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Sustainable Technology Evaluation Program

Implementing IEC 61853 in Canada:
A Study of Common PV Operating Conditions in Ontario
Overview

- Introduction to STEP
- Background
  - IEC 61853
- Aims
  - Evaluating IEC 61853 Testing Points
- Method
  - PVSyst Simulations
- Results
- Conclusion
Introduction to STEP

- Sustainable Technology Evaluation Program
- Branch of TRCA
- Industry-level research supporting the dissemination of sustainable technologies in Ontario and beyond
- Funded by government, NGOs, industry and academic partnerships
- Education, Outreach, Training
Introduction to STEP

May 14 to 16, 2014

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Background – IEC 61853

- Common Rating
  - Standard IEC 61215 (and IEC 61646)
    - STC Conditions 25°C; AM 1.5; 1000 W/m², etc.
    - $P_{\text{MAX}}$, $V_{\text{OC}}$, $I_{\text{SC}}$, Temp Coeffs., NOCT

- To predict energy (profit) yield – simulate
- From limited data, assumptions are made regarding the performance at different:
  - Irradiance levels
  - Module temperatures
  - Incidence angles
  - Wind speeds (thermal model)
  - Variations in spectrums
Background – IEC 61853

- Effect of irradiance level on efficiency [2]
Background

- IEC 61853
- Addresses these assumptions via additional performance measurements
- Introduces matrix of 23 testing points
- Suitable for Ontario/Canadian climate?
Aims

- STEP was funded by NRCan to complete multi-phase study concerning development of IEC 61853 for Ontario and Canadian climate
- **1st Phase: Compare Ontario/Canadian climate with IEC 61853 test points – are they suitable?**
- STEP commissioned SAIC (now Leidos) to complete that phase of the study
- STEP focus thus far has been on implementing monitoring infrastructure for tracing IV curves according to test matrix and acquiring data
Evaluating IEC 61853

- Representative 100 kW ground mount and roof mount PV system simulated in PVSyst for 13 different locations in Ontario
- Climate data from Canadian Weather for Energy Calculation (CWEC) data files
- Output: hourly data for plane of array solar irradiance, module temperature and array energy produced over TMY
Results – Ground Mount

Operating Condition Frequency of Occurrence: Ground Installs (Ontario)

POA Irradiance [W/m²]

Module Temperature [°C]
Results – Roof Mount

Operating Condition Frequency of Occurrence: Roof Installs (Ontario)

Module Temperature [°C]

POA Irradiance [W/m²]

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Results - Overall

Array Output (% annual production)
Ground and Roof Mount

IEC 61853 Test...
Results

- Over 26 (13 sites x 2 installations) simulations:
  - 23% of all energy is produced below 15 °C
  - 10% of energy is produced below 5 °C
  - Several high temperature points never occurred
  - Worst disagreement was for Timmins
  - 33% of energy produced is below 15 °C
  - Require new test points at 0 °C
  - Some high temperature points unnecessary

![Results Table]

<table>
<thead>
<tr>
<th>Module Temperature</th>
<th>100 W/m²</th>
<th>200 W/m²</th>
<th>400 W/m²</th>
<th>600 W/m²</th>
<th>800 W/m²</th>
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<td>12</td>
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<tr>
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<td>25</td>
<td>24</td>
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</table>

Legend:
- Not required
- Additions
- Optional
Conclusion

- IEC 61853 allows for more accurate energy yield predictions via expanded testing
- Investigated if testing points are suitable for Ontario
- Simulated representative PV installations
- 23% of energy produced below testing matrix points
- Suggested changes to IEC 61853 matrix for Ontario climate
- **Future work** – use experimental data to inform development of performance metrics from results of IEC 61853-1 and -2
Acknowledgments

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- Leigh St. Hilaire of STEP – Project manager
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References
