEW	
7-8-2024	INTERCONNECT REV.	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

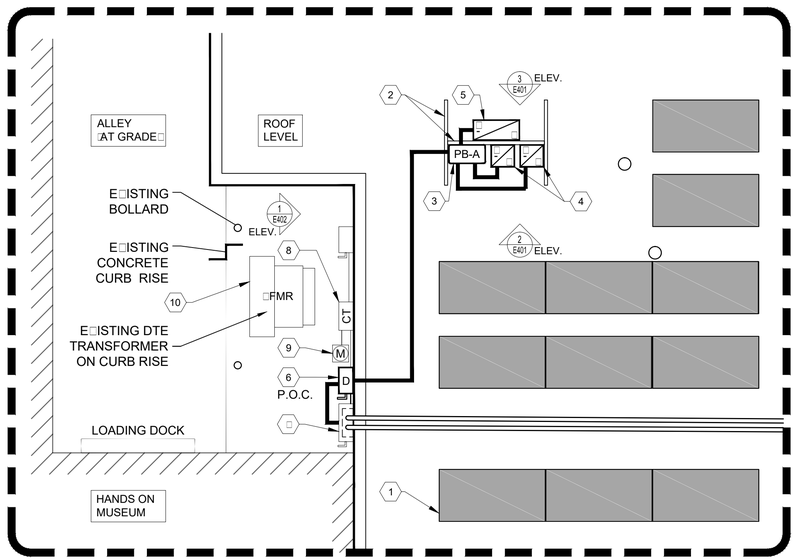
111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

ELECTRICAL SITE PLAN

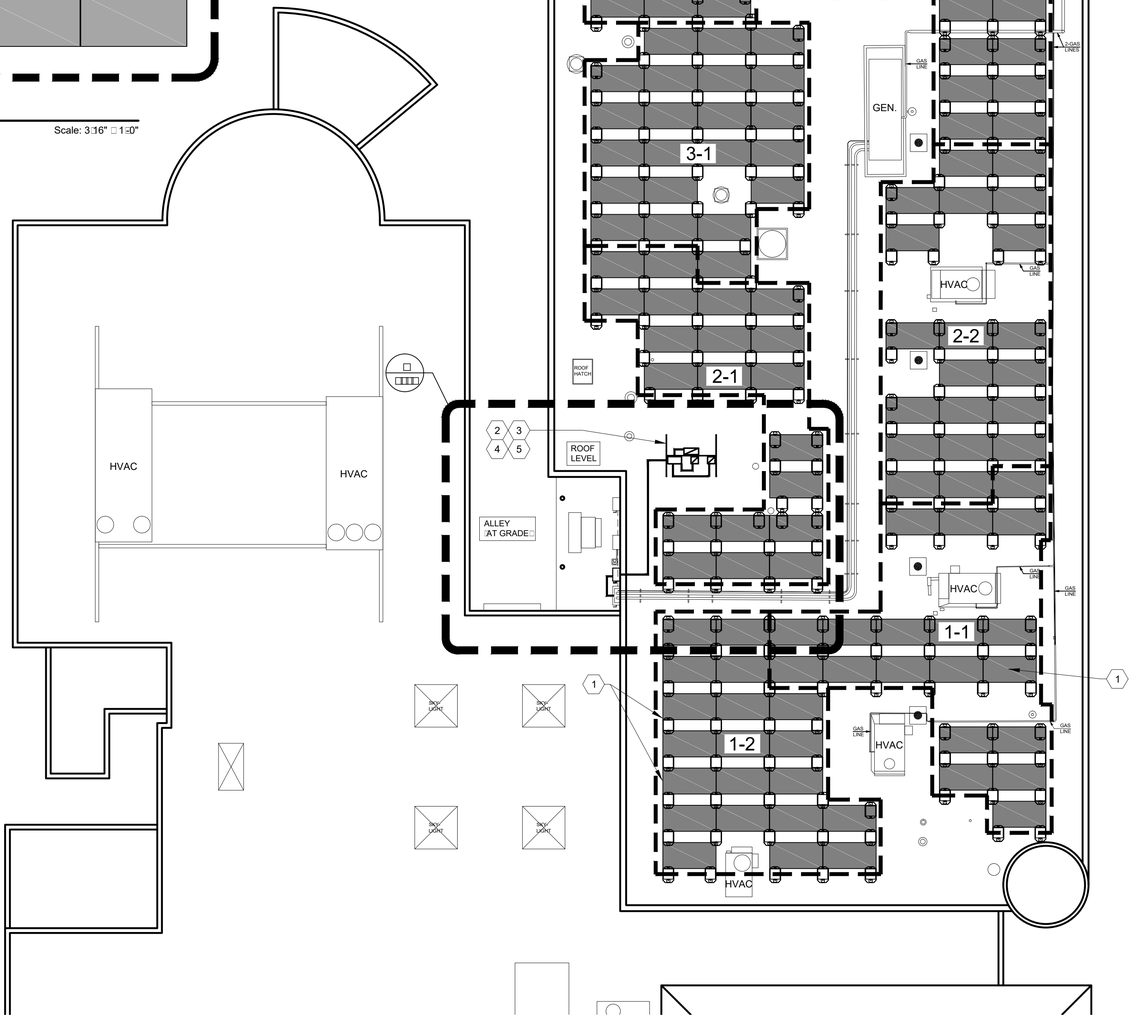
PROJECT NUMBER: 23-11-1168-FS1

DRAWN BY	SHEET NUMBER
BD, GAK	E101
SCALE: AS NOTED	
SHEET SIZE: 22"x34"	



PLAN DETAIL - AT EQUIPMENT RACKS

Scale: 3/16" = 1'-0"



AC POWER PLAN

SCALE: N.T.S.

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 96.8 kW DC SOLAR ARRAY, 84.6 kW AC SOLAR ARRAY
2. SERVICE RACK (ON ROOF)
3. PB-A, (ON ROOF)
4. (2)(1)(3 kW INVERTERS 1 - 2.(ON ROOF)
5. (1)(50 kW INVERTER 3, (ON ROOF)
6. DISCONNECT-A (P.O.C.)
7. EQUIST. MAIN-1 DISCONNECT
8. EQUIST. CT CABINET
9. EQUIST. UTILITY METER
10. EQUIST. DTE TRANSFORMER

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
	AC WIRING CONDUIT
(P.O.C.)	POINT OF CONNECTION

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Phone: (248)34-3512
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REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

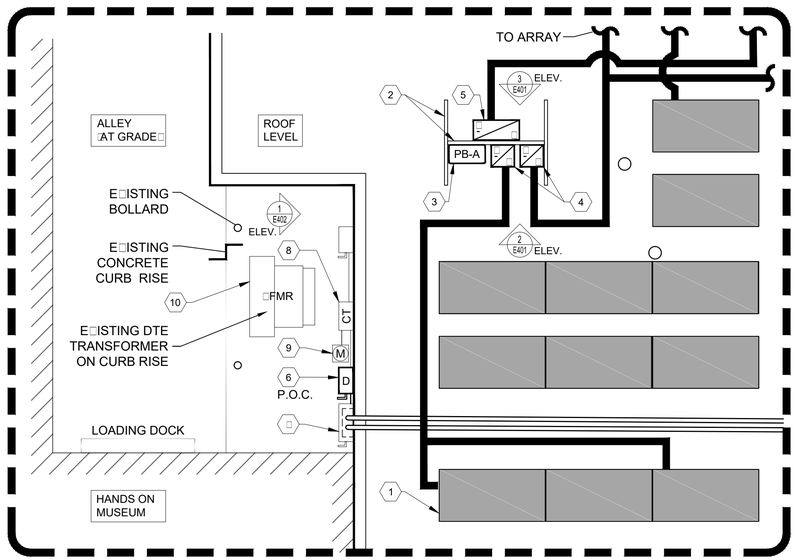
FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

96.8 kW DC SOLAR ARRAY
84.6 kW AC SOLAR ARRAY

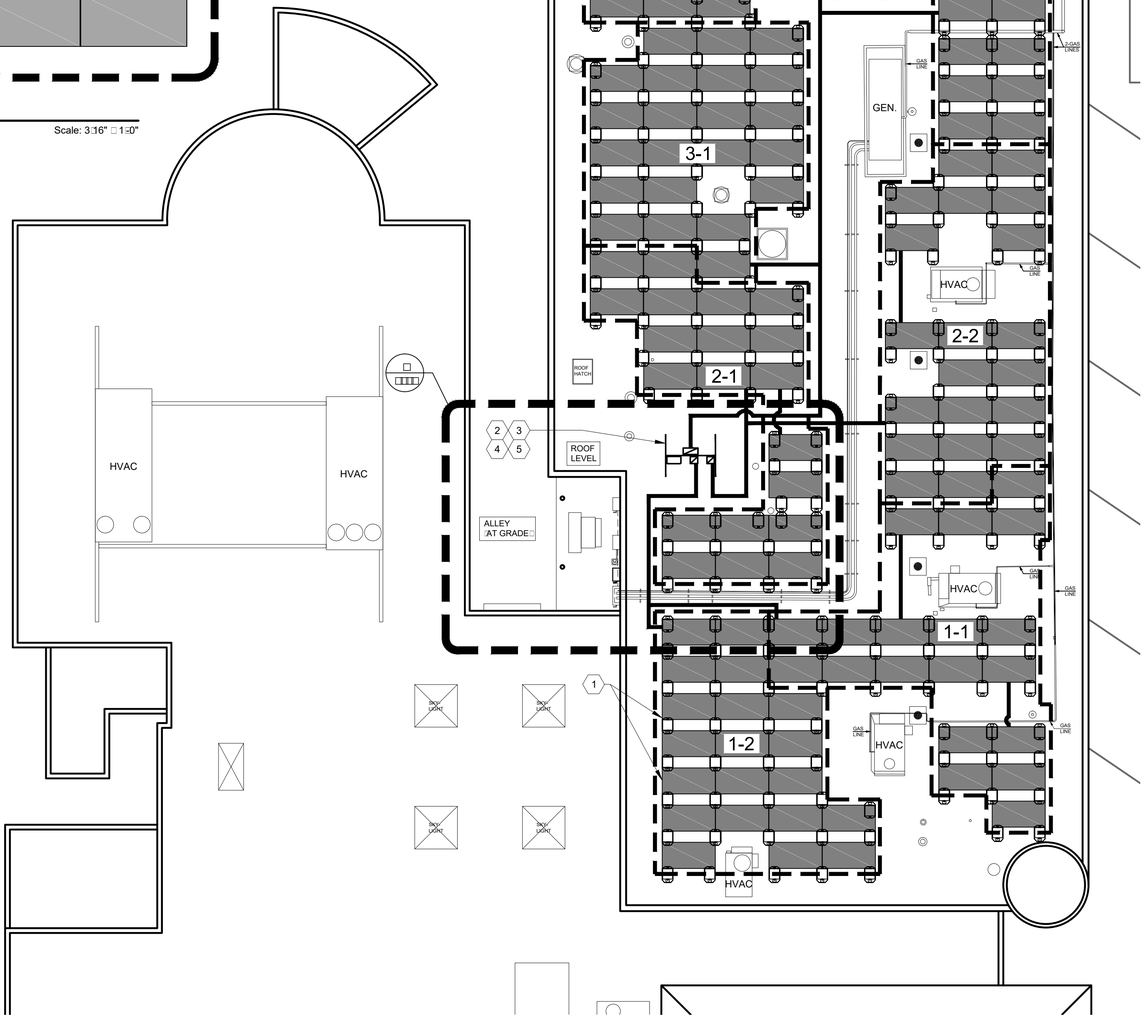
AC POWER PLAN

PROJECT NUMBER	23-11-1168-FS1
DRAWN BY	BD, GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E102



PLAN DETAIL - AT EUIPMENT RACKS

Scale: 3:16" 1:0"



NORTH

DC POWER PLAN

SCALE: N.T.S.

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE NEC; 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.

SHEET KEY NOTES

1. 96.8 kW DC SOLAR ARRAY, 84.6 kW AC SOLAR ARRAY
2. SERVICE RACK ON ROOF
3. PB-A, ON ROOF
4. 21 3 kW INVERTERS 1 2, ON ROOF
5. 1 50 kW INVERTER 3, ON ROOF
6. DISCONNECT-A P.O.C.
7. EIST. MAIN-1 DISCONNECT
8. EIST. CT CABINET
9. EIST. UTILITY METER
10. EIST. DTE TRANSFORMER
11. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR EUAL.
12. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT WALL AND CONDUIT SUPPORT DETAILS ROOF ON SHEET E501.
13. SEE CONDUIT AND WIRE SIE CHART ON SHEET E601

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
	AC WIRING CONDUIT
	DC WIRING CONDUIT
P.O.C.	POINT OF CONNECTION

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21580 No i Road
S ite 300
No i, MI 483 5
Phone: 248 34 -3512
Fa 248 34 -4152
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DATE	DESCRIPTION	APPVD.
6-28-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

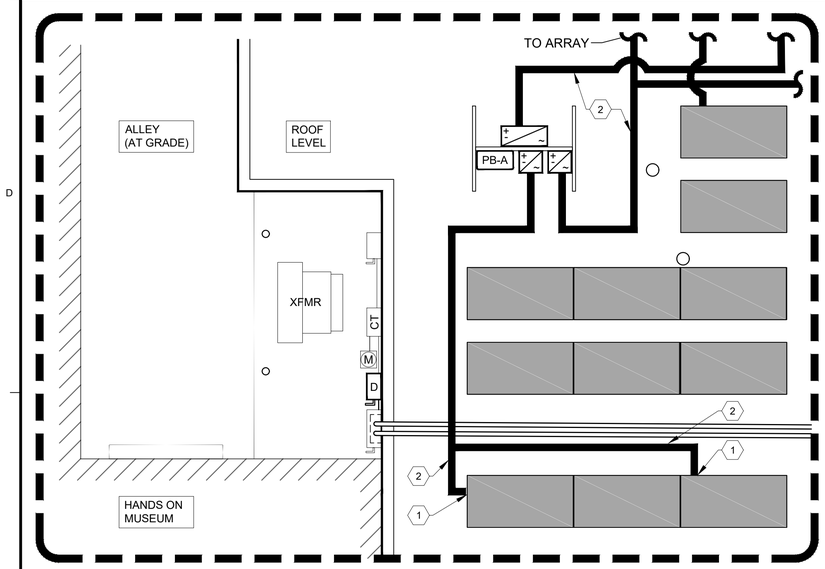
FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

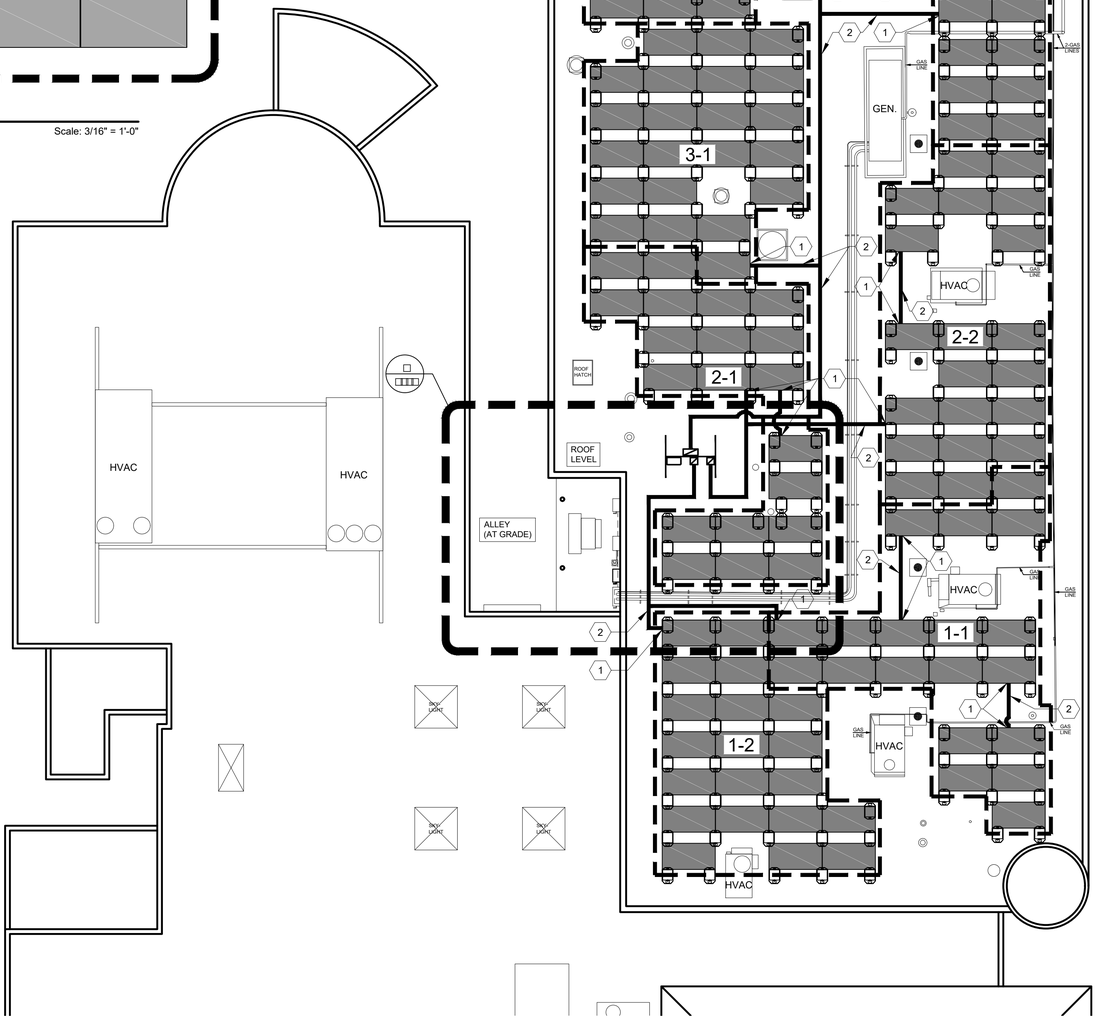
DC POWER PLAN

PROJECT NUMBER	23-11-1168-FS1
DRAWN BY	RGM, GAK
SCALE	AS NOTED
SHEET SIE	22 34
SHEET NUMBER	E103



PLAN DETAIL - AT EQUIPMENT RACK(S)

Scale: 3/16" = 1'-0"



NORTH

GROUNDING PLAN

SCALE: N.T.S.

SHEET GENERAL NOTES

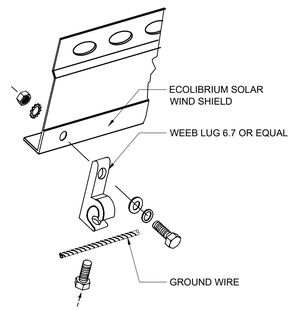
1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS..
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. CONDUIT FILL TO BE LESS THAN 40%.
4. CONTRACTOR TO VERIFY THAT MODULES ARE COMPATABLE WITH RACKING SYSTEM FOR ADEQUATE BONDING AND GROUNDING.
5. CONTRACTOR TO VERIFY WITH RACKING MANUFACTURER THE NUMBER OF GROUNDING LUGS REQUIRED. 1 LUG PER. CONTINUOUS ARRAY, NOT TO EXCEED 150' x 150'.
6. SOLAR PV WIRING METHODS AND WIRING SYSTEMS TO BE INSTALLED GROUNDING COMPLIANT WITH ARTICLE 250 PER NEC 690, PARTS IV AND V.
7. SEE SHEET E501 FOR GROUNDING DETAILS (2)

SHEET KEY NOTES

1. INSTALL GROUND LUG PER MANUFACTURER SPECIFICATIONS
2. RACK TO RACK GROUNDING BARE #6 CU. RACK TO INVERTER GROUNDING USE GREEN USE-2 #6 CU

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS



2 / E104 GROUNDING LUG DETAIL

SCALE: N.T.S.

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
± ~	INVERTER
PB	PANEL BOARD
D	DISCONNECT
M	METER
XFMR	TRANSFORMER
———	GROUND WIRE
(P.O.C.)	POINT OF CONNECTION

0 5'-41/2" 10'-9" 21'-6"

SCALE: 1 = 3/32"

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21580 Novi Road
Suite 300
Novi, MI 48375
Phone: (248) 347-3512
Fax: (248) 347-4152
www.novaconsultants.com

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RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

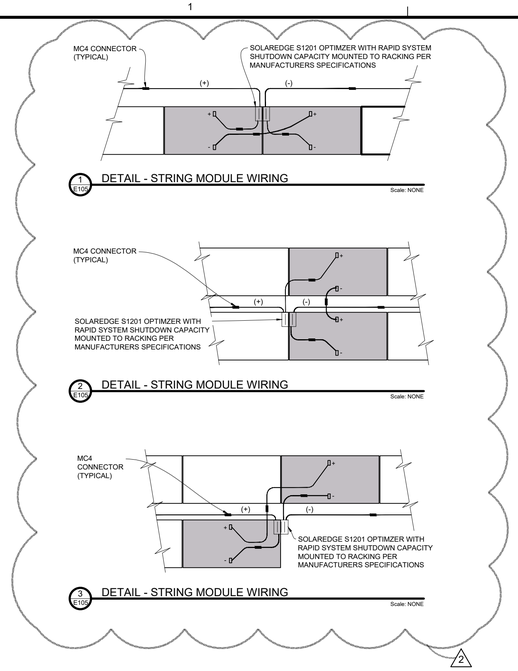
FIRE STATION 1

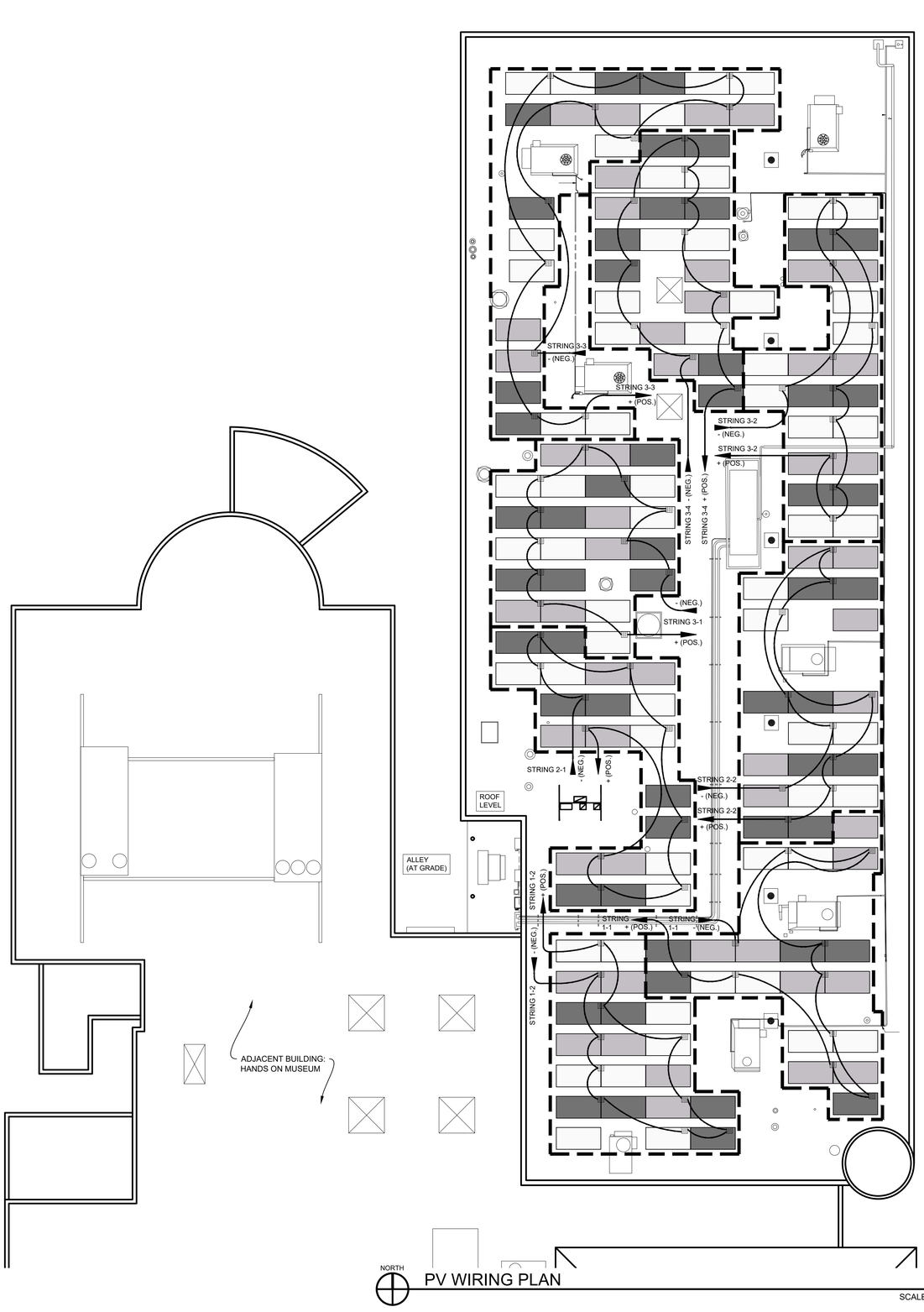
111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

GROUNDING PLAN

PROJECT NUMBER	23-11-1168-FS1
DRAWN BY	RGM, GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E104





SHEET GENERAL NOTES

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2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. FIELD ADJUST THE ARRAY LAYOUT BASED ON ROOF OBSTRUCTIONS IF NECESSARY.
4. PANEL MODULE PAIRS ARE WIRED IN SERIAL. POSITIVE OF FIRST PANEL TO NEGATIVE OF SECOND PANEL WITH REMAINING PANEL FEEDS CONNECTED TO S1201 OPTIMIZERS.

