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NY-Sun PV Trainers Network

First Responder System Identification Quiz

Presented by the
NY-SUN PV Trainers Network

MEISTER CONSULTANTS GROUP
Independent Contractor to NYSERDA

BRONX COMMUNITY COLLEGE

ENTECH ENGINEERING INC.

CCC Workforce DEVELOPMENT

ULSTER BOCES

Delhi STATE UNIVERSITY of NEW YORK

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

SYSTEM 1

Questions:

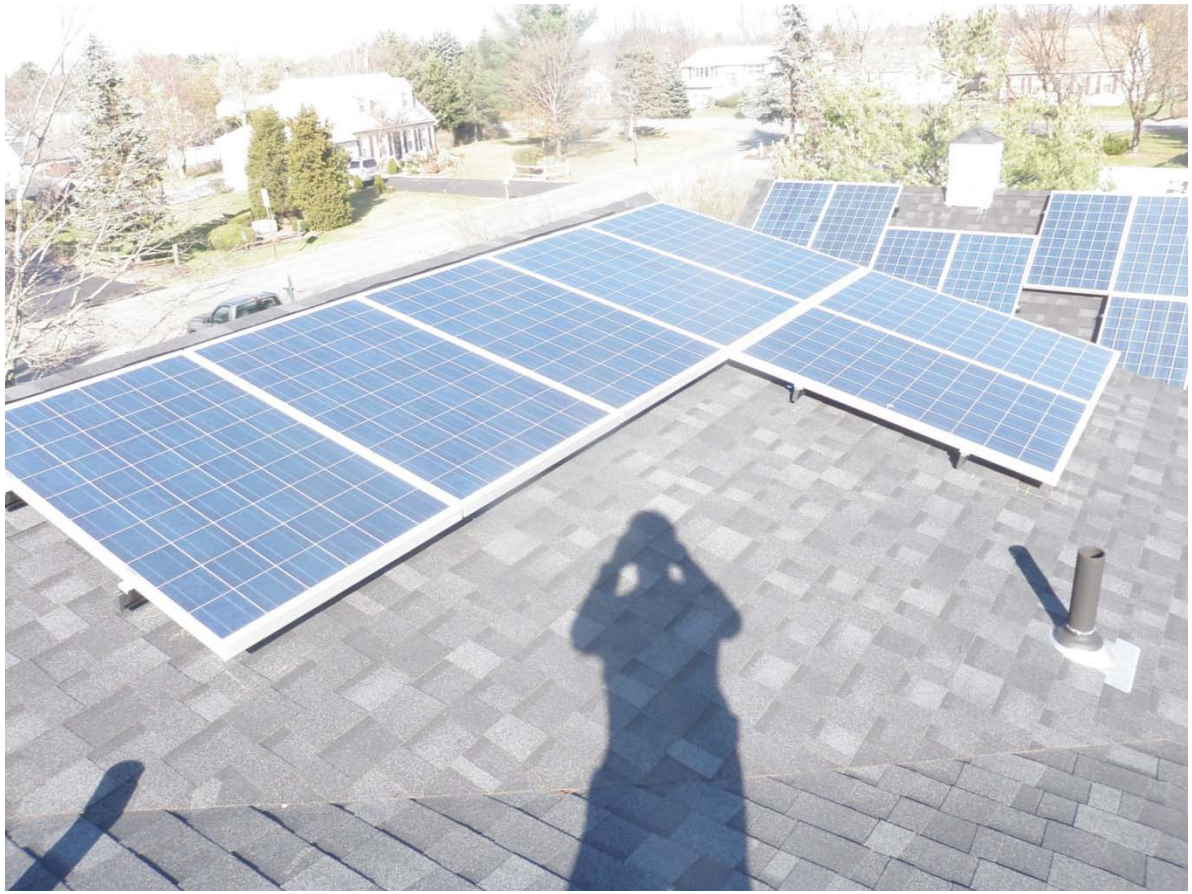
1) Is there a solar electric system at the site?

2) What is your next step?

SYSTEM 1

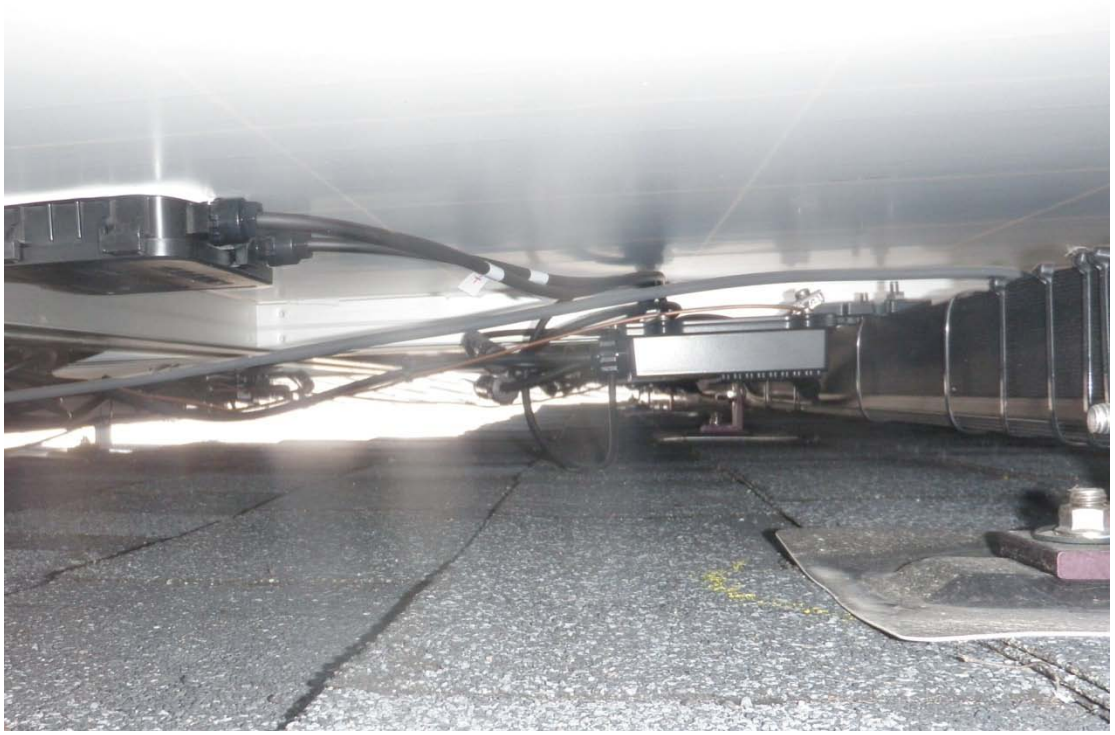
3) Given the information known at this time and using the Process Flow Chart, what type of solar electric system should be assumed on site?

SYSTEM 1



It has been determined that it is a false alarm.
You decide to look under the modules.

SYSTEM 1



4) What type of system does it appear to be now?

a. Battery back up, grid interconnected

b. Micro inverter

c. Non-battery, string grid interconnected

d. Battery back up, grid isolated

SYSTEM 1

5) Assuming proper labeling, where is the best place to go at a site to begin to determine the type of solar electric system at the site?

6) Where are dc Disconnect Switches most likely located for micro inverter systems?

7) Are solar modules still energized if the dc and ac Disconnect Switches are turned off?

8) Do micro inverter systems have an ac Disconnect Switch?

9) Does pulling the meter, or turning the ac Disconnect Switch off de-energize the dc circuits?

10) What is the highest dc voltage that may exist on a residential solar electric system?

SYSTEM 1

Components of a Micro Inverter Solar Electric System

- Directory
- Modules
- Combiner Box *
- DC Conductors (just under the modules)
- DC Disconnect Switch (the connectors on the inverter under the modules)
- Inverters, (under the modules)
- AC Conductors
- AC Disconnect Switch
- Utility Interconnection

* Combiner Box may not be present in all systems

SYSTEM 2

A fire has been reported at this site.

1) What is your first move?

SYSTEM 2

1) Micro Inverter System. There are no dc Disconnect Switches. DC Current and Voltage terminates at the array.

2) The ac Disconnect Switches are located at:

a) At inverter combiner box located at the array which is ground mounted at the south side of this building.

b) At breaker in the Main Service Panel (MSP) which is on the wall interior to this utility electric meter.

