Theoretic expected performance ≠ actual operational performance

- Pro-active maintenance requires accurate anomaly detection and alerting
- Accurate anomaly detection requires an accurate model of expected field system behaviour
- Theoretic PV system models are based on up-front assumptions, not behaviour in the field

How to assess the real expected behaviour of a well-functioning PV array?

Several options with different qualities:

<table>
<thead>
<tr>
<th>PAN files</th>
<th>IV curve tracer</th>
<th>Operational data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Characterisation</td>
<td>Lab up-front</td>
<td>Field continuously</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Low</td>
<td>High (potentially)</td>
</tr>
<tr>
<td>Methodology</td>
<td>Well defined</td>
<td>Various</td>
</tr>
</tbody>
</table>

→ Operational data is very well suited for PV array characterisation ... but a good methodology is lacking!

Methodology and results

- Define physical models of MPP voltage and current as a function of the environment
  - Problem: link between MPP models and IV curve models not well described
  - Problem: present MPP regression models do not reflect physics well!
- Train coefficients of physical models with operational data
  - Problem: coefficients are correct only when physics are reflected in model!
  - Partly circumvented by training on high irradiation hours only

- Analyse differences between theoretic and trained model parameters
- Analyse differences between measured, modelled and theoretic performance

3E Health Scan methodology

Conclusions

- Pro-active maintenance requires accurate models of expected PV behaviour
- Accurate MPP models would ideally be created and updated using operational data
- 3E Health Scan methodology provides insight in root causes of performance losses

Acknowledgement

This work received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 308991.