2

SHEET KEY NOTES

1. DC HOME RUNS UNDER MODULES: PV WIRING SHALL BE SECURED VIA HEYCO CABLE CLIPS OR EQUAL.
2. DC HOME RUNS NOT UNDER MODULES, AND AC WIRING: WIRING SHALL BE IN CONDUIT PER CODE, SEE VERTICAL CONDUIT SUPPORT (WALL) AND CONDUIT SUPPORT DETAILS (ROOF) ON SHEET E501.
3. SEE CONDUIT AND WIRE SIZE CHART ON SHEET E601.

PV SYSTEM DESCRIPTION - GENERAL

ARRAY TYPE	BALLASTED ROOF MOUNT
TILT	10°
AZIMUTH	182°
INTRAROW SPACING	1.6 FT. PER RACKING SPECIFICATIONS

LEGEND

1-1 (STRING # / INVERTER #)	PV STRING DESIGNATION
+ − ~	INVERTER
D	DISCONNECT
M	METER
	STRING WIRING

0 5'-41/2" 10'-9" 21'-6"
SCALE: 1 = 3/32"

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CITY OF ANN ARBOR
SOLAR FACILITIES

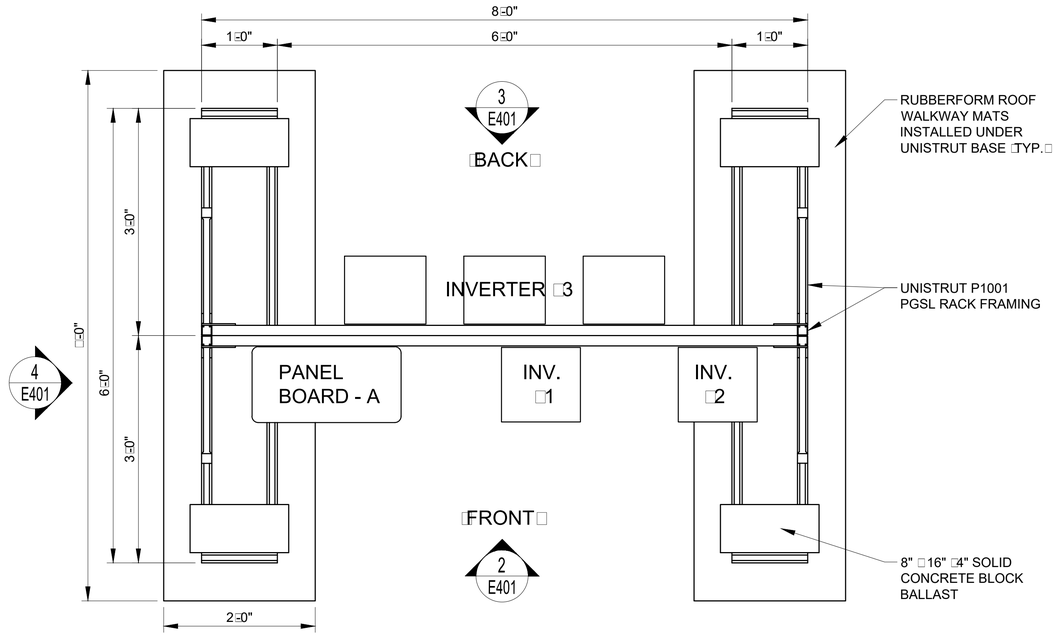
FIRE STATION 1
111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

PV WIRING PLAN

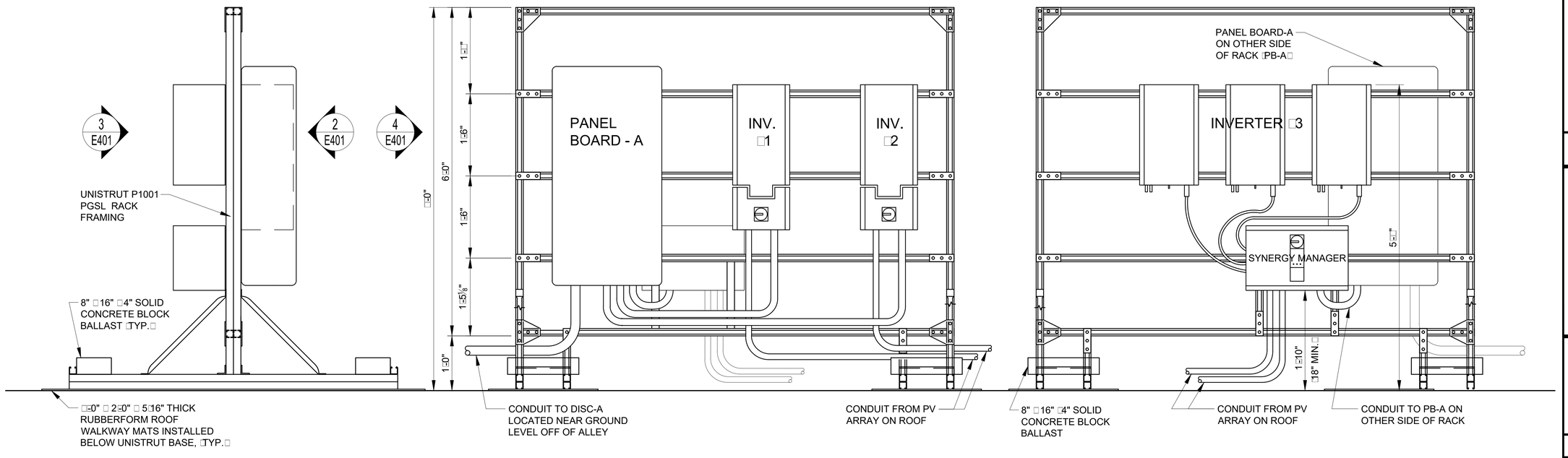
PROJECT NUMBER 23-11-1168-FS1

DRAWN BY	SHEET NUMBER
BD, GAK	E105
SCALE: AS NOTED	
SHEET SIZE: 22x34	



ELECTRICAL EQUIPMENT RACK PLAN - ON ROOF

Scale: 1" = 1'-0"



SIDE ELEVATION

Scale: 1" = 1'-0"

FRONT ELEVATION

Scale: 1" = 1'-0"

BACK ELEVATION

Scale: 1" = 1'-0"

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Suite 300
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Fax: 248-34-4152

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CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

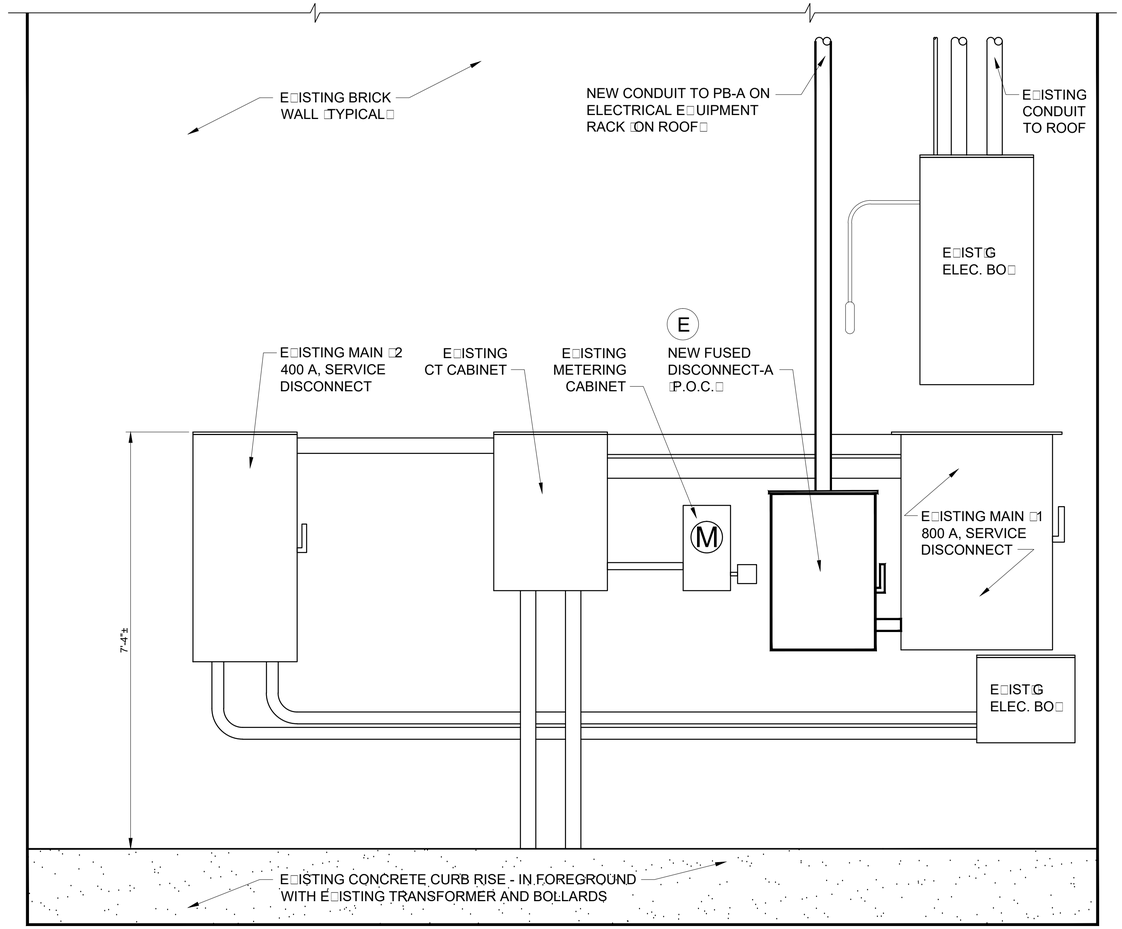
84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

ELECTRICAL EQUIPMENT RACK ON ROOF

PROJECT NUMBER
23-11-1168-FS1

DRAWN BY	SHEET NUMBER
BD, GAK	E401
SCALE: AS NOTED	
SHEET SIZE: 22x34	

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Fire Station 1\Drawings\23111168-FS1-E401.dwg Date: Jun 28 2024; 8:52AM User: george



ELECTRICAL E□UIPMENT ELEVATION - OUTSIDE - GROUND LEVEL IN ALLEY

Scale: 3⁄4" □ 1□0"

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S□te 300
No□i, MI 483□5

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6-28-2024	BID REVIEW	

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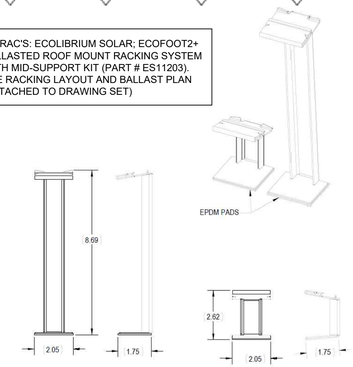
96.8 kW DC SOLAR ARRAY

ELECTRICAL E□UIPMENT ELEVATION □GROUND LEVEL□

PROJECT NUMBER
23-11-1168-FS1

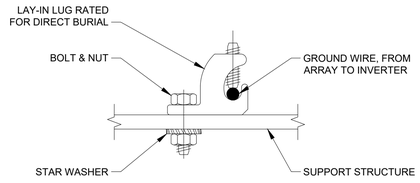
DRAWN BY	SHEET NUMBER
BD, GAK	E402
SCALE	
SHEET SI□E	
22□34	

UNIRAC'S: ECOLIBRIUM SOLAR; ECOFOOT2+ BALLASTED ROOF MOUNT RACKING SYSTEM WITH MID-SUPPORT KIT (PART # ES11203). SEE RACKING LAYOUT AND BALLAST PLAN (ATTACHED TO DRAWING SET)



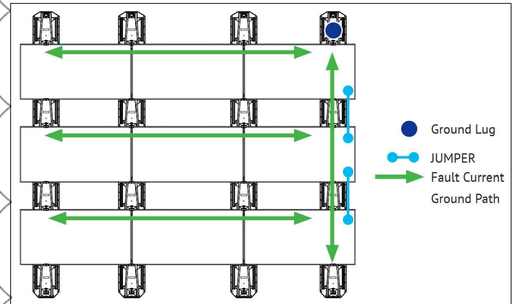
12 E501 MID-SUPPORT KIT

RACK	LUG	HARDWARE
GALVANIZED STEEL	COPPER	GALVANIZED STEEL
ALUMINUM	STAINLESS OR TIN-PLATED COPPER	STAINLESS STEEL
STAINLESS STEEL	COPPER, STAINLESS OR TIN-PLATED COPPER	STAINLESS STEEL



9 E501 GROUNDING DETAIL - MECH. / ELEC.

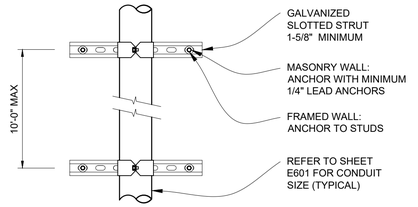
SCALE: NONE



Wind Deflectors carry module-to-module East/West ground bond. Bonding jumpers carry row-to-row North/South ground bond.

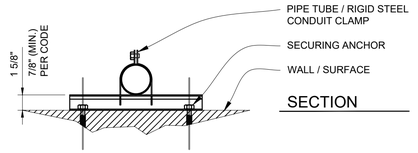
13 E501 MANUFACTURERS GROUNDING PLAN DET.

SCALE: N.T.S.



PLAN VIEW

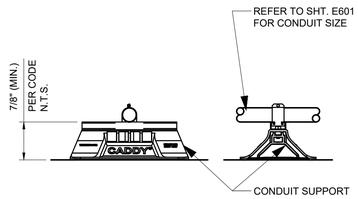
NOTE:
SUPPORT CONDUIT PER NEC 2023
MINIMUM EVERY 10'-0"



SECTION

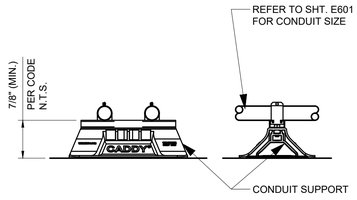
1 E501 VERTICAL CONDUIT SUPPORT - WALL

N.T.S.



2 E501 CONDUIT SUPPORT DETAIL - ROOF

N.T.S.



3 E501 CONDUIT SUPPORT DETAIL - ROOF

N.T.S.

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. CONDUIT FILL TO BE LESS THAN 40%.

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Novi, MI 48375

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CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

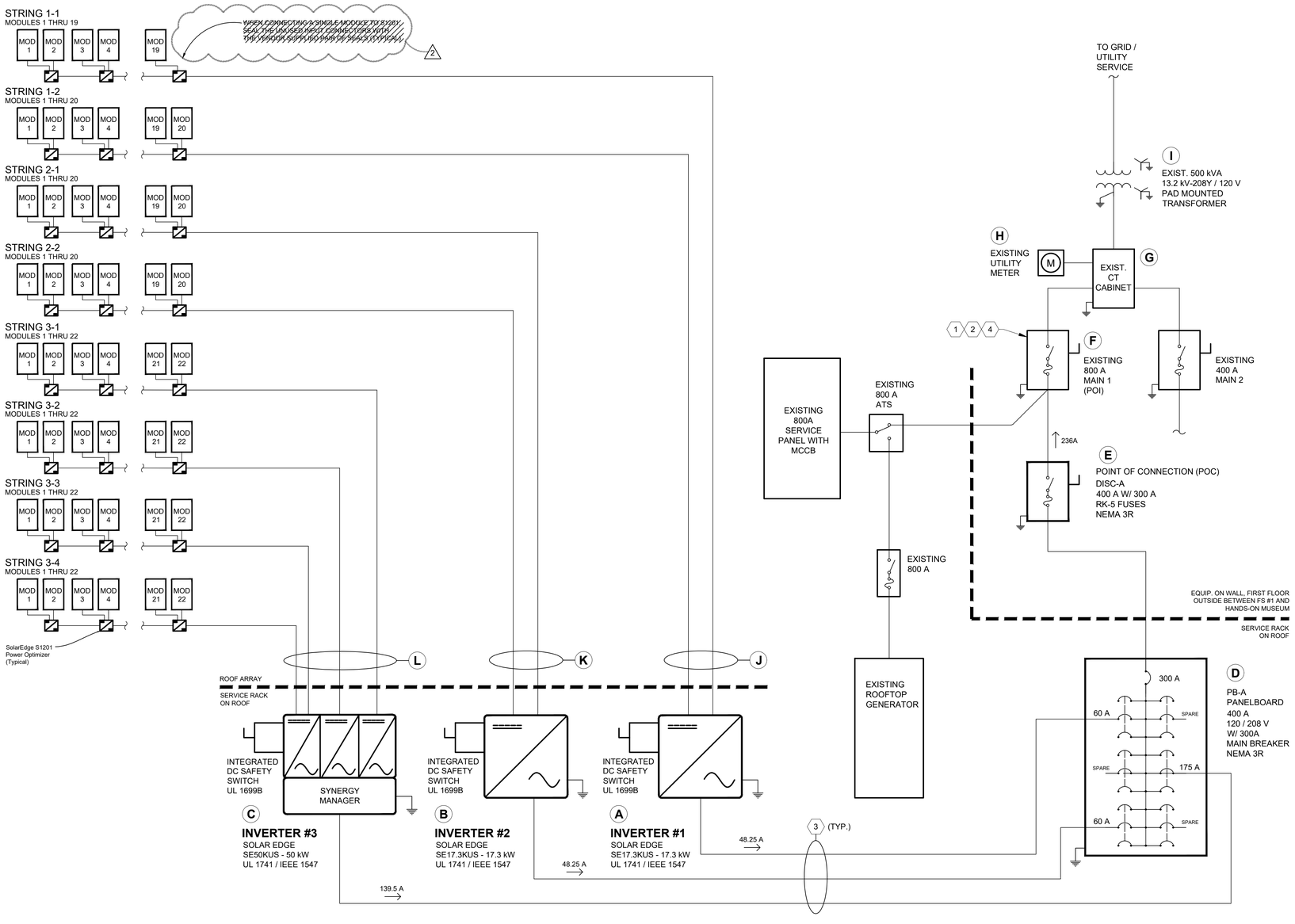
ELECTRICAL DETAILS

PROJECT NUMBER 23-11-1168-FS1

DRAWN BY	SHEET NUMBER
GAK	E501
SCALE	
SHEET SIZE 22x34	

CONDUIT AND WIRE SIZE CHART

Item	Description	Label	Route	Conduit	Wire (CU)	Neutral / Ground (CU)
A	Inverter - 17.3kW, 120/208V and DC Combiner Box	INV-1	A-D	1" EMT	(3) #6 XHHW-2	(2) #10 XHHW-2
B	Inverter - 17.3kW, 120/208V and DC Combiner Box	INV-2	B-D	1" EMT	(3) #6 XHHW-2	(2) #10 XHHW-2
C	Inverter - 50kW, 120/208V and DC Combiner Box	INV-3	C-D	1 1/2" EMT	(3) 2/0 XHHW-2	(2) #6 XHHW-2
D	PanelBoard - 400A, 120/208V, NEMA 3R W/300 A Main Breaker	PB-A				
E	Disconnect - 400A, 120/208 V, NEMA 3R, W/ 300A RK-5 Fuses	DISC - A	D-E	2" EMT	(3) 350 KCMIL XHHW-2	(2) #4 XHHW-2
F	Existing 800A Main Disconnect - Point of Interconnect (POI)	POI	E-F	2" EMT	(3) 350 KCMIL XHHW-2	(2) #4 XHHW-2
G	Existing CT Cabinet		F-G	Existing	Existing	Existing
H	Existing Utility Meter		G-H	Existing	Existing	Existing
I	Existing Utility Transformer		G-I	Existing	Existing	Existing
J	DC Home Runs Inverter 1	1-1 to 1-2	J-A	1" EMT	(4) - #10 PV Wire 2000V	(1) - #6 USE-2
K	DC Home Runs Inverter 2	2-1 to 2-2	K-B	1" EMT	(4) - #10 PV Wire 2000V	(1) - #6 USE-2
L	DC Home Runs Inverter 3	3-1 to 3-4	L-C	1 1/4" EMT	(8) - #10 PV Wire 2000V	(1) - #6 USE-2



A1 ONE LINE DIAGRAM

SCALE: N.T.S.

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. THE INVERTERS INCLUDE RESIDUAL CURRENT DETECTION GFIC AS PART OF THE DC GROUND FAULT DETECTION METHOD REQUIRED BY UL 1741.
3. ARTICLE 310.15 (B)(2) EXCEPTION: TYPE XHHW-2 INSULATED CONDUCTORS SHALL NOT BE SUBJECT TO THIS AMPACITY ADJUSTMENT PER 310.15.
4. DC CONDUCTORS SHALL BE DERATED PER 310.15.
5. SOLAR EDGE INVERTERS ARE CERTIFIED UL 1699B FOR ARC FAULT PROTECTION PER SECTION 690.11.
6. INVERTERS INCLUDE ANTI-ISLANDING PROTECTION COMPLIANT WITH UL 1741 AND IEEE 1547 PER NEC 690.
7. CONTRACTOR TO FIELD VERIFY THAT ALL LISTED GROUNDING ELECTRODES ARE PRESENT AND PROPERLY TERMINATED ON SITE.
8. CONTRACTOR TO VERIFY THAT ALL CIRCUIT BREAKERS ARE SUITABLE FOR BACKFEED.

2

SHEET KEY NOTES

1. AC GROUNDING CONNECTION TO EXISTING MAIN DISCONNECT PROVIDES CONNECTION TO BUILDING GROUNDING ELECTRODE GROUNDING CONDUCTORS AND BONDING JUMPERS TO BE INSTALLED TO COMPLY WITH ARTICLE 250.
2. NEW SUPPLY SIDE AC CONNECTION POWER PRODUCTION CONDUCTORS MUST MEET NEC 690, AND 705.11(D) AND (F) FOR SERVICE DISCONNECTING MEANS AND OVERCURRENT PROTECTION.
3. REFER TO CHART FOR CONDUIT AND WIRE SIZES.
4. INSTALL PLACARD SHOWING LOCATIONS OF DISCONNECT AND SOLAR ARRAY.

PV SYSTEM DESCRIPTION

FOR TOTAL SYSTEM:

PV MODULE MODEL:	JINKO SOLAR, JKM580N-72HL4-BDV (580 W)
PV MODULE SIZE:	89.69" L X 44.65" W X 1.18" D
NUMBER OF MODULES:	167
PV MODULE P_{MAX}:	580 W
OPTIMIZERS: (84)	SOLAR EDGE S1201 (DUAL OPTIMIZER)
INVERTERS : (3)	1. SOLAR EDGE - SE 17.3 KUS 2. SOLAR EDGE - SE 17.3 KUS 3. SOLAR EDGE - SE 50 KUS
NO. OF STRINGS PER INVERTER:	INV #1 (2 STRINGS)
NO. OF STRINGS PER INVERTER:	INV #2 (2 STRINGS)
NO. OF STRINGS PER INVERTER:	INV #3 (4 STRINGS)
DC TO AC RATIO:	1.14
NUMBER OF STRINGS:	8
TOTAL NAMEPLATE SIZE:	96.86 kW DC 84.6 kW AC

NOTE: PV SYSTEM IS 600 V DC (MAX.)

LEGEND

- DISCONNECT SWITCH
- GROUND
- 1-1 PV STRING DESIGNATION (STRING # / INVERTER #)

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ISSUED

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5-8-2024	INTERCONNECT	JE
6-28-2024	BID REVIEW	
1-27-2025	ADDENDUM-2	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

ONE LINE DIAGRAM

PROJECT NUMBER 23-11-1168-FS1

DRAWN BY RGM, GAK | SHEET NUMBER E601

SCALE

SHEET SIZE 22x34

PHOTOVOLTAIC SYSTEM DISCONNECT

LABEL 1

EACH PV STSTEM DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HA□ARD

DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD SIDES
MAY BE ENERGI□ED IN THE OPEN POSITION

LABEL 2

THE UTILITY METERING CABINET, EACH INVERTER, EACH DC AND AC DISCONNECTING MEANS □SWITCHES AND BREAKERS□MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HA□ARD

IF GROUND FAULT IS INDICATED ALL
NORMALLY GROUNDED CONDUCTORS
MAY BE UNGROUNDED AND ENERGI□ED

LABEL 3

PHOTOVOLTAIC SYSTEM DC DISCONNECT

MA□ SYSTEM DC VOLTAGE		1000 V
SHORT CIRCUIT DC CURRENT	1□.3kW INV-1	55 A

LABEL 4A

INVERTER DC DISCONNECT MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

PHOTOVOLTAIC SYSTEM DC DISCONNECT

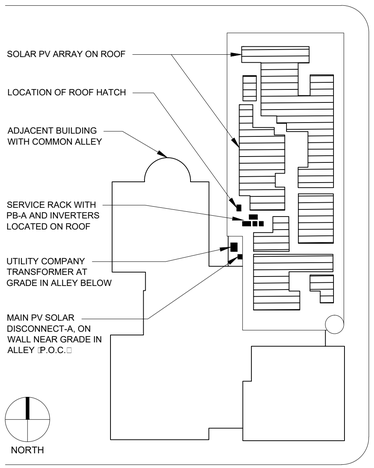
MA□ SYSTEM DC VOLTAGE		1000 V
SHORT CIRCUIT DC CURRENT	1□.3kW INV-2	55 A

LABEL 4B

INVERTER DC DISCONNECT MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

CAUTION

POWER TO THIS FACILITY IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS AS SHOWN:



LABEL 6

INSTALL MAP PLACARD AS PER UTILITY RE□UIREMENTS, SIGNAGE SHALL BE RED BACKGROUND WITH WHITE ENGRAVED LETTERS: □CAUTION ¾", POWER TO...¼"□ CALL OUTS ⅛"□

THIS LABEL TO BE INSTALLED ON FENCE BESIDE GATE AND AT DISCONNECT DISC-MAIN.