2) What kind of solar electric system is this?
3) Where are the dc disconnect switches?
4) Where are the ac disconnect switches?
5) Is this a proper directory?

SYSTEM 2

UTILITY DISCONNECT BREAKERS
Under Cover
V = 240 Vac
I = 4.5 A

SYSTEM 2

6) There are three main characteristics of the labeling on an ac Disconnect Switch. Which of the following is required to be on ac Disconnect Switch label?

a. Short Circuit Current
b. AC Disconnect Switch identification
c. Nominal Inverter Voltage
d. Nominal Inverter Current
e. Borg Resistance Factor
f. DC Disconnect Switch Identification
g. Location of Inverter

7) Does turning off the ac Disconnect Switch at the array de-energize the ac circuits in the building?

SYSTEM 2

Components of a Micro Inverter Solar Electric System

Directory
Modules
Combiner Box *
DC Conductors (just under the modules)
DC Disconnect Switch (the connectors on the inverter under the modules)
Inverters, (under the modules)
AC Conductors
AC Disconnect Switch
Utility Interconnection

* Combiner Box may not be present in all systems

SYSTEM 3

There is a report of a fire at this site. Upon arriving, you find the owner and a friendly dog in the yard. You decide you should shut down the solar electric system and check the site for a possible fire.

1) What is your first step?

SYSTEM 3

2) Is this directory missing any information?

SYSTEM 3

PV Combiner

Voc = 550Vdc
Vmp = 498Vdc
Isc = 15.6 amps
Imp = 14.0 amps
Charge Controller
Amperage = NA

3) Is this a dc or ac combiner box?
4) Using the Process Flow Chart, do we know what type of system we have on site?

SYSTEM 3

5) Where are the dc disconnect switches located on these inverters?
6) Based upon the information known, what type of inverters are these?
   a. Battery back up, grid interconnected
   b. Micro inverter
   c. Non-battery, string grid interconnected
   d. Battery back up, grid isolated

SYSTEM 3

7) Assuming proper labeling, where is the best place to go at a site to begin to determine the type of solar electric system at the site?

8) What two types of voltages have dedicated switches for a Non-Battery, Grid Interconnected solar electric system?

9) If charge controller current is indicated on the dc System Characteristic Label, is this a Non-Battery, Grid Interconnected solar electric system?

10) How do you recognize an ac Disconnect Switch?

11) How do you recognize a dc Disconnect Switch?

12) Does pulling the meter, or turning the ac Disconnect Switch off de-energize the dc circuits?

SYSTEM 4

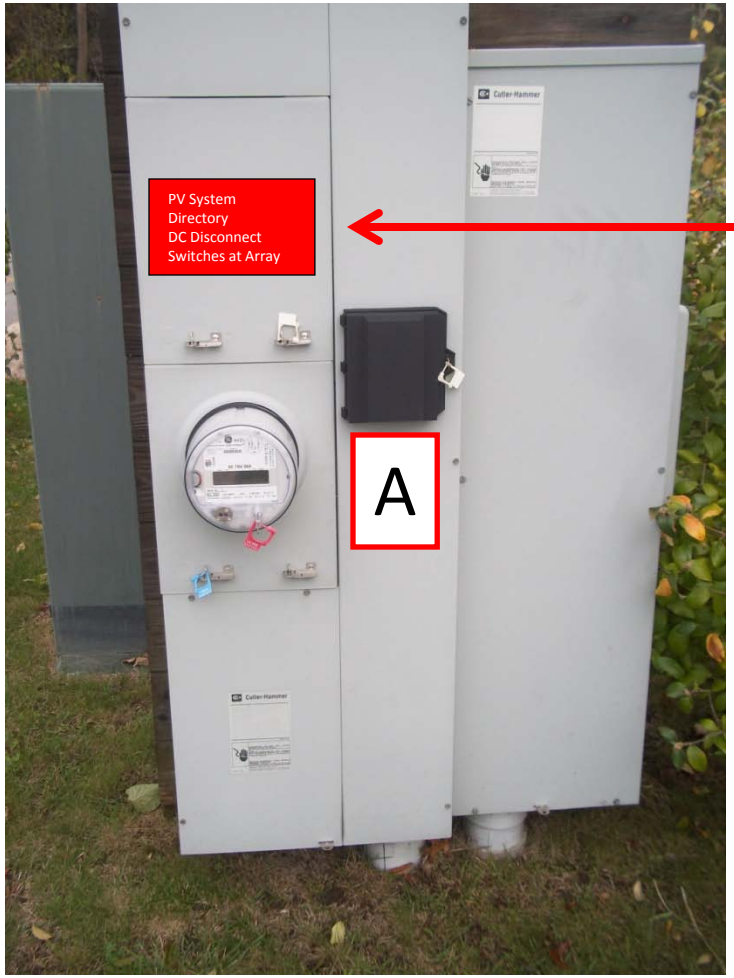
Preliminary Information

Report of fire at location
Scene upon arrival at location. You survey the site.

SYSTEM 4

1) What is your next step?

