Craftsbury Public Library
Resilience Center Project

The Craftsbury Public Library(CPL) Resilience Center Project

History

CPL Board had been thinking about backup power for the library for quite a while and had received a grant for 10k that would pay for the installation of fossil fuel powered generator. Intro by Ned Houston.

Purpose:

The goals of the project are:

1. to ensure that the Library's internet and computer resources remain available to community members during power outages.
2. to reduce CO_2 emissions
3. on a limited basis to provide emergency shelter
4. to provide an emergency cooling shelter(future plan)
5. to create a replicable resilience center demonstration facility
6. to educate, inform and engage the public about climate change solutions
    a. real time system data will be embedded on the CPL website

Areas of public life affected: Infrastructure, Economic Development, Health & Wellness, Public Safety, Environment/Energy, Culture, Education & Childcare

Obstacle(s):

1. Funding

We used the umbrella of the Energy Committee to provide a level of institutional familiarity and accountability for ARPA and VCRD grant applications in order to acquire the balance of funds needed for the $26,000.00 budget(see below).

2. Permitting

The permitting requirements for an installation on a public building are a bit challenging(for good reasons) but are manageable.

Methods of implementation - How

Method 1- professional installation

pros: relatively easy, just make rational and informed estimates of need and system size and type, get quotes and pay your money! It's more complicated than that but generally the project installation is taken care of by your hired installation professional.

cons:

1. cost - quotes of $47,000.00 and $59,000.00 for an 8kW solar/ 18.5kWh storage grid tied system
2. possible contracting issues

Method 2 - DIY with volunteer labor

pros:

cost - Total system cost for our 9.6kW/18.5kWh, which is 20% larger than the vendor quoted systems, is $26,000.00. With the IRA solar/storage credit of 30%, final cost is $18,200.00. The cash credit will allow us to install a cold climate heat pump further reducing our carbon footprint and increasing our system resilience. Consult 2023 IRS rules for credit payment.

cons: DIY is a misnomer and is not possible without extensive knowledge of the design, permitting, purchasing and installation requirements for a complex project of this type. This can't be emphasized enough.

1. CPG application requires time and system knowledge
2. Permitting and permitting cost
   a. electrical permit requires Master's electrical license
   b. building permit requires structural engineering stamp
3. System design
   a. determine critical loads
   b. evaluate site for type of system
   c. design and optimize array and type(s) of components including rapid shutdown fire code requirements
   d. optimize vendor/component/freight/interconnection, etc.
4. Purchase within budget and vendor requirements
5. Installation: must comply with all electrical and fire codes

This doesn't mean that a volunteer affordable community installation of a system isn't possible; rather that expectations and preparation should be realistic and thorough.

General recommendations for DIY option:

1. Make sure you have or can develop the competence and professional experience to implement. Have one or more project members take this course:

   https://solarpvtraining.com/courses/residential-solar-installation-design/

   This is a thorough and affordable solar design and installation course that will provide a good knowledge foundation for the project.
2. Spend time with the system variables and various vendors to get the best pricing permutation(including freight). Previous project management or business experience helps.
3. Make sure you have a relationship with a master electrician who is willing to provide oversight, for hire or pro-bono, and permitting sign-off.

Other considerations:

If you're in Green Mountain Power or Vermont Electric Coop service territory, you're in luck! You can exploit the storage potential of your battery to help reduce peak demand of the utility, thereby reducing CO2 emissions, while getting paid up to $1200.00/year for a battery the size of the one we're installing. If you're in any other utility territory this financially and environmentally modern grid solution isn't available. Make sure you demand it from your utility!

