String monitoring in practice – characteristic of errors in a large scale PV plant

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1. Introduction – progress report from a 2 MWp PV power station in Murcia, Spain

In large scale PV systems errors and reductions in power are often not promptly detected due to missing monitoring equipment. Such undetected errors reduce the current yield and thereby also the return for the system operator. Effective system maintenance and monitoring keeps running costs low and ensures that maximum yield is achieved.

In a previous investigation three typical failure characteristics of large scale PV plants have been identified by the example of a 2 MWp PV power station in Murcia, Spain.

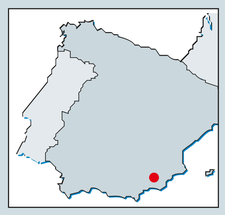
The failure types have been the following:

1. Errors which have a minimal effect on operation.
2. Errors which sometimes affect operation.
3. Errors which result in total failure.

This further work will especially point out the occurrence rate of the error type two. This type of error has

- the most frequent occurrence
- is clearly detectable by string monitoring
- is not clearly detectable by other supervision facilities like e.g. included monitoring in central inverters

The investigation is related to the same PV plant in Murcia, Spain as the previous work but over a timeline of six month.

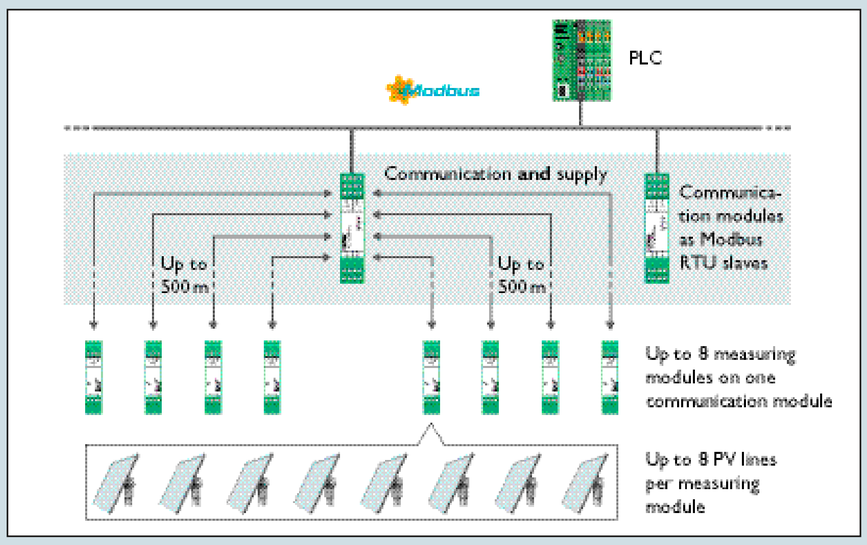


2 MWp system in Murcia, Spain

2. Measuring technology and structure – the SOLCHECK PV string monitoring solution

String current measurement:

The current generated by a solar module is directly related to the total insolation. An insolation sensor in the vicinity of a PV module provides an indication of the expected current yield in relation to the error-related deviation. Contact-related errors are also noticeable as altered currents. The modular structure enables reliable coverage of large distances and clear assignment of data to the appropriate strings.



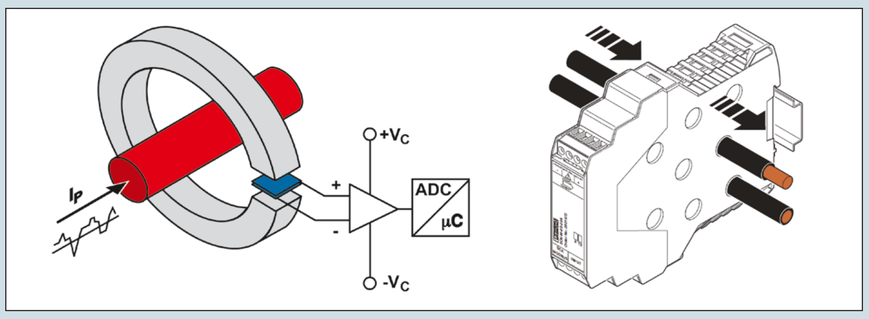
Solarcheck networking concept

Measuring technology:

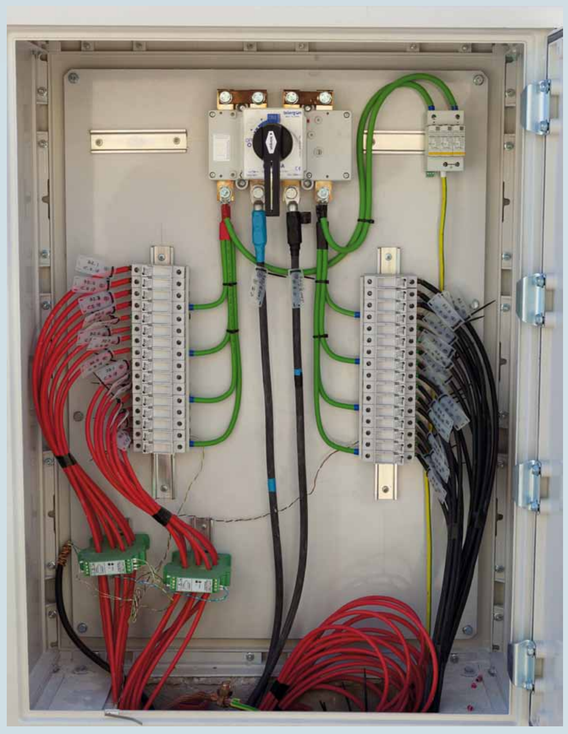
- 8 measuring channels per measuring module, according to the Hall sensor principle
- The string cabling is routed through the measuring channel, measuring is contact-free.