WARNING

DUAL POWER SUPPLY

SOURCES UTILITY GRID AND
PV SOLAR ELECTRIC SYSTEM

LABEL □

E□UIPMENT BACK FED FROM PHOTOVOLTAIC SYSTEMS MUST BE LABELED WITH THIS PLACARD INCLUDING BOTH 480 V. DISCONNECTS AND PRIMARY SWITCH AT SUBSTATION

PHOTOVOLTAIC SYSTEM DC DISCONNECT

MA□ SYSTEM DC VOLTAGE		1000 V
SHORT CIRCUIT DC CURRENT	50kW INV-3	139.5 A

LABEL 4C

INVERTER DC DISCONNECT MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

PHOTOVOLTAIC SYSTEM AC POINT OF INTERCONNECTION

RATED AC OUTPUT CURRENT	236 A
NOMINAL OPERATING AC VOLTAGE	208 VAC

LABEL 5

INTERACTIVE SYSTEM POINT OF CONNECTION - P.O.C. □DISC-A□ MUST BE LABELED WITH THIS PLACARD
TOP OF LABEL IS WHITE ON BLACK, BOTTOM IS BLACK ON WHITE

PHOTOVOLTAIC SOLAR BREAKER

LABEL 8

DO NOT RELOCATETHIS OVERCURRENT DEVICE

LABEL 9

WARNING

THIS E□UIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICE SHALL NOT E□CEED AMPACITY OF BUSSBAR

LABEL 10

PHOTOVOLTAIC SYSTEM kWH METER

LABEL 11

AC DISCONNECT

LABEL 12

EACH AC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

DC DISCONNECT

LABEL 13

EACH DC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

CAUTION

PV OUTPUT CIRCUIT

LABEL 14

CAUTION

INVERTER OUTPUT CIRCUIT

LABEL 15

PHOTOVOLTAIC SYSTEM E□UIPPED WITH RAPID SHUTDOWN

LABEL 16

INVERTER AND P.O.I.

DC PHOTOVOLTAIC SOURCE CIRCUIT

LABEL 1□

CAUTION SOLAR CIRCUIT

LABEL 19

NOVA Cons□ltants, Inc.
21580 No□ Road
S□ite 300
No□, MI 483□5
Phone: □248□34□-3512
Fa□: □248□34□-4152
www.no□acons□ltants.co□

ISSUED

DATE	DESCRIPTION	APPVD.
3-22-2024	50□ REVIEW	
6-28-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

LABELS AND PLACARDS

PROJECT NUMBER 23-11-1168-FS1

DRAWN BY BD, GAK

SCALE

SHEET SI□E 22□34

SHEET NUMBER E□01

1. BASIC ELECTRICAL RE□UIREMENTS

A. FURNISH AND INSTALL THE MATERIAL, E□UIPMENT AND SYSTEMS COMPLETE AS SPECIFIED AND□OR INDICATED ON THE DRAWINGS.

B. COMPLY WITH THE 2023 NATIONAL ELECTRICAL CODE □NEC□AND ALL APPLICABLE MUNICIPAL, STATE, LOCAL CODES.

C. OBTAIN ALL APPLICABLE PERMITS INCLUDING BUILDING AND ELECTRICAL, LICENSES AND INSPECTIONS AS RE□UIRED.

D. ALL MATERIALS AND E□UIPMENT SHALL BE LISTED AND LABELED BY UL OR OTHER NATIONALLY RECOGNI□ED TESTING LABORATORY.

E. SUBMIT SHOP DRAWINGS, WIRING DIAGRAMS, SPECIFICATIONS, OPERATING DATA, AND□OR CATALOG CUTS FOR ALL E□UIPMENT.

F. FOLLOW □UALITY ASSURANCE PROJECT PLAN □APP□ STARTUP AND COMMISSIONING PROTOCOL.

G. UPON COMPLETION OF THE ELECTRICAL INSTALLATION, THE CONTRACTOR SHALL DELIVER TO NOVA ONE □1□ SET OF PRINTS OF AS-BUILT CONTRACT DRAWINGS SHOWING ALL ADDITIONS AND CHANGES DURING THE INSTALLATION. THESE DRAWINGS SHALL BE SUITABLE FOR USE IN PREPARATION OF RECORD DRAWINGS.

2. BASIC ELECTRICAL MATERIALS AND METHODS.

A. RACEWAYS

INSTALL ALL WIRING IN CONDUIT EXCEPT AS OTHERWISE INDICATED. MINIMUM CONDUIT SIZE TO BE ¾". CONDUIT SHALL BE RIGID GALVANI□ED STEEL ABOVE GROUND AND WHERE USED AS ELBOWS AND STUB-UPS UNDERGROUND. ELECTRICAL METALLIC TUBING □EMT□MAY BE INSTALLED ABOVE GROUND WHERE NOT SUBJECT TO DAMAGE. UNDERGROUND CONDUIT SHALL BE SCHEDULE 40 PVC. INSTALL CONDUITS PARALLEL AND PERPENDICULAR TO WALLS AND OTHER SURFACES. CLEAN, CAP, AND PROVIDE A PULL STRING IN EACH CONDUIT TO BE LEFT EMPTY.

B. BO□ES

JUNCTION BO□ES AND PULL BO□ES SHALL BE STAMPED STEEL OR CAST ALUMINUM, UL LISTED FOR THE APPLICATION.

C. DISCONNECT SWITCHES

UNLESS OTHERWISE INDICATED, DISCONNECT SWITCHES USED INDOORS SHALL HAVE A NEMA 12 ENCLOSURE AND DISCONNECT SWITCHES USED OUTDOORS SHALL HAVE A NEMA 3R ENCLOSURE. DISCONNECT SWITCHES SHALL BE PAD LOCKABLE IN THE OPEN POSITION.

D. GROUNDING

PROVIDE GROUNDING OF THE ENTIRE ELECTRICAL SYSTEM IN ACCORDANCE WITH NEC ARTICLE 250.

PROVIDE E□UIPMENT GROUNDING CONDUCTORS IN ALL BRANCH CIRCUITS AND ALL FEEDERS.

GROUNDING CONDUCTORS SHALL BE CLASS B STRANDED COPPER, GREEN INSULATED. TERMINATE EACH END USING A SUITABLE LISTED CONNECTOR.

BOND PV MODULES AS SHOWN ON THE DRAWINGS. CONNECT BONDING PIGTAILS TO MODULES PER MANUFACTURER'S INSTRUCTIONS. WHERE USED LUGS SHALL BE UL LISTED FOR DIRECT BURIAL.

GROUNDING ELECTRODES □GROUND RODS□SHALL BE COPPER-CLAD STEEL, MINIMUM 5/8" DIAMETER AND 8 FT. LONG.

BOND TOGETHER METAL STRUCTURES PER NEC 250.110.

E. WIRE AND CABLE

1□ WIRE FOR AC CIRCUITS SHALL BE RATED 90 DEGREES C WET OR DRY AND SHALL BE STRANDED COPPER WIRES, TYPE THHN□THWN-2 AND RATED 600V.

2□ WIRE FOR MEDIUM VOLTAGE SHALL BE 1C-15kV CLASS.

3□ WIRE FOR DC CIRCUITS SHALL BE RATED 90 DEGREES C WET OR DRY AND SHALL BE STRANDED COPPER. ALL DC WIRING NOT IN RACEWAY SHALL BE INSULATED TYPE USE-2 OR PV RATED TO 2000V.

4□ DC E□UIPMENT GROUNDING CONDUCTOR SHALL BE MINIMUM OF □6 AWG COPPER AND BE MECHANICALLY ATTACHED TO EACH PV RACKING STRUCTURE UNLESS OTHERWISE NOTED.

5□ NO SPLICES SHALL BE MADE E□CEPT WITHIN BO□ES UL LISTED FOR THE PURPOSE.

F. SENSORS AND SENSOR WIRING

1□ FURNISH AND INSTALL PYRANOMETERS, TEMPERATURE SENSORS, ETC. AS RE□UIRED AND AS SHOWN ON DRAWINGS. ALL WIRING USED FOR CONTROLS AND MONITORING SHALL BE APPROVED BY NOVA.

3. DATA AND COMMUNICATIONS SYSTEMS

A. ALL DATA AND COMMUNICATIONS WIRING □INCLUDING CELL MODEMS□SHALL BE COORDINATED WITH THE CITY OF ANN ARBOR AND INSTALLED BY ELECTRICAL CONTRACTOR OR AS DIRECTED BY NOVA.

4. IDENTIFICATION AND LABELS

A. ALL WIRES SHALL BE LABELED AT EACH END.

B. ALL E□UIPMENT MUST BE LABELED PER NEC ARTICLE 690 AND SHEET E-□01.

C. PROVIDE LABEL ON EACH PIECE OF E□UIPMENT, SUCH AS INVERTER, COMBINER BO□ES, DISCONNECT SWITCHES, ETC. THE LABEL SHALL IDENTIFY THE E□UIPMENT BY THE NAME USED ON THE DRAWINGS, SUCH AS INVERTERS, COMBINER BO□ES, DISCONNECT SWITCHES.

5. PV SYSTEM E□UIPMENT

A. PV MODULES:

1□ JINKO SOLAR □EAGLE□JKM580N-□2HL4-BDV □580W□

a. MA□ POWER OUTPUT: P□a□□580W AT STC

b. VOLTAGE AT MA□ POWER: V□p □42.59V

c. OPEN CIRCUIT VOLTAGE: Voc □51.4□V

d. CURRENT AT MA□ POWER: I □pp □13.62A

e. SHORT CIRCUIT CURRENT: I sc □14.3□A

2□ MODULES PER STRING □ VARIES, SEE ONE LINE DRAWING ON SHEET E601

3□ STRINGS PER INVERTER □2 □INV. □1□□2 □INV. □2□ □4 □INV. □3□

4□ NUMBER OF STRINGS □8

5□ No. OF MODULES □16□

6□ NEG LEAD LENGTH □LANDSCAPE□□55.12"

□□ POS LEAD LENGTH □LANDSCAPE□□55.12"

B. POWER OPTIMI□ER

1□ SOLAREDGE S1201 □DUAL OPTIMI□ER□

2□ INPUT WIRE LENGTH IN FEET

INPUT 1	OUTPUT
5.25□	□□□1□38□□□0.32□

3□ RATED INPUT DC POWER □1200W

4□ USE WITH 2 MODULES CONNECTED IN PARALLEL

5□ PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM, COMPLIANT WITH NEC 2014, 201□, 2023

C. TOTAL ARRAY:

1□ DC NAMEPLATE RATING: □16□□580□□96.86 kW

D. RACKING SYSTEM:

1□ UNIRAC'S ECOLIBRIUM SOLAR, ECOFOOT2□WITH BALLAST

2□ MODULES TILTED 10 DEGREES

E. INVERTER

1□ SOLAREDGE SE 1□3K US □SE 50K US

2□ NUMBER OF INVERTERS □2 □1

3□ MEETS IEEE-154□, RULE 21, RULE 14 □HI□

4□ UL LISTED TO UL-1□41, UL-1□41 SA, UL-1699B. CSA 2.22

5□ NOMINAL INPUT VOLTAGE DC□TO DC- □ 3□0 TO 600 VDC RANGE □EACH□

6□ MA□IMUM INPUT VOLTAGE DC□TO DC- □600 VDC □EACH□

□□ MA□ INPUT CURRENT: 48.25A □INV-1□□48.25A □INV-2□□3 □46.5A □139.5A □INV-3□

8□ NOMINAL OUTPUT VOLTAGE: 120 □208 VAC

9□ CONTINUOUS CURRENT OUTPUT: 48.25A □INV-1□□48.25A □INV-2□□139.5A □INV-2□

10□MA□ CONTINUOUS OUTPUT POWER: 1□3kW □INV-1□□1□3kW □INV-2□□50kW □INV-3□

5. INSTALLATION

A.

1□ STORE MODULES IN MANUFACTURER'S PACKAGING UNTIL READY TO INSTALL.

2□ PREPARE SURFACE AND INSTALL PER MANUFACTURER'S RECOMMENDATIONS.

3□ ATTACH MODULE GROUNDING TERMINAL TO GROUNDING SYSTEM PER DRAWINGS.

NOVA Cons□ltants, Inc.
21580 No□i Road
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No□i, MI 483□5

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FIRE STATION 1

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84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

ELECTRICAL SPECIFICATIONS

PROJECT NUMBER
23-11-1168-FS1

DRAWN BY
RGM, GAK

SCALE

SHEET SI□E
22□34

SHEET NUMBER
E□02

EAGLE
MODULES

THE MOST DEPENDABLE
SOLAR PRODUCT

EAGLE 72 G6B

565-585 WATT • N-TYPE BIFACIAL

Positive power tolerance of 0~+3%

- NYSE-listed since 2010, Bloomberg Tier 1 manufacturer
- Top performance in the strictest 3rd party labs
- Automated manufacturing utilizing artificial intelligence
- Vertically integrated, tight controls on quality
- Premium solar factories in USA, Vietnam, and Malaysia

KEY FEATURES

N-Type Technology
N-type cells offer Jinko's in-house TOPCon technology with better performance and improved reliability.

Multi Busbar Half Cell Technology
Better light trapping and current collection to improve module power output and reliability.

Bifacial Power Gain
N-Type architecture increases bifaciality for higher backside bonus and better lifetime yield.

Low Temperature Coefficient
Best in class temperature coefficient for highest lifetime energy yield in all climates.

Industrial Grade Construction
Fire Type 29 with optimized dual-glass construction and thick frame for highest mechanical load resistance.

Shade Tolerant
Twin array design allows continued performance even with shading by trees or debris.

Protected Against All Environments
Certified to withstand humidity, heat, rain, marine environments, wind, hailstorms, and packed snow.

Warranty
12-year product and 30-year linear power warranty.

- ISO9001:2015 Quality Standards
- ISO14001:2015 Environmental Standards
- IEC61215, IEC61730 certified products
- ISO45001: 2018 Occupational Health & Safety Standards
- UL61730 certified products

TÜVRheinland CE c UL us LISTED IEC

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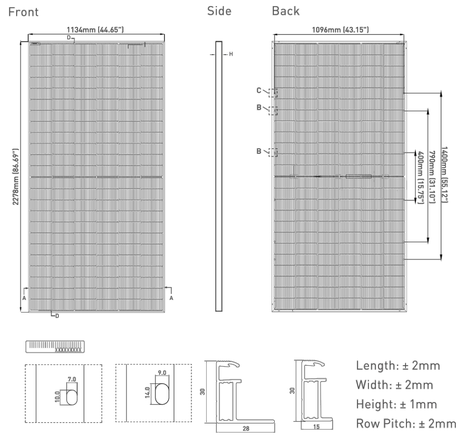
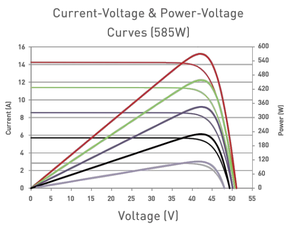
Jinko Solar

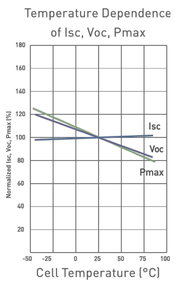
ENGINEERING DRAWINGS



Length: ± 2mm
Width: ± 2mm
Height: ± 1mm
Row Pitch: ± 2mm

ELECTRICAL PERFORMANCE & TEMPERATURE DEPENDENCE





MECHANICAL CHARACTERISTICS

No. of Half Cells	144 (2 x 72)
Dimensions	2278 x 1134 x 30mm (89.69 x 44.65 x 1.18in)
Weight	32kg (70.55lbs)
Front Glass	2.0mm, Anti-Reflection Coating
Back Glass	2.0mm, Heat Strengthened Glass
Frame	Anodized Aluminum Alloy
Junction Box	IP68 Rated
Output Cables	12 AWG, 1400mm (55.12in)
Fire Type	Type 29
Pressure Rating	5400Pa (Snow) & 2400Pa (Wind)

TEMPERATURE CHARACTERISTICS

Temperature Coefficients of Pmax	-0.29%/°C
Temperature Coefficients of Voc	-0.25%/°C
Temperature Coefficients of Isc	0.045%/°C
Nominal Operating Cell Temperature (NOCT)	45±2°C
Bifacial Factor	80±5%

MAXIMUM RATINGS

Operating Temperature (°C)	-40°C~+85°C
Maximum System Voltage	1500VDC
Maximum Series Fuse Rating	30A

PACKAGING CONFIGURATION

(Two pallets = One stack)

36pcs/pallets, 72pcs/stack, 720pcs/40 HQ Container

BIFACIAL OUTPUT-REARSIDE POWER GAIN

5%	Maximum Power (Pmax)	593Wp	599Wp	604Wp	609Wp	614Wp
	Module Efficiency (%)	22.97%	23.17%	23.37%	23.57%	23.78%
15%	Maximum Power (Pmax)	650Wp	656Wp	661Wp	667Wp	673Wp
	Module Efficiency (%)	25.15%	25.37%	25.60%	25.82%	26.05%
25%	Maximum Power (Pmax)	706Wp	713Wp	719Wp	725Wp	731Wp
	Module Efficiency (%)	27.34%	27.58%	27.82%	28.07%	28.31%

WARRANTY

12-year product and 30-year linear power warranty

1st year degradation not to exceed 1%, each subsequent year not to exceed 0.4%, minimum power at year 30 is 87.4% or greater.

ELECTRICAL CHARACTERISTICS

Module Type	JKM565N-72HL4-BDV		JKM570N-72HL4-BDV		JKM575N-72HL4-BDV		JKM580N-72HL4-BDV		JKM585N-72HL4-BDV	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	565Wp	425Wp	570Wp	429Wp	575Wp	432Wp	580Wp	436Wp	585Wp	440Wp
Maximum Power Voltage (Vmp)	42.14V	39.52V	42.29V	39.65V	42.44V	39.78V	42.59V	39.87V	42.74V	40.03V
Maximum Power Current (Imp)	13.41A	10.75A	13.48A	10.81A	13.55A	10.87A	13.62A	10.94A	13.69A	10.99A
Open-circuit Voltage (Voc)	50.87V	48.32V	51.07V	48.51V	51.27V	48.70V	51.47V	48.89V	51.67V	49.08V
Short-circuit Current (Isc)	14.19A	11.46A	14.25A	11.50A	14.31A	11.55A	14.37A	11.60A	14.43A	11.65A
Module Efficiency STC (%)	21.87%		22.07%		22.26%		22.45%		22.65%	

***STC:** Irradiance 1000W/m² Cell Temperature 25°C AM = 1.5
NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM = 1.5 Wind Speed 1m/s

*Power measurement tolerance: ±3%

The company reserves the final right for explanation on any of the information presented hereby. JKM565-585N-72HL4-BDV-F2-US

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96.8 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER 23-11-1168-FS1
DRAWN BY GAK
SCALE
SHEET SI□E 22□34
SHEET NUMBER E801

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Fire Station 1\Drawings\23111168-FS1-E801.dwg Date: J□n 28 2024; 10:30AM User: george

Power Optimizer

For North America

S1201

POWER OPTIMIZER

SolarEdge's most advanced, cost-effective Power Optimizer for commercial and large field installations

- **Greater Energy Yields**
  - High efficiency (99.5%) with module-level MPPT, for maximized system energy production and revenue, and fast project ROI
  - Supports high power and bifacial PV modules, and high string current for more power per string.
- **Maximum Protection with Built-In Safety**
  - Designed to automatically reduce high DC voltage to touch-safe levels, upon grid/inverter shutdown, with SafeDC™
  - Includes SolarEdge Sense Connect, allowing continuous monitoring to detect overheating due to installation issues or connector-level wear and tear
- **Lower BoS Costs**
  - Flexible system design enables maximum space utilization and up to 2x longer string lengths, 50% less cables, fuses and combiner boxes
  - Supports connection of two PV modules in series with easy cable management and fast installation times
- **Simpler O&M**
  - Module-level system monitoring enabling pinpointed fault detection and remote, time-saving troubleshooting

solaredge.com

solaredge

Power Optimizer

For North America

S1201

	S1201	Units
INPUT		
Rated Input DC Power(1)	1200	W
Absolute Maximum Input Voltage (Voc)	125	Vdc
MPPT Operating Range	12.5 – 105	Vdc
Maximum Short Circuit Current (Isc) of Connected PV Module	15	Adc
Maximum Efficiency	99.5	%
Weighted Efficiency	98.8	%
Overvoltage Category	II	
OUTPUT DURING OPERATION		
Maximum Output Current	18	Adc
Maximum Output Voltage	80	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)		
Safety Output Voltage per Power Optimizer	1	Vdc
STANDARD COMPLIANCE		
Photovoltaic Rapid Shutdown System	Compliant with NEC 2014, 2017, 2020	
EMC	FCC Part15, IEC 61000-6-2, and IEC 61000-6-3	
Safety	IEC62109-1 (class II safety), UL1741, UL3741, CSA C22.2#107.1	
Material	UL94 V-0, UV Resistant	
RoHS	Yes	
Fire Safety	VDE-AR-E 2100-712:2013-05	
INSTALLATION SPECIFICATIONS		
Maximum Allowed System Voltage	1000	Vdc
Dimensions (W x L x H)	129 x 155 x 59 / 5.08 x 6.10 x 2.32	mm / in
Weight	1106 / 2.4	gr / lb
Input Connector	MC4(2)	
Input Wire Length	1.6 / 5.25(3)	m / ft
Output Connector	MC4	
Output Wire Length	(+) 5.3 (-) 0.10 / (+) 17.38, (-) 0.32	m / ft
Operating Temperature Range(4)	-40 to +85 / -40 to +185	°C / °F
Protection Rating	IP68 / NEMA6P	
Relative Humidity	0 – 100	%

(1) Rated power of the module at STC will not exceed the power optimizer Rated Input DC Power. Modules with up to +5% power tolerance are allowed.
(2) For other connector types please contact SolarEdge.
(3) The Sense Connect feature is only enabled on the output cable connectors.
(4) For ambient temperatures above +65°C / +149°F power de-rating is applied.

PV System Design Using a SolarEdge Inverter(5)(6)(7)		208V Grid SE10K	208V Grid SE17.3K*	277/480V Grid SE20K, SE30K	277/480V Grid SE40K*	
Compatible Power Optimizers		S1201				
Minimum String Length	Power Optimizers	8	10	15	15	
	PV Modules	15	19	29	29	
Maximum String Length	Power Optimizers	30	30	30	30	
	PV Modules	60	60	60	60	
Maximum Continuous Power per String		7200	8820	15300	15300	W
Maximum Allowed Connected Power per String(7)		1 string – 8400	1 string – 10020	1 string – 17550	2 strings or less – 17550	W
		2 strings or more – 10600	2 strings or more – 13000	2 strings or more – 23000	3 strings or more – 23000	
Parallel Strings of Different Lengths or Orientations		Yes				
Maximum Difference in Number of Power Optimizers Allowed Between the Shortest and Longest String Connected to the Same Inverter Unit		5 Power Optimizers				

*The same rules apply for Synergy units of equivalent power ratings, that are part of the modular Synergy Technology inverter.
(5) S1201 cannot be mixed with any other Power Optimizers models in the same string.
(6) For each string, a Power Optimizer may be connected to a single PV module if 1) each Power Optimizer is connected to a single PV module or 2) it is the only Power Optimizer connected to a single PV module in the string.
(7) To connect more STC power per string, design your project using SolarEdge Designer.

