Concerns with the Inspection of Grid-Connected Solar PV Systems Installed in Alberta

Compiled by
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Edmonton
2010 December, 2013 January, 2014 March

There are now some 800 grid-dependent solar PV systems in Alberta, growing at 100% per year.

In Alberta, the training of companies and people involved in designing and installing solar PV industry and the training of safety codes officers is becoming an issue with regard to the adequate design, installation and inspection of solar photovoltaic (PV) systems, with some contractors and inspection companies taking a cavalier attitude towards the importance of electrical and structural safety.

Training of electrical safety codes officer is a big issue that is only now starting to be seriously considered. Here is an actual example of inadequate electrical safety codes officer training:

- In 2013, the ESCO arrived on site without first having the electrical single-line diagram, then asked the client where the inverters were (they were underneath the PV modules on the roof).
- The ESCO did not go on to the roof to inspect the most-critical electrical safety parts of the PV systems: PV module bonding, PV array bonding, PV wire management, roof cabling penetrations, PV modules and, in many cases, inverters and inverter bonding.
- The ESCO then wrote up two identical reports and sent them in to Alberta Municipal Affairs. When I asked him for what reason there were two identical reports, he said that Alberta Municipal Affairs wants a rough-in and a final inspection report even if both reports have the same dates! (sounds like fraud to me)
- He then said that he had made a mistake showing the reports as being identical instead of one being a rough-in and then asked me what words he should put into the report!
- The electrical permit fee for this project was $582. Did we get much of any value from this?

The following pages show several examples of PV systems in Alberta that have been inspected, and some that have not been inspected.

The blank lines underneath each photo are intended for safety codes officers to fill in, to see if they can determine what are the safety code issues shown in the photo.

All questions and discussion are welcome.

Item #1. Calgary, house

PV array size:	100 W
Electrical specs:	V_{OC} = 70 VDC, V_{MP} = 35 VDC, Vinverter = 120 VAC
Operating status:	removed, not in service
Inspection status:	guerrilla PV system installed in 2001, never inspected
Installed by:	homeowner

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #2. **Edmonton, municipal building** (same PV system as in Item #3, Item #7, Item #11, Item #12, Item #23, Item #24)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

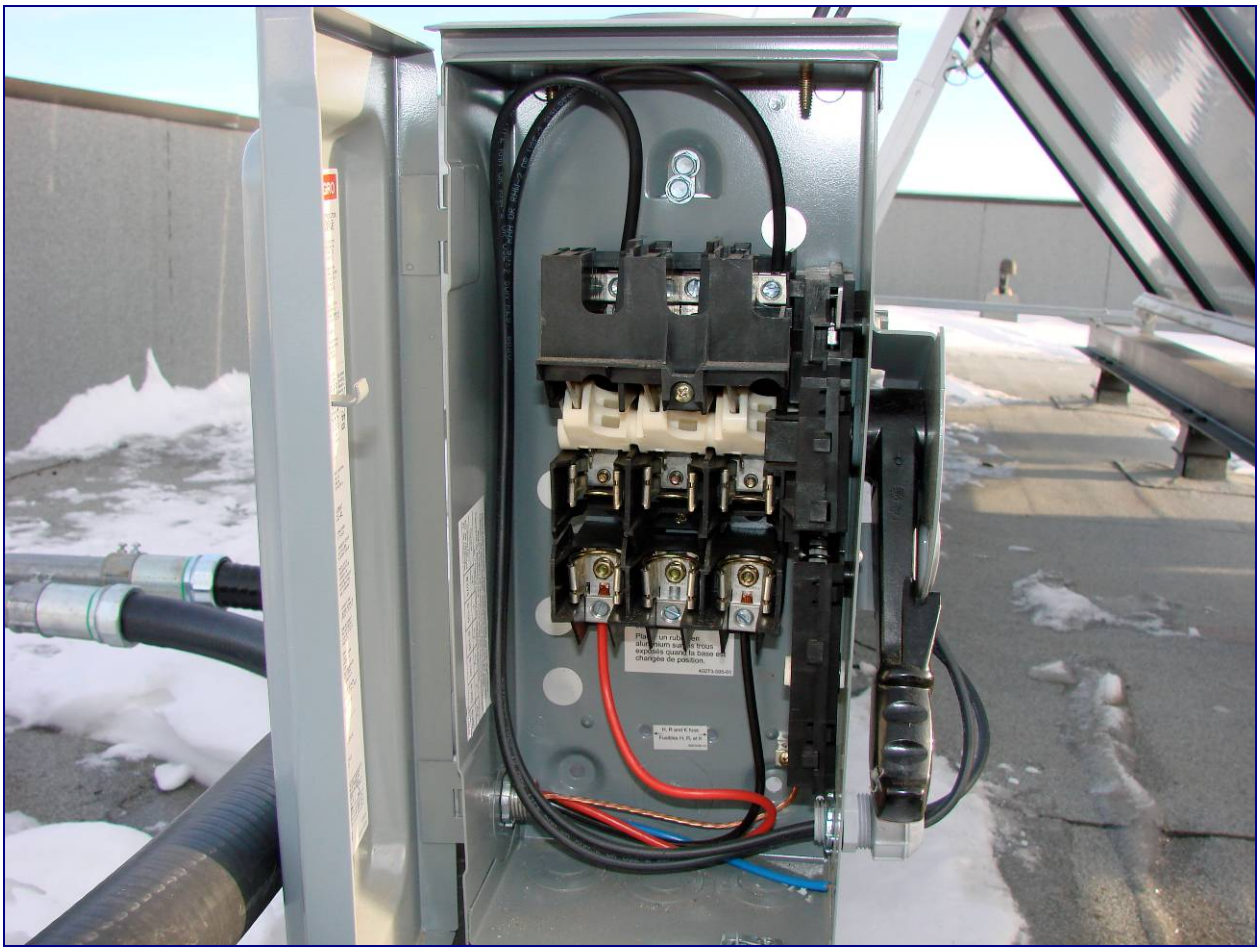

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #3. **Edmonton, municipal building** (same PV system as in Item #2, Item #7, Item #11, Item #12, Item #23, Item #24)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #4. Edmonton, house

PV array size:	2.9 kW
Electrical specs:	Vbattery = 24 VDC, Vinverter = 120 VAC
Operating status:	refused by Supply Authority
Inspection status:	installation had not been completed at the time of the photo
Installed by:	electrical contractor, not PV qualified
Comments:	Dealers in Edmonton and Calgary refused to refund the product or deal with the manufacturing issues. The inverter had to be sent back to the manufacturer to be replaced by a new one.

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #5. Edmonton, house

PV array size:	8 kW
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2006
Inspection status:	Inspected, passed
Installed by:	electrical contractor specializing in PV systems

Photo credit: ETI Solar

List of inspection issues: _____

Item #6. **Edmonton, commercial building** (same PV system as in Item #18)

PV array size:	2 kW
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2008
Inspection status:	inspected, passed
Installed by:	electrical contractor specializing in PV systems

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #7. **Edmonton, municipal building** (same PV system as in Item #2, Item #3, Item #11, Item #12, Item #23, Item #24)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