1 PV-2 SITE PLAN
SCALE: 1" = 10'

GENERAL NOTES	
1	EQUIPMENT LIKELY TO BE WORKED UPON WHILE ENERGIZED SHALL BE INSTALLED IN LOCATIONS THAT SATISFY MINIMUM WORKING CLEARANCES PER NEC 110.26.
2	CONTRACTOR SHALL USE ONLY COMPONENTS LISTED BY A NATIONALLY RECOGNIZED TESTING LABORATORY FOR THE INTENDED USE.
3	CONTRACTOR IS RESPONSIBLE FOR FURNISHING ALL EQUIPMENT, CABLES, ADDITIONAL CONDUITS, RACEWAYS, AND OTHER ACCESSORIES NECESSARY FOR A COMPLETE AND OPERATIONAL PV SYSTEM.
4	WHERE DC PV SOURCE OR DC PV OUTPUT CIRCUITS ARE RUN INSIDE THE BUILDING, THEY SHALL BE CONTAINED IN METAL RACEWAYS, TYPE MC METAL-CLAD CABLE, OR METAL ENCLOSURES FROM THE POINT OF PENETRATION INTO THE BUILDING TO THE FIRST READILY ACCESSIBLE DISCONNECTING MEANS, PER NEC 690.31(G).
5	ALL EMT CONDUIT FITTINGS SHALL BE LISTED AS WEATHERPROOF FITTINGS AND INSTALLED TO ENSURE A RAINTIGHT FIT, PER NEC 358.42.

1. (N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. 10:12 (40°) SLOPED ROOF, 7 PV MODULES (BLACK FRAME, BLACK BACKSHEET), 175° AZIMUTH
2. (N) INVERTER, INDOOR , OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT THROUGH THE INTERIOR OF THE BUILDING
3. (N) STRING COMBINER, OUTDOOR , OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT OVER ROOF NO CLOSER THAN 0.5" ABOVE ROOF SURFACE
4. (N) VISIBLE, LOCKABLE, READILY-ACCESSIBLE AC DISCONNECT LOCATED WITHIN 10 FT OF UTILITY METER, OUTDOOR , OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT THROUGH THE INTERIOR OF THE BUILDING
5. (N) DISCONNECT, OUTDOOR , OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT THROUGH THE INTERIOR OF THE BUILDING
6. (N) PRODUCTION METER, OUTDOOR , OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT THROUGH THE INTERIOR OF THE BUILDING
7. (N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. 4:12 (18°) SLOPED ROOF, 21 PV MODULES (BLACK FRAME, BLACK BACKSHEET), 176° AZIMUTH

P-182569

GRID-TIED SOLAR POWER SYSTEM

12 CHURCH LN
CRAFTSBURY, VT 05827

SITE PLAN

DOC ID: 182569-225712-1
DATE: 12/27/22
CREATOR: V.O.
REVIEWER:

REVISIONS

PV-2

DC RACEWAYS
1

C1 - STRING COMBINER
(MODEL NOT SPECIFIED)
3

SW1 - DISCONNECT
(EATON DG222URB)
3 5 6

SW2 - DISCONNECT
(EATON DG222NRB)
3 5 6 7

I1 - INVERTER
(SOL-ARK 12K-P)
3 4

MSP - MAIN SERVICE PANEL
2 5 6 8 9
10

1 SEE NOTE NO. 4 (DC RACEWAYS)

WARNING
PHOTOVOLTAIC POWER SOURCE

NEC690.31(G)(3) AND NFPA 111.12.2.1.3

3 EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT (C1, SW1, SW2, I1)

! WARNING !
ELECTRIC SHOCK HAZARD. TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

NEC690.13(B)

4 DC DISCONNECT (MPPT CHANNEL A OF I1, MPPT CHANNEL B OF I1) (I1)

DIRECT-CURRENT PHOTOVOLTAIC
POWER SOURCE
MAXIMUM VOLTAGE: 325V
MAX CIRCUIT-CURRENT: 34.2A

NEC690.53

2 POINT-OF-INTERCONNECTION OR AT MAIN SERVICE DISCONNECT (MSP)

! CAUTION !
POWER TO THIS BUILDING IS ALSO FROM ROOF ARRAYS WITH DISCONNECTS AS SHOWN

INSTALLED BY VINCE O'CONNELL ACCOUNT

NEC690.56(B),705.10

5 AC SOLAR DISCONNECT (SW1, SW2, CB1 IN MSP)

PV SYSTEM DISCONNECT

NEC690.13(B)