RoHS

Intertek

NOVA Cons□ltants, Inc.
21580 No□i Road
S□ite 300
No□, MI 483□5

Phone: □248□34□-3512
Fa□: □248□34□-4152

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ISSUED

DATE	DESCRIPTION	APPVD.
6-28-2024	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 1

111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER
23-11-1168-FS1

DRAWN BY: GAK
SCALE:
SHEET SI□E: 22□34

SHEET NUMBER
E802

INVERTER - 1 □ 2

Three Phase Inverters for the 120/208V Grid

For North America

SE10KUS / SE17.3KUS

INVERTERS

The best choice for SolarEdge enabled systems

- Specifically designed to work with power optimizers
- Quick and easy inverter commissioning directly from a smartphone using SolarEdge SetApp
- Fixed voltage inverter for superior efficiency and longer strings
- Built-in type 2 DC and AC Surge Protection, to better withstand lightning events
- Small, lightest in its class, and easy to install outdoors or indoors on provided bracket
- Integrated arc fault protection and rapid shutdown for NEC 2014, 2017, and 2020, per article 690.11 and 690.12
- Built-in module-level monitoring with Ethernet, wireless or cellular communication for full system visibility
- Integrated Safety Switch
- UL1741 SA and SB certified, for CPUC Rule 21 grid compliance

W□INTERNAL SIMCARD CELLULAR PLUG-IN AND DATA PLAN

solaredge.com

solaredge

Three Phase Inverters for the 120/208V Grid(1)

For North America

~~SE10KUS~~ / SE17.3KUS

INVERTER - 1 □ 2

Model Number	SE10KUS	SE17.3KUS	
Applicable to inverters with part number	SEXXK-US□2IXXXX		
OUTPUT			
Rated AC Power Output	10000	17300	W
Maximum Apparent AC Output Power	10000	17300	VA
AC Output Line Connections	3W + PE, 4W + PE		
AC Output Voltage Minimum-Nominal-Maximum(2) (L-N)	105 – 120 – 132.5		Vac
AC Output Voltage Minimum-Nominal-Maximum(2) (L-L)	183 – 208 – 229		Vac
AC Frequency Minimum-Nominal-Maximum(2)	59.3 – 60 – 60.5		Hz
Continuous Output Current (per Phase)	27.8	48.25	Aac
GFDI Threshold	1		A
Utility Monitoring, Islanding Protection, Country Configurable Set Points	Yes		
THD	≤ 3		%
Power Factor Range	+/- 0.85 to 1		
INPUT			
Maximum DC Power (Module STC)	17500	30275	W
Transformer-less, Ungrounded	Yes		
Maximum Input Voltage DC+ to DC-	600		Vdc
Operating Voltage Range	370 – 600		Vdc
Maximum Input Current	27.8	48.25	Adc
Maximum Input Short Circuit Current	55		Adc
Reverse-Polarity Protection	Yes		
Ground-Fault Isolation Detection	167kΩ Sensitivity(3)		
CEC Weighted Efficiency	97	97.5	%
Night-time Power Consumption	< 4		W
ADDITIONAL FEATURES			
Supported Communication Interfaces	2 x RS485, Ethernet, Cellular (optional)		
Inverter Commissioning	With the SetApp mobile application using built-in Wi-Fi access point for local connection		
Rapid Shutdown	NEC2014, NEC2017 and NEC2020 compliant/certified		
RS485 Surge Protection Plug-in	Supplied with the inverter, Built-in		
AC, DC Surge Protection	Type II, field replaceable, Built-in		
DC Fuses (Single Pole)	25A, Built-in		
Smart Energy Management	Export Limitation		
DC SAFETY SWITCH			
DC Disconnect	Integrated		
STANDARD COMPLIANCE			
Safety	UL1741, UL1741 SA, UL1741 SB, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07		
Grid Connection Standards	IEEE1547-2018, Rule 21, Rule 14 (HI)		
Emissions	FCC part15 class A		
INSTALLATION SPECIFICATIONS			
AC Output Conduit size /AWG range	¾" or 1" / 6 - 10 AWG		
DC Input Conduit size / AWG range	¾" or 1" / 6 - 12 AWG		
Number of DC inputs pairs	4		
Dimensions with Safety Switch (H x W x D)	31.8 x 12.5 x 11.8 / 808 x 317 x 300		in / mm
Weight with Safety Switch	78.2 / 35.5		lb / kg
Cooling	Fans (user replaceable)		
Noise	< 62		dBA
Operating Temperature Range	-40 to +140 / -40 to +60(4)		°F / °C
Protection Rating	NEMA 3R		
Mounting	Bracket provided		

(1) For 277/480V inverters refer to the Three Phase Inverters for the 277/480V Grid for North America datasheet.
(2) For other regional settings please contact SolarEdge support.
(3) Where permitted by local regulations.
(4) For power de-rating information refer to the Temperature De-rating - Technical Note (North America).

CE

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111 NORTH 5TH AVENUE
ANN ARBOR, MI 48104

84.6 kW AC SOLAR ARRAY
96.8 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER 23-11-1168-FS1
DRAWN BY GAK
SCALE
SHEET SI□E 22□34
SHEET NUMBER E803

INVERTER - 3

Three Phase Inverter with Synergy Technology

For the 208V Grid for North America

SE50KUS

INVERTERS

Powered by unique pre-commissioning process for rapid system installation

- Pre-commissioning feature for automated validation of system components and wiring during the site installation process and prior to grid connection
- Easy 2-person installation with lightweight, modular design (each inverter consists of 3 Synergy units and 1 Synergy Manager)
- Independent operation of each Synergy unit enables higher uptime and easy serviceability
- Built-in thermal sensors detect faulty wiring ensuring enhanced protection and safety
- Built-in arc fault protection and rapid shutdown
- Built-in PID mitigation for maximized system performance
- Monitored* and field-replaceable surge protection devices, to better withstand surges caused by lightning or other events
- Built-in module-level monitoring with Ethernet or cellular communication for full system visibility

*Applicable only for DC and AC SPDs

W□INTERNAL SIMCARD CELLULAR PLUG-IN AND DATA PLAN

solaredge.com

solaredge

Three Phase Inverter with Synergy Technology

For the 208V Grid for North America

SE50KUS

INVERTER - 3

MODEL NUMBER	SExxK-USx2Ixxxx	
APPLICABLE TO INVERTERS WITH PART NUMBER	SE50KUS	UNITS
OUTPUT		
Rated AC Active Output Power	50000	W
Maximum AC Apparent Output Power	50000	VA
AC Output Line Connections	3W + PE, 4W + PE	
Supported Grids	WYE: TN-C, TN-S, TN-C-S, TT, IT, Delta: IT	
AC Output Voltage Minimum-Nominal-Maximum(1) (L-N)	105 – 120 – 132.5	Vac
AC Output Voltage Minimum-Nominal-Maximum(1) (L-L)	183 – 208 – 229	Vac
AC Frequency Min-Nom-Max(1)	59.5 – 60 – 60.5	Hz
Maximum Continuous Output Current (per Phase, PF=1)	139.5	Aac
GFDI Threshold	1	A
Utility Monitoring, Islanding Protection, Configurable Power Factor, Country Configurable Thresholds	Yes	
Total Harmonic Distortion	≤ 3	%
Power Factor Range	±0.85 to 1	
INPUT		
Maximum DC Power (Module STC) Inverter / Synergy Unit	87500 / 29165	W
Transformer-less, Ungrounded	Yes	
Maximum Input Voltage DC+ to DC-	600	Vdc
Operating Voltage Range	370 – 600	Vdc
Maximum Input Current	3 x 46.5	Adc
Reverse-Polarity Protection	Yes	
Ground-Fault Isolation Detection	167kΩ sensitivity per Synergy Unit(2)	
CEC Weighted Efficiency	97	%
Nighttime Power Consumption	< 12	W
ADDITIONAL FEATURES		
Supported Communication Interfaces(3)	2 x RS485, Ethernet, Wi-Fi (optional), Cellular (optional)	
Smart Energy Management	Export Limitation	
Inverter Commissioning	With the SetApp mobile application using built-in Wi-Fi access point for local connection	
Arc Fault Protection	Built-in, User Configurable (According to UL1699B)	
Photovoltaic Rapid Shutdown System	NEC 2014, 2017 and 2020, Built-in	
PID Rectifier	Nighttime, built-in	
RS485 Surge Protection (ports 1+2)	Type II, field replaceable, integrated	
AC, DC Surge Protection	Type II, field replaceable, integrated	
DC Fuses (Single Pole)	25A, integrated	
Pre-Commissioning	Built-in(4)	
DC SAFETY SWITCH		
DC Disconnect	Built-in	
STANDARD COMPLIANCE		
Safety	UL1699B, UL1741, UL1741 SA, UL1741 SB, UL1998, CSA C22.2#107.1, Canadian AFCI according to T.I.L. M-07	
Grid Connection Standards	IEEE 1547-2018, Rule 21, Rule 14 (HI)	
Emissions	FCC part 15 class A	

(1) For other regional settings please contact SolarEdge support.
(2) Where permitted by local regulations.
(3) For specifications of the optional communication options, visit the Communication product page or the Knowledge Center to download the relevant product datasheet.
(4) Not available for P/Ns SExxK-xxxxxBPxx.

Three Phase Inverter with Synergy Technology

For the 208V Grid for North America

SE50KUS

INVERTER - 3 □cont.□

MODEL NUMBER		SExxK-USx2Ixxxx	
APPLICABLE TO INVERTERS WITH PART NUMBER		SE50KUS	UNITS
INSTALLATION SPECIFICATIONS			
Number of Synergy Units per Inverter		3	
AC Max Conduit Size		2 ½"	in
Max AWG Line / PE		4/0 / 1/0	
DC Max Conduit Size		1 x 3"; 2 x 2"	in
DC Input Inverter / Synergy Unit	Multi-input (SExxK-USxxxxxZ4)	12 / 4 pairs; 6 – 12 AWG	
	Combined input (SExxK-USxxxxxW4)	3 pairs / 1 pair, Max 2 AWG; copper or aluminum	
Dimensions (H x W x D)		Synergy Unit: 22 x 12.9 x 10.75 / 558 x 328 x 273 Synergy Manager: 14.17 x 22.4 x 11.6 / 360 x 560 x 295	in / mm
Weight		Synergy Unit: 70.4 / 32 Synergy Manager: 39.6 / 18	lb / kg
Operating Temperature Range		-40 to +140 / -40 to +60(5)	℉ / ℃
Cooling		Fan (user replaceable)	
Noise		< 67	dBA
Protection Rating		NEMA 3R	
Mounting		Brackets provided	

(5) For power de-rating information refer to the Temperature Derating Technical Note for North America.

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96.8 kW DC SOLAR ARRAY

DATA SHEETS

PROJECT NUMBER 23-11-1168-FS1
DRAWN BY GAK
SCALE
SHEET SI□E 22□34
SHEET NUMBER E804

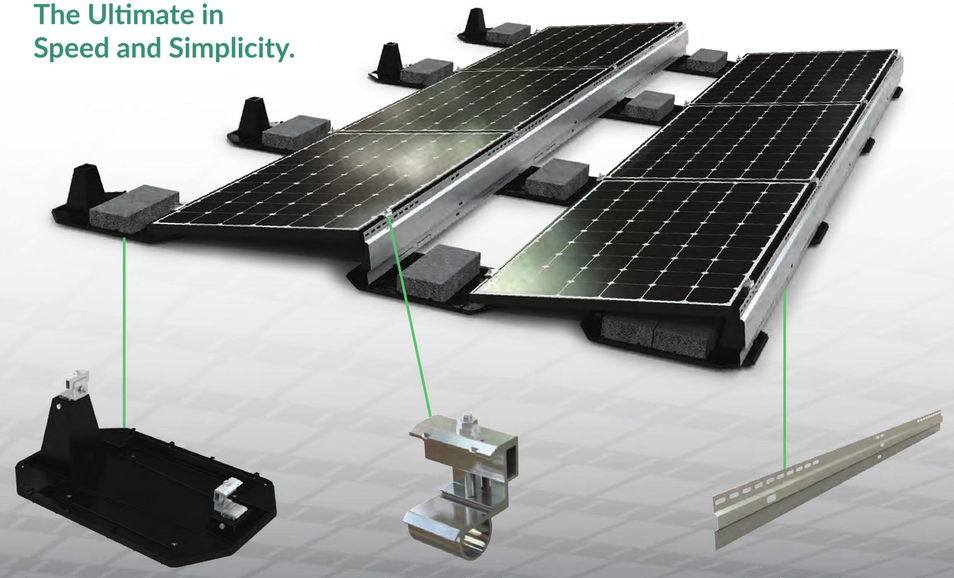
EcoFoot2+®

Ballasted Racking System

Installer-Preferred for Low-Slope Roofs

Three Main Components.

The Ultimate in Speed and Simplicity.



Base

UL-Listed ASA based resin is a durable material commonly used for automotive and construction products. Wire Clips are built-in for easy wire management. Class A fire rated and UL2703 Certified.

Universal Clamp

The preassembled Universal Clamp is ready to go right out of the box. Simply drop the Clamp into the Base. Integrated Bond Pin achieves integrated grounding without the use of grounding washers. Fits 30-50mm module frames with a single component.

Wind Deflector

Corrosion-resistant wind deflector on every module helps minimize uplift, reduce ballast requirements and carries UL2703 validated ground path from modules and racking components.

Ecolibrium Solar

Contact: 740.249.1877 | sales@ecolibriumsolar.com | www.ecolibriumsolar.com

Pure Performance

Unbeatable, Right Out of the Box.

No other racking products install flat roof arrays better than EcoFoot2+ Racking Solution. Installers prefer EcoFoot2+ because it's fast, simple, and durable. The line-up is unbeatable:

- Ready-to-go, preassembled components and simple installation
- No PV panel prep required: bases self-align
- Low-effort roof layout, just two chalk lines required
- No training required, 5-minute learning curve

Commercial

Residential

Design Flexibility

Wire Management Built-In

Master the Most Challenging Rooftop

Stackable Bases fit up to 50kW of Bases delivered on a standard pallet.

System Benefits

- Low part count
- Rapid system deployment
- Preassembled Universal Clamp
- Increased design flexibility
- More ballast capacity
- Simplified logistics
- Ship up to 50kW per pallet

Validation Summary

- Certified to UL2703 Fire Class A for Type I and II modules
- Certified to UL2703
- Grounding and Bonding
- Wind tunnel tested to 150mph
- SEAOC seismic compliant
- CFD and structurally tested
- DNV GL rated at 13.5 panels per installer-hour

Technical Specifications

Dimensions: 26.5"L x 18.25"W x 8.3"H
Typical System Weight: 3.5–6 lbs. per sq. ft.
Module orientation: Landscape/Portrait
Tilt angle: Landscape 10°/Portrait 5°
Module inter-row spacing: 18.9"
Roof pitch: 0° to 7°
Clamping range: 30-50mm
Ballast requirements: 4" x 8" x 16"
Warranty: 25 years
Slip sheets: not required by Ecolibrium Solar.
If required by roofer, use 20"x29" under Base.

Ecolibrium Solar

740-249-1877 | www.ecolibriumsolar.com
507 Richland Avenue, Athens, OH 45701

EcoFoot2+ Sales Sheet v2.1 121919

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375
Phone: 248-347-3512
Fax: 248-347-4152
www.novaconsultants.com

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84.6 kW AC SOLAR ARRAY
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PROJECT NUMBER 23-11-1168-FS1
DRAWN BY GAK
SCALE
SHEET SIZE 22x34
SHEET NUMBER E805

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Fire Station 1\Drawings\23111168-FS1-E805.dwg Date: Jun 28 2024; 10:48AM User: george

BOM and AVG PSF Array 1			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	60	5	300
WIND DEFLECTORS K	32	6	192
BALLAST BLOCKS	126	32	4032
PANELS	32	68.34	2186.88000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		6730.08000	
ARRAY AREA(sft)		1439.72	
AVG PSF		4.67458	

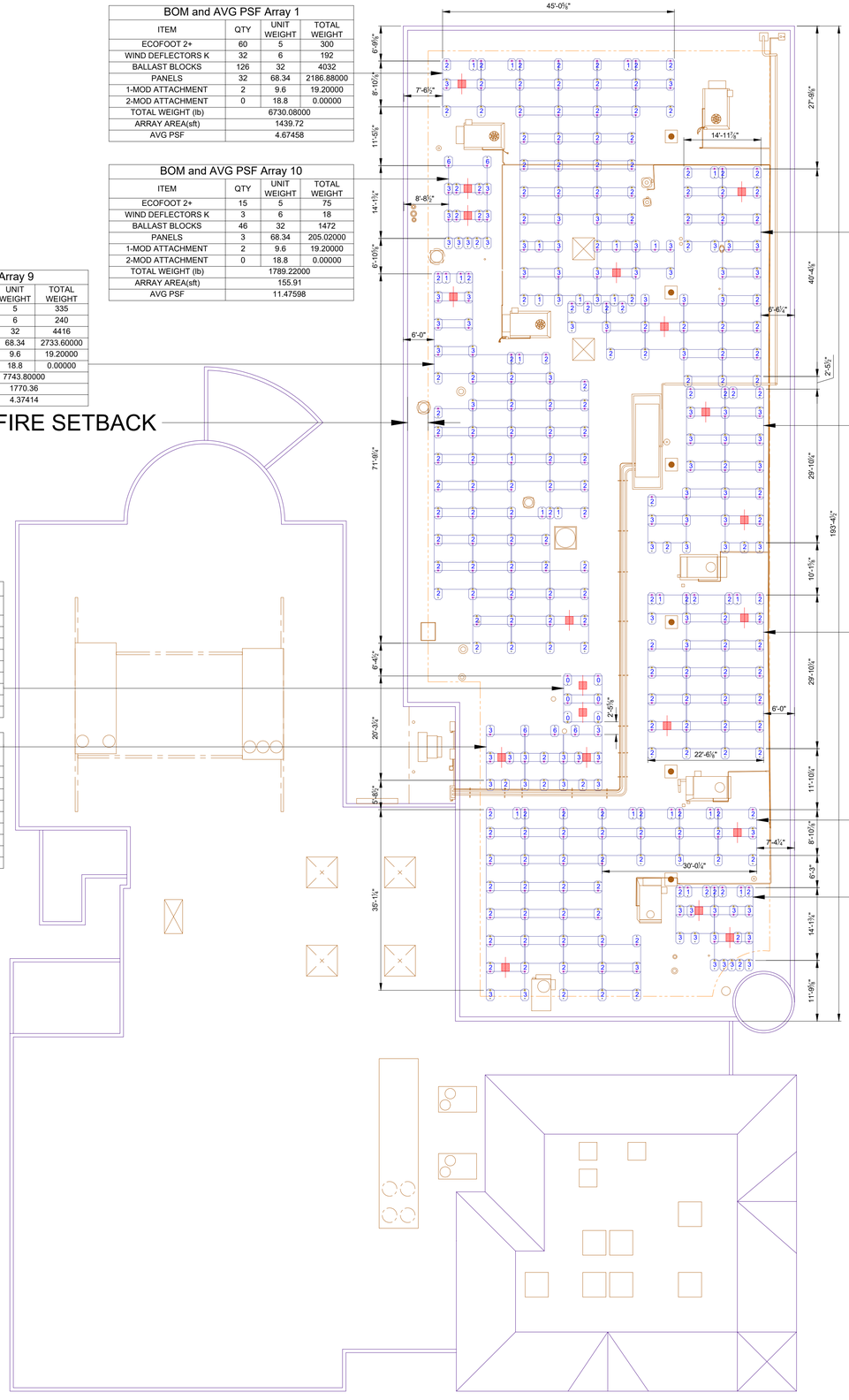
BOM and AVG PSF Array 10			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	15	5	75
WIND DEFLECTORS K	3	6	18
BALLAST BLOCKS	46	32	1472
PANELS	3	68.34	205.02000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		1789.22000	
ARRAY AREA(sft)		155.91	
AVG PSF		11.47598	

BOM and AVG PSF Array 9			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	67	5	335
WIND DEFLECTORS K	40	6	240
BALLAST BLOCKS	138	32	4416
PANELS	40	68.34	2733.60000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		7743.80000	
ARRAY AREA(sft)		1770.36	
AVG PSF		4.37414	

4' FIRE SETBACK

BOM and AVG PSF Array 8			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	6	5	30
WIND DEFLECTORS K	2	6	12
BALLAST BLOCKS	0	32	0
PANELS	2	68.34	136.68000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		197.88000	
ARRAY AREA(sft)		108.67	
AVG PSF		1.82093	

BOM and AVG PSF Array 7			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	19	5	95
WIND DEFLECTORS K	6	6	36
BALLAST BLOCKS	62	32	1984
PANELS	6	68.34	410.04000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		2544.24000	
ARRAY AREA(sft)		289.86	
AVG PSF		8.77748	



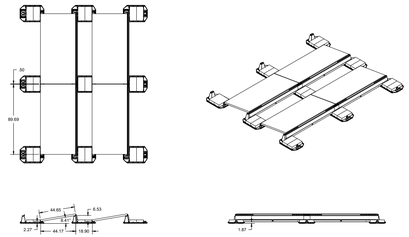
BOM and AVG PSF Array 2			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	38	5	190
WIND DEFLECTORS K	19	6	114
BALLAST BLOCKS	87	32	2784
PANELS	19	68.34	1298.46000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		4405.66000	
ARRAY AREA(sft)		884.44	
AVG PSF		4.98130	

BOM and AVG PSF Array 3			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	27	5	135
WIND DEFLECTORS K	13	6	78
BALLAST BLOCKS	71	32	2272
PANELS	13	68.34	888.42000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		3392.62000	
ARRAY AREA(sft)		608.78	
AVG PSF		5.57282	

BOM and AVG PSF Array 4			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	31	5	155
WIND DEFLECTORS K	17	6	102
BALLAST BLOCKS	63	32	2016
PANELS	17	68.34	1161.78000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		3453.98000	
ARRAY AREA(sft)		766.29	
AVG PSF		4.50741	

BOM and AVG PSF Array 6			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	51	5	255
WIND DEFLECTORS K	30	6	180
BALLAST BLOCKS	103	32	3296
PANELS	30	68.34	2050.20000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		5800.40000	
ARRAY AREA(sft)		1345.24	
AVG PSF		4.31180	

BOM and AVG PSF Array 5			
ITEM	QTY	UNIT WEIGHT	TOTAL WEIGHT
ECOFOOT 2+	22	5	110
WIND DEFLECTORS K	5	6	30
BALLAST BLOCKS	55	32	1760
PANELS	5	68.34	341.70000
1-MOD ATTACHMENT	2	9.6	19.20000
2-MOD ATTACHMENT	0	18.8	0.00000
TOTAL WEIGHT (lb)		2260.90000	
ARRAY AREA(sft)		246.5	
AVG PSF		9.17201	



JINKO SOLAR JKM580N-72HL4-BDV 580W

ECOFOOT2+ LANDSCAPE ELEVATION/ISO VIEWS

SCALE: NTS UNITS: INCHES

MODULE NOTES

-PV MODULE SPECS (W): 580

-PV MODULE QUANTITY: 167

-SYSTEM POWER RATING (STC KWDC): 96.86

-ORIENTATION/TILT (DEGREE): LANDSCAPE/8.41°

BALLAST NOTES

-BALLAST BLOCK: 16"x8"x4" @ 32 LBS

ECOFOOT 2+ (BLOCK PER E2+):

N = BASE WITH BLOCK COUNT

= SEISMIC ATTACHMENT / 1 MODULE ATTACHMENT

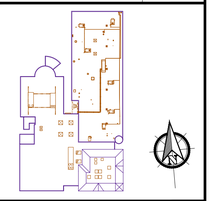
ARRAY OF GREATEST AVERAGE PSF = 11.47

BILL OF MATERIALS

PART NO	NAME	QTY
ES20207	ECOFOOT2+	336
ES10466	UNIVERSAL CLAMP KIT	265
ES20311K	WIND DEFLECTOR	167
ES10970	ECOFOOT MLPE BRACKET	167
ES10378	38" BONDING JUMPER	56
ES11203	MID-SUPPORT KIT	167
310999	FLASHLOC RM	20
ES10843	ROOF TO STRUT	20
ES10844	STRUT TO MODULE	20
ES20501	1 5/8" X 1 5/8" 12 GAUGE STRUT (10')	6
USER SUPPLIED	32 LBS BALLAST BLOCK (SOURCED LOCALLY OR SUPPLIED BY OTHERS)	751
008009P	ILSCO LAY IN LUG	10

SITE NOTES

BASIC WIND SPEED (MPH)	115
EXPOSURE CATEGORY	B
GROUND SNOW LOAD (PSF)	20
OCCUPANCY CATEGORY	IV
SEISMIC (Ss)	0.094
ROOF HEIGHT (FT)	30
PARAPET HEIGHT (IN)	12
SETBACK TYP. (IN)	48
ROOF SLOPE (DEG)	1.2
ROOFING TYPE	EPDM MEMBRANE
ASCE7 VERSION	2010
BUILDING CODE	IBC2015



NO.	REVISION	BY	DATE
0	INITIAL RELEASE	MN	2024-6-5
A	LAYOUT CHANGE	MN	2024-8-1

UNIRAC®

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ALBUQUERQUE, NEW MEXICO, USA, 87102
WWW.UNIRAC.COM

PRODUCED FOR: NOVA CONSULTANTS INC

PROJECT NAME: FIRE STATION 1

111 N 5TH AVE
ANN ARBOR, MI 48104

Date: 2024-08-01

Scale: CUSTOM

Drawn By: MN

Sheet: S-1.0

DRAWING INDICATES PLACEMENT OF EQUIPMENT AND BALLAST. PLEASE REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS. INSTALLER IS RESPONSIBLE FOR VERIFICATION OF SITE AND PROJECT SPECIFICS. DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

SOLAR PROJECT DESIGN

Prepared For: Nova Consultants Inc
Project Name: Fire Station 1
Project Address: 111 N 5th Ave, Ann Arbor, MI 48104
Date: August 1, 2024

SOLUTION OVERVIEW

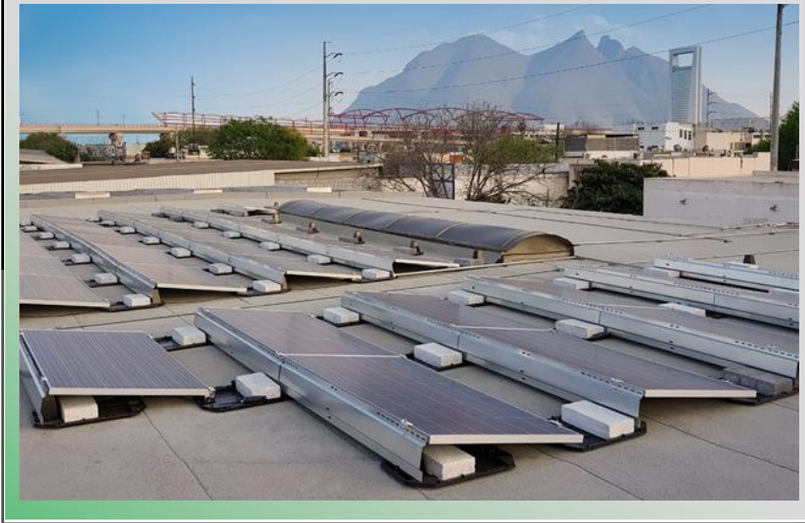
EcoFoot2+ Low-Slope Racking

With 500MW installed, EcoFoot Racking is preferred by installers for fast, simple installation and streamlined logistics. The enclosed provides the layout and system details for a complete solution for your project using this validated and reliable product.

