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Initial analysis of a 22-year old PV system in Quebec, Canada

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Introduction

Installed in 1992, the 23.5 kW PV array near Montreal, Quebec is possibly the oldest continually monitored PV system in Canada. The climate is temperate, with low temperatures, significant snow falls and freeze-thaw events in winter, and high temperatures in summer. With a growing PV industry, it is important to have data to support 20 year+ estimated lifetimes for both PV modules and the entire system. A basic visual inspection of all modules was completed, and seven modules representing various observations were removed for further analysis. This poster presents these observations. Further inspections of the 22 year old modules are underway, including analysis of monitored performance data.

CanmetENERGY PV System, Varennes, QC, Canada

Initial year of operation:	1992	**Encapsulant:**	EVA
Location:	Montreal, Canada	**Backsheet:**	PVF/PET/Tie Layer
# of modules:	552 inspected	**P_{max}:**	42.6 W
System size:	23.5 kW	**Cell Efficiency:**	10%
Mounting configuration:	Roof Open Rack	**Date of inspection:**	December, 2011
Cell type:	Monocrystalline Silicon (some poly)	**Max. System Voltage:**	600 V
Module Manufacturer:	Astropower Canada	**Fixed tilt or tracking:**	45 degrees, fixed tilt

System degradation over years

- Visual inspection after 20 years revealed 21% of modules had backsheet delamination and 10% had visible cell corrosion and encapsulant delamination (without encapsulant discoloration). Snow (load or freeze-thaw) may have contributed to minor frame loosening or bowing allowing moisture to penetrate the module laminate.
- Upon inspection of the system, seven modules were selected for further study. Two modules were in good conditions, two had junction boxes hanging, one was heavily corroded, and two had delaminated backsheets.
- Relative change from original IV measurement, for six modules:

  P_{max} Range: -10% (-0.5%/yr) to -26% (-1.3%/yr)

  Average P_{max} : -18% (-0.9%/yr)

  Average I_{SC} : -11%

  Average V_{OC} : -3%

  Average FF : -5%

  Power loss is mainly a function of I_{sc}

Results Summary

a. Modules with low to moderate power loss exhibit uniform degradation and diode hot spots.

b. Modules with high power loss exhibit visible encapsulant delamination, cell corrosion, and diode hot spots.

c. Module manufacturing inconsistencies are borne out over time as observed through inhomogeneous degradation in side-by-side outdoor exposure.

d. Inter-related module subcomponents undergo concurrent phenomena, which can make the lifetime of any one component limited by a different component's failure mechanism or stress, such as edge seal, frame, and adhesive.

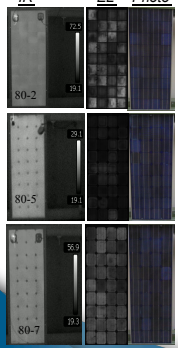
e. Framing (screws) and edge seal gaskets may have loosened, initiating cell corrosion and backsheet delamination

c

Inhomogeneous cell corrosion

Inhomogeneous backsheet delamination

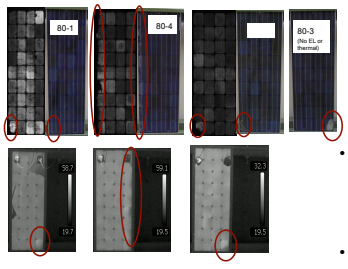
a



	P_{max}	I_{sc}	V_{oc}	FF
80-2	11%	9%	2%	1%
80-5	17%	12%	4%	2%
80-7	10%	6%	3%	1%

- Diodes exhibiting hot spots
- No encapsulant discoloration or cracked cells

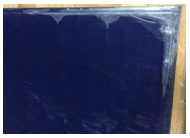
b



	P_{max}	I_{sc}	V_{oc}	FF
80-1	18%	15%	1%	3%
80-3	Not functional			
80-4	24%	15%	4%	8%
80-6	26%	12%	2%	14%

- Four modules visible encapsulant delamination and cell corrosion correlate with highest power loss (a function of Isc and FF).
- Diodes exhibiting hot spots.
- No encapsulant discoloration or cracked cells observed.

d



e

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