PID SOLUTION

SECURE DETECTION AND SUCCESSFUL HEALING OF POTENTIAL INDUCED DEGRADATION
PID FULL SERVICE PACKAGE ELIMINATES OUTPUT LOSSES IN PV INSTALLATIONS

The service and technology companies SUNCYCLE and PADCON are now offering a joint all-in-one service package which detects and eliminates potential induced degradation (PID).

The PID effect occurs in crystalline photovoltaic modules and directly leads to output losses. If not treated in time yield losses of up to 90% are the consequence. The SUNCYCLE and PADCON strategic partnership offers plant operators all necessary services from a single source: beginning with PID detection to the sustainable regeneration.

With our professional solution even seriously degraded modules recover to their nominal output in few weeks time. SUNCYCLE and PADCON have a proven track record with PID in all parts of the world. Protect your investment and contact us for more information.

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Potential induced degradation (PID) is a phenomena that has only recently become a concern in the photovoltaic industry. PID impacts the ions of a solar cell and results in the degradation of the module output.

PID can significantly reduce the power output of a photovoltaic (pv) module. Power losses as high as 70% in the first 18 months are not uncommon. With the slow developing degradation PID can significantly impact your power output before it is detected.

Potential induced degradation is often seen as a module defect but re-quires changes at system level. The occurrence of PID depends mainly on the electrical configuration of the system and module design/con-struction. However system voltage, temperature, humidity and irra-diance also contribute to the occurrence of PID.

Protect your investment by following the described four step approach offered by SUNCYCLE and PADCON.

At the signing ceremony: CEOs of Suncycle and PADCON Dr. Mischa Paterna and Constantin Wenzlik

Measurement: output Performance: 58%

Measurement: after 6 weeks Performance: 85%

Measurement: after 16 weeks Performance: 100%
SUCCESSFUL PROBLEM SOLVING STARTS WITH THE RIGHT ANALYSIS

PID detection requires not only the right measurement equipment but also experience in the subject. SUNCYCLE has extensive experience in PID with over 50 MWp of regenerated capacity. PID is a slowly developing problem affecting first the modules at the minus pole of the string. Surrounding conditions of the installation affect the PID problem and can accelerate the degradation. Detection is best performed through lab-grade electroluminescence test. SUNCYCLE has especially developed the CTU flexEL for in-situ EL-test. The CTU flexEL not only offers a high resolution but can also be used during day time. Early detection assures minimum yield loss and faster recovery. Investors should sensitize their O&M companies to have a close look at performance data. In case of yield loss sample tests of affected strings should quickly be authorized. SUNCYCLE can also assist with data analysis.

Suncycle Solar Services
Elektrolumineszenz- und Leistungstest vor Ort
STC-Leistungsmessung | EL ohne Moduldemontage | EL bei Tageslicht | hochauflösend | Gutachten

1. PID-DETECTION

CTU COMPACT TEST UNIT

The PADCON Float Controller offers a practical alternative. It allows the operation of a non-earthed system whilst simultaneously combating the PID effect. Thanks to single-fault tolerance, the PV system creates a higher yield than an earthed system, whereby the earth short-circuit results in an immediate yield loss.

The PADCON Float Controller can be installed both in new systems as well as in existing systems. The product range offers an appropriate solution for all types of inverters.

PADCON DELIVERS SUPERIOR FUNCTIONALITY AT ATTRACTIVE PRICING

<table>
<thead>
<tr>
<th>Grounding</th>
<th>„PID-Boxes“</th>
<th>PADCON Float Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant PID protection</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Recovery-effect</td>
<td>partially</td>
<td>✓</td>
</tr>
<tr>
<td>Easy to retrofit</td>
<td>✓</td>
<td>partially</td>
</tr>
<tr>
<td>Inverter independent</td>
<td>✓</td>
<td>partially</td>
</tr>
<tr>
<td>One-error tolerance</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>String inverters</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Central inverters</td>
<td>✓</td>
<td>partially</td>
</tr>
</tbody>
</table>
3. PLANT RECOVERY

Successful plant recovery is well documented from our installed references. In this example we have compiled the output data at string level to demonstrate the effect.

Since the inverter has 5 individual performance parts, PADCON installed in addition to the Float Controller CI 30, a Multi Connector, to supply all the power units / MPPT.

In addition to the comparison measurements at each string package, PADCON recorded or documented the recovery development of the photovoltaic plant through the monitoring system. By connecting the Float Controller with the monitoring system, we could easily supervise the individual parameters and the operation of the device.

It is interesting to note that in this reference installation the individual strings packages returned to the same proficiency of performance (PR) within the same time even though their original level of degradation was different.

Following the successful tests the entire system was equipped with PADCON Float Controllers and performs since then at a very high level (> 83% PR).

To secure the achieved recovery and to prevent future degradation the PID protection process needs to be permanently implemented. The installed float controllers are robust in the field and supported by our nationwide service network.

The lasting effect of the “PID Killer” should be ensured by an ongoing monitoring. Aside from the observation of the PID effect through professional monitoring the customer receives an early warning system to identify all possible kinds of incidents of the pv-plant.

As international companies with immaculate reputation - certified by renowned banks and insurance companies - SUNCYCLE & PADCON guarantee a professional service level to permanently protect your pv investments.

### Test set up:
1x Central inverter | 1x PADCON Float Controller CI 30 | 1x PADCON Multi Connector

### PV-Plant:
3,0 MW | Central inverter | 5 DC input / 5 MPPT | 245W / polycrystalline

### String / String package
<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67,36%</td>
<td>84,11%</td>
</tr>
<tr>
<td>2</td>
<td>64,36%</td>
<td>83,18%</td>
</tr>
<tr>
<td>3</td>
<td>67,68%</td>
<td>83,16%</td>
</tr>
<tr>
<td>4</td>
<td>72,43%</td>
<td>83,30%</td>
</tr>
<tr>
<td>5</td>
<td>70,18%</td>
<td>84,50%</td>
</tr>
</tbody>
</table>

### String / String package

90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %

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4. PROTECTION & MONITORING

PERMANENTLY SECURING OF HIGH YIELDS

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# ADDRESS AND CONTACT

<table>
<thead>
<tr>
<th>Company</th>
<th>Address</th>
<th>Zip Code / City</th>
<th>Country</th>
<th>Phone Number</th>
<th>E-Mail</th>
<th>Website</th>
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</thead>
<tbody>
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