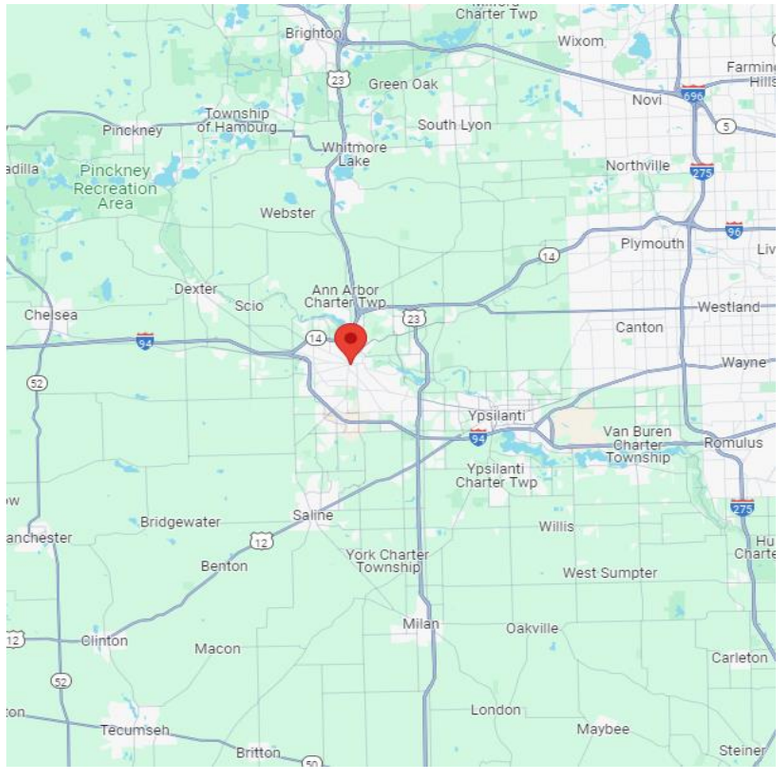
EcoFoot2+ delivers key advantages for a successful, efficient installation.
Faster Installation: Installers complete projects in less time with self-aligning Bases, simple pre-assembled components, five-minute learning curve, and one-tool installation. Install speed is rated at 13.5 modules/installer-hour by DNV-GL.

Low Part Count & Streamlined Logistics: EcoFoot2+ consists of three core components: roof friendly, durable Base with integrated north/south Wire Clips, pre-assembled Clamps, and Wind Deflector to reduce ballast and provide east/west bonding. Stackable Bases fit up to 50kW per pallet, meaning fewer crane lifts and less space used on the job site.

Dedicated Support: Experienced project managers and field technicians support your project from bid to inspection. Project managers ensure you have needed details to obtain a permit and pass inspection. Our field team offers a dedicated phone line and email. On-site training is available.



VICINTY MAP



PROJECT SPECIFICATIONS

SYSTEM INFORMATION	
Total System Size (KW)	96.86
Total Module Quantity	167
Module Orientation	Landscape
EQUIPMENT	
Module Manufacturer	JINKO SOLAR
Module Model	JKM580N-72HL4-BDV
Module Wattage	580
Module Length (in.)	89.69
Module Width (in.)	44.65
Module Weight (lbs)	68.34
BUILDING DATA	
Roof Type	EPDM Membrane
Parapet Height (in)	12
Setback (in)	48
Roof Height (ft)	30
Roof Slope (degrees)	1.20
DESIGN VALUES	
ASCE Version	2010
Basic Windspeed (mph)	115
Wind Exposure Category	B
Occupancy Category	IV
Ground Snow Load (lb/ft^2)	20

DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.

CONTRACTOR IS RESPONSIBLE FOR VERIFYING ROOF CAPACITY.
CONTRACTOR IS RESPONSIBLE FOR CONFIRMING ALL DESIGN CRITERIA ARE CORRECT AND APPROPRIATE FOR THE PROJECT SITE.
CONTRACTOR MUST CONFIRM DESIGN MEETS ALL UTILITY AND AHJ REQUIREMENTS.
CONTRACTOR IS RESPONSIBLE FOR VERIFYING THAT BUILDING STRUCTURE AND RELATED CONNECTIONS CAN SUPPORT ALL LOADS IMPOSED BY PV SYSTEM.
REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS AND ADDITIONAL INFORMATION.

Uplift, Sliding and Seismic Calculations

Explanation of EcoFoot System Calculations and Design Procedure

Installer Name:	Nova Consultants Inc
Project Name:	Fire Station 1
Project Address:	111 N 5th Ave Ann Arbor, MI 48104
Date Prepared:	8/1/2024

Calculation Explanation Key Sections:

Table Of Figures:

3rd Party Engineering Resources

Rowan, Williams, Davies, & Irwin Inc (RWDI) -- Wind Tunnel Testing Per ASCE 7 / IBC
Maffei Structural Engineering -- Peer Review of Wind Tunnel Testing
Testing Engineers, Inc. -- Friction Testing per ASTM G115
CBC Engineers -- Professional Engineering Review and Certification

Introduction, Site Specifics and Variable Definition

In order to efficiently design EcoFoot2+ and EcoFoot5D ballasted photovoltaic systems, Unirac makes use of a proprietary solar array design aid called "EcoCalcs". Starting with a set of design criteria, shown here in Table 1 below, EcoCalcs utilizes methodologies laid out in the ASCE7 and SEAOC PV1/PV2 documents, and derivative building codes. Actual calculations for this project are included herein, and are accompanied by a step-by-step explanation of Unirac's design process.

The output of EcoCalcs is a comprehensive set of ballast prescriptions, including Image 3 found on Page 6. Ballast prescriptions are applied to a proposed system layout by the Unirac engineering team. Engineering Alliance, Unirac's professional engineering partner, has reviewed and verified EcoCalcs and reviews system designs to ensure that calculations and ballast prescriptions were correctly applied. Upon successful review, Engineering Alliance provides a stamped design review including relevant supporting documentation (this explanation included) and a stamped, approved ballast plan.

Please note: Unirac and Engineering Alliance are not conducting a structural review of the proposed site.

Below, Table 1 and Table 2 list the design criteria and project details for a proposed system in Ann Arbor, MI. These values will be used throughout the remainder of this explanation.

Table 1: System Design Criteria

Product Line	EcoFoot 2+
ASCE7 Version	2010
Ground Elevation (ft)	N/A
Roof Type	EPDM Membrane
Roof Height (ft.)	30
Roof Slope (deg)	1.20
Min Edge Setback (in)	48
Parapet Height (in.)	12
3 Sec. Gust (mph)	115
Occupancy Category	IV
Wind Exposure	B
Snow Load (psf)	20.0
Seismic Data (SS)	0.0940
Soil Site Class	D-Stiff Soil
Coeff. Of Friction (fn)*	0.49

**req's slip sheets*

Table 2: PV Module Specifics

Module Manufacturer	JINKO SOLAR
Module Model	JKM580N-72HL4-BDV
Module Orientation	Landscape
Module Power (w)	580
Module Length (in)	89.69
Module Width (in)	44.65
Module Weight (lbs.)	68.34

Utilizing the inputs from Tables 1 and 2, the factors in Table 3 are generated for the site. This list of factors is used in various ways to fully define a proposed system according to calculations laid out in the SEAOC and ASCE documents. In the scope of this explanation, factors are used to calculate velocity pressure, qh as defined in ASCE7-05, Section 6.5.10; ASCE7-10, Section 30.3.2; or ASCE7-16 and ASCE7-22, Section 26.10.2, and ultimately the amount of ballast required to offset uplift and drag forces.

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Table 3: Calculation Inputs, Constants, and Variables

Racking Component Weight per Module	15.19	lbs.
Ballast Block Weight	32	lbs.
Asymmetric lift load Ratio (North Row)	1.4	
Asymmetric lift load Ratio (South Row)	1.6	
Ala= Effective Lift Area of PV Module	27.511	ft^2
Ada= Effective Drag Area of PV Module	4.07	ft^2
dLF1= Dead Load of Module and Attributed Racking	83.528	lbs.
Roof Setback Minimum	48	in.
Load Combination Factor for Wind	0.6	
Load Combination Factor for Seismic	0.7	
α (from ASCE7 Table 6-2 or 26.9.1 or 26.11-1)=	7	
zg (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	1200	ft.
zmin (from ASCE7 Table 6-2 or 26.9.1 or 26.11.1)=	30	ft.
z selected (from zmin & inputs)=	30	ft.
Kz= Velocity pressure exposure coefficient at height	0.70	
Kzt= Topographic Factor	1	
Kd= Directionality Factor	0.85	
Ke= Ground Elevation Factor	1	
Wind design load factor	0.6	
Dead Load design load factor	0.6	
qh_wind= Velocity Pressure (0.00256*Kz*Kzt*Ke*Kd*V^2*I)	20.16	psf

An explanation of variables:

Asymmetric Lift Load Ratio: This is a ratio describing the leverage created by EcoFoot base dimensions, module attachment location and location of center of ballast mass. Assessed as a multiplier on top of ballast distribution scheme in Image 4.

dLF1= Dead Load of Module and Attributed Racking: the weight of one module and hardware attributed to that module, not including ballast.

Ala= Effective Lift Area of PV Module: The surface area of a module projected onto the horizontal plane for lift calculations.

Ada= Effective Drag Area of PV Module: The surface area of a module projected onto the horizontal plane for drag calculations.

qh= Velocity Pressure at height "h": Calculation prescribed by ASCE7-05, eq. 6-15, and ASCE7-10, eq. 30.3-1, or ASCE7-16 and ASCE 7-22, eq. 26.10-1 (subscript "h" used here for clarity, ASCE7 utilizes subscript "z").

Wind Tunnel Testing, Uplift and Drag Force Calculations

Wind tunnel testing of the EcoFoot product line to determine GCn values has been conducted by Rowan Williams Davies & Irwin Inc. (RWDI), a nationally recognized boundary-layer wind tunnel test firm. Testing was conducted in accordance with ASCE7-05, section 6.6; and ASCE7-10/16/22, section 31.2. Module-specific GCn data allows for precise application of ballast to prevent uplift. Deviation from prescriptive wind GCn values has been addressed according to SEAOC PV2 via a peer review of the wind tunnel testing and results by Maffei Structural Engineering.

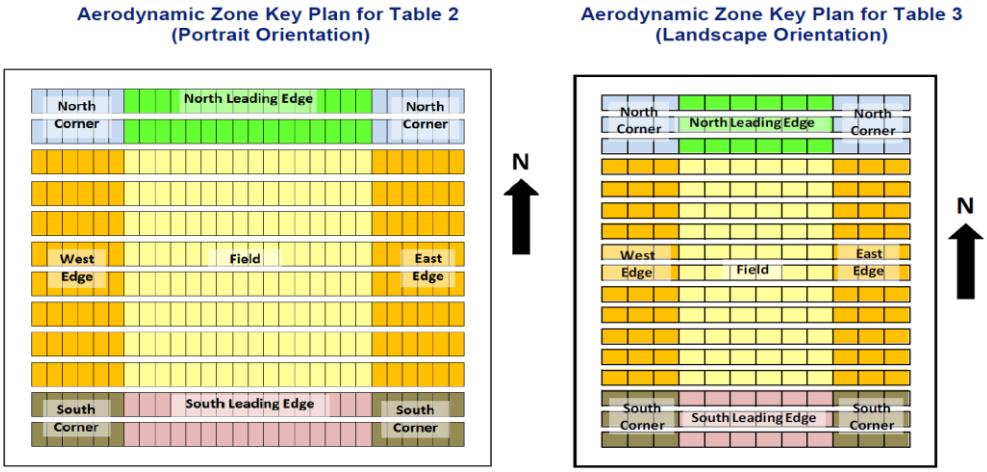
GCn and qh are used to calculate the pressure exerted on each module via the design wind pressure equations (ASCE7-05 – section 6.5.12.4, ASCE7-10 – section 30.4.2, ASCE7-16-30.5.2 and ASCE7-22 – section 30.3.2). Ballast required to offset uplift and drag forces (BWUz) is calculated in accordance with RWDI recoemndations. Detailed calculations for this project are found in Table 4. Resulting required ballast BWUz is displayed graphically in Image 3.

Table 4: Ballast to Resist Uplift Calculations for Project Proposed in Ann Arbor, MI 48104

			Load Sharing Area						
		#col x #rows	2x2	2x3			3x2	3x3	Down (1x1)
North Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.8	-6.0			-5.4	-5.0	12.8
	WLFUz=Uplift wind force =pUz*Ala	lbs.	-187.4	-164.7			-147.7	-136.3	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-62.4	-48.7			-38.5	-31.7	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	103.9	81.2			64.2	52.8	
North Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-5.4	-4.7			-4.5	-4.1	11.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-147.7	-130.6			-125.0	-113.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-38.5	-28.3			-24.9	-18.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	64.2	47.1			41.4	30.1	
E/W Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.8	-5.0			-5.4	-4.1	12.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-187.4	-136.3			-147.7	-113.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-62.4	-31.7			-38.5	-18.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	103.9	52.8			64.2	30.1	
Field	pUz=Uplift design wind pressure =qh*GCnUz	psf	-5.4	-4.7			-4.5	-4.1	11.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-147.7	-130.6			-125.0	-113.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-38.5	-28.3			-24.9	-18.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	64.2	47.1			41.4	30.1	
South Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.8	-5.0			-5.8	-4.1	12.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-187.4	-136.3			-159.0	-113.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-62.4	-31.7			-45.3	-18.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	103.9	52.8			75.5	30.1	
South Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.2	-4.7			-5.4	-4.1	11.8
	WLFUz=Uplift wind force =pUz*Ala	lbs	-170.4	-130.6			-147.7	-113.6	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*0.6	lbs	-52.1	-28.3			-38.5	-18.0	
	BWuz=ballast required = -DLFUz/0.6	**lbs**	86.9	47.1			64.2	30.1	

The aerodynamic differences among different sub-sections of a large array are handled by various calculation sections (North Corner, North Edge, E/W Edge...) and apply according to the excerpt from the RWDI report shown below in Image 1. The highlighted sections of Table 4 correspond to specific module locations, also shown in Image 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for expanded calculations pertaining to the highlighted sections.

Image 1: Aerodynamic Zones from RWDI Report



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To check the amount of drag a given sub-array will experience, the equation in Image 2 is utilized - an excerpt from RWDI's test report. Each sub-array is checked for sliding, proceeding from the smallest to largest or until drag no longer governs total required ballast.

Table 5 lists the calculations used to identify the total required ballast to counteract drag forces and prevent sliding. Friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients. Unless detailed information is available pertaining to the location of the sub-array, the roof's worst case uplift GCp are utilized in calculating drag and required ballast.

Image 2: Ballast to Resist Sliding Equation

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot Ballast_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)^*_{drag} \cdot A_{drag} \cdot \left(\frac{1}{f_n}\right) + |GC_p|^*_{uplift} \cdot A_{uplift} \right] - \alpha_D \cdot M \qquad (lb)$$

Table 5: Ballast to Resist Sliding Calculation

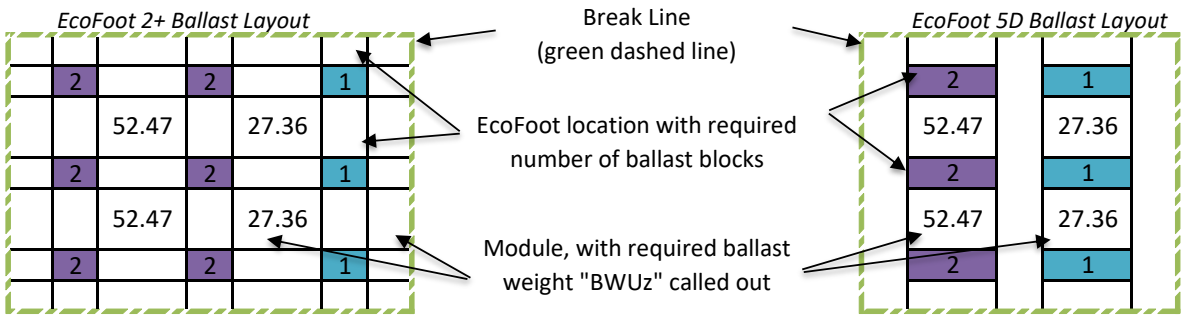
Sub-Array Module Count Total:	16
a_w = Wind Load Combination Factor =	0.6
a_d = Dead Load Combination Factor =	0.6
qz (qh in Table 3)	20.16
M = dLF1 from Table 3 =	83.53
f_n (also see Table 1) =	0.49
A_{uplift} = Ala in Table 3 =	27.51
A_{drag} = Ada in Table 3 =	4.07
$GC_{p\text{-}drag}$	1.42
$GC_{p\text{-}uplift}$	-0.62
Area Reduction Factor =	0.31
$(GCp)^*_{drag}$ =	0.44
$\lvert GCp \rvert^*_{uplift}$ =	0.19
Total Required Ballast Weight (Per Image 2)=	**1546.31**
$W_{ballastblock}$ =	32
Total Required Ballast Blocks:	**49**

Ballast Application to Sheet S-1.0

For easier interpretation, the results calculated in Table 4 are laid out in graphical representations of a solar array, shown in Image 4. Unirac engineers and drafters make use of this graphical layout when applying ballast to a given system design.

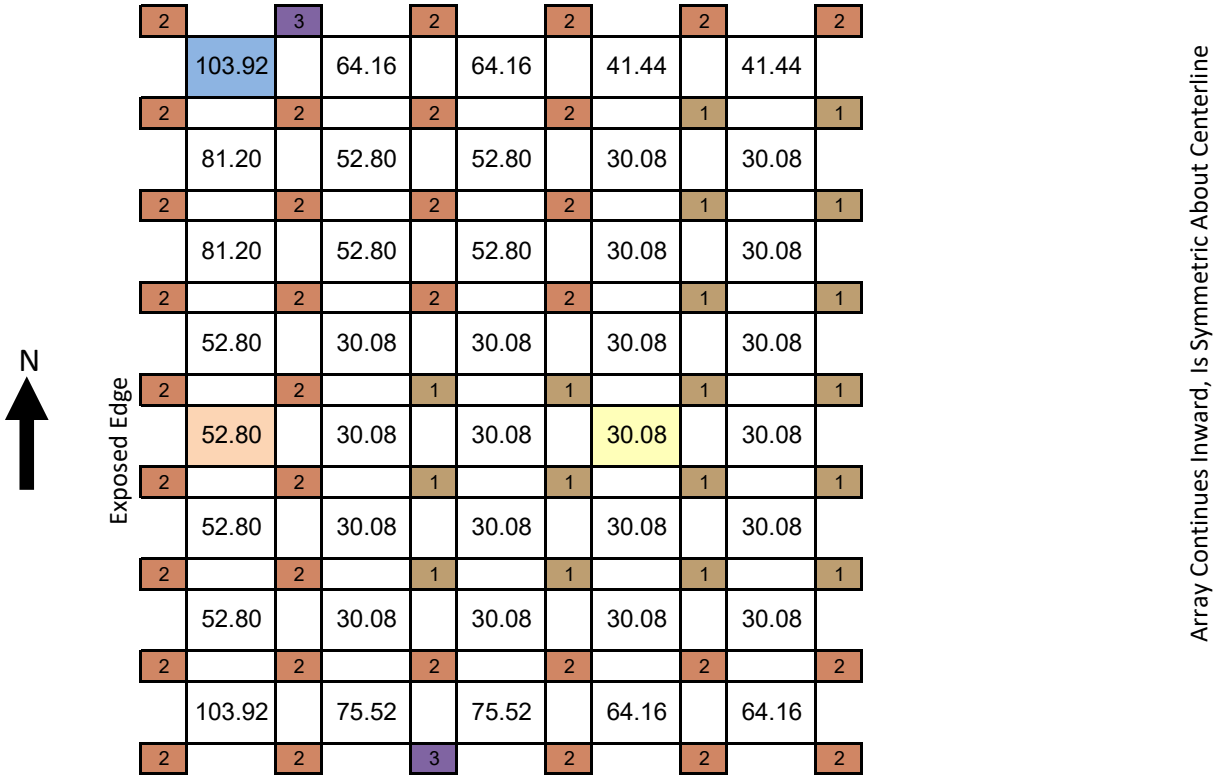
As shown in Image 3, the ballast required to resist lift - BWUz from Table 4 - is listed for each module location in Image 4. A portion of each BWUz value is distributed to each of the connected EcoFoot Bases, also detailed in Image 3 and included in Image 4. The total ballast required at each EcoFoot location is then calculated and rounded up to the next ballast block increment.

Image 3: Example of Module and Ballast Graphical Representation



The ballast prescription array shown in Image 4 is one of many similar arrays created automatically through EcoCalcs in order to address all possible array configurations. The data calculated in Table 4 was ultimately used to assign ballast to the system design in Sheet S-1.0 by Unirac. EcoCalcs and the resulting ballast plan S-1.0 are reviewed by CBC Engineers for correctness and completeness. Once approved, an engineering report including Sheet S-1.0 and any supporting material (this explanation included) are stamped and sealed by a professional engineer registered in the state where the project is proposed.

Image 4: Ballast Prescriptions Produced by Table 4



NOTE: The colored module locations in Image 4 correspond to the same colored areas in Table 4: blue - the north corners, orange - the east or west edge, yellow - the deep interior. See Page 7 for more detailed calculations.

Detailed Calculations From Table 4

North Corner Module		
GCn Value from RWDI report:	-0.34	
qh value from Table 3:	20.16	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-6.81	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-187.45	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-62.35	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	103.92	lbf

East/West Edge Module		
GCn Value from RWDI report:	-0.25	
qh value from Table 3:	20.16	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-4.96	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-136.33	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-31.68	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	52.80	lbf

Interior Module		
GCn Value from RWDI report:	-0.20	
qh value from Table 3:	20.16	
pUz = Uplift design wind pressure in Z direction = qh*GCn:	-4.13	psf
Am = Surface Area of Module:	27.81	sqft
Θm = Module Incline:	8.41	deg
Ala = PV Module Lift Area = Am * Cos (Θm):	27.51	sqft
WLFUz=Uplift wind load force in Z direction=pUz*Ala	-113.60	lbf
dLF1 = Dead load of one module and attributed hardware:	83.53	lbf
DLFUz=Uplift design load using ASD combo #7 = dLF1*0.6 + WLFUz*0.6	-18.05	lbf
BWuz=ballast weight required to resist wind uplift= -DLFUz/0.6	30.08	lbf

Max downpoint load calculations

No of Mid supports	1	
Tributary Area to support/bays/base	0.5	of module area
Wind force down (WL)	176 lbs	
Snow load Down (SL)	330.13 lbs	
Total Dead load per Bay (DL)	145.36 lbs	

Load Combinations

DL+ SL	**475.49 lbs**
DL+0.6WL	251.01 lbs
DL+0.75SL+0.45WL	472.20 lbs

SEAOC PV1 - 2012 - Section 4: attached Arrays

Unirac utilizes the unattached design approach to account for seismic force as provided for by Section 16 of the 2016 California Building Code, the Structural Engineering Association of California PV1 Requirements (SEAOC PV1-2012) and ASCE 7. Section 1613.5 defines “Ballasted Photovoltaic System” which also defines "partially attached" systems, and provides guidance for designing arrays that utilize physical anchors and friction to resist seismic forces. SEAOC PV1 or ASCE 7 Chapter 13 defines the calculations required design attached photovoltaic systems, including friction to partially offset seismic forces.

The following explanation walks through calculations outlined in Section 4 - Attached Arrays. The attached approach begins with the project specific design criteria outlined in Table 6. These values reflect site inputs as well as assumptions permitted in the SEAOC PV1-2012 document Section 4 and ASCE 7 chapter 13 .