SYSTEM 4

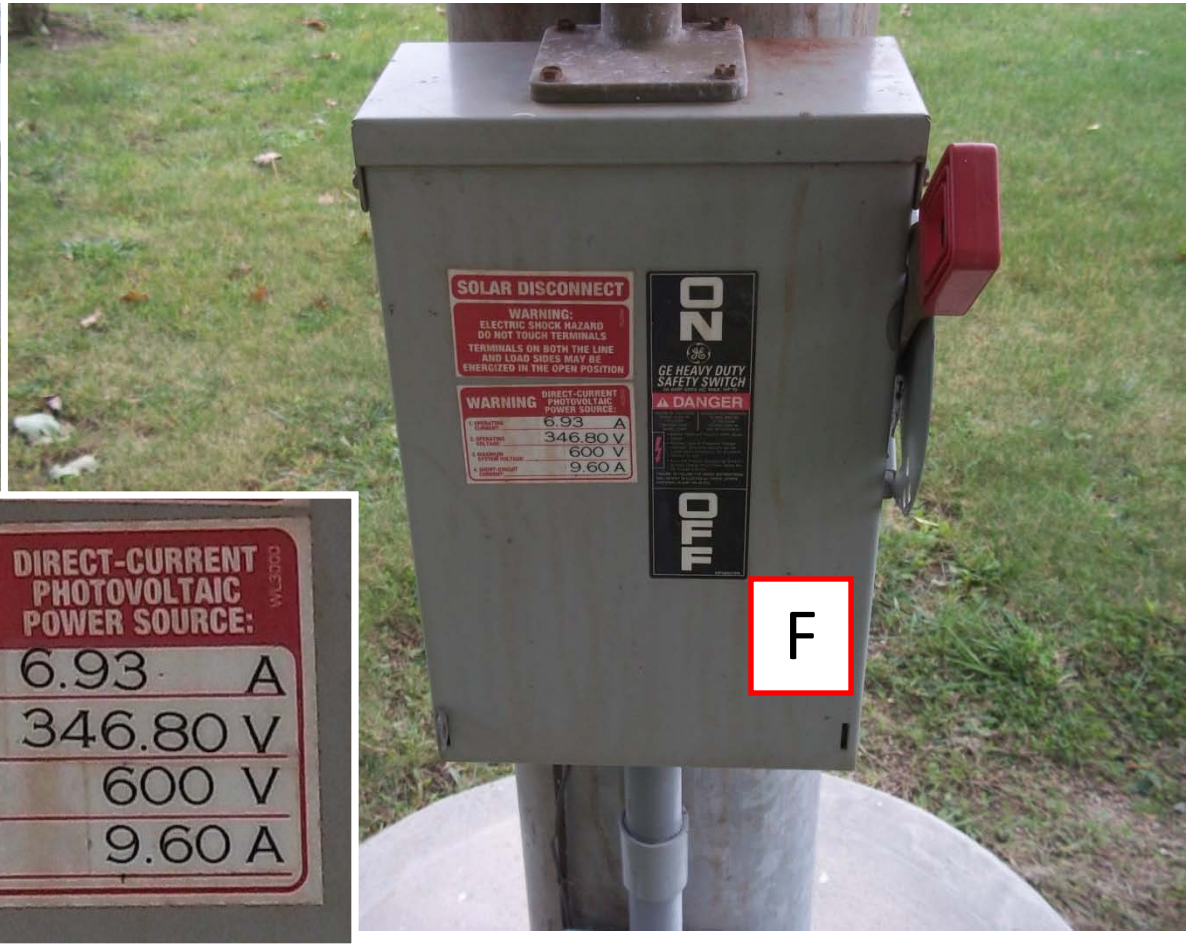


PV System Directory
DC Disconnect Switches
at Array

AC Disconnect Switch at
Inverter in Basement,
and on south side of building

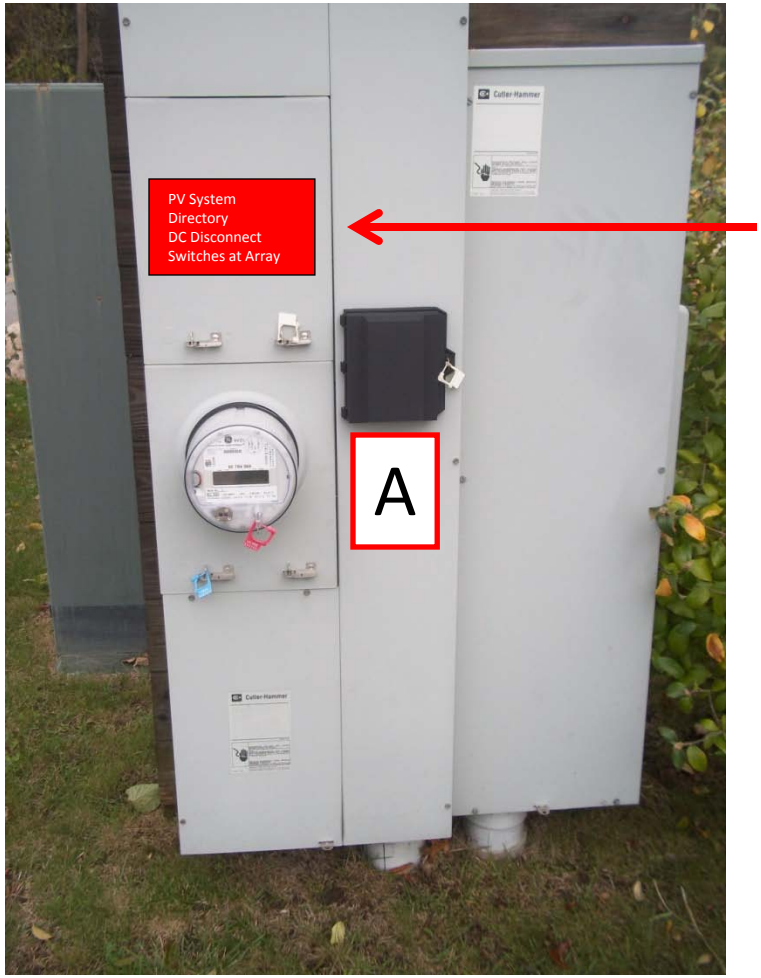
2) What is your next step?

SYSTEM 4



3) What type of solar electric system is this under NEC2014 labeling requirements?

SYSTEM 4



PV System Directory
DC Disconnect Switches
at Array

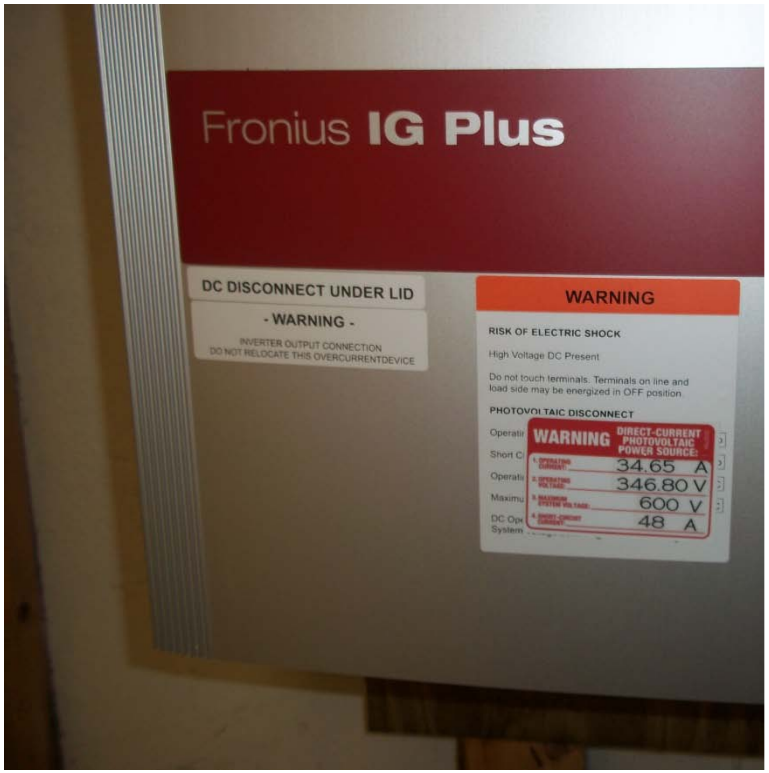
AC Disconnect Switch at
Inverter in Basement,
and on south side of building

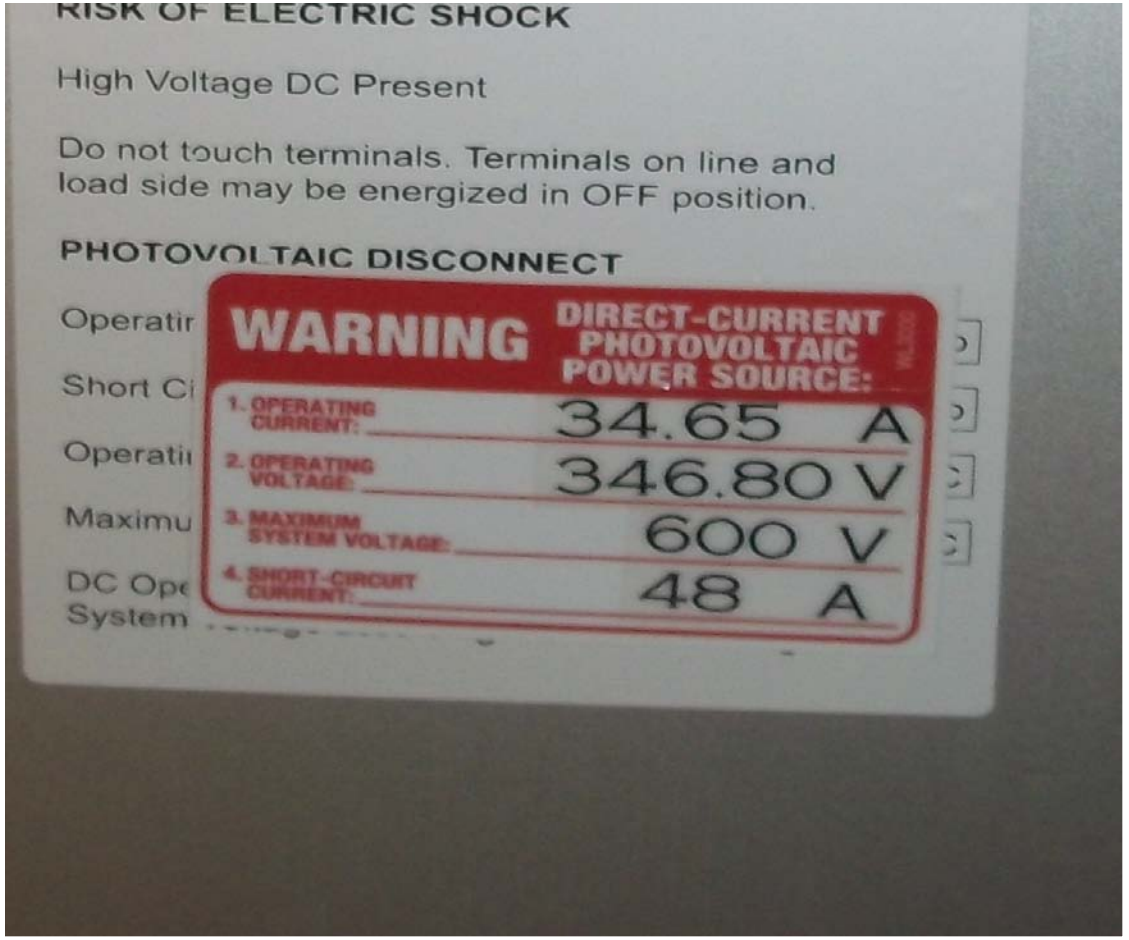
4) What is the next appropriate course of action?