6 AC DISCONNECT (SW1, SW2, CB1 IN MSP)

MAXIMUM AC OPERATING CURRENT: 37.5A
MAXIMUM AC OPERATING VOLTAGE: 240V

NEC690.54

7 SEE NOTE NO. 5 (SW2)

RAPID SHUTDOWN SWITCH
FOR SOLAR PV SYSTEM

NEC690.56(C)(3)

8 SOLAR BREAKER (MSP)

MAIN BREAKER HAS BEEN RESIZED TO 175 AMPS. DO NOT UPSIZE BREAKER.

9 ANY AC ELECTRICAL PANEL THAT IS FED BY BOTH THE UTILITY AND THE PHOTOVOLTAIC SYSTEM (MSP)

! WARNING !
DUAL POWER SOURCE. SECOND SOURCE IS PHOTOVOLTAIC SYSTEM.

NEC705.12(B)(3)

10 SOLAR BREAKER (MSP)

! WARNING !
INVERTER OUTPUT CONNECTION. DO NOT RELOCATE THIS OVERCURRENT DEVICE.

NEC705.12(B)(2)(3)(B)

LABELING NOTES

1	ALL PLAQUES AND SIGNAGE REQUIRED BY 2017 NEC AND 2015 NFPA 1 WILL BE INSTALLED AS REQUIRED.
2	LABELS, WARNING(S) AND MARKING SHALL COMPLY WITH ANSI Z535.4, WHICH REQUIRES THAT DANGER, WARNING, AND CAUTION SIGNS USED THE STANDARD HEADER COLORS, HEADER TEXT, AND SAFETY ALERT SYMBOL ON EACH LABEL. THE ANSI STANDARD REQUIRES A HEADING THAT IS AT LEAST 50% TALLER THAN THE BODY TEXT, IN ACCORDANCE WITH NEC 110.21(B).
3	A PERMANENT PLAQUE OR DIRECTORY SHALL BE INSTALLED PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION IN ACCORDANCE WITH NEC 690.56(B).
4	LABEL(S) WITH MARKING, "WARNING PHOTOVOLTAIC POWER SOURCE," SHALL BE LOCATED AT EVERY 10 FEET OF EACH DC RACEWAY AND WITHIN ONE FOOT OF EVERY TURN OR BEND AND WITHIN ONE FOOT ABOVE AND BELOW ALL PENETRATIONS OF ROOF/CEILING ASSEMBLIES, WALLS AND BARRIERS. THE LABEL SHALL HAVE 3/8" TALL LETTERS AND BE REFLECTIVE WITH WHITE TEXT ON A RED BACKGROUND
5	LABEL(S) WITH MARKING, "RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM," SHALL BE LOCATED WITHIN 3FT OF RAPID SHUTDOWN SWITCH THE LABEL SHALL HAVE 3/8" TALL LETTERS AND BE REFLECTIVE WITH WHITE TEXT ON A RED BACKGROUND

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GRID-TIED SOLAR POWER SYSTEM