Table 6: Seismic Design Inputs

Number of blocks per Ecofoot	6.00
Wp=Weight per unit	275.53
Site Class	D-Stiff Soil
Seismic Design Category	A
Ip	1.50
Rp	1.50
'Seismic Calcs (Attached)'!A9	1.00
Fa (Site Class E)	2.5
Sms = Fa x Ss	0.15
Sds = (2/3) x Sms	0.10

Table 7: ASCE7 Inputs

z=height of point of attachment (in.)	1.00
h=structure height compared to base (in.)	1.00
Fp=0.4*ap*Sds*Wp*(1+2*z/h)/(Rp/Ip)	33.15
Fp=1.6*Sds*Ip*Wp	66.30
Fp=0.3*Sds*Ip*Wp	12.43
Fp	33.15
Fp (ASD)	23.21

SEAOC PV1 specifies that “PV support systems that are attached to the roof structure shall be designed to resist the lateral seismic force *Fp* specified in ASCE 7-16/22 Chapter 13.” Although SEAOC PV1 was released prior to ASCE 7-16/22, *Fp* is defined the same way in Chapter 13 of both ASCE verions 7-10, 7-16 and 7-22. Therefore the lateral seismic force analysis applied is valid for both ASCE 7-10, 16 and 22. In utilizing the *Fp* calculations for nominal, minimum, and maximum values laid out in Section 13.3.1, the values in Table 7 are found.

The following is excerpted from SEAOC PV1-2012, Section 4 – Attached Arrays:

“For attached roof-bearing systems, friction is permitted to contribute in combination with the design lateral strength of attachments to resist the lateral force Fp when all of the following conditions are met:

- “The maximum roof slope at the location of the array is less than or equal to 7 degrees (12.3 percent);
- “The height above the roof surface to the center of mass of the solar array is less than the smaller of 36 inches and half the least plan dimension of the supporting base of the array
- “Rp shall not exceed 1.5 unless it is shown that the lateral displacement behavior of attachments is compatible with the simultaneous development of frictional resistance.”

The EcoFoot 2+ and EcoFoot 5D systems have been demonstrated to be in conformance with the above stated stipulations. As such, and in accordance with the remainder of Section 4 – Attached Arrays from SEAOC PV1-2012, the force required to resist movement due to seismic shifting is calculated. Based on the minimum ultimate shear strength of the roof mounting method prescribed for this job, the total lateral load that one attachment may offset is calculated, and by extension the number of modules allowed per attachment point. These values can be found in Table 8.

All friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients, methodology that is in agreement with SEAOC PV2 and Los Angeles, CA stipulations.

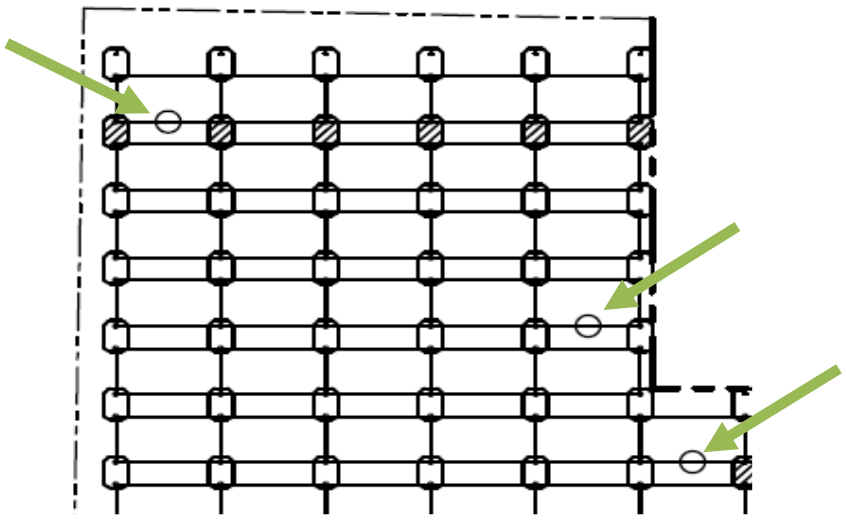
Table 8: Calculation of Physical Attachment Requirements

Friction Coefficient	0.49	*ASTM G115 Tested*
Ff (max friction) = (0.6-0.14*Sds)*(0.7*u)*Wp	55.38	*SEAOC section 4 (ASD), Friction Force*
Excess force per unit	-32.17	*Force to be offset by physical attachments*
Attachment system rating (allowable)	634.91	*ASD design load*
Number of panels per attachment	-19.74	*(if negative, no fasteners are needed)*

This final number of panels per attachment represents the maximum number of modules that any given attachment point may account for in terms of offsetting seismic force Fp. Physical attachments shall be installed per the manufacturer's instructions, and attached to the EcoFoot 2+ or EcoFoot 5D system per the installation instructions provided by Unirac.

On Sheet S-1.0 physical attachments are called out as shown below in Image 5:

Image 5: Example of ballast layout with seismic attachment callouts



LIST OF DRAWINGS

NUM	TITLE	REV	DATE: 12-13-2024	12-13-2024	1-10-2025	1-24-2025
			ISSUED: INTERCONNECT	70% REVIEW	BID REVIEW	INTERCONNECT REV-1
	GENERAL					
G001	COVER SHEET		●	●	●	●
G002	GENERAL NOTATION				●	
	CIVIL					
C101	SITE PLAN			●	●	
C102	CONSTRUCTION PLAN			●	●	
C103	FOUNDATION PLAN				●	
	ELECTRICAL					
E101	ELECTRICAL PLAN		●	●	●	●
E104	GROUNDING PLAN			●	●	
E501	ELECTRICAL DETAILS			●	●	
E601	ONE-LINE DIAGRAM		●	●	●	●
E602	CONDUIT AND WIRE SIZE CHART		●	●	●	
E701	LABELS AND PLACARDS			●	●	
E801	DATA SHEETS		●	●	●	

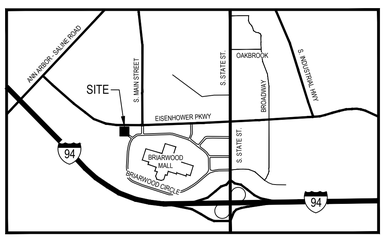
NOVA PROJECT #23-11-1168-FS6
60 kW AC, 360 KWh MICROGRID BATTERY ENERGY STORAGE SYSTEM

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

NOVA PROJECT MANAGER: JEFF ECKHOUT



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SITE LOCATION MAP

NO SCALE

NOVA Consultants, Inc.
21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

www.novaconsultants.com

ISSUED

DATE	DESCRIPTION	APPVD.
12-13-2024	INTERCONNECT	
12-13-2024	70% REVIEW	
1-10-2025	BID REVIEW	
1-24-2025	INTERCONNECT REV-1	

1

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

COVER SHEET

PROJECT NUMBER	23-11-1168-FS6
DRAWN BY	RGM, GAK
SCALE	NONE
SHEET SIZE	22x34
SHEET NUMBER	G001

Dwg: J:\PROJECTS\23 projs\23-11-1168 City of Ann Arbor - Solar at City Facilities\Fire Station 6\Drawings\23111168-FS6-G001.dwg Date: Jan 24 2025; 8:53AM User: george kachadoorian

STANDARD METHODS OF NOTATION

- SHEET KEY NOTES (TAGS)
- ITEM DESIGNATION (E601 WIRE AND CONDUIT SCHEDULE)
- REVISION / ADDENDUM TAG
- DETAIL NUMBER (ELEVATION TAG) SHEET WHERE FOUND
- DETAIL NUMBER (SECTION CUT TAG) SHEET WHERE FOUND
- DETAIL NUMBER SHEET WHERE FOUND (BUBBLE DETAIL) ENLARGEMENT AREA
- DETAIL NUMBER / NAME (DRAWING TITLE & IDENTIFICATION) SHEET WHERE FOUND / SCALE
- SPOT ELEVATION
- MATCH LINE
- CENTER LINE
- LIGHT LINE INDICATES EXISTING WORK
- HEAVY LINE INDICATES NEW WORK
- DASHED LINE INDICATES DEMOLITION
- UNDERGROUND CONDUIT AND WIRING

SITE, ROOF & FLOOR PLAN SYMBOLS

- PV STRING DESIGNATION
- MODULE (SITE & ROOF PLAN)
- SWITCHGEAR
- INVERTER
- PANEL BOARD
- DISCONNECT
- METER
- TRANSFORMER
- CT CABINET
- COMBINER
- DUPLEX RECEPTACLE
- EV CHARGING STATION
- EV CHARGING ONLY (PARKING SPACE)
- COPPER CLAD GROUND ROD
- SILT FENCE
- CHAIN LINK FENCE
- GRAPHIC SCALE
- NORTH ARROW

ELECTRICAL DETAIL SYMBOLS

- PV STRING DESIGNATION
- MODULE (PV WIRING PLAN)
- SWITCHGEAR
- INVERTER
- PANEL BOARD
- DISCONNECT
- METER
- TRANSFORMER
- CT CABINET
- COMBINER
- DUPLEX RECEPTACLE
- EV CHARGING STATION
- EV CHARGING ONLY (PARKING SPACE)
- COPPER CLAD GROUND ROD

ONE LINE DIAGRAM SYMBOLS (SHEET E601)

- PV STRING DESIGNATION
- MODULE (ONE - LINE DIAGRAM)
- OPTIMIZER
- RAPID SHUTDOWN
- PANELBOARD (PB) W/ MAIN BREAKER
- DISCONNECT
- FUSED DISCONNECT
- DISCONNECT SWITCH
- TRANSFORMER
- FUSE
- CIRCUIT BREAKER
- CURRENT TRANSFORMER (CTs)
- POTENTIAL TRANSFORMER (PTs)
- BUS BAR
- WYE TRANSFORMER CIRCUIT CONNECTION
- DELTA TRANSFORMER CIRCUIT CONNECTION
- GROUND
- INVERTER
- DISCONNECT
- METER
- COMBINER
- SURGE PROTECTIVE DEVICE (SPD)
- DUPLEX RECEPTACLE
- GFCI DUPLEX RECEPTACLE
- GFCI WITH IN USE COVER OUTDOOR RATED WEATHER RESISTANT
- EV CHARGING STATION
- UTILITY POLE TO GRID
- CIRCUIT HOMERUN W/ STRING IDENTIFIER
- AREA DIVIDER LINE (E601 ONE-LINE DIAGRAM)

ELECTRICAL ABBREVIATION LIST

ABBREVIATION	DESCRIPTION
A	AMPERES
A.F.F.	ABOVE FINISH FLOOR
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CT	CURRENT TRANSFORMER
DEMO	DEMOLITION
DIM	DIMENSION
DISC	DISCONNECT
DP	DISTRIBUTION PANEL
DWG	DRAWING
ELEC	ELECTRICAL
EM / EMER	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
EVCS	ELECTRIC VEHICLE CHARGING STATION
EX / EXIST	EXISTING
FLR	FLOOR
G / GRD / EG	GROUND
GFCI / GFI	GROUND FAULT CIRCUIT INTERRUPTER
HP	HORSEPOWER
HV	HIGH VOLTAGE
HZ	HERTZ
INV	INVERTER
IG	ISOLATED GROUND
JB	JUNCTION BOX
kV	KILOVOLT
kVA	KILOVOLT- AMPERES
kW	KILOWATT
kWH	KILOWATT - HOURS
MAX	MAXIMUM
MPPT	MAXIMUM POWER POINT TRACKING
MDP	MAIN DISTRIBUTION PANEL
MIN	MINIMUM
MISC	MISCELLANEOUS
MTD	MOUNTED
NEC	NATIONAL ELECTRICAL CODE
N/A	NOT APPLICABLE
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
PNL	PANEL
P	POLE
PH	PHASE
PV	PHOTOVOLTAIC
PT	POTENTIAL TRANSFORMER
PDP	POWER DISTRIBUTION PANEL
RSD	RAPID SHUTDOWN DEVICE
RECEPT	RECEPTACLE
REQ'D	REQUIRED
RSC	RIGID STEEL CONDUIT
SW	SWITCH
SWBD	SWITCH BOARD
SWGR	SWITCH GEAR
TELCOM	TELECOMMUNICATIONS
TP	TAMPERPROOF
TYP	TYPICAL
U.O.N.	UNLESS OTHERWISE NOTED
V	VOLTS
V.I.F.	VERIFY IN FIELD
W	WIRE
WP	WEATHERPROOF
XFMR	TRANSFORMER

INVERTER ANNOTATION

INV-1
SOLAR EDGE
SE120KUS

- INVERTER DESIGNATION
- MANUFACTURER / MODEL
- MODEL NUMBER
- SIZE
- AC VOLTAGE / CURRENT
- STANDARD

120 kW INVERTER
277 / 480 V, 144.3A
UL1741/1EEE 1547

NOTE: SOME SYMBOLS AND ABBREVIATIONS SHOWN MAY NOT APPLY TO THIS PROJECT.

STANDARD MOUNTING HEIGHTS

DESCRIPTION	HEIGHT
PANELBOARD	6'-0" A.F.F. TO TOP OF BOX
RECEPTACLE OUTLET	16" A.F.F. TO BOTTOM OF BOX. (MIN.) 48" A.F.F. TO TOP OF BOX (MAX.)
CONDUIT IN TRENCH	18" BELOW GRADE - TO TOP OF CONDIUT (MIN.)

LINES & WIRES

- GAS LINE
- AC WIRING
- AC WIRING UNDERGROUND
- DC WIRING
- STRING WIRING
- GROUND WIRE
- CONDUIT DOWN
- CONDUIT UP

PV ARRAY ANNOTATION PLAN

- BOUNDARY AREA OF STRING
- PV STRING DESIGNATION
- SOLAR PV MODULE
- INTRAROW SPACING

1-1

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DATE	DESCRIPTION	APPVD.
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

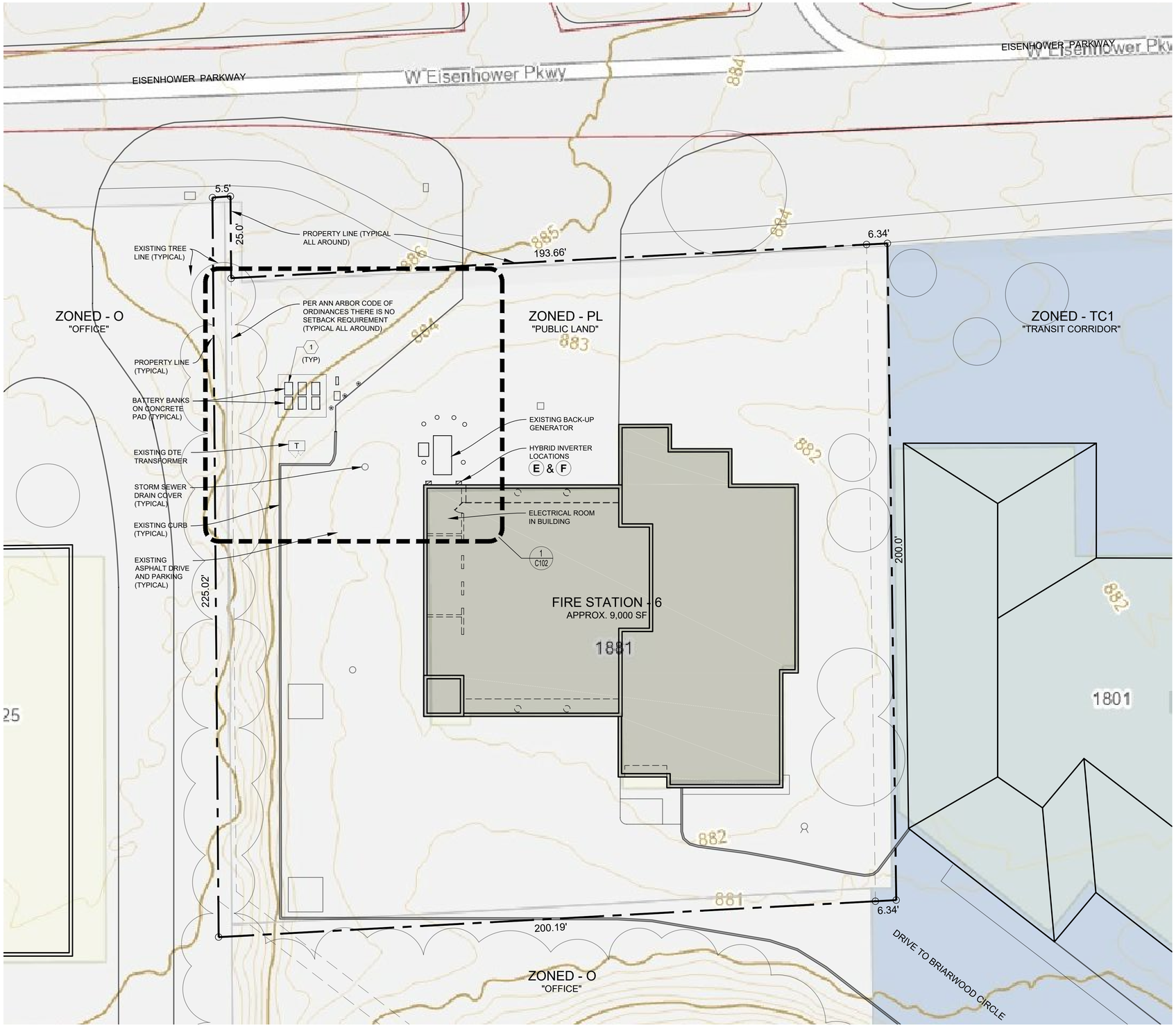
FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

GENERAL NOTATION

PROJECT NUMBER 23-11-1168-FS6
DRAWN BY GAK
SCALE
SHEET SIZE 22x34
SHEET NUMBER G002



NORTH

SITE PLAN

SCALE: 1/16" = 1'-0"

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. EXISTING APPROXIMATELY 9,000 SF 1-STORY MUNICIPAL BUILDING (MASONRY CONSTRUCTION) INCLUDING GARAGE, ZONED PL "PUBLIC LAND", ON .95 ACRES LOCATED IN CITY OF ANN ARBOR AND WITHIN WASHTENAW COUNTY.
3. LEGAL DESCRIPTION: PRT OF NW 1/4 SEC 8 T3S R6E ALSO PRT OF LOT 10 BRIARWOOD SUB COM NW COR LOT 10 BRIARWOOD SUB TH N 86 DEG 38 MIN 10 SEC E 6.34 FT FOR POB TH S 00 DEG 50 MIN 20 SEC E 200 FT TH S 86 DEG 38 MIN 10 SEC W 206.62 FT TH N 00 DEG 50 MIN 20 SEC W 225.02 FT TH N 86 DEG 38 MIN 10 SEC E 5.51 FT TH S 03 DEG 21 MIN 50 SEC E 25 FT TH 200 FT TO POB
4. PARCEL NUMBER: 09-12-08-200-011

* INFORMATION FROM CITY OF ANN ARBOR - WASHTENAW COUNTY "PARCEL VIEWER"; ON THE INTERNET AT BSAONLINE.COM

INVERTER DESCRIPTION

(E) PRIMARY (HV-1)
HYBRID INVERTER-1
SOL-ARK
(C&I) HYBRID INVERTER 30K-208V
COMMERCIAL & INDUSTRIAL
MODEL: 30K-3P-208V
30kW INVERTER
120 / 208 V, 83.4 A 1000V DC
UL1741/IEEE 1547

SOL-ARK PRODUCT SKU:
30K-3P-208V

(F) SECONDARY (HV-2)
HYBRID INVERTER-2
SOL-ARK
(C&I) HYBRID INVERTER 30K-208V
COMMERCIAL & INDUSTRIAL
MODEL: 30K-3P-208V
30kW INVERTER
120 / 208 V, 83.4 A 1000V DC
UL1741/IEEE 1547

SOL-ARK PRODUCT SKU:
30K-3P-208V

SEE PRODUCT EQUIPMENT DATA SHEET ON E801

(1) BATTERY ENERGY STORAGE SYSTEM

MANUFACTURER:	SOL-ARK (L3 SERIES LIMITLESS LITHIUM)
BATTERY ENERGY CAPACITY:	60 kWh
BATTERY MODEL NAME:	SOL-ARK, L3 HVR-60 (OUTDOOR)
ESS MODEL NAME:	SOL-ARK, L3 HVR-60kWh-30k (OUTDOOR)
NUMBER OF BATTERIES:	(2) BANKS X (3) BATTERIES = 6 BATTERIES
BESS CAPACITY:	360 kWh (6 X 60 kWh = 360 kWh)
SOL-ARK PRODUCT SKU:	L3-HVR-60KWH

SEE PRODUCT EQUIPMENT DATA SHEET ON E801

LEGEND

INVERTER

BATTERY PACK

T — TRANSFORMER

3 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171

FOR FREE LOCATION OF PUBLIC UTILITY LINES IN MICHIGAN CALL: 811

0 4' 8' 16' 32'
SCALE: 1/16" = 1'-0"

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DATE	DESCRIPTION	APPVD.
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

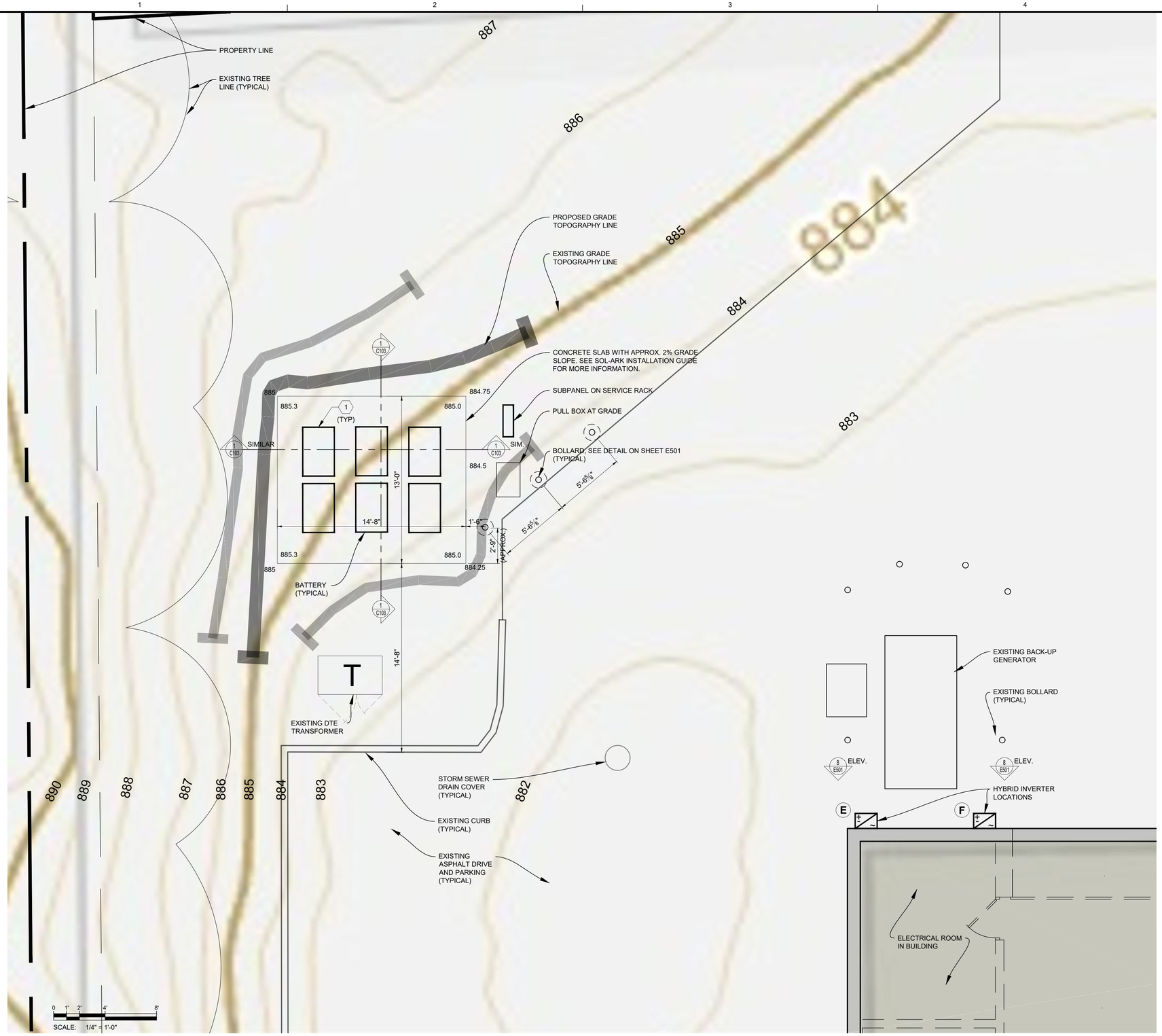
FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

SITE PLAN

PROJECT NUMBER	23-11-1168-FS6
DRAWN BY	RGM, GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	C101



1 C102 CONSTRUCTION PLAN DETAIL - BATTERY YARD

NTS

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. CONDUIT FILL TO BE LESS THAN 40%.