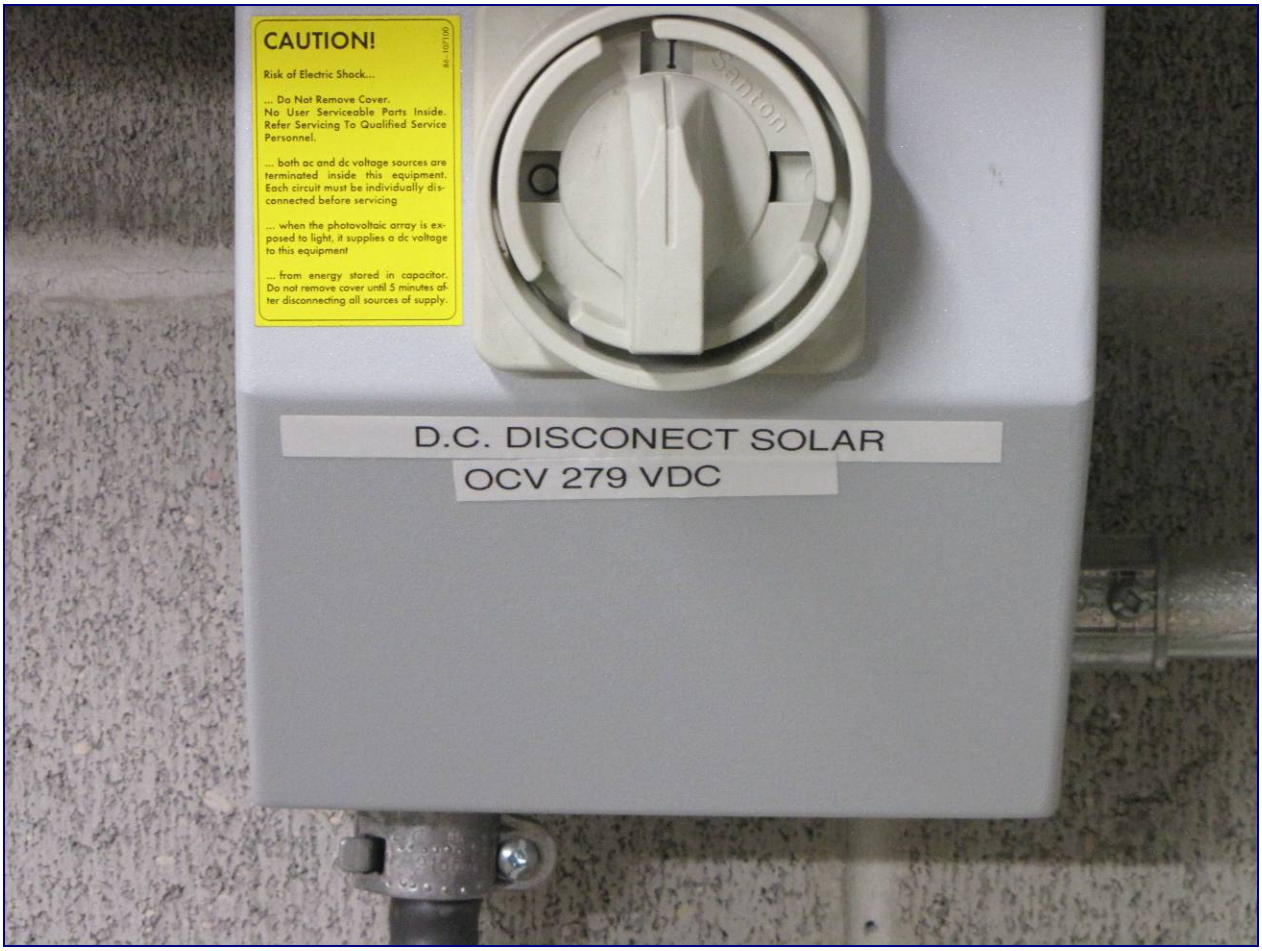

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #8. Edmonton, house

PV array size:	4.4 kW
Electrical specs:	Voc = 398 to 496 VDC, V_{MP} = 318 to 415 VDC, Vinv = 240 VAC
Operating status:	operating since 2010
Inspection status:	inspected, passed
Installed by:	electrical contractor specializing in PV systems

Photo credit: Gordon Howell

List of inspection issues: _____

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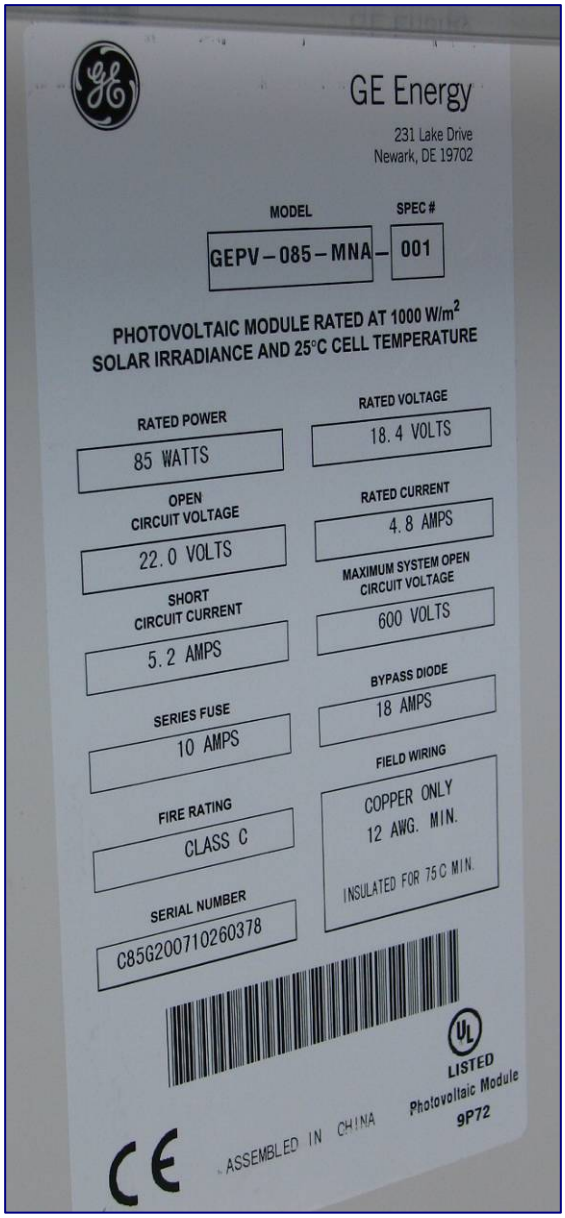
Item #9. **Red Deer, municipal building** (same PV system as in Item #9, Item #34, Item #35, Item #36)

PV array size:	1 kW
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2008
Inspection status:	inspected, passed
Installed by:	electrical contractor, not PV qualified
Photo credit:	Gordon Howell



List of inspection issues:

Item #10. Edmonton, house

PV array size:	0.6 kW (?)
Electrical specs:	Vinverter = 120 VAC
Operating status:	operating since 2006
Inspection status:	inspected, passed
Installed by:	PV equipment supplier

Photo credit: ETI Solar

List of inspection issues: _____

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Item #11. **Edmonton, municipal building** (same PV system as in Item #2, Item #3, Item #7, Item #12, Item #23, Item #24)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #12. **Edmonton, municipal building** (same PV system as in Item #2, Item #3, Item #7, Item #11, Item #23, Item #24)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