SYSTEM 4

If you could get into the structure, this is what you would see:

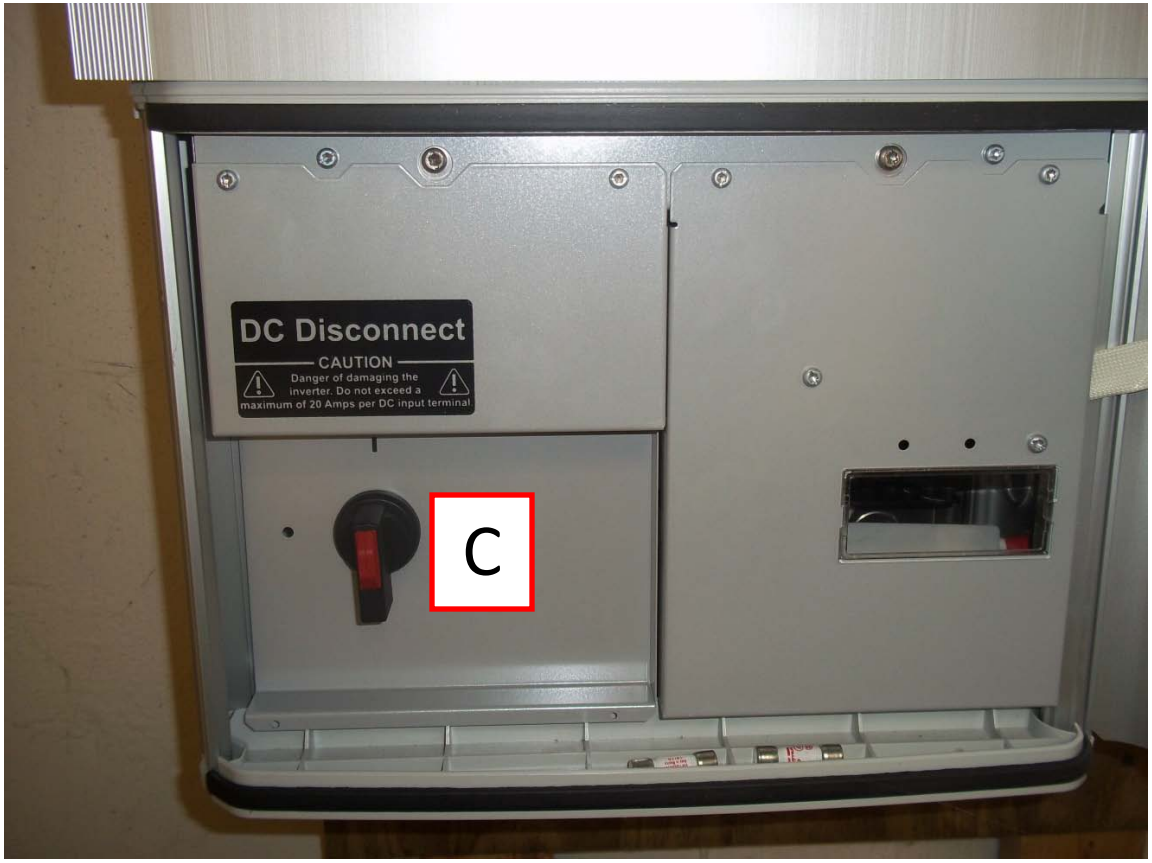
SYSTEM 4





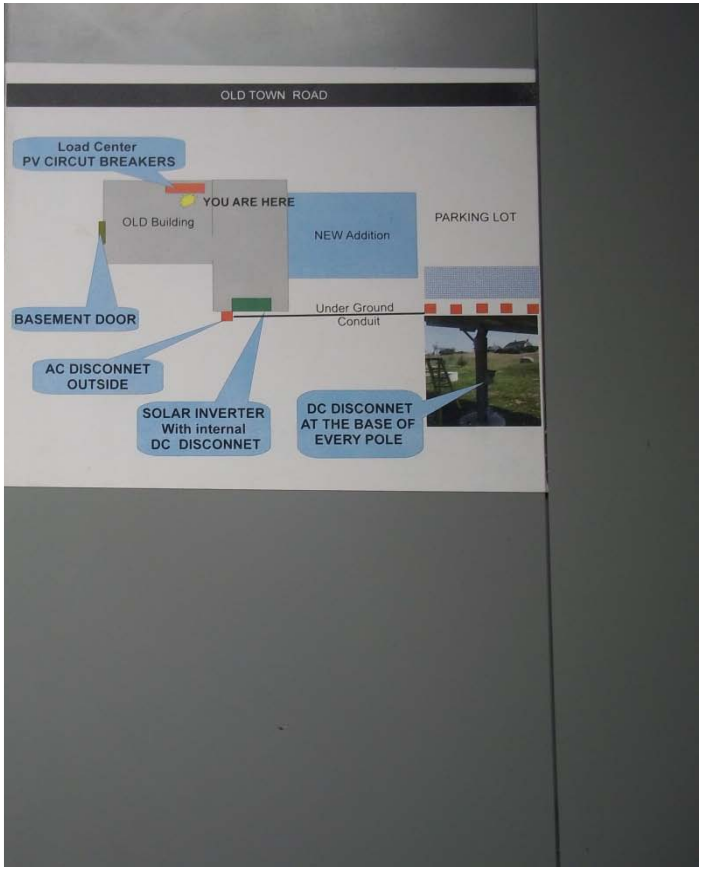
5) Is this a dc or ac system characteristic label?

SYSTEM 4

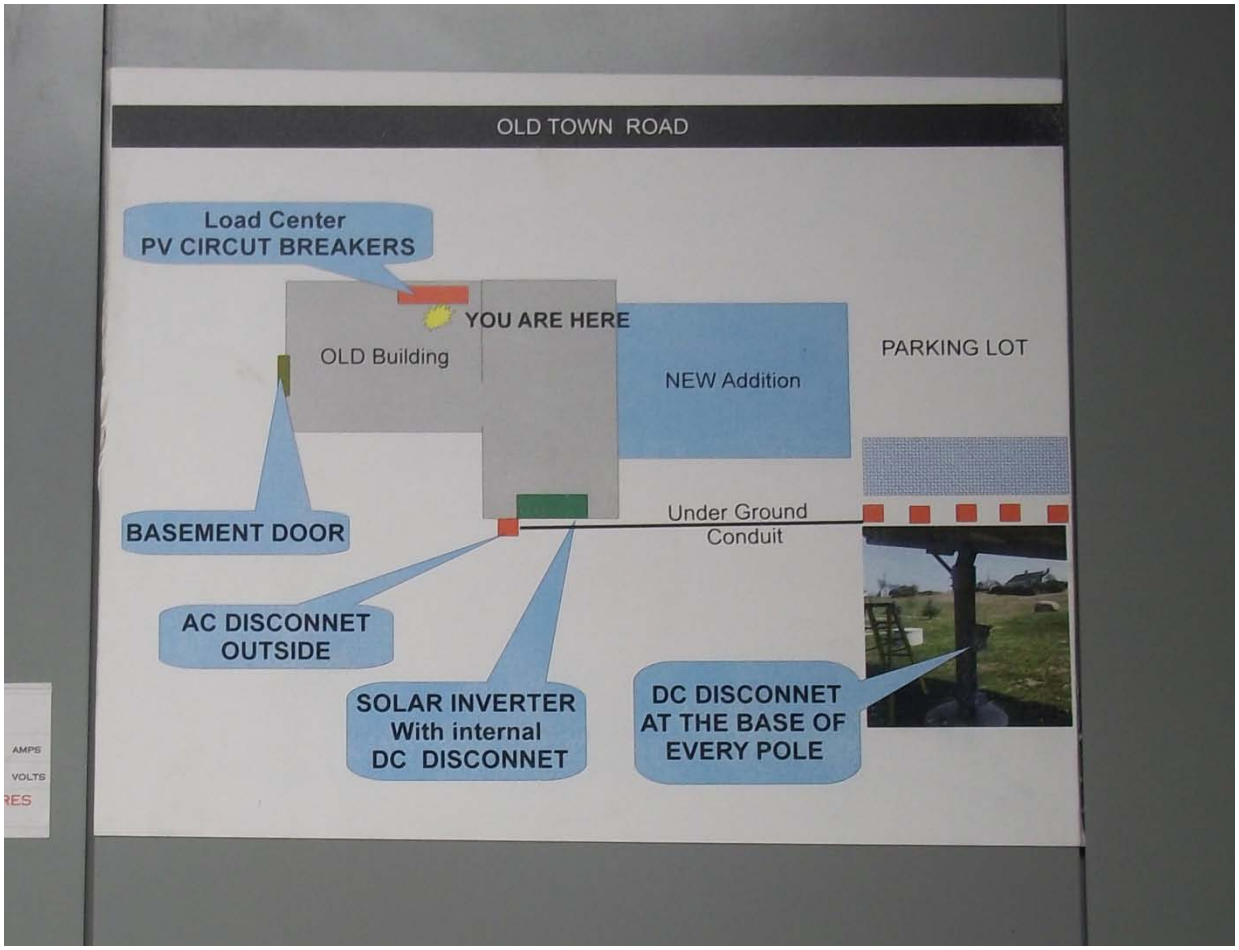


6) What is “C”?