INVERTER DESCRIPTION

(E) PRIMARY (HV-1)
HYBRID INVERTER-1
SOL-ARK
(C&I) HYBRID INVERTER 30K-208V
COMMERCIAL & INDUSTRIAL
MODEL: 30K-3P-208V
30kW INVERTER
120 / 208 V, 83.4 A 1000V DC
UL1741/IEEE 1547

SOL-ARK PRODUCT SKU:
30K-3P-208V

(F) SECONDARY (HV-2)
HYBRID INVERTER-2
SOL-ARK
(C&I) HYBRID INVERTER 30K-208V
COMMERCIAL & INDUSTRIAL
MODEL: 30K-3P-208V
30kW INVERTER
120 / 208 V, 83.4 A 1000V DC
UL1741/IEEE 1547

SOL-ARK PRODUCT SKU:
30K-3P-208V

SEE PRODUCT EQUIPMENT DATA SHEET ON E801

(1) BATTERY ENERGY STORAGE SYSTEM

MANUFACTURER:	SOL-ARK (L3 SERIES LIMITLESS LITHIUM)
BATTERY ENERGY CAPACITY:	60 kWh
BATTERY MODEL NAME:	SOL-ARK, L3 HVR-60 (OUTDOOR)
ESS MODEL NAME:	SOL-ARK, L3 HVR-60kWh-30k (OUTDOOR)
NUMBER OF BATTERIES:	(2) BANKS X (3) BATTERIES = 6 BATTERIES
BESS CAPACITY:	360 kWh (6 X 60 kWh = 360 kWh)
SOL-ARK PRODUCT SKU:	L3-HVR-60KWH

SEE PRODUCT EQUIPMENT DATA SHEET ON E801

LEGEND

- INVERTER
- L3 HVR — BATTERY STACK ENCLOSURE
- T — TRANSFORMER - EXISTING
- PBA — PANEL BOARD - EXISTING
- D — DISCONNECT - EXISTING
- M — METER - EXISTING

3 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171
FOR FREE LOCATION OF PUBLIC UTILITY LINES IN MICHIGAN CALL: 811

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DATE	DESCRIPTION	APPVD.
11-26-2024	PRELIMINARY DRAFT	
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

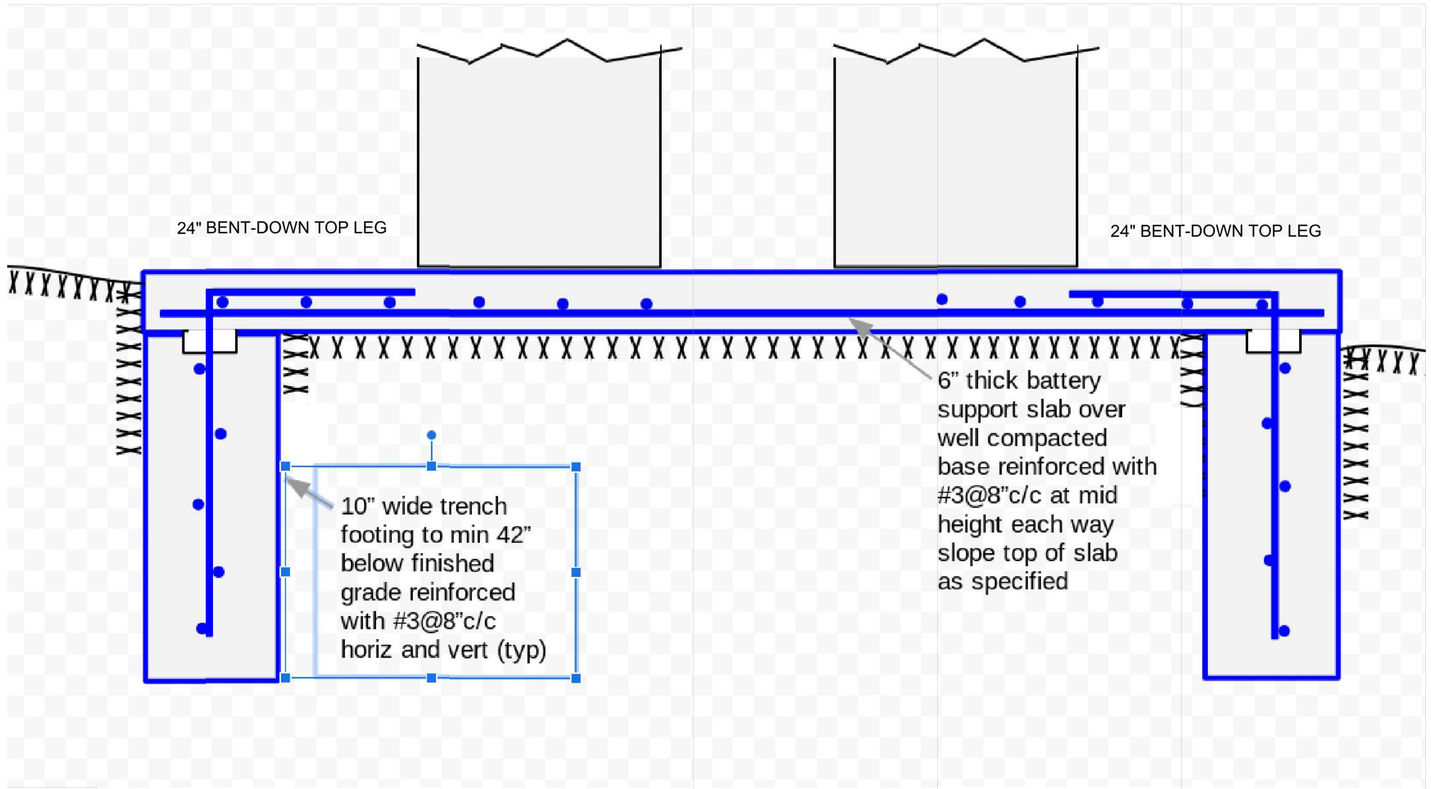
FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

CONSTRUCTION PLAN

PROJECT NUMBER	23-11-1168-FS6
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	C102



FOUNDATION SECTION THROUGH BATTERY PAD

(for Plan Layout, Location, and other details see sheets C102 and E101)

concrete: f'c = 4000 psi

reinforcing steel: ASTM A615 Gr 60

1 / C103 CONSTRUCTION PLAN DETAIL - BATTERY YARD

NTS

NovC1J2404--241225

3 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171

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DATE	DESCRIPTION	APPVD.
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

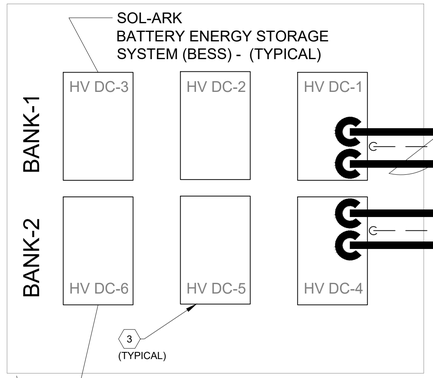
FIRE STATION 6

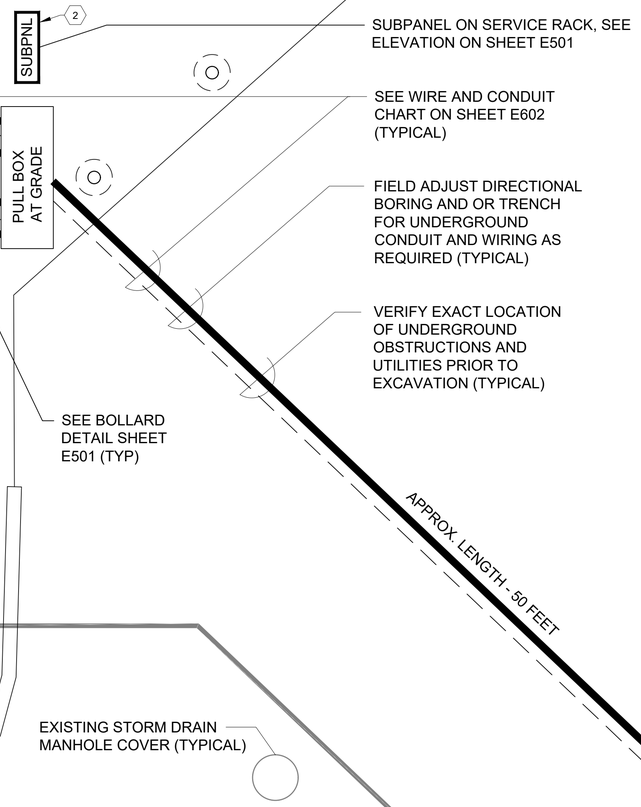
1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

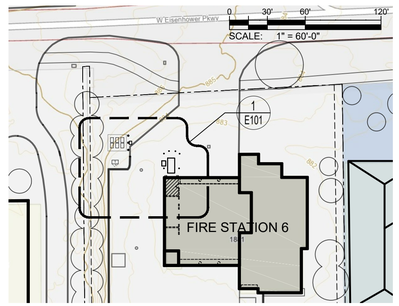
60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

FOUNDATION

PROJECT NUMBER	23-11-1168-FS6
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	C103







ELECTRICAL PLAN

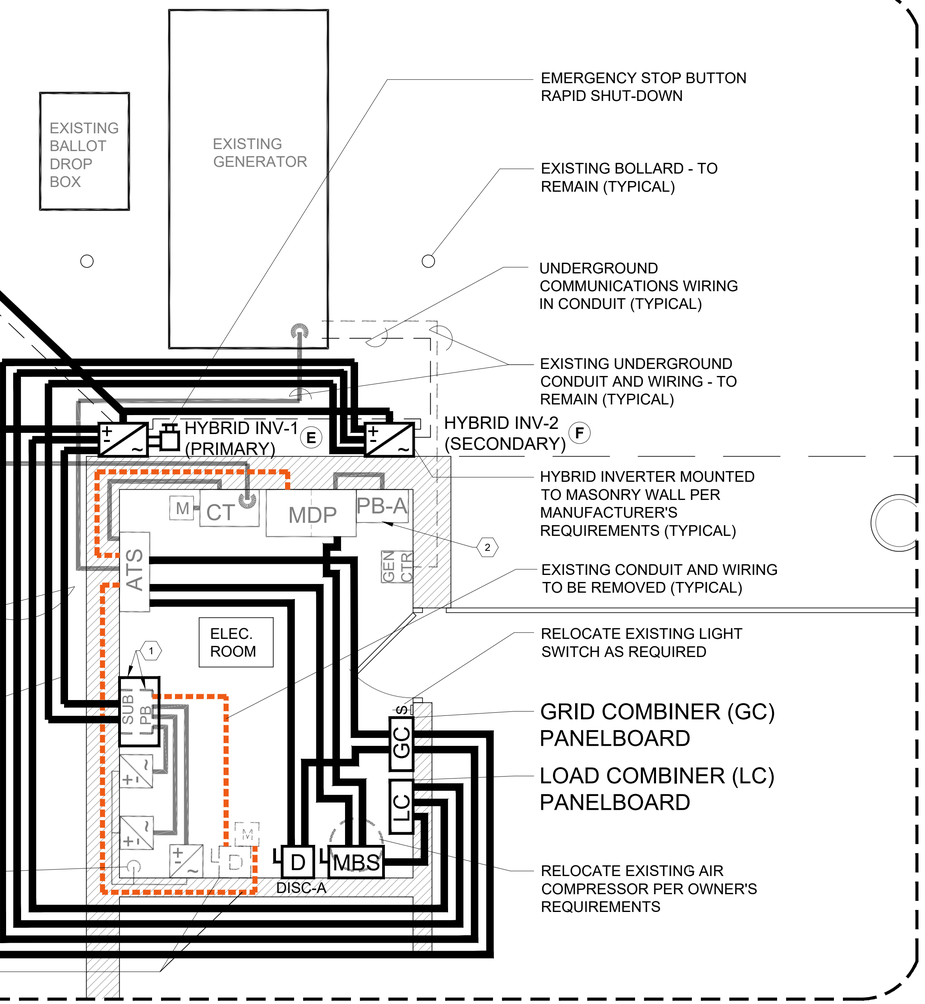
NTS

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. REFER TO SHEET E601 FOR ONE-LINE DIAGRAM FOR INTERCONNECTION BETWEEN EQUIPMENT.
3. CONDUIT FILL TO BE LESS THAN 40%.

SHEET KEY NOTES

1. REMOVE AND REPLACE WITH NEW
2. FOR POWERING THE BATTERY HVAC UNITS, FROM EXISTING PANELBOARD A OR B, INSTALL A NEW 100A 2 POLE BREAKER. INSTALL A SERVICE RACK ON BATTERY PAD WITH A NEW 100A SUBPANEL, SINGLE PHASE, NEMA 3R, 120/208V WITH 100A MAIN BREAKER, 6 – 2 POLE 15A BREAKERS. EACH OF THE 6 BREAKERS TO FEED EACH BATTERY HVAC UNIT. INSTALL ONE 15A SINGLE POLE BREAKER TO FEED A NEW OUTDOOR RATED SERVICE RECEPTACLE UNDERNEATH THE SUBPANEL. INSTALL NEW WIRE AND CONDUIT FROM PANELBOARD A OR B TO SUBPANEL, FROM SUBPANEL TO BATTERY HVAC UNITS AND RECEPTACLE PER NEC 2023. 1



LEGEND

	INVERTER
L3 HVR	BATTERY STACK ENCLOSURE
T	TRANSFORMER - EXISTING
PBA	PANEL BOARD - EXISTING
D	DISCONNECT - EXISTING
M	METER - EXISTING
	COMMUNICATION WIRE / CONDUIT
	AC CONDUIT
	EXISTING DC CONDUIT
	EXISTING AC CONDUIT
	EXISTING CONDUIT TO BE REMOVED

INVERTER DESCRIPTION 1

E PRIMARY (HV-1)
HYBRID INVERTER-1
SOL-ARK
(C&I) HYBRID INVERTER 30K-208V
COMMERCIAL & INDUSTRIAL
MODEL: 30K-3P-208V
30kW INVERTER
120 / 208 V, 83.4 A 1000V DC
UL1741/1EEE 1547

SOL-ARK PRODUCT SKU:
30K-3P-208V

F SECONDARY (HV-2)
HYBRID INVERTER-2
SOL-ARK
(C&I) HYBRID INVERTER 30K-208V
COMMERCIAL & INDUSTRIAL
MODEL: 30K-3P-208V
30kW INVERTER
120 / 208 V, 83.4 A 1000V DC
UL1741/1EEE 1547

SOL-ARK PRODUCT SKU:
30K-3P-208V

SEE PRODUCT EQUIPMENT DATA SHEET ON E801

3 BATTERY ENERGY STORAGE SYSTEM 1

MANUFACTURER:	SOL-ARK (L3 SERIES LIMITLESS LITHIUM)
BATTERY ENERGY CAPACITY:	60 kWh
BATTERY MODEL NAME:	SOL-ARK, L3 HVR-60 (OUTDOOR)
ESS MODEL NAME:	SOL-ARK, L3 HVR-60kWh-30k (OUTDOOR)
NUMBER OF BATTERIES:	(2) BANKS X (3) BATTERIES = 6 BATTERIES
BESS CAPACITY:	360 kWh (6 X 60 kWh = 360 kWh)
SOL-ARK PRODUCT SKU:	L3-HVR-60KWH

SEE PRODUCT EQUIPMENT DATA SHEET ON E801

3 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171
FOR FREE LOCATION OF PUBLIC UTILITY LINES
IN MICHIGAN CALL: 811

1 E101 PLAN DETAIL - ELECTRICAL ROOM & BESS (BATTERY YARD)

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ISSUED

DATE	DESCRIPTION	APPVD.
12-30-2024	INTERCONNECT	
1-10-2025	BID REVIEW	
1-24-2025	INTERCONNECT REV-1	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

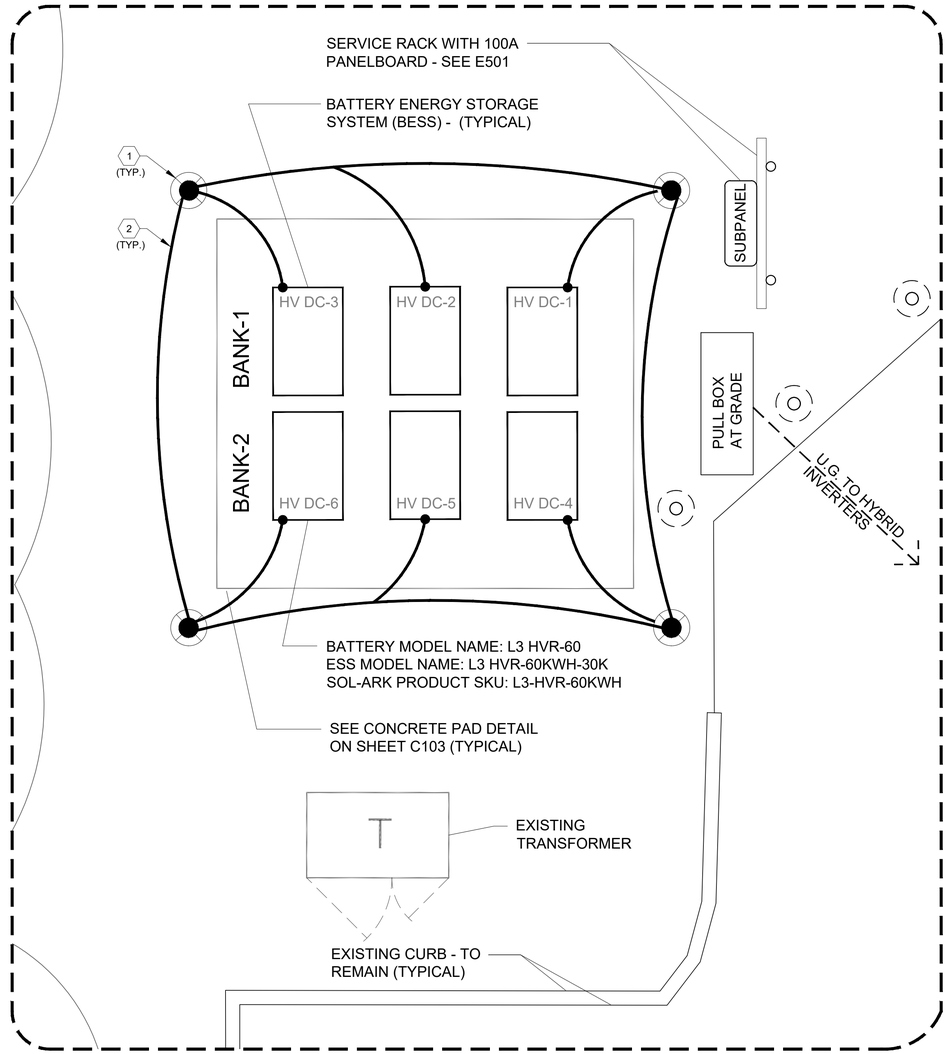
FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

ELECTRICAL
PLAN

PROJECT NUMBER	23-11-1168-FS6
DRAWN BY	GAK
SCALE	AS NOTED
SHEET SIZE	22x34
SHEET NUMBER	E101



1 E104 GROUNDING PLAN DETAIL @ BESS (BATTERY YARD)

SCALE: 3/8" = 1'-0"

SHEET GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT MICHIGAN ELECTRICAL CODE, 2023 NATIONAL ELECTRICAL CODE (NEC), 2015 MICHIGAN BUILDING CODE, CURRENT INTERNATIONAL FIRE CODE, AND ALL APPLICABLE LOCAL CODES AND STANDARDS.
2. GROUNDING SHALL COMPLY WITH CURRENT MICHIGAN ELECTRICAL CODE REQUIREMENTS.
3. ALL EXPOSED METAL SURFACES SHALL BE GROUNDED WITH EQUIPMENT GROUNDING CONDUCTORS.

SHEET KEY NOTES

1. GROUND RODS TO BE 5/8" X 8'-0" LONG COPPER CLAD STEEL.
2. 1/0 BARE COPPER, CAD WELD TO GROUND ROD, TYPICAL.

LEGEND

- COPPER CLAD GROUND ROD
- T — TRANSFORMER (EXISTING)
- GROUND WIRE

NORTH

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ISSUED

DATE	DESCRIPTION	APPVD.
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

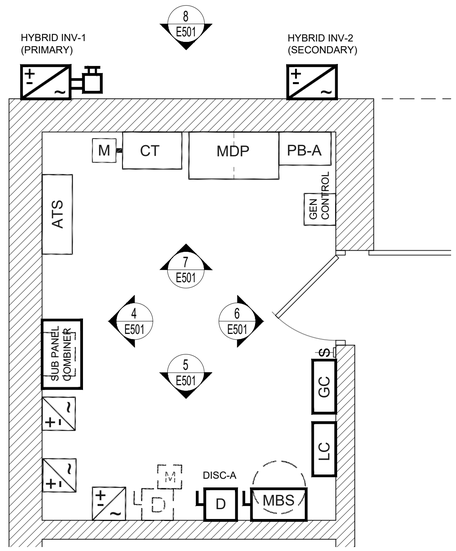
FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

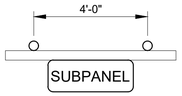
GROUNDING PLAN

PROJECT NUMBER	
23-11-1168-FS6	
DRAWN BY: GAK	SHEET NUMBER: E104
SCALE: AS NOTED	
SHEET SIZE: 22x34	



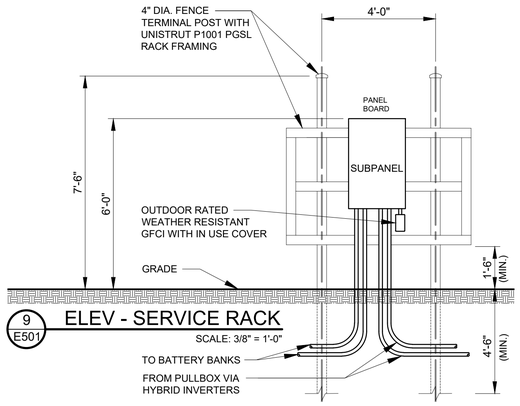
10 E501 ELECTRICAL ROOM - KEY PLAN

SCALE: 3/8" = 1'-0"



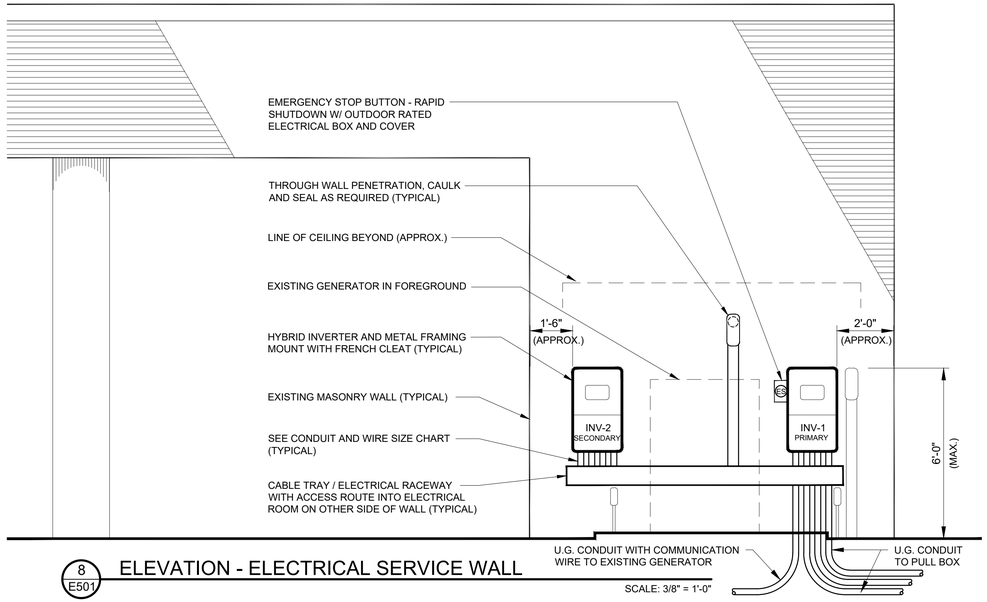
NORTH PLAN - SERVICE RACK

SCALE: 3/8" = 1'-0"



9 E501 ELEV - SERVICE RACK

SCALE: 3/8" = 1'-0"



8 E501 ELEVATION - ELECTRICAL SERVICE WALL

SCALE: 3/8" = 1'-0"

7 E501 INT. EL. - NORTH

SCALE: 3/8" = 1'-0"

6 E501 INT. ELEV. - EAST WALL

SCALE: 3/8" = 1'-0"

5 E501 INT. ELEV. - SOUTH WALL

SCALE: 3/8" = 1'-0"

4 E501 INT. ELEV. - WEST

SCALE: 3/8" = 1'-0"

3 E501 DETAIL - SECURING CONDUIT TO STEEL

SCALE: NONE

2 E501 TRENCH DETAIL - UNDERGROUND

SCALE: NONE

1 E501 BOLLARD DETAIL

SCALE: 3/4" = 1'-0"

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21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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DATE	DESCRIPTION	APPVD.
12-13-2025	70% REVIEW	
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

EQUIPMENT RACK & ELEC. SERVICE ELEVATIONS

PROJECT NUMBER	
23-11-1168-FS6	
DRAWN BY: GAK	SHEET NUMBER: E501
SCALE: AS NOTED	
SHEET SIZE: 22x34	

GENERAL NOTE:

SEE DRAWING E801 FOR DATA SHEETS INCLUDING CERTIFICATIONS AND LISTINGS

FROM UTILITY GRID

(EXISTING) **TRANSFORMER** (DTE) 120 / 208V SECONDARY

O (EXISTING) **GENERATOR** 150kW

2-WIRE START WIRE (COMMUNICATIONS)

OUTSIDE ELECTRICAL ROOM

ROOF ELECTRICAL ROOM

STRING 1-1 (EXISTING) MODULES 1 THRU 16
STRING 1-2 (EXISTING) MODULES 1 THRU 16
STRING 1-3 (EXISTING) MODULES 1 THRU 16

A (EXISTING) **INVERTER-1**

SOLAR EDGE SE14.4KUS - 208V W/ INTERNAL DC DISCONNECT

40A

D **SUB PANEL COMBINER** 200A, 120/280V, 3P, 4W PV SUB PANEL

50A 50A 50A 80A 80A

CONTACTORS

60A 60A

M (EXISTING) **UTILITY METER** 208V, 3Ø

L (EXISTING) **CT CABINET**

CT

I **DISC-A** SOLAR PV DISC AND (P.O.I.) POINT OF INTERCONNECTION 400A, 120/208V FUSED DISCONNECT SWITCH W/ 400A RK-5 FUSES NEMA 1

CT

K (EXISTING) **ATS** 400A

1 320A 1 320A

J **MANUAL BYPASS SWITCH** 400A

STRING 2-1 (EXISTING) MODULES 1 THRU 16
STRING 2-2 (EXISTING) MODULES 1 THRU 16
STRING 2-3 (EXISTING) MODULES 1 THRU 16

B (EXISTING) **INVERTER-2**

SOLAR EDGE SE14.4KUS - 208V W/ INTERNAL DC DISCONNECT

40A

H **LOAD COMBINER PANELBOARD** 400A

400A BUS 200A 200A

N (EXISTING) **MAIN DISTRIBUTION PANEL**

MAIN DISC FOR BLDG 400A

PB-A & PB-B
SOUTH DOORS
NORTH DOORS
VENT EXHAUST

AIR COND.
AIR COND.
WEST WELDER

STRING 3-1 (EXISTING) MODULES 1 THRU 16
STRING 3-2 (EXISTING) MODULES 1 THRU 16
STRING 3-3 (EXISTING) MODULES 1 THRU 14

C (EXISTING) **INVERTER-3**

SOLAR EDGE SE14.4KUS - 208V W/ INTERNAL DC DISCONNECT

40A

SolarEdge P505 Power Optimizer at each module (Typical)

G **GRID COMBINER PANELBOARD** 400A

400A BUS 200A 200A PV LOAD

1 160A 1 160A

1 160A 1 160A

E **PRIMARY (HV-1) HYBRID INVERTER-1**

SOL-ARK (C&I) HYBRID INVERTER 30K-208V COMMERCIAL & INDUSTRIAL MODEL: 30K-3P-208V 30kW INVERTER 120 / 208 V, 83.4 A 1000V DC UL1741/1EEE 1547

DC AC 9 10 COMMUNICATION LOADS GEN BATT GRID 50A 50A ESEN DC INPUTS

EMERGENCY STOP BUTTON RAPID SHUT-DOWN

COMMUNICATION TO BATTERY BANK-1 PER MANUFACTURERS REQUIREMENTS (TYP.)