12 CHURCH LN
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SAFETY LABELS

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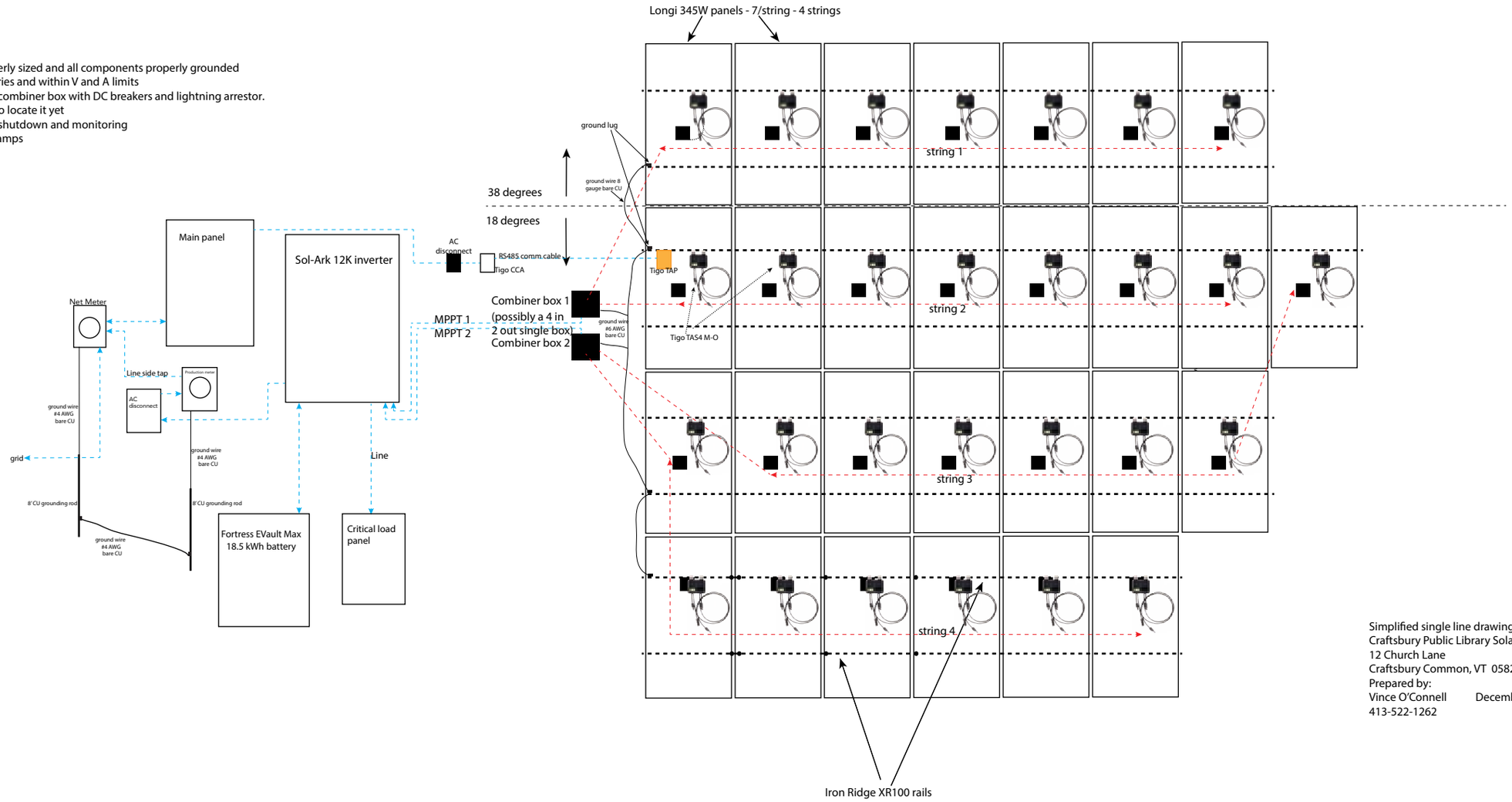
REVISIONS

PV-4

Simplified Single Line Diagram

Comments:
1. All wiring will be properly sized and all components properly grounded
2. Strings are wired in series and within V and A limits
3. Will likely use a single combiner box with DC breakers and lightning arrestor. Not quite sure where to locate it yet
4. Tigo system has rapid shutdown and monitoring
5. Standing seam roof clamps



Simplified single line drawing
Craftsbury Public Library Solar Plus Storage Project
12 Church Lane
Craftsbury Common, VT 05827
Prepared by:
Vince O'Connell December 19, 2022
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