SYSTEM 4

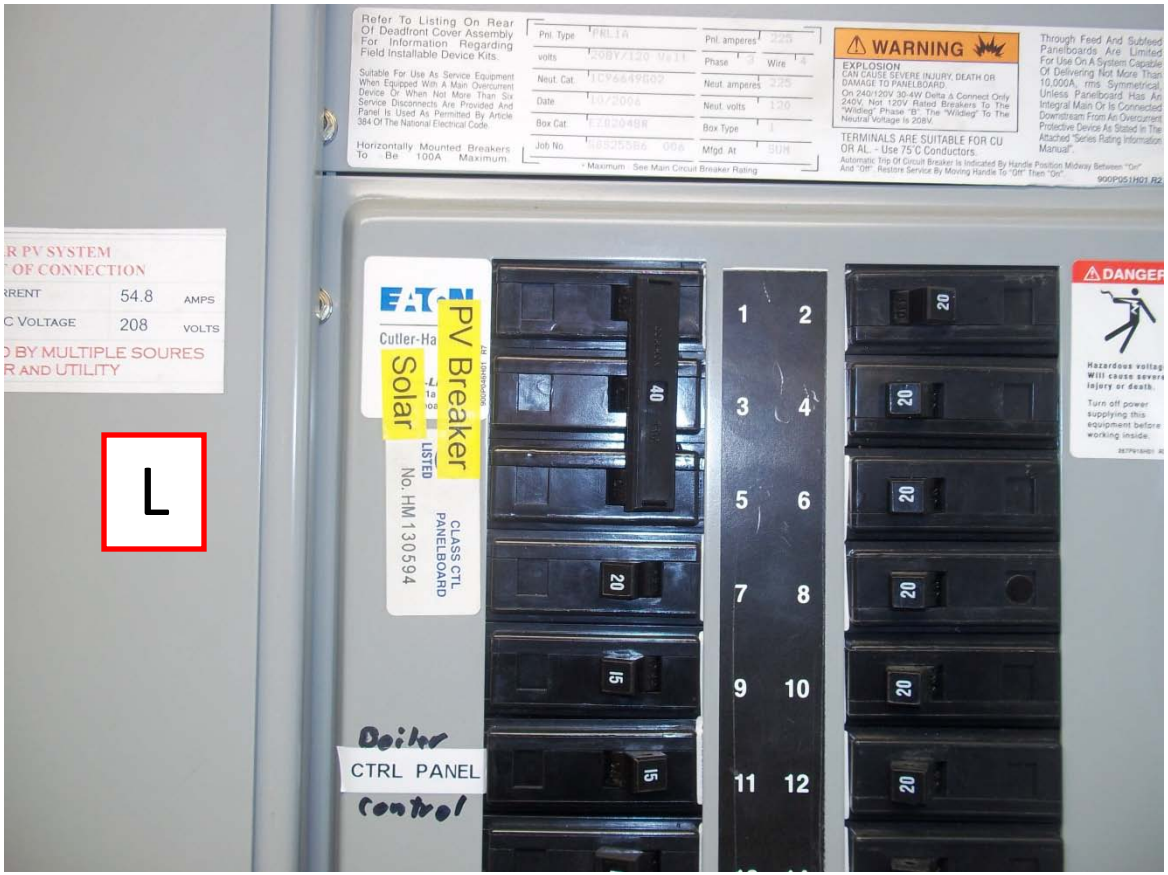

OLD TOWN ROAD
Load Center
PV CIRCUT BREAKERS
YOU ARE HERE
OLD Building
NEW Addition
PARKING LOT
BASEMENT DOOR
Under Ground
Conduit
AC DISCONNET
OUTSIDE
SOLAR INVERTER
With internal
DC DISCONNET
DC DISCONNET
AT THE BASE OF
EVERY POLE

SYSTEM 4



7) What is this label known as?
8) Is it in the correct location?

SYSTEM 4



9) What is breaker “L”?

SYSTEM 4

10) What is switch “B”?
11) What information should be on it?
12) Which equipment (A,B,C,F,L) would you operate to turn off dc power to the inverter?
13) Which equipment (A,B,C,F,L) would you operate to turn off ac power to the inverter?
14)What parts of the system are energized when sunlight is present and the dc Disconnect Switch at the inverter (C) is turned off?

SYSTEM 4

Components of a Non-Battery, Grid Interconnected Solar Electric System

Directory
Modules
Combiner Box *
DC Conductors
DC Disconnect Switch
Inverter
AC Conductors
AC Disconnect Switch
Utility Interconnection

* May not be present in every system

SYSTEM 5

Preliminary Information

Report of fire at location
Scene upon arrival at location. You survey the site.

SYSTEM 5

PV System Directory

The utility ac interconnection switch is to the left. The dc system and battery Disconnect Switches are in the basement on the north wall.

AC Disconnect Switch

Operating Voltage = 240 Vac
Operating Current = 40 A

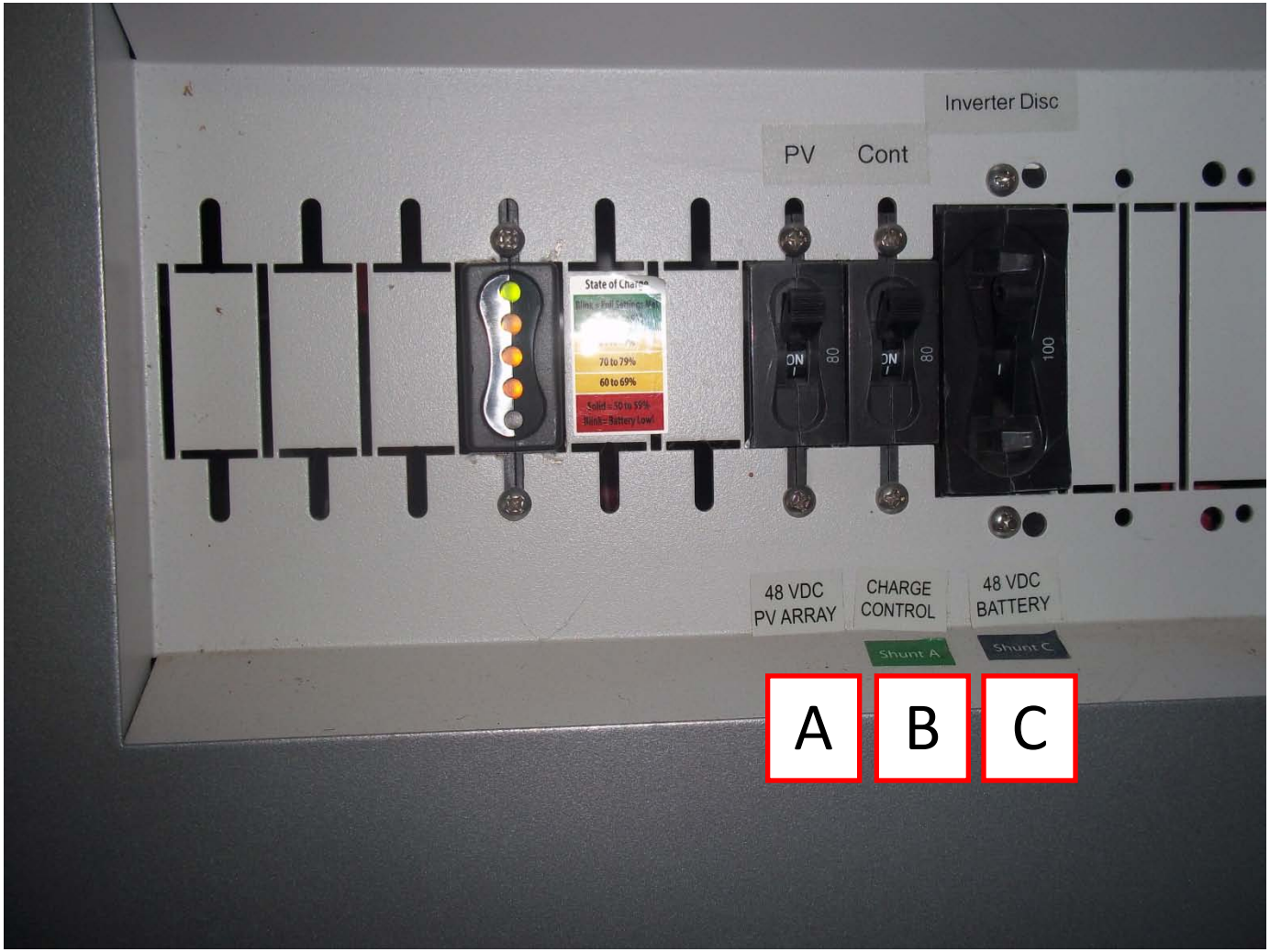
2) What type of solar electric system is this?