PARALLEL COMMUNICATIONS

BATTERY INPUTS / OUTPUTS (TYPICAL)

F **SECONDARY (HV-2) HYBRID INVERTER-2**

SOL-ARK (C&I) HYBRID INVERTER 30K-208V COMMERCIAL & INDUSTRIAL MODEL: 30K-3P-208V 30kW INVERTER 120 / 208 V, 83.4 A 1000V DC UL1741/1EEE 1547

COMMUNICATION TO BATTERY BANK-2 PER MANUFACTURERS REQUIREMENTS (TYP.)

HYBRID INVERTERS LOCATED ON WALL ADJACENT TO EXIST'G GENERATOR (TYP.)

50A 50A 50A 50A 50A 50A 50A 50A

70A DC FUSE 70A DC FUSE 70A DC FUSE 70A DC FUSE

BATTERY BUSBARS

CURRENT LIMITING FUSE 125A DC

125A DC FUSE

HV DC - 4 L3 HVR-60kWH-30k
HV DC - 5 L3 HVR-60kWH-30k
HV DC - 6 L3 HVR-60kWH-30k
HV DC - 1 L3 HVR-60kWH-30k
HV DC - 2 L3 HVR-60kWH-30k
HV DC - 3 L3 HVR-60kWH-30k

BATTERY STACKS HV DC - 1 THRU 6 ON CONCRETE PAD LOCATED ADJACENT TO EXISTING XFMR IN GREEN SPACE (SEE E101)

CONNECT BUS BARS IN PARALLEL USING 1-1/4" EMT CONDUIT WITH (2) TWO #1, AND (1) ONE #6 GROUND WIRES (TYPICAL)

1 (TYP)

Q **BATTERY BANK-2** **P** **BATTERY BANK-1**

1 BATTERY ENERGY STORAGE SYSTEM

MANUFACTURER:	SOL-ARK (L3 SERIES LIMITLESS LITHIUM)
BATTERY ENERGY CAPACITY:	60 kWh
BATTERY MODEL NAME:	SOL-ARK, L3 HVR-60 (OUTDOOR)
ESS MODEL NAME:	SOL-ARK, L3 HVR-60kWh-30k (OUTDOOR)
NUMBER OF BATTERIES:	(2) BANKS X (3) BATTERIES = 6 BATTERIES
BESS CAPACITY:	360 kWh (6 X 60 kWh = 360 kWh)

A1 ONE LINE DIAGRAM

SCALE: N.T.S.

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21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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DATE	DESCRIPTION	APPVD.
12-23-2024	90% REVIEW	
12-30-2024	INTERCONNECT	
1-10-2025	BID REVIEW	
1-24-2025	INTERCONNECT REV-1	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

ONE LINE DIAGRAM

PROJECT NUMBER 23-11-1168-FS6
DRAWN BY RGM, GAK
SCALE
SHEET SIZE 22x34
SHEET NUMBER E601

CONDUIT AND WIRE SIZE CHART

Item	Description	Label	Route	Conduit	Wire (CU)	Neutral / Ground (CU)
A	Existing Inverter-1 - 14.4kW, 120/208V, 40A, 3P, 4W	INV-1	A-D	1" PVC	3 - #6 THWN-2	2 - #8 THWN-2
B	Existing Inverter-2 - 14.4kW, 120/208V, 40A, 3P, 4W	INV-2	B-D	1" PVC	3 - #6 THWN-2	2 - #8 THWN-2
C	Existing Inverter-3 - 14.4kW, 120/208V, 40A, 3P, 4W	INV-3	C-D	1" PVC	3 - #6 THWN-2	2 - #8 THWN-2
D	Sub Panel Combiner - 120/208V, 200A, 3P, 4W	SUB-PANEL				
						Ground (CU)
E	Hybrid Inverter-1 - 30kW, 120/208V, 83.4A, 3P, 4W	HI-1	D-E	1 1/4" EMT	4 - #4 THWN-2	1 - #8 THWN-2
F	Hybrid Inverter-2 - 30kW, 120/208V, 83.4A, 3P, 4W	HI-2	D-F	1 1/4" EMT	4 - #4 THWN-2	1 - #8 THWN-2
G	Grid Combiner Panelboard- 120/208V, 400A, 3P, 4W, NEMA1	GC	E-G	2" EMT	4 - 3/0 THWN-2	1 - #6 THWN-2
			F-G	2" EMT	4 - 3/0 THWN-2	1 - #6 THWN-2
			G-I	(2) 2" EMT	(2) 4 - 3/0 THWN-2	(2) 1 - #3 THWN-2
H	Load Combiner Panelboard- 120/208V, 400A, 3P, 4W, NEMA1	LC	E-H	2" EMT	4 - 3/0 THWN-2	1 - #6 THWN-2
			F-H	2" EMT	4 - 3/0 THWN-2	1 - #6 THWN-2
I	PV Disconnect A - 120/208V, 400A, 3P, 4W, W/400A RK-5 Fuses	PV DISC - A	H-J	(2) 2" EMT	(2) 4 - 3/0 THWN-2	(2) 1 - #3 THWN-2
J	Manual Bypass Switch	MBS	I-K	(2) 2" EMT	(2) 4 - 3/0 THWN-2	(2) 1 - #3 THWN-2
K	Existing Automatic Transfer Switch	ATS	J-K	(2) 2" EMT	(2) 4 - 3/0 THWN-2	(2) 1 - #3 THWN-2
L	Existing CT Cabinet	PB-A	K-L	EXISTING	EXISTING	EXISTING
M	Existing Utility Meter	METER	L-M	EXISTING	EXISTING	EXISTING
N	Existing Main Distribution Section Panel	MDP	J-N	EXISTING	EXISTING	EXISTING
O	Existing Generator - 150kW	GEN	O-K	EXISTING	EXISTING	EXISTING
P	BATTERY BANK-1 (HV DC-1 THRU HV DC-3)	HV DC-1,2,3	P-E	(2) 1" PVC/HDPE	(2) 2 - #4 THWN-2	(2) 1 - #8 THWN-2
Q	BATTERY BANK-2 (HV DC-4 THRU HV DC-6)	HV DC-4,5,6	Q-F	(2) 1" PVC/HDPE	(2) 2 - #4 THWN-2	(2) 1 - #8 THWN-2

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21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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DATE	DESCRIPTION	APPVD.
12-30-2024	INTERCONNECT	
1-10-2025	BID REVIEW	
1-21-2025	INTERCONNECT REV-1	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

DESIGNED BY | CHECKED BY

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

CONDUIT AND
WIRE SIZE CHART

PROJECT NUMBER 23-11-1168-FS6

DRAWN BY GAK | SHEET NUMBER E602

SCALE

SHEET SIZE 22x34

BATTERY DISCONNECT

DO NOT RELOCATE THIS OVERCURRENT DEVICE

LABEL 1

REQ'D BY: NEC 705.12
LABEL LOCATION: BATTERY BREAKERS

WARNING

ELECTRIC SHOCK HAZARD

DO NOT TOUCH TERMINALS
TERMINALS ON BOTH LINE AND LOAD SIDES
MAY BE ENERGIZED IN THE OPEN POSITION

LABEL 2

THE UTILITY METERING CABINET, EACH INVERTER, EACH DC AND AC DISCONNECTING MEANS (SWITCHES AND BREAKERS) MUST BE LABELED WITH THIS PLACARD

WARNING

ELECTRIC SHOCK HAZARD

IF GROUND FAULT IS INDICATED ALL
NORMALLY GROUNDED CONDUCTORS
MAY BE UNGROUNDED AND ENERGIZED

LABEL 3

LABEL LOCATION:
HYBRID INVERTER

CAUTION-TRI POWER SOURCE

FIRST SOURCE IS UTILITY ELECTRICAL GRID
SECOND SOURCE IS AC BATTERY
THIRD SOURCE IS PV INVERTER

LABEL 4

REQ'D BY: NEC 705.10
LABEL LOCATION:
SUB PANEL OR BACKUP LOADS PANEL, HYBRID INVERTER OUTPUT PANEL, MAIN SERVICE PANEL, METER/MAIN, AND PV AC DISCONNECT

WARNING

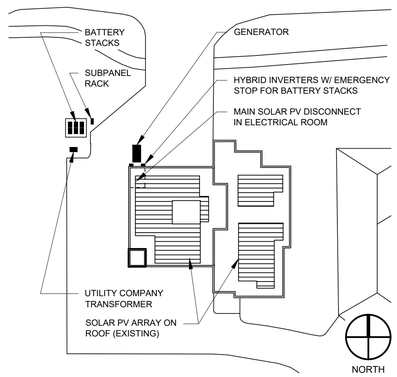
TRI POWER SOURCE SECOND SOURCE IS BATTERY BACKUP SYSTEM THIRD SOURCE IS PHOTOVOLTAIC SYSTEM.

LABEL 5

LABEL LOCATION:
POINT OF INTERCONNECTION
PER CODE: NEC705.12(C)

CAUTION: MULTIPLE SOURCES OF POWER

POWER TO THIS FACILITY IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS AS SHOWN:



LABEL 6

INSTALL MAP PLACARD AS PER UTILITY REQUIREMENTS, SIGNAGE SHALL BE RED BACKGROUND WITH WHITE ENGRAVED LETTERS: (CAUTION ¾", POWER TO...(¼"), CALL OUTS (⅛")

THIS LABEL TO BE INSTALLED ON BOTH FENCED IN ELECTRICAL SERVICE YARDS.

WARNING

THIS EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSSBAR

LABEL 7

LABEL LOCATION:
P.O.I.

DO NOT ADD LOADS

LABEL 8

REQ'D BY: NEC 705.10
LABEL LOCATION:
SUB PANEL OR BACKUP LOADS PANEL, HYBRID INVERTER OUTPUT PANEL, MAIN SERVICE PANEL, METER/MAIN, AND PV AC DISCONNECT

WARNING - Electric Shock Hazard
No user serviceable parts inside
Contact authorized service provider for assistance

LABEL 9

LABEL LOCATION:
HYBRID INVERTER, JUNCTION BOX, BATTERY COMBINER
(PER CODE: NEC690.13.G.3 & NEC 690.13.G.4)

AC DISCONNECT

LABEL 10

EACH AC DISCONNECTING MEANS MUST BE LABELED WITH THIS PLACARD

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

LABEL 11

HYBRID INVERTER AND P.O.I.

CAUTION SOLAR CIRCUIT

LABEL 12

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21580 Novi Road
Suite 300
Novi, MI 48375

Phone: (248) 347-3512
Fax: (248) 347-4152

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DATE	DESCRIPTION	APPVD.
11-27-2024	70% REVIEW	
1-10-2025	BID REVIEW	

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NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

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CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

LABELS AND PLACARDS

PROJECT NUMBER 23-11-1168-FS6

DRAWN BY GAK | SCALE | SHEET SIZE 22x34

SHEET NUMBER E701

Commercial: 30K-3P-208V

Perfect for Light Commercial

Simplifies adding energy storage to small commercial buildings.

Native 120/208 3P output simplifies installation removing the need for bulky step-down transformers

AC/DC Coupling Capability

Enabling seamless integration with existing grid-tied PV systems

Allows for efficient DC coupling using the integrated 4x channel MPPT charge controller.

Modular & Scalable Energy

Modular and flexible design allowing for easy installation and expansion.

Accommodates a range of system sizes with outputs starting from 30kW going to 300kW

Seamless Backup Power

Helps met your corporate renewable energy goals and decarbonization efforts

Blazing fast 5ms transfer time with 200A grid relay allows for business continuity during grid outages.

DATASHEET

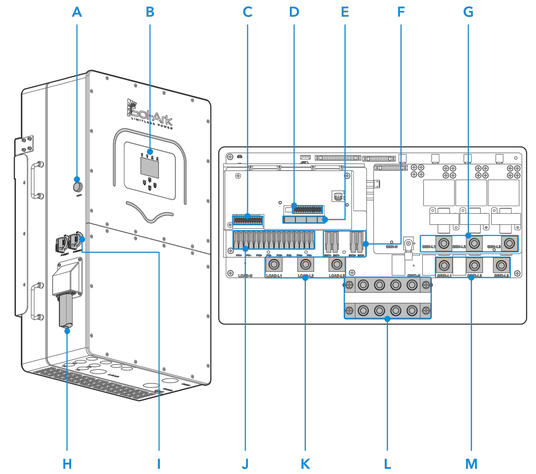
30K-208V

C&I Hybrid Inverter

Inverter Model Name: / Sol-Ark Product SKU:	30K-3P-208V / 30K-3P-208V
Input Data (PV)	
Max. Allowed PV Power (STC)	39,000W
MPPT Voltage Range	150-500V
Startup Voltage	180V
Max. Input Voltage [1]	550V
Max. operating input current per MPPT	36A
Max. short circuit current per MPPT	55A
No. of MPP Trackers	4
No. of PV Strings per MPPT	2
Max. AC Coupled Input Power	30,000W
Output Data (AC)	
Nominal AC Voltage (3Φ)	120/208V
Grid Frequency	50 / 60Hz
Real Power, max continuous (3Φ)	30,000W
Max. Output Current	83.4A
Peak Apparent Power (10s, off-grid, 3Φ)	45,000VA
Max. Grid Passthrough Current (10min)	200A
Continuous Grid Passthrough Current	180A
Power Factor Output Range	+/- 0.8 adjustable
Backup Transfer Time	5ms (adjustable)
CEC Efficiency	96.5%
Max Efficiency	97.5%
Design (DC to AC)	Transformerless DC
Stackable	Up to 10 in parallel
Battery Input Data (DC)	
Battery Chemistry	Lithium iron phosphate
No. of Battery Inputs	2
Battery Input Terminal Rating	50A
Nominal DC Voltage	≥300V
Operating Voltage Range	160 - 500V
Battery Capacity Range	50 – 9900Ah
Max. Battery Charge / Discharge Current	100A (50A per input)
Charge Controller Type	3-Stage with Equalization
Grid to Battery Charging Efficiency	96.0%
Automatic Generator Start (AGS)	2 Wire Start - Integrated
BMS Communication [2]	CANBus & RS485
General Data	
Dimensions (H x W x D)	894 x 528 x 295 mm (35.2 x 20.8 x 11.6 in)
Weight	80 Kg / 176 lb.
Enclosure	IP65 / NEMA 3R
Ambient Temperature	-40 - 60°C, >45°C Derating
Noise	< 30 dB @ 25°C (77°F)
Idle Consumption - No Load	60W
Communication and Monitoring	Wi-Fi & LAN Hardware Included
Warranty [3]	10 Years (15 Years)
Category	
Certifications and Listings (Grid Support Interactive Inverter)	UL 1741-2021 (UL1741SB), CSA C22.2 No 107.1-16, IEEE 1547-2018 & 1547a-2020 & 1547.1-2020 (SRD V2.0), UL 1741 CRD-PCS, UL1699B, CEC, SGIP [4]
PV DC Disconnect Switch – NEC 240.15	Integrated
Ground Fault Detection – NEC 690.5	Integrated
PV Rapid Shutdown Control – NEC 690.12	Integrated
PV Arc Fault Detection – NEC 690.11	Integrated
PV Input Lightning Protection	Integrated
PV String Input Reverse Polarity Protection	Integrated
Surge Protection	DC Type II / AC Type III

1. See Installation Guide for more details on sizing array strings. The highest input voltage is based on the open-circuit voltage of the array at the minimum design temperature.
2. Active BMS communication is required for all lithium batteries. A list of compatible batteries can be found on our website.
3. 5-year extension is available for purchase by registered Gold level installers only.
4. Pending listing.

1.1 General Description



Component	Name	Component	Name
A	ON / OFF Button	H	Wi-Fi / Ethernet dongle
B	LCD touch screen	I	2x PV DC disconnects
C	Pin board 1 for sensors and accessories	J	4x MPPT inputs
D	Pin board 2 for sensors and accessories	K	LOAD terminal
E	Communication port board	L	NEUTRAL / GROUND Busbars
F	2x (50A) Battery port	M	GRID terminal
G	GEN terminal		

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12-13-2024	INTERCONNECT	
1-10-2025	BID REVIEW	

REVISED

NO.	DATE	DESCRIPTION	APPVD.

CERTIFICATION

INSTALLATION GUIDE
AND USER MANUAL

L3 SERIES LIMITLESS LITHIUM™

L3 HVR

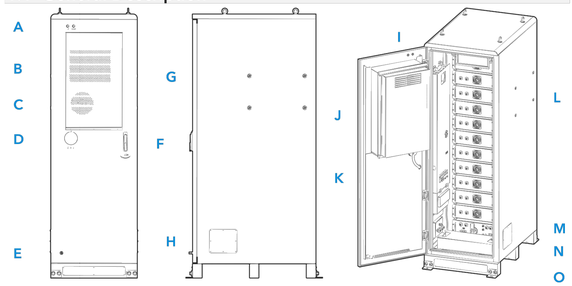
Sol-Ark | L3 Series Limitless Lithium™ Battery Energy Storage System

208V Options
Battery Energy Storage System

Battery Model Name: / ESS Model Name: / Sol-Ark Product SKU:	Outdoor: L3 HVR-60 / L3 HVR-60KWH-30K / L3-HVR-60KWH	Indoor: L3 HV-40 / L3 HV-40KWH-30K / L3-HV-40KWH
System Data		
Compatible Inverter Model	Sol-Ark 30K-3P-208V	
Cell Chemistry	Lithium Iron Phosphate	
Nameplate Energy Capacity (DC)	61.44 kWh	40.96 kWh
Usable Energy Capacity (DC) [1]	55.30 kWh	36.86 kWh
Built-In DC Disconnect Rating	200A	
Internal Fuse Rating	160A	
Max. # Battery Units Per Inverter	6	16
Max. # Inverters in Parallel	6	10
Recommend Depth of Discharge	90%	
Roundtrip Efficiency Charge/Discharge (DC)	94% (25C, 0.5C)	
System Nominal Voltage (DC)	307V	410V
System Operating Voltage (DC)	294V – 336V	392V – 448V
Battery Pack Internal Configuration	6s6p	8s1p
Charge/Discharge Current (DC) [2]		
• Recommend	100A	50A
• Max. Continuous	100A	
• Peak Discharge (60 sec @ 25°C)	125A	
Battery Max. Continuous Charge/Discharge Power (DC)	61.44kW	40.96kW
ESS Max. Continuous Charge/Discharge Power (AC)	30kW	
Fault Current Contribution per Battery	4,200A / 1.47ms	
Mechanical Specifications		
Product Dimensions (WxDxH)	76x107x226 cm (30x42x89 in)	58x58x163 cm (23x23x64 in)
Net Weight (We need 6 stacks)	950 kg (2,095 lbs) x 6	628 kg (1,384 lbs)
Mounting Type	Outdoor Enclosure	Freestanding Rack Mount
Material and Finish	Steel – Corrosion Resistant Powder Coat	Steel – Powder Coated
Operating Temperature [3] and Humidity	-20°C – 50°C (14°F – 122°F) – 5%–85% RH	4°C – 43°C (40°F – 110°F) – 5%–85% RH
Operating Altitude [4]	3000m (9,843 ft)	
Storage Conditions [5]	-4°F – 95°F – Up to 85% RH (non-condensing) and State of Charge (SOC) 30%	
Ingress Rating	IP55 (NEMA 3R)	IP20 (NEMA 1)
Noise Level @ 1m	75 dBA at 30°C (86°F)	< 40 dBA at 30°C (86°F)
Seismic Mounting	Up to Category F	
Communication Ports	CAN2.0/RS485	
Battery Module Specifications		
Battery Module Nominal Energy Capacity	5.12kWh	
Battery Module Nominal Voltage and Capacity	51.2V / 100Ah	
Terminal Type	Amphenol SurLok - Push Lock Connector	
Warranty and Certification		
Performance Warranty [6]	10 years or 196MWh Throughput	10 years or 130MWh Throughput
Product Warranty	10 Years	
Certifications	UL1973, UL9540, UL9540a, UN38.3, FCC, Prop 65	

1. DC usable energy, test conditions: 90% DOD, 0.3C charge and discharge at 25°C. System usable energy may very due to system configuration parameters.
2. Output current is affected by battery temperature and SOC.
3. Temperature is based on the average cell temperature as measured by the BMS. Charging is disabled below 0°C (32°F). Derating occurs above 45°C (113°F). See Sol-Ark technical sales for outdoor sites.
4. Battery will operate at a maximum of 1C charge/discharge up to 2000m, above 2000m maximum output is derated to 0.8C, contact Sol-Ark for details.
5. Storage temperature of the battery with no charge or discharge
6. EOL (End of Life) 70% retained capacity. See L3 Series warranty document for details.

1.1 General Description



Component	Name
A	Indicator Lights (ON & ALARM)
B	HVAC Unit Air Outlet
C	HVAC Unit Air Intake
D	Emergency Stop Button (shuts down battery output)
E	HVAC Condensate Drain Outlet
F	Keyed Cabinet Door Handle
G	Inverter Carrier Mounting Holes
H	R/L side Condit Entry Cover
I	Lifting Points
J	HVAC Unit (heating/cooling)
K	Auxiliary Power Input Terminals and Internal Systems Breakers
L	12x L3 HVR-5.1kWh Battery Modules
M	1x L3 HVR BMS-750V - Battery Management Unit (BMU)
N	Safety Cover for Built-in DC busbar
O	Cabinet Mounting Feet

L3 HVR FASTENER TORQUE TABLE

⚠ *Do not use impact drivers to tighten any fasteners on the cabinet or inverter*

Connection	Torque [ft-lb or in-lb]	Torque [Nm]
M10 - Mounting Feet Bolts	37ft-lb	51 N-m
M6 - Internal Busbar +/- Connections	7.7 ft-lb	10.5N-m
M10 - Ext. Grounding Screws	37ft-lb	51N-m
M12 - Inverter Mounting Carrier Bolts	74 ft-lb	100 N-m
M4 - Inverter to Carrier Socket Screws	12 in-lb	1.37N-m

DESIGNED BY	CHECKED BY
RGM	JE

CITY OF ANN ARBOR
SOLAR FACILITIES

FIRE STATION 6

1881 BRIARWOOD CIRCLE
ANN ARBOR, MI 48108

60 kW AC INVERTER(S)
360 KWh BESS (BATTERY)
SUPPORTED MICROGRID

DATA SHEETS

PROJECT NUMBER 23-11-1168-FS6

DRAWN BY GAK

SCALE AS NOTED

SHEET SIZE 22x34

SHEET NUMBER E801