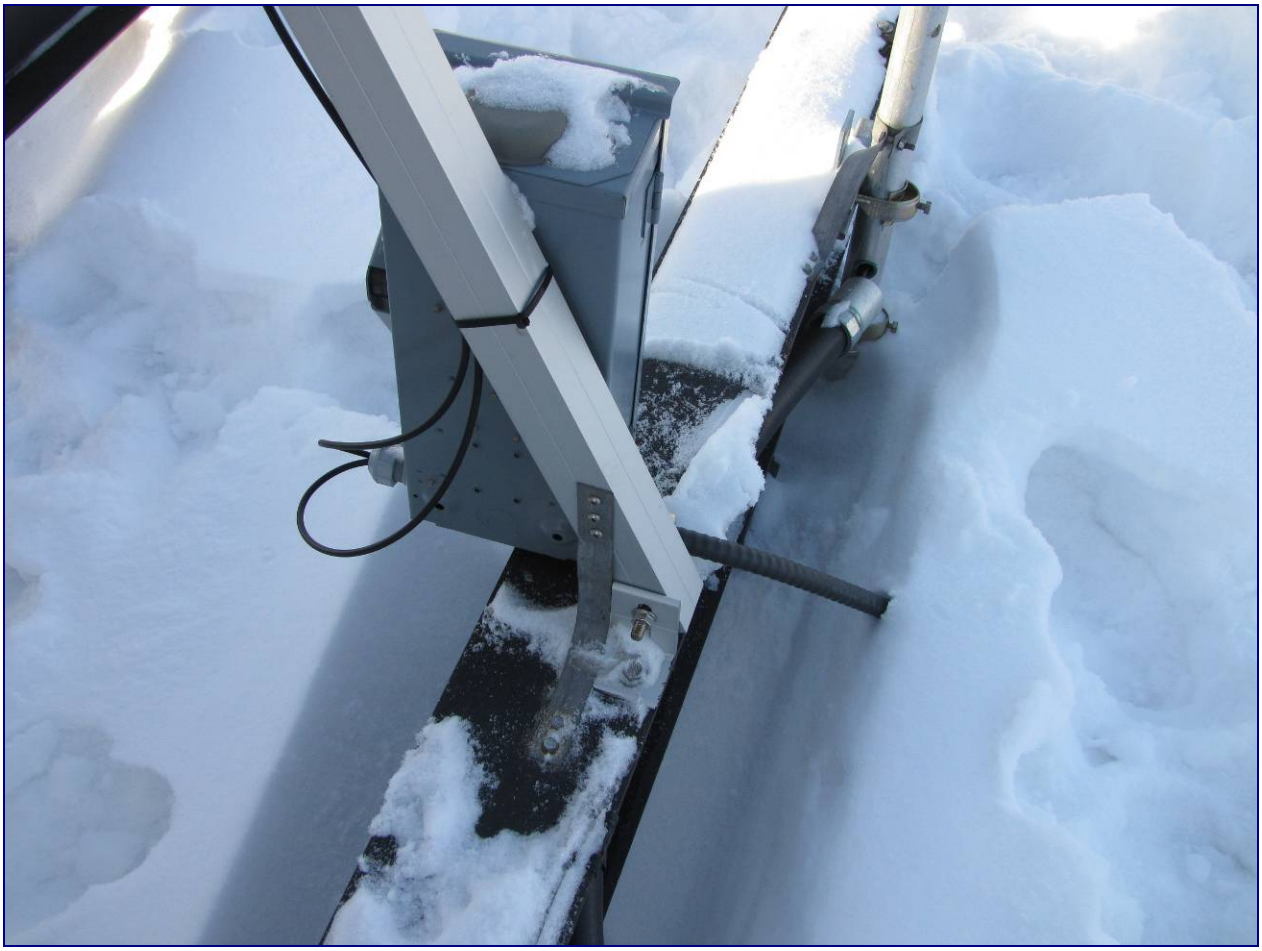

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #13. Edmonton, house

PV array size:	2 kW?
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2010 (?)
Inspection status:	inspected, passed
Installed by:	homeowner (?)

Photo credit: not known

List of inspection issues: _____

Item #14. **Calgary, house** (same PV system as in Item #15)

PV array size:	2 kW (?)
Electrical specs:	Vinverter = 120 VAC
Operating status:	operating since 1999
Inspection status:	likely not inspected
Installed by:	homeowner
Photo credit:	Gordon Howell

List of inspection issues:

Item #15. **Calgary, house** (same PV system as in Item #14)

PV array size:	2 kW (?)
Electrical specs:	Vinverter = 120 VAC
Operating status:	operating since 1999
Inspection status:	likely not inspected
Installed by:	homeowner

Photo credit: Gordon Howell

List of inspection issues: _____

Item #16. Edmonton house

PV array size:	not known, 100 W?
Electrical specs:	not known
Operating status:	not known
Inspection status:	likely not inspected
Installed by:	homeowner

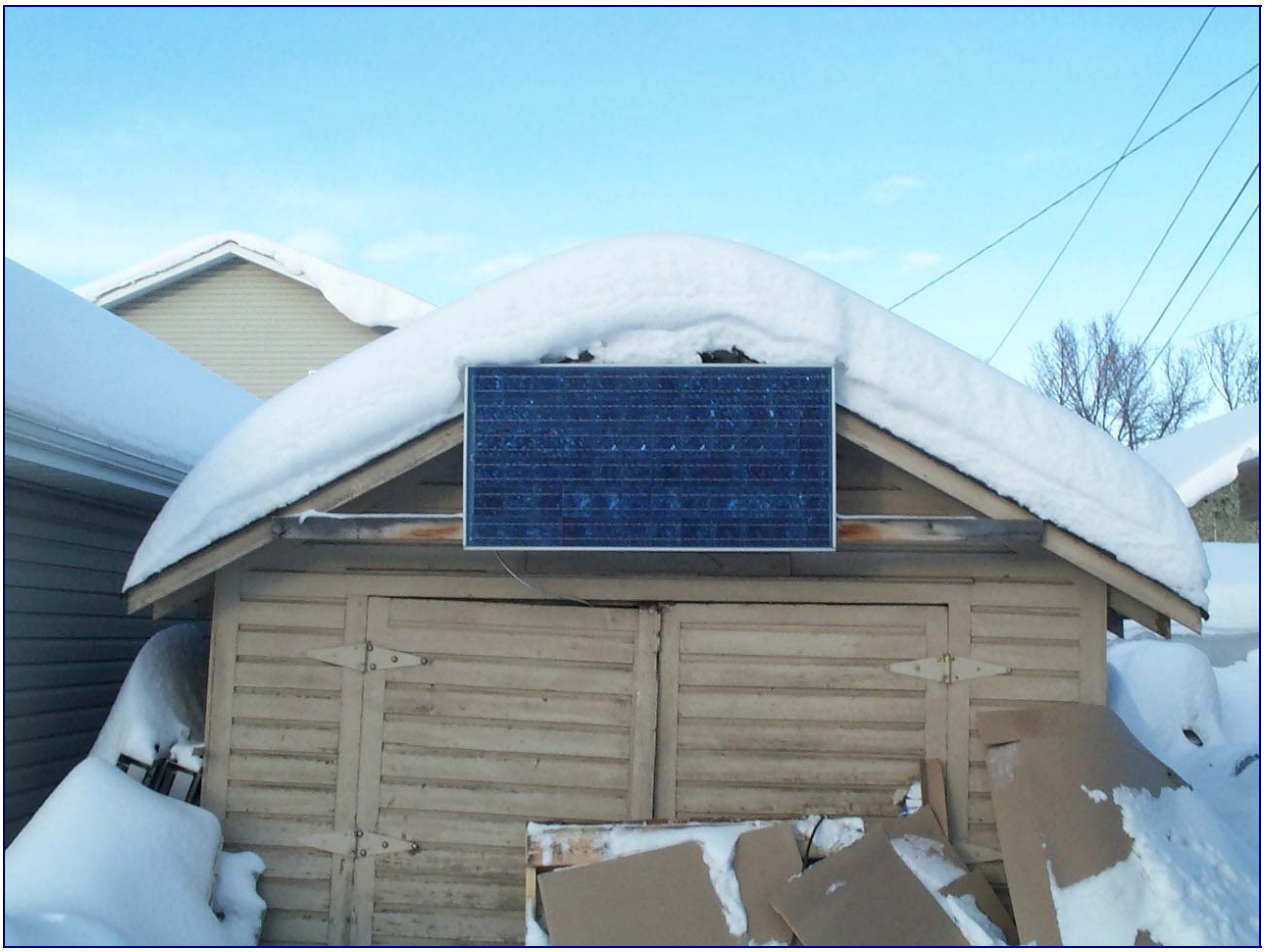

Photo credit: not known

List of inspection issues: _____

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Item #17. City not known, house

PV array size:	not known
Electrical specs:	not known
Operating status:	not known
Inspection status:	not known
Installed by:	not known