3) Using the Decision Chart, what is the appropriate course of action?

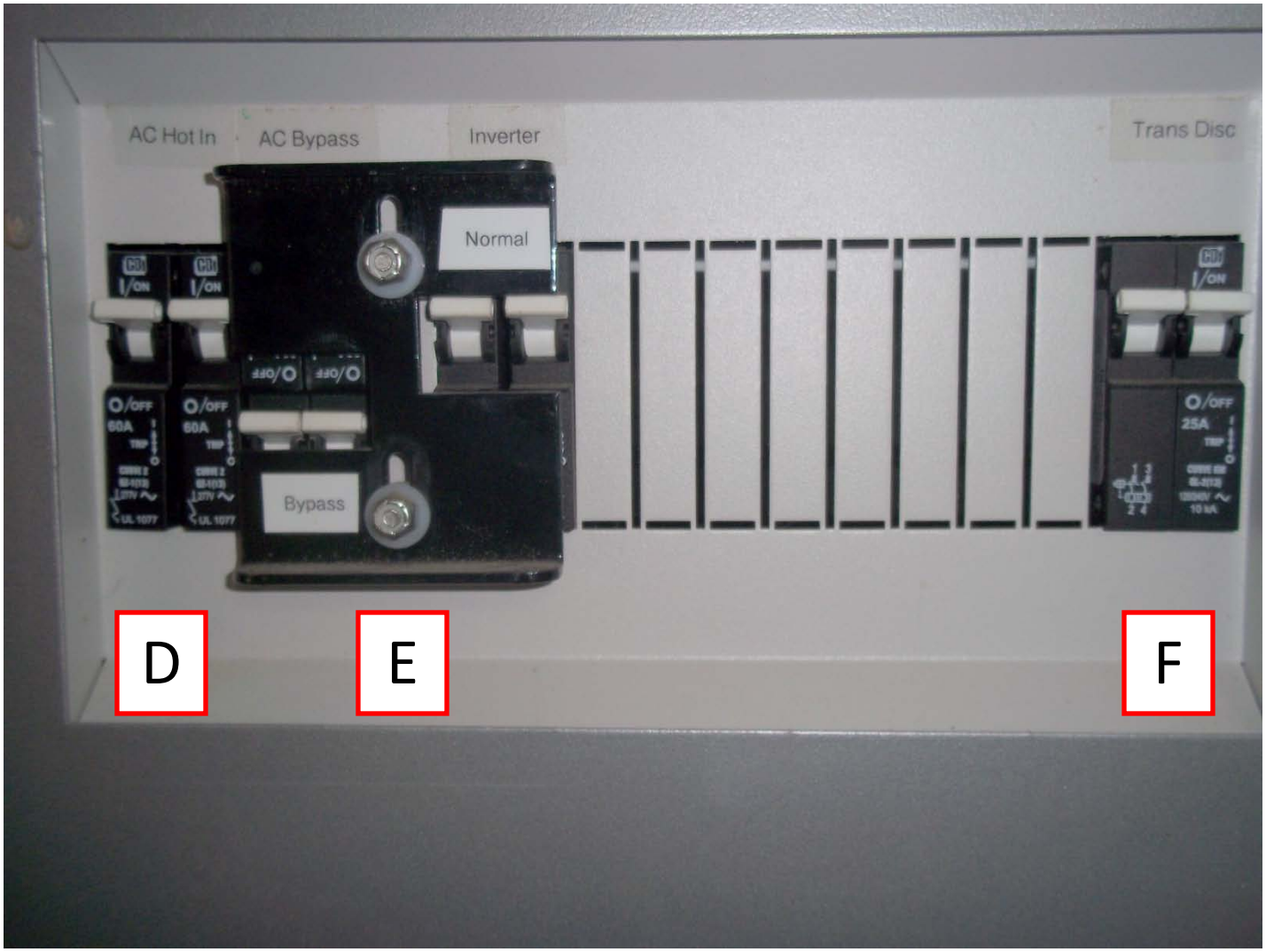
SYSTEM 5

If you could get into the basement, this is what you would see:

SYSTEM 5


Inverter Disc
PV
Cont
70 to 79%
60 to 69%
48 VDC
PV ARRAY
CHARGE
CONTROL
48 VDC
BATTERY
Shunt A
Shunt C
A
B
C

SYSTEM 5



SYSTEM 5

4) Which breaker would you operate to turn off dc power from the batteries?

5) Which breaker would you operate to turn off ac power to the inverter?

6) Which breaker would you operate to turn off ALL the power output from the inverter?

7) Describe or circle the parts of the system below that are energized when light is present and the dc Disconnect Switch in the basement is turned off?

SYSTEM 5

Additional Questions:

8) Which of the following components installed in a utility interconnected PV system **with** battery storage would not be installed in a utility interconnected PV system **without** energy storage?

a. DC Disconnect Switch
b. AC Disconnect Switch
c. Battery bank
d. Charge controller
e. Emergency power panel
f. Inverter(s)

9) Can a utility interconnected PV system with energy storage be shut down by removing the electrical meter?

10) How can a battery bank be shut down?

SYSTEM 5

11) Which disconnect will most effectively disable a battery-backup system?

12) How can rooftop wiring be disabled on a grid-interactive battery-backup system?

13) Where will a battery bank most likely be installed?

14) If the battery disconnect cannot be located, how can the solar electric system be disabled?

SYSTEM 5

Components of Grid Connected Solar Electric System with Battery Backed-up Circuits:

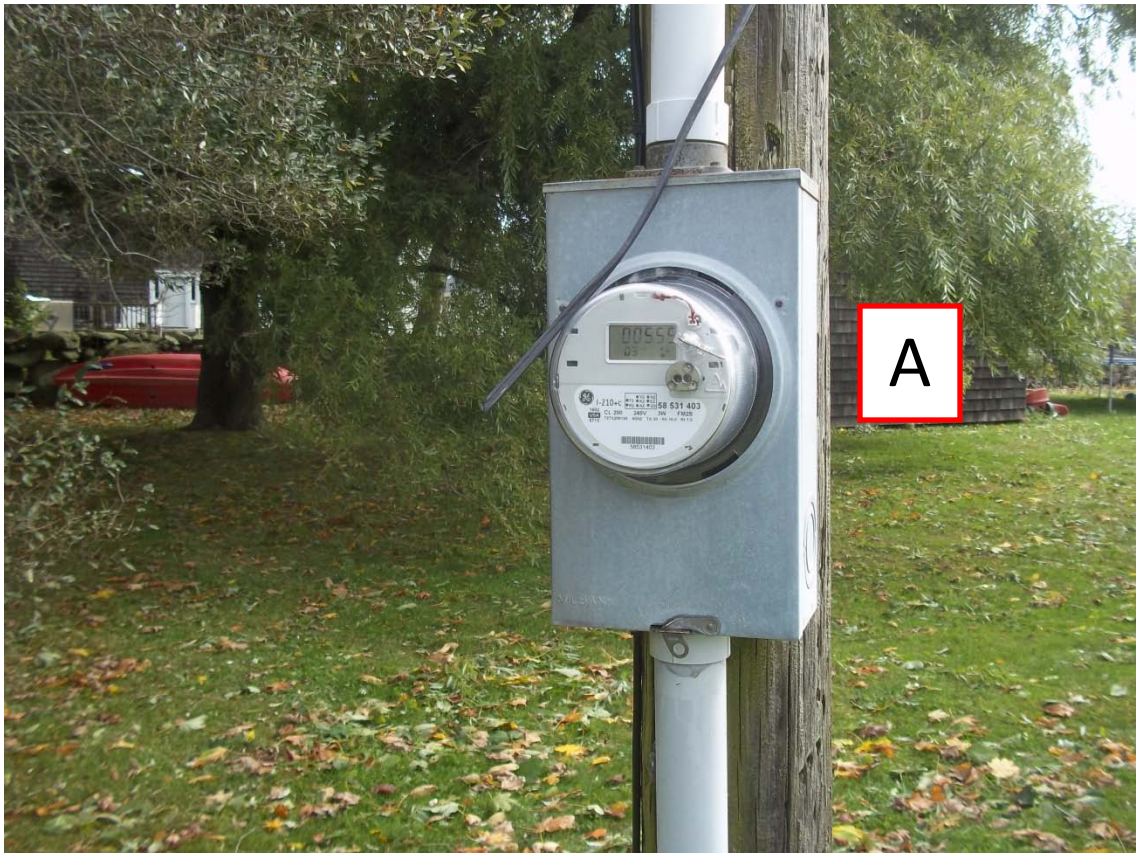
Directory and associated labeling of dc and ac switches.
Modules – Wired into lower voltage subarray strings than non battery systems; typically l less than 150Vdc.
Combiner Box – combines the subarray strings into a smaller number of larger conductors that carry the higher current of the combined subarrays.
Batteries – wired into parallel strings of batteries in series to get necessary voltage, no greater than 50Vdc. HIGH AMPERAGE.
Charge Controllers – to limit over charging and over discharging of batteries.
DC fuse/switch/circuit breakers.
Grid interconnected inverter w two ac outputs, one to the utility panel and one to the critical loads panel.
Critical loads panel, which is powered by the batteries.
DC Breakers to disconnect from inverter.
AC Breakers to disconnect from utility.
Transfer Switch to power critical loads directly from utility in the case of inverter failure.

SYSTEM 6

Preliminary Information
Report of fire at location
Scene upon arrival at location. You survey the site.

1) What is your next step?

SYSTEM 6



2) Is there sufficient information here to determine system type?

3) Using the Decision Chart, what is the system type one should assume given the information known at this time?

SYSTEM 6

If you could get into the garage, this is what you would see:

PV System Disconnect Switch

Voc = 345Vdc

Vmp = 324Vmp

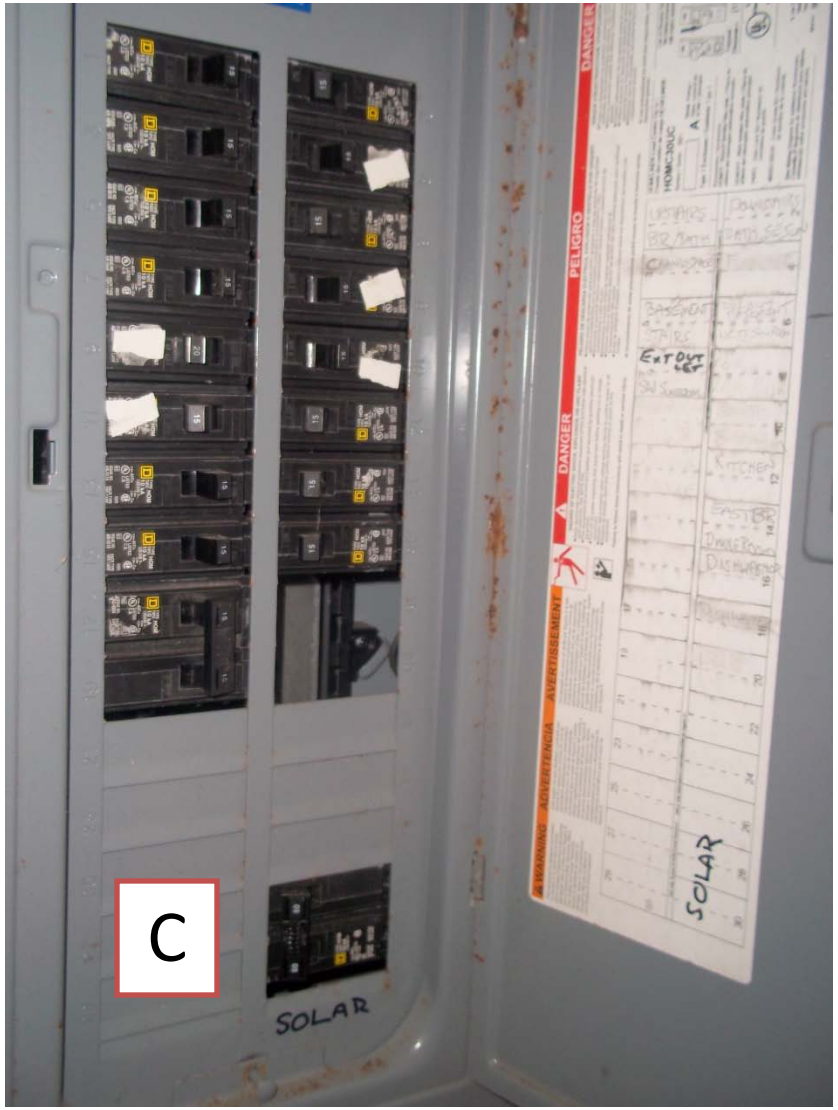
Isc = 12.9A

Imp = 8.4A

Charge Controller Maximum Current = NA

4) Using the Decision Chart, what is the system type one should assume given the information known at this time?

SYSTEM 6



5) Which equipment (A, B, C) would turn off dc power to the inverter?

6) Which equipment (A, B, C) would remove ac power from the system?

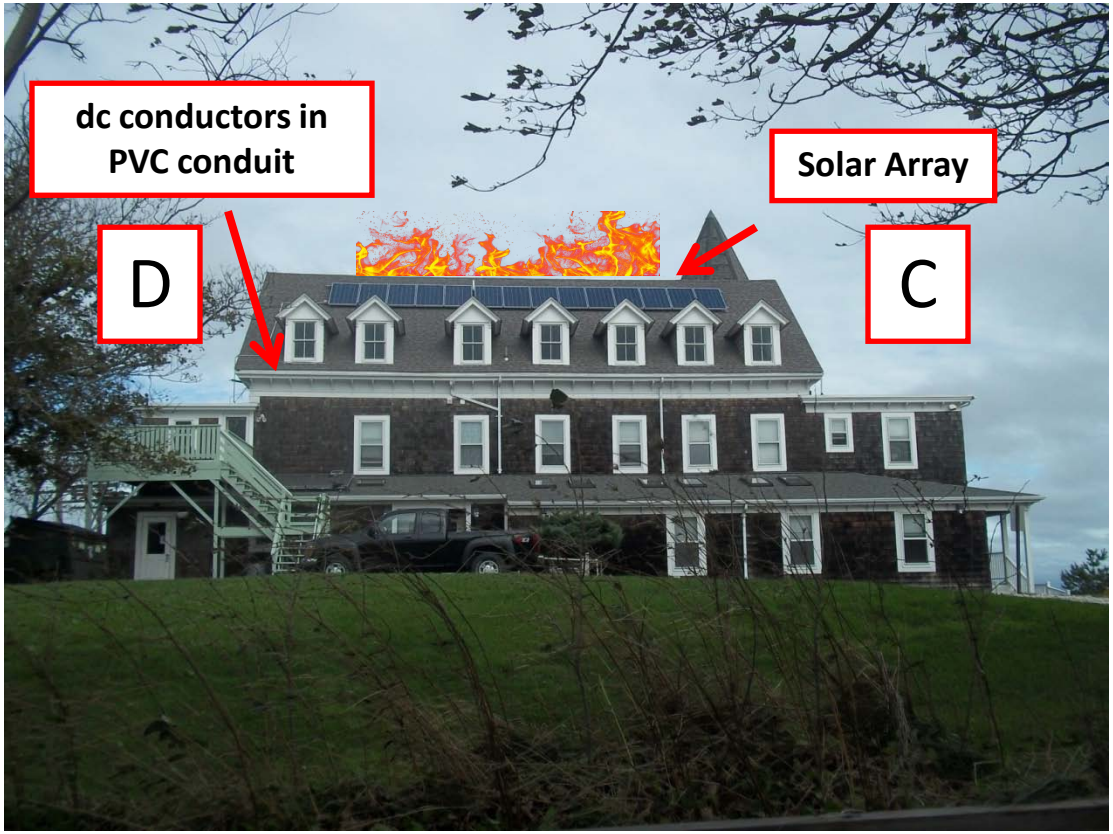
7) If “C” is turned OFF, is there any ac power on the site?