Each measuring channel is surrounded by a magnetic core. This absorbs the magnetic field generated by the current flow from the string cabling.

The Hall sensor, positioned vertically in a gap in the magnetic core, generates a corresponding current signal according to the strength and direction of this magnetic field. This signal is thereby in proportion to the string current and is used for evaluation purposes.



Current measurement principle using a Hall sensor



String box with Solarcheck monitoring

3. Error characteristics and how to respond – detected by the permanent string current monitoring

Type 2 – errors are errors which sometimes affect operation. Examples:

- Tripped string fuses
- Inverter failures (scale: 10 kW inverter in 1000 kW system)
- Premature switch off of system components due to suboptimal inverter design

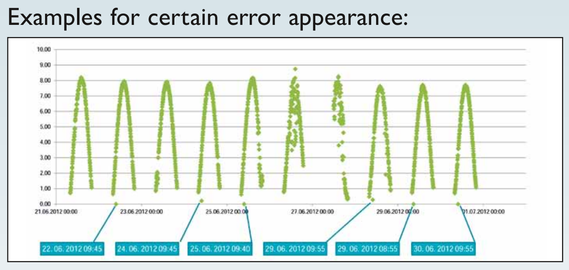
Impact of the errors: The system (partially) continues to operate, minor financial losses.

Nominal response: 24 hours, the benefit of immediate action is usually compared with the cost of potential losses.

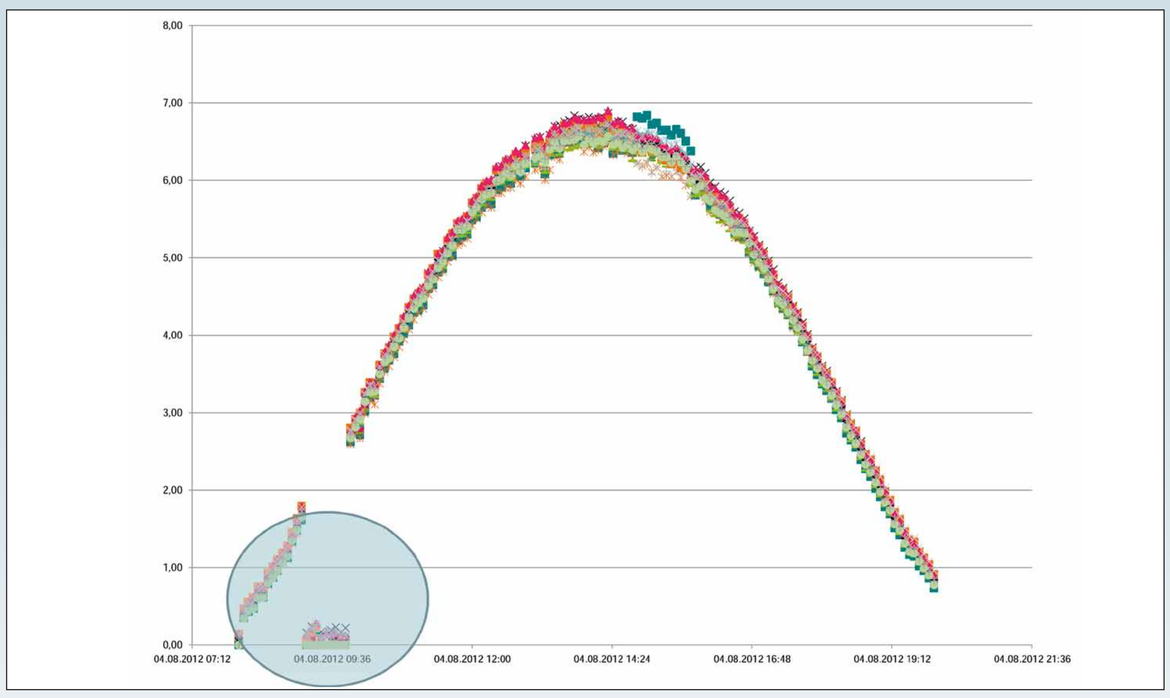
Typical response: 1 hour

Error rate estimation: 20 times a year

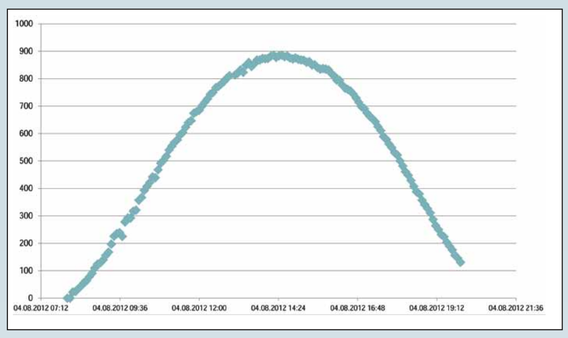
Examples for certain error appearance:



Recurrent drop of string current between 08:55 am and 09:55 am



40 minutes string defect



Irradiance and string voltage as a reference

4. Conclusion

The example case demonstrates that maximum yield is achieved by effective system maintenance and monitoring, and ensuring running costs are kept to a low. In the case of a PV system of this size, it is both advisable and financially beneficial to monitor the system beyond the specified functions of the inverter.

Especially type two errors which have a minor impact on the effectiveness of the System can be clearly detected and promptly rectified. The single impact of each type two-error is low but the error rate shows clearly the necessity of detecting those errors promptly.

The operating information provided on the strings significantly improves troubleshooting, causal research, and detecting where failures and reduced output are occurring.

The ability to react faster and improved troubleshooting notably increases system effectiveness.

Expression of thanks

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