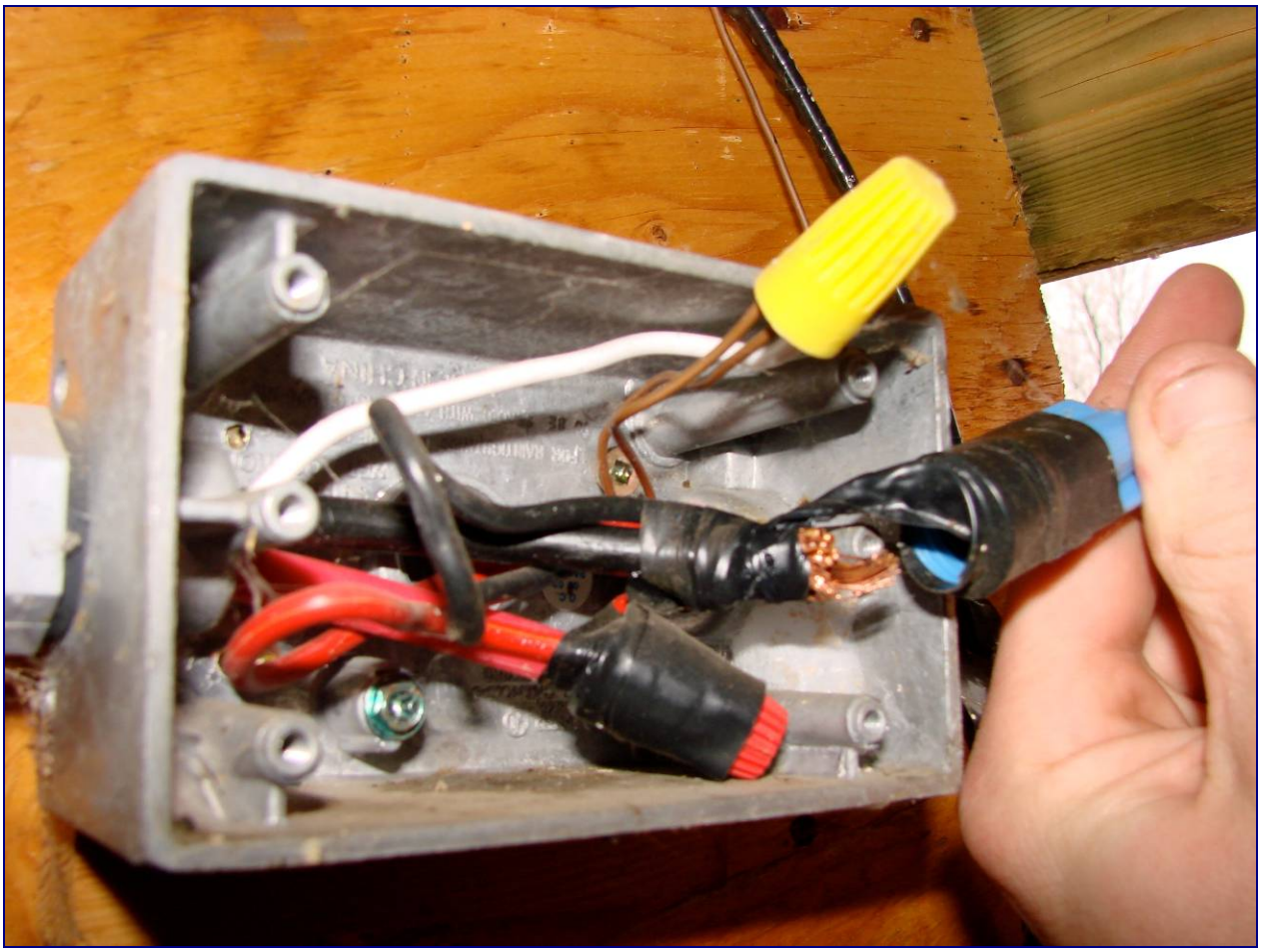

Photo credit: not known

List of inspection issues: _____

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Item #18. Edmonton, commercial building (same PV system as in Item #6)

PV array size:	2 kW (?)
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2008
Inspection status:	inspected, passed
Installed by:	electrical contractor specializing in PV systems

Photo credit: Gordon Howell

List of inspection issues: _____

Item #19. Edmonton, house

PV array size:	16 kW (?)
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2006 (?)
Inspection status:	inspected, passed
Installed by:	PV equipment supplier

Photo credit: not known

List of inspection issues: _____

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Item #20. **Edmonton, house** (same PV system as in Item #19)

PV array size:	16 kW (?)
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2006 (?)
Inspection status:	inspected, passed
Installed by:	PV equipment supplier

Photo credit: not known

List of inspection issues: _____

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Item #21. Edmonton, house

PV array size:	2.9 kW
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2007 (?)
Inspection status:	inspected, passed
Installed by:	PV equipment supplier

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #22. **Edmonton, house** (same PV system as in Item #21)

PV array size:	2.9 kW
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2007 (?)
Inspection status:	inspected, passed
Installed by:	PV equipment supplier

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #23. **Edmonton, municipal building** (same PV system as in Item #2, Item #3, Item #7, Item #11, Item #12, Item #24)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

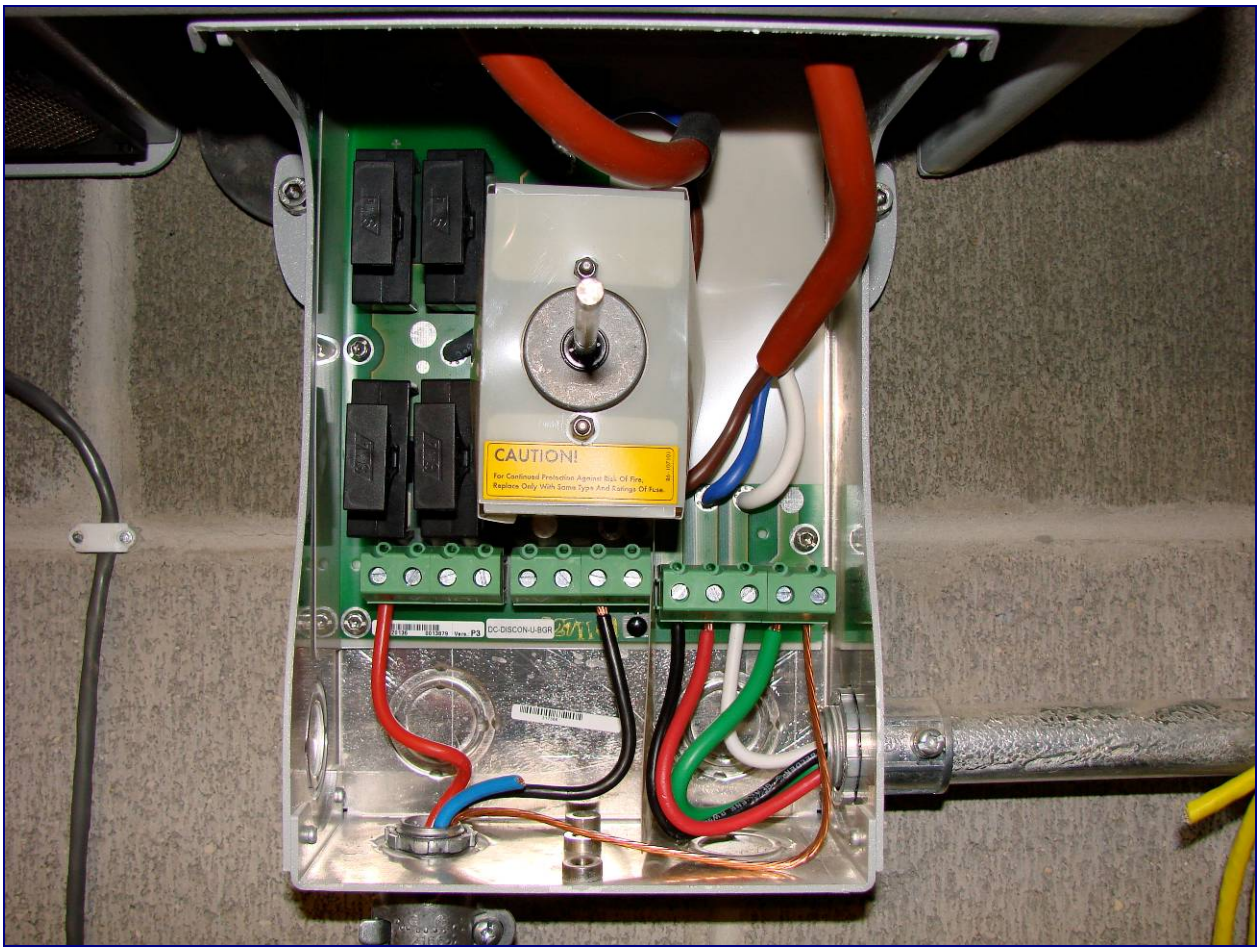

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #24. **Edmonton, municipal building** (same PV system as in Item #2, Item #3, Item #7, Item #11, Item #12, Item #23)