8) If “A” is pulled, is there any ac power on the site?

SYSTEM 6

9) Assuming the dc Disconnect Switch “B” in the garage is turned off, which color/pattern indicates dc voltage still present after the dc Disconnect Switch is turned off? ▪▪▪▪▪▪ OR ——

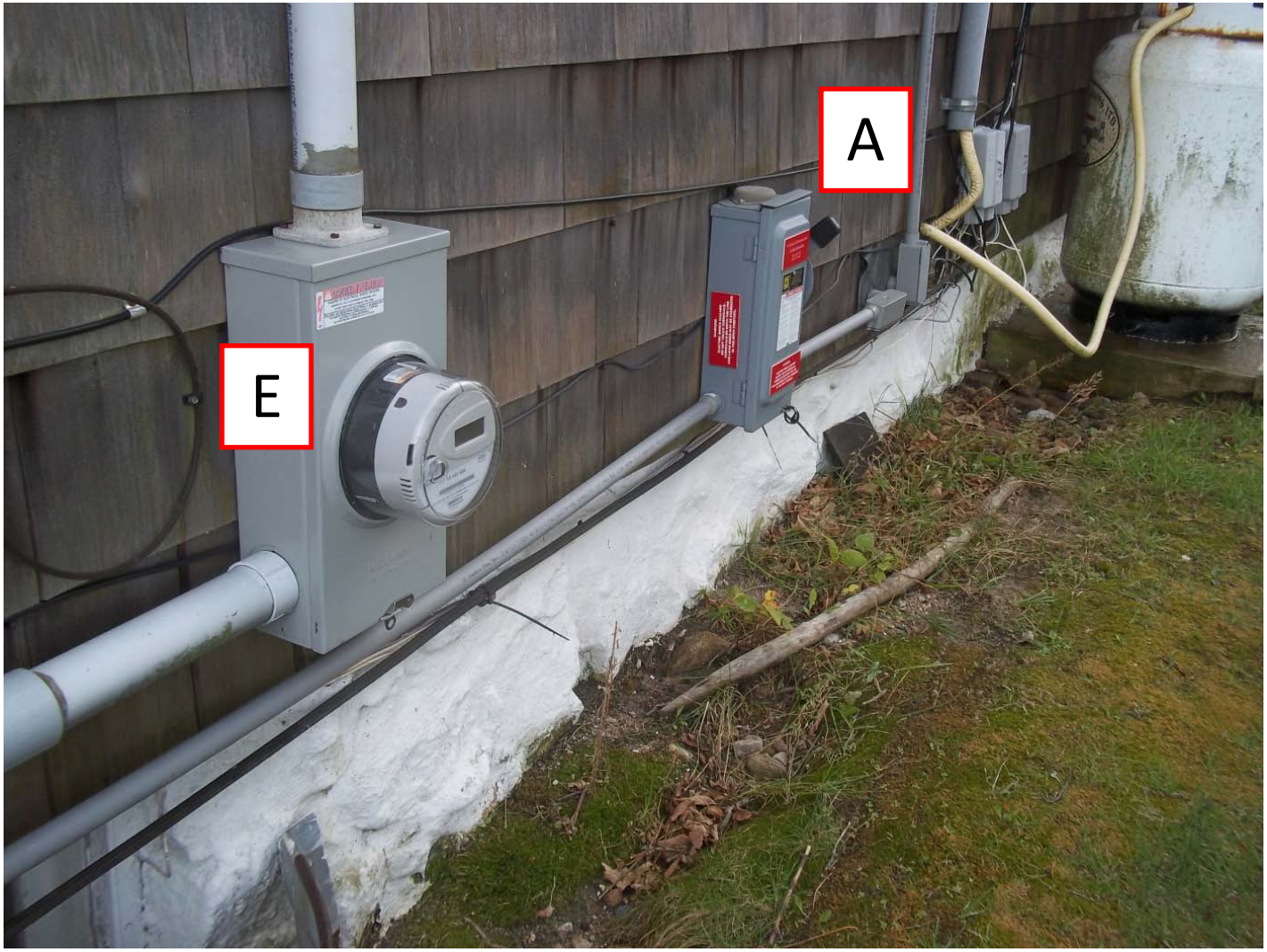
SYSTEM 7



Preliminary Information
Report of fire at location
Scene upon arrival at location. You survey the site.

1) What is your next step?

SYSTEM 7



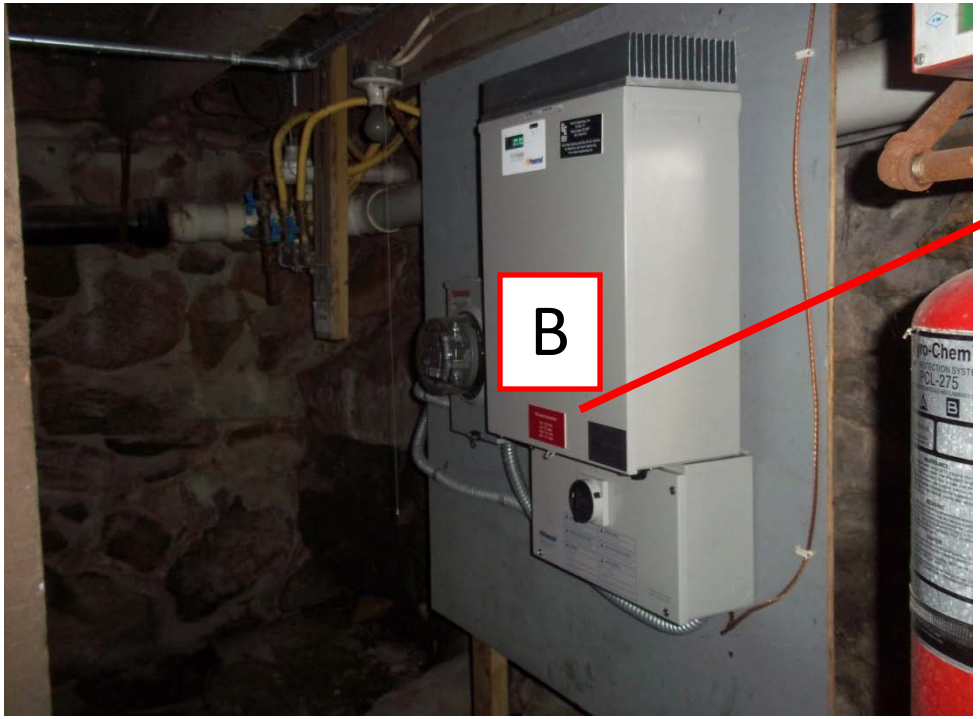
SYSTEM 7

2) Using the Decision Chart, what type of solar electric system should be assumed?

3) What is your next step?

SYSTEM 7

If you could get into the garage, this is what you would see:



DC System Characteristics

Voc= 293 volts
Isc= 21.1 amps
Vmp= 231 volts
Imp= 19.7 amps

4) Which equipment would you operate to turn off dc power to the inverter?
5) What would you operate to turn off ac power to/from the inverter?
6) What parts of the system are energized when light is present and the dc Disconnect Switch is turned off?

SYSTEM 7

Components of a Non Battery, Grid Interconnected Solar Electric System

Directory
Modules
Combiner Box *
DC Conductors
DC Disconnect Switch
Inverter
AC Conductors
AC Disconnect Switch
Utility Interconnection

* May not be present in every system