ADVANTAGES OF USING HIGH RESOLUTION, CONTINUOUS POWER QUALITY RECORDER / ANALYZER IN SOLAR FARMS

OVERVIEW

As there are more and more Wind Turbine and Photo Voltaic manufacturers for energy producing farms worldwide, there is a growing need for continuous power quality monitoring at the Point of Common Coupling (PCC). Monitoring PQ has technical, economical and legal implications.
Electrical parameters fluctuates continuously and depend on many factors such as

wind and sun. Installing Continuous, high resolution recording and monitoring devices in PCC location enables the utility and/or the farm operators to ensure compliance with

range, can still be a source of problem to the energy producers and consumers which many times are a source for power quality investigation and thorough post event

analysis.

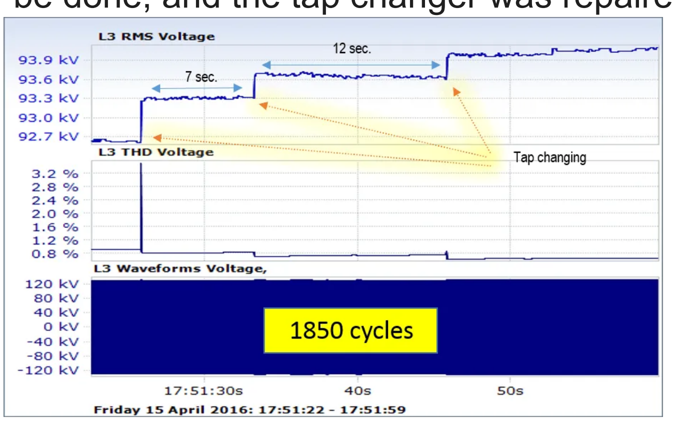
The ideal way for analyzing the above abnormalities is the use of a Class-A power quality analyzer capable of continuously recording & retaining all network parameters for a long period of time at a high resolution, including waveform. This kind of PQA should enable the investigation and presentation of all electrical parameters based on the applicable industry standards. This PQA should serve as a "Black-Box" used in airplanes. It will record all data as mentioned above without the need of setting up triggers or thresholds.

The following are examples of data recorded by a continuous high resolution PQA at a PCC location in Photovoltaic Farms. These measurements show anomalies that are still within the standards but thanks to the specific Elspec PQA capabilities, these occurrences can be observed and analyzed.

TRANSFORMER TAP CHANGING

The customer reported transformer taps changing on DATE. When this occurred, the measurements showed that during the operation of a tap change in HV, the voltage changed by approximately 0.5%. This change level cannot be recorded since it was far away from any threshold level used for recordings. What this means is that the event was not recorded. It also should be noted that in term of power quality, this event was not deemed significant. Figure 1 shows three steps presenting three voltage levels.

Zoom-in at the first step shows that the voltage was also distorted. This indicates a potential problem in the tap changer. This information triggered maintenance activity to be done, and the tap changer was repaired as a result.