PV array size:	1 kW
Electrical specs:	Voc = 343 to 429 V_{DC}, V_{MP} = 279 V_{DC}, Vinverter = 208 V_{AC}
Operating status:	in service since 2008
Inspection status:	inspected, passed
Installed by:	HVAC contractor installing PV systems

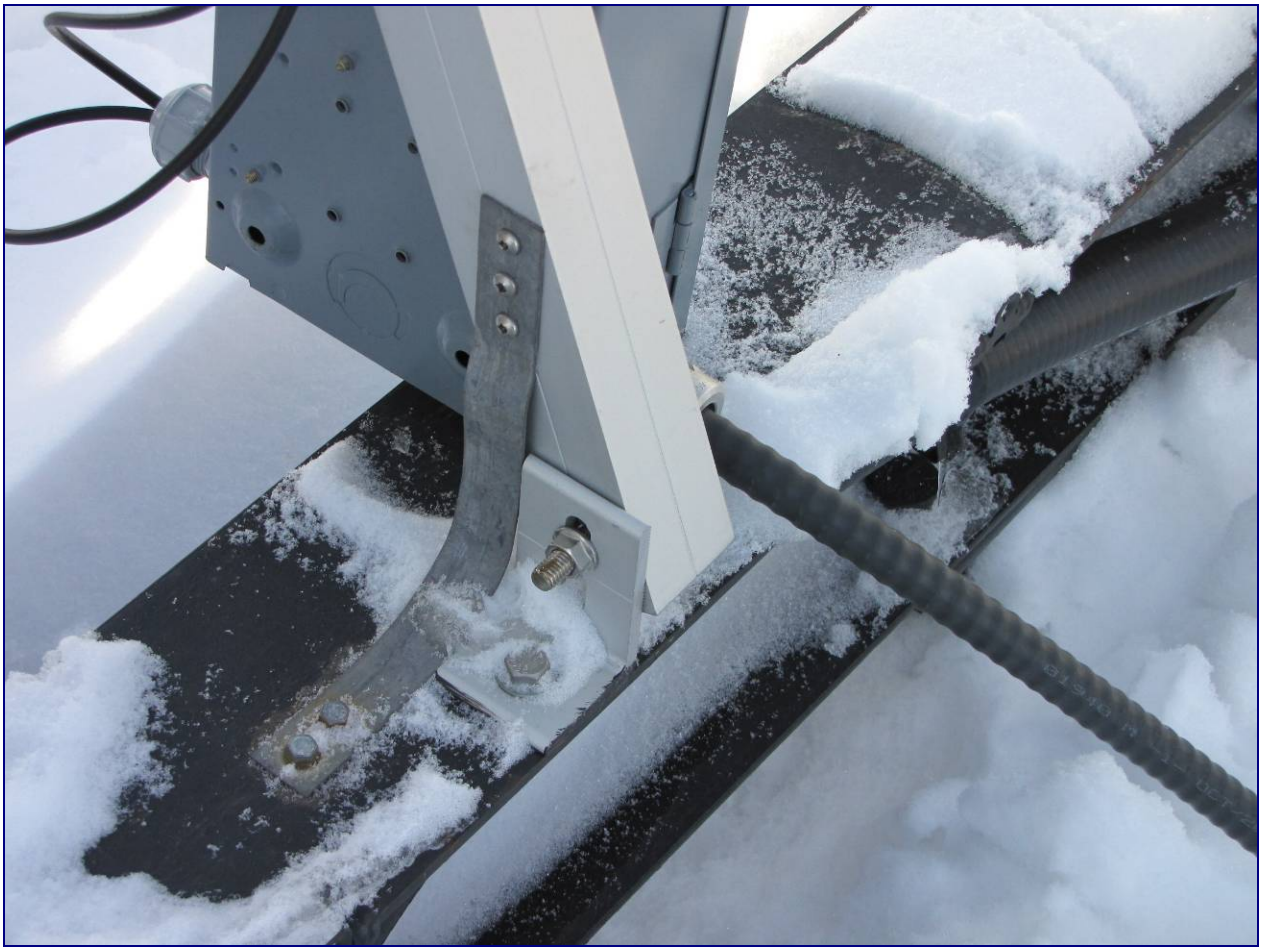

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #25. **Calgary, house** (same PV system as in Item #26, Item #27)

PV array size:	2 kW (?)
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2009 (?)
Inspection status:	not known
Installed by:	electrical contractor, not PV qualified

Photo credit: SkyFire

List of inspection issues: _____

Item #26. **Calgary, house** (same PV system as in **Item #25, Item #27**)

PV array size:	2 kW (?)
Electrical specs:	Vinverter = 240 VAC
Operating status:	operating since 2009 (?)
Inspection status:	not known
Installed by:	electrical contractor, not PV qualified

Photo credit: SkyFire

List of inspection issues: _____

Item #27. Calgary, house (same PV system as in **Item #25, Item #26**)

PV array size: 2 kW (?)
Electrical specs: Vinverter = 240 VAC
Operating status: operating since 2009 (?)
Inspection status: not known
Installed by: electrical contractor, not PV qualified

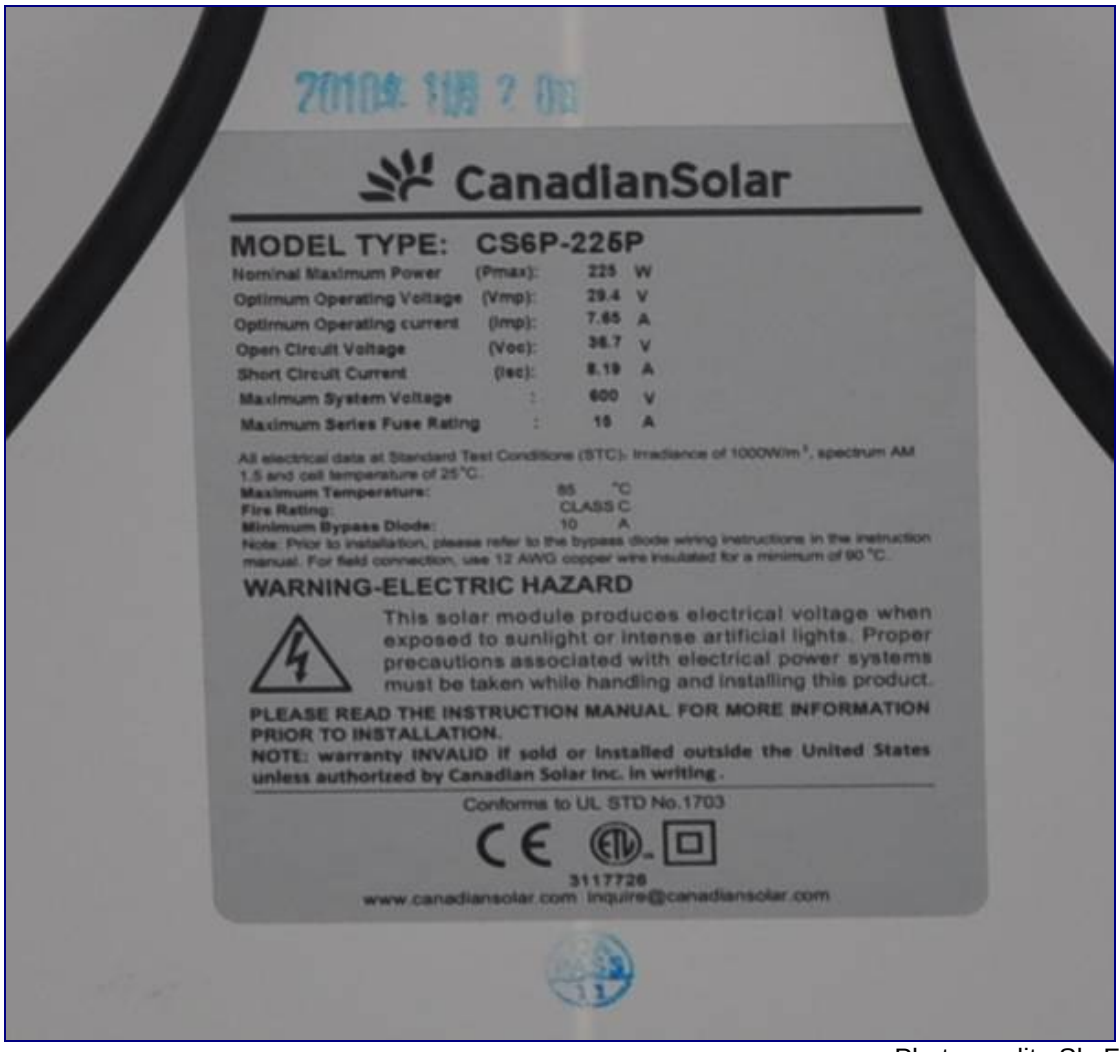

Photo credit: SkyFire

List of inspection issues: _____

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Item #28. **west of Calgary, house, off-grid** (same PV system as in Item #29, Item #30, Item #31, Item #32)

PV array size:	not known
Electrical specs:	Vbatt = 24 VDC (?), Vinverter = 120 VAC
Operating status:	operating
Inspection status:	not known
Installed by:	HVAC contractor installing PV systems

Photo credit: confidential

List of inspection issues: _____

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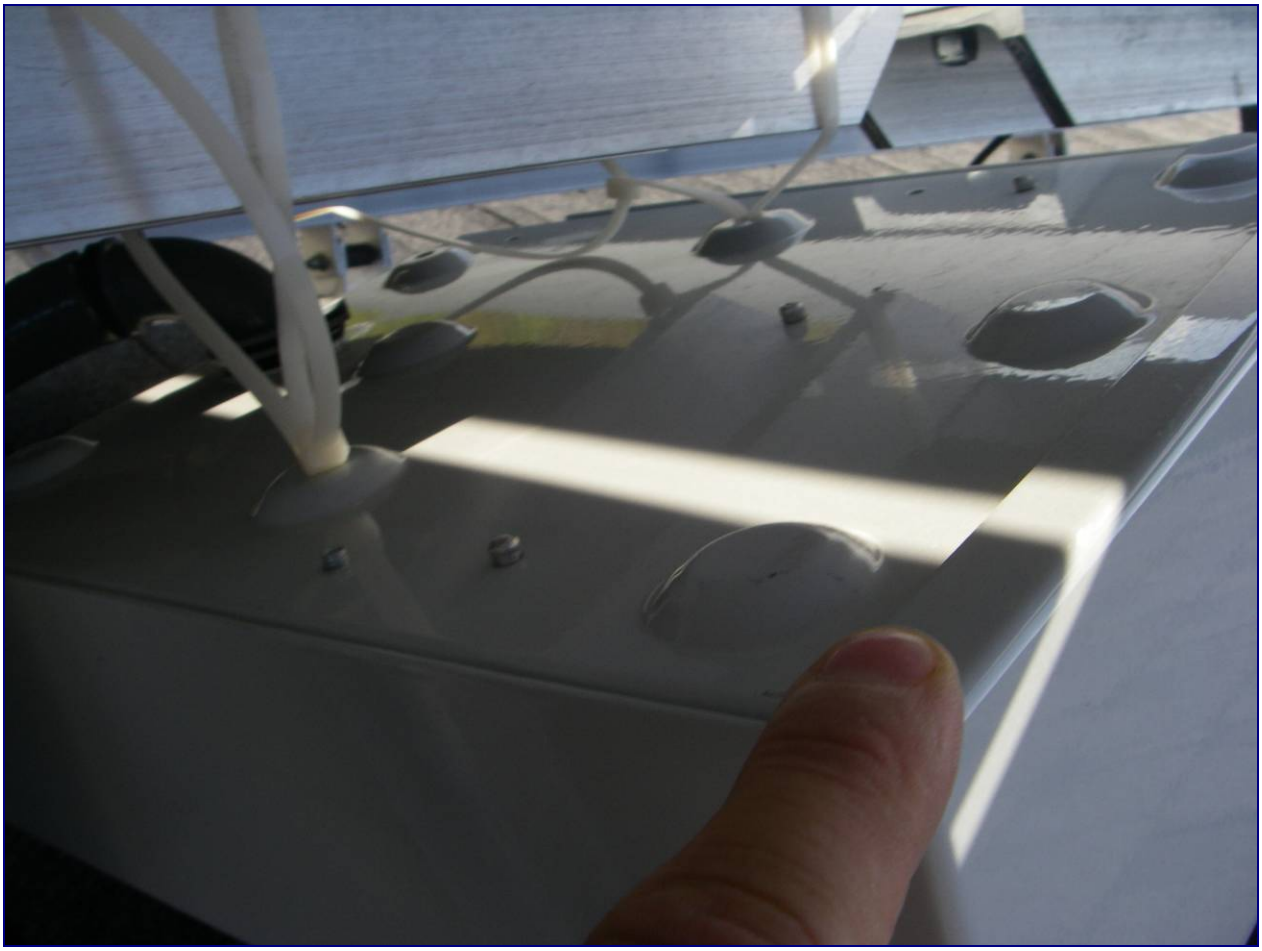
Item #29. **west of Calgary, house, off-grid** (same PV system as in Item #28, Item #30, Item #31, Item #32)

PV array size:	not known
Electrical specs:	Vbatt = 24 VDC (?), Vinverter = 120 VAC
Operating status:	operating
Inspection status:	not known
Installed by:	HVAC contractor installing PV systems



(this is a photo of a combiner box mounted upside down) Photo credit: confidential

List of inspection issues: _____

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Item #30. **west of Calgary, house, off-grid** (same PV system as in Item #28, Item #29, Item #31, Item #32)

PV array size:	not known
Electrical specs:	Vbatt = 24 VDC (?), Vinverter = 120 VAC
Operating status:	operating
Inspection status:	not known
Installed by:	HVAC contractor installing PV systems

Photo credit: confidential

List of inspection issues: _____

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Item #31. **west of Calgary, house, off-grid** (same PV system as in Item #28, Item #29, Item #30, Item #31, Item #32)

PV array size:	not known
Electrical specs:	Vbatt = 24 VDC (?), Vinverter = 120 VAC
Operating status:	operating
Inspection status:	not known
Installed by:	HVAC contractor installing PV systems

Photo credit: confidential

List of inspection issues: _____

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Item #32. **west of Calgary, house, off-grid** (same PV system as in Item #28, Item #29, Item #30, Item #31)

PV array size:	not known
Electrical specs:	Vbatt = 24 VDC (?), Vinverter = 120 VAC
Operating status:	operating
Inspection status:	not known
Installed by:	HVAC contractor installing PV systems

Photo credit: confidential

List of inspection issues: _____

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Item #33. near Lethbridge (wind generator)

Generator size: 3 kW (?)

Electrical specs: not known

Operating status: operating since 2010 (?)

Inspection status: not known

Installed by: not known

Photo credit: not known

List of inspection issues: _____

Item #34. Red Deer, municipal building (same PV system as in Item #9, Item #35, Item #36)

PV array size:	1 kW
Electrical specs:	Vinverter = 120 VAC
Operating status:	operating since 2005 (?)
Inspection status:	inspected, passed
Installed by:	electrical contractor, not PV qualified

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #35. Red Deer, municipal building (same PV system as in Item #9, Item #34, Item #36)

PV array size:	1 kW
Electrical specs:	Vinverter = 120 VAC
Operating status:	operating since 2005 (?)
Inspection status:	inspected, passed
Installed by:	electrical contractor, not PV qualified

Photo credit: Gordon Howell

List of inspection issues: _____

Item #36. Red Deer, municipal building (same PV system as in Item #9, Item #34, Item #35)

PV array size:	1 kW
Electrical specs:	Vinverter = 120 VAC
Operating status:	operating since 2005 (?)
Inspection status:	inspected, passed
Installed by:	electrical contractor, not PV qualified

Photo credit: Gordon Howell

List of inspection issues: _____

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Item #37. Mayerthorpe, house

PV array size:	7.8 kW
Electrical specs:	V_{MP} = 336 VDC, I_{MP} = 15.4 ADC, Vinverter = 240 VAC
Operating status:	likely operating
Inspection status:	unknown
Installed by:	electrical contractor specializing in PV systems

Photo credit: unknown

List of inspection issues: _____

Item #38. Cardston, house

PV array size:	not known, perhaps 1 kW
Electrical specs:	not known
Operating status:	not known
Inspection status:	likely not inspected
Installed by:	homeowner

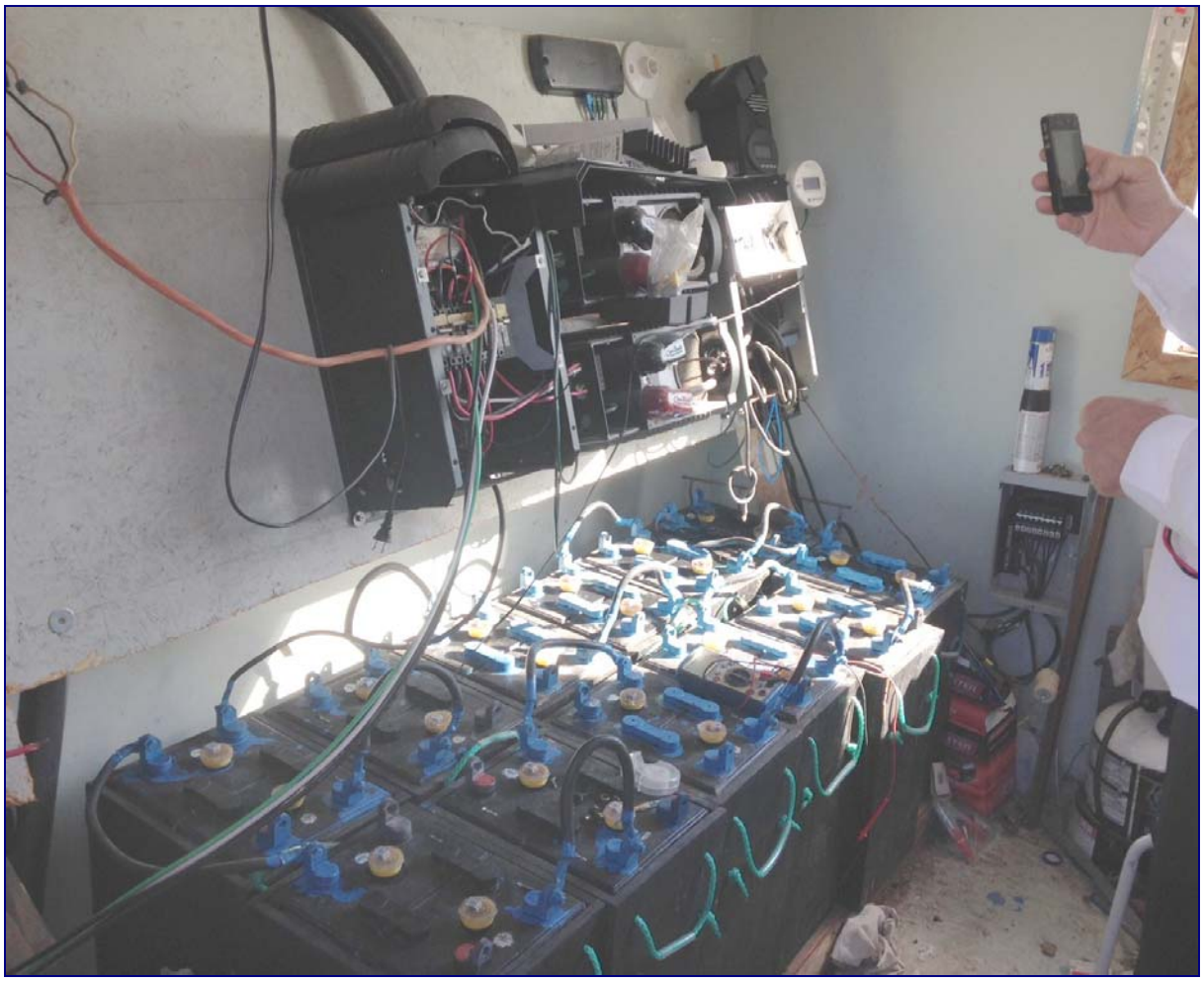


Photo credit: confidential

List of inspection issues: _____

Item #39. Sherwood Park, house (same PV company as in Item #40)

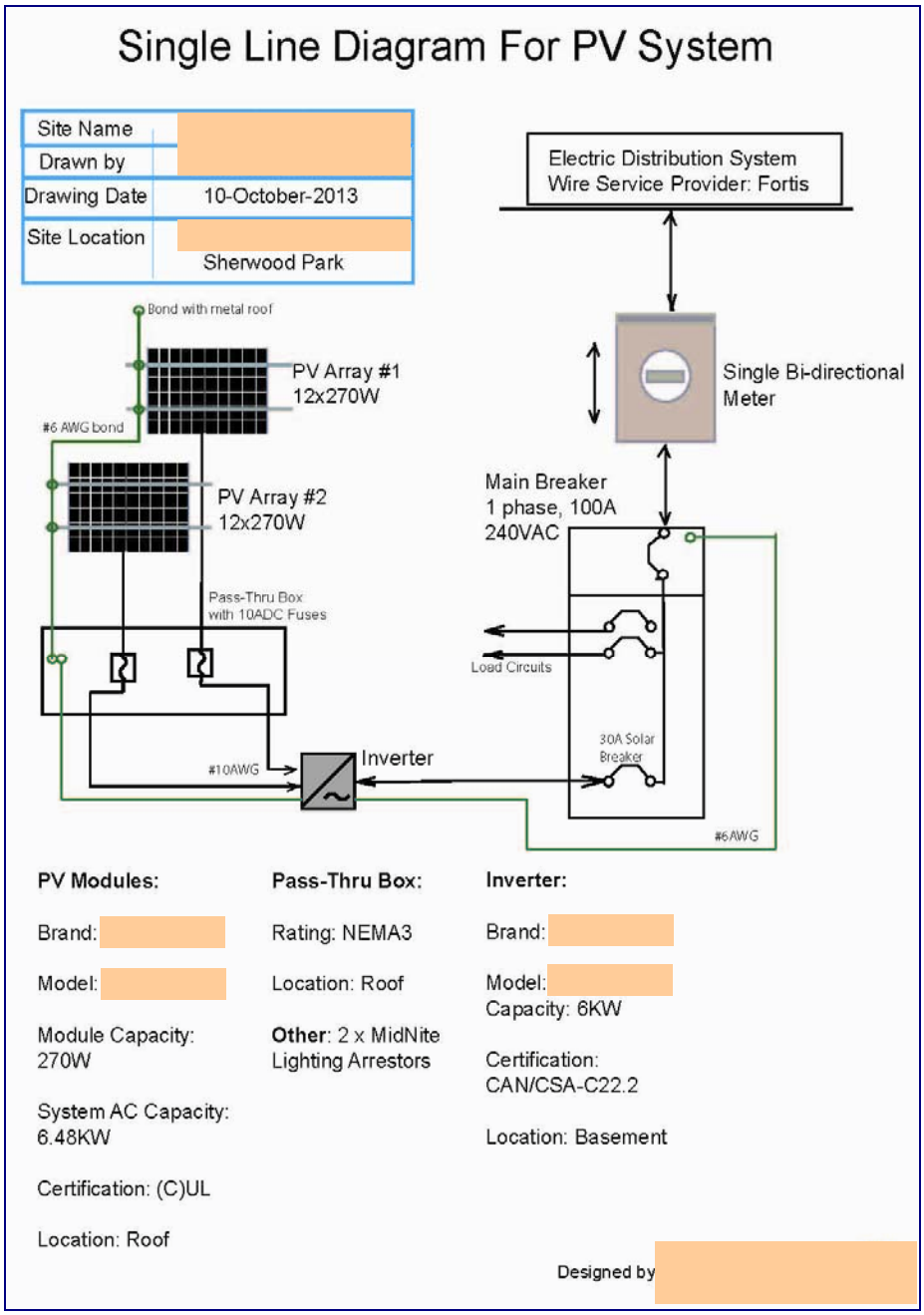
PV array size: 6.5 kW

Electrical specs: max V_{OC} = 558 V, max I_{SC} = 19 A, Vinverter = 240 VAC

Operating status: operating since 2013

Inspection status: likely inspected

Designed and drawn by: electrical contractor specializing in PV systems



Drawing Credit: confidential

Note: This electrical contractor has made similar drawings for other of their PV systems in Edmonton.

List of inspection issues: _____

List of design issues: _____

List of drawing issues: _____

Item #40. Edmonton, house (same PV company as in Item #39)

PV array size:	5.5 kW
Electrical specs:	not known
Operating status:	operating
Inspection status:	likely inspected
Designed by:	electrical contractor specializing in PV systems

AUC
Alberta Utilities Commission

MICRO GENERATOR APPLICATION
Appendix - E

APPENDIX E – SINGLE LINE DIAGRAM

The following 2 Single Line Diagram forms are for your use. Submit one of the following forms with your MG Application.

SLD #1

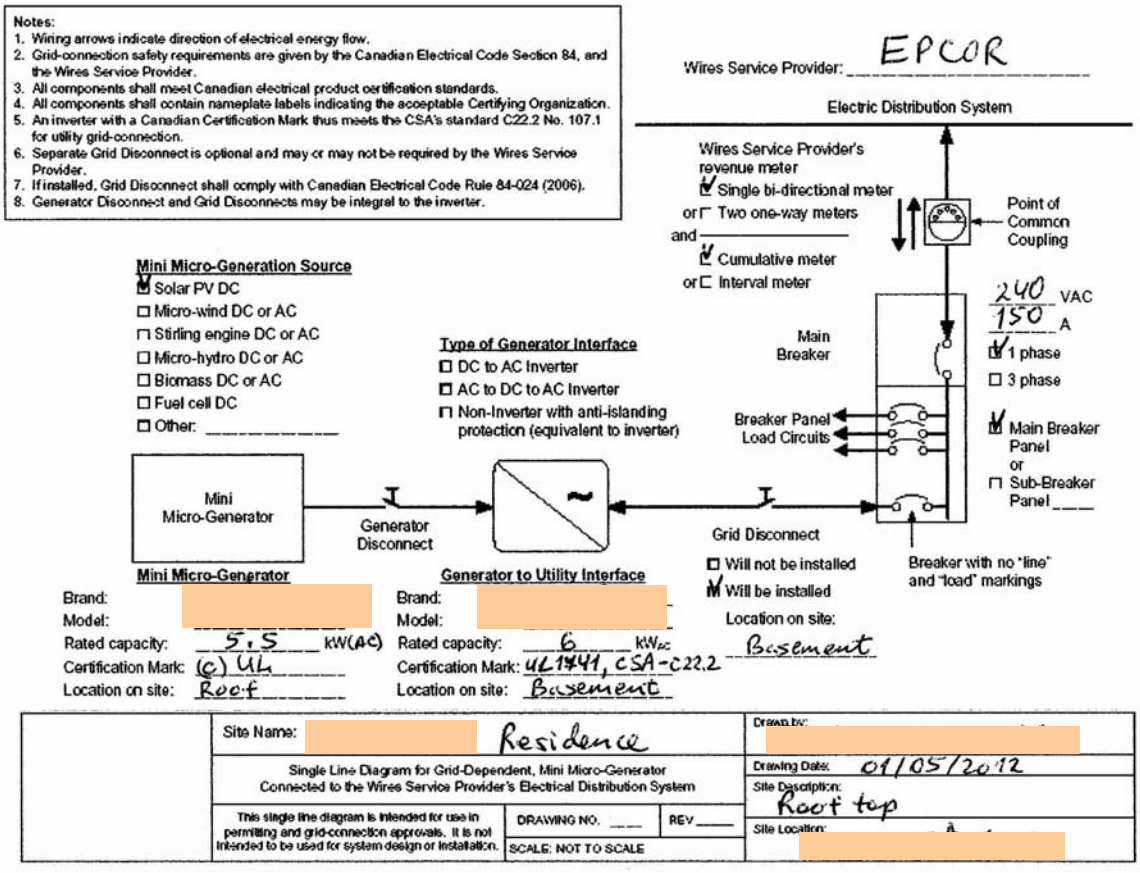


Diagram Courtesy of Howell-Mayhew Engineering

List of inspection issues: _____

List of design issues: _____

List of drawing issues: _____

Item #41. Strathcona County, house

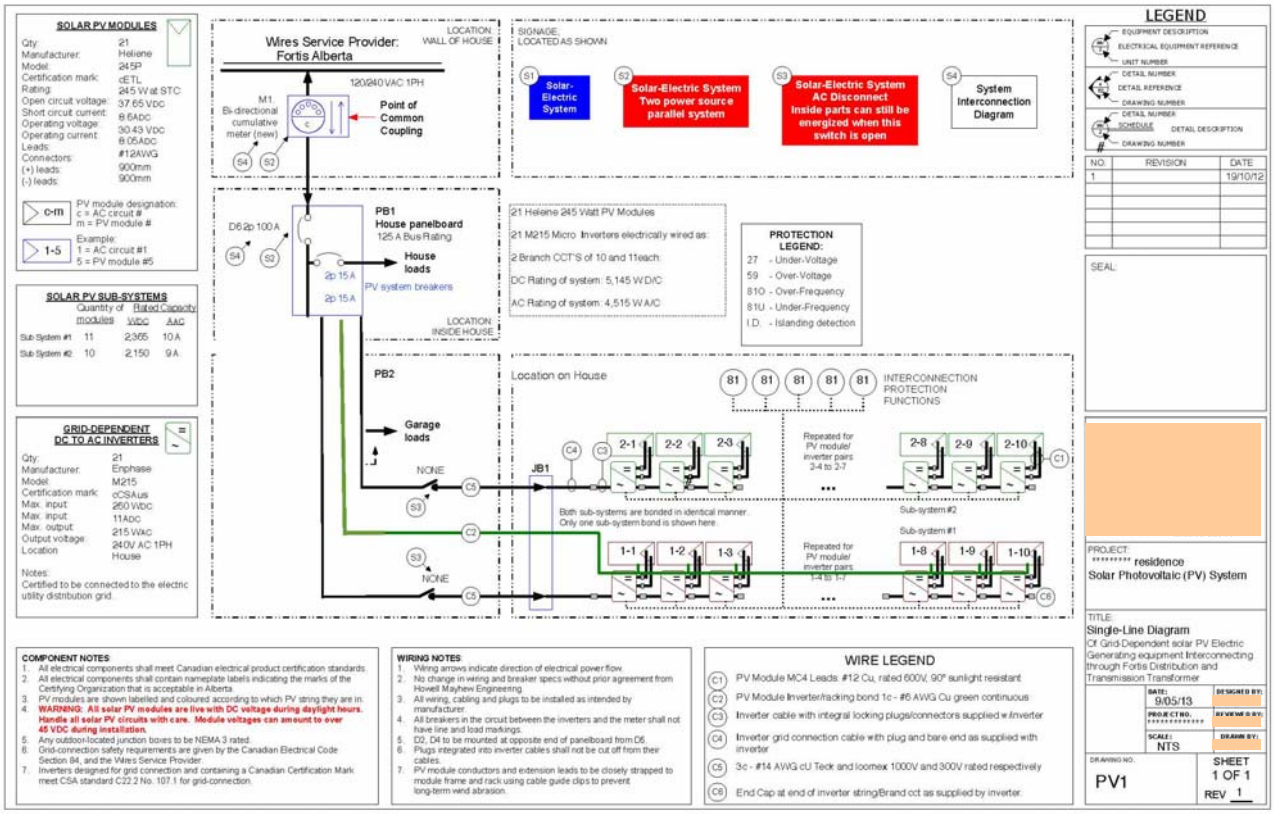
PV array size: 4.5 kW

Electrical specs: Vinverter = 240 VAC

Operating status: likely operating

Inspection status: likely inspected

Designed and drawn by: original: professional engineer specialising in solar PV systems; copy: electrical contractor specializing in PV systems



Drawing credit: original: Howell Mayhew Engineering. This **copy**: electrical contractor

List of inspection issues: _____

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List of drawing issues: _____

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Item #42. Old Crow, Yukon (federal government building)

Electrical specs: Vcable = 240 VAC

Operating status: operating since 2012

Inspection status: not (permit? not)

Installed by: handyman

Photo credit: Gordon Howell

List of inspection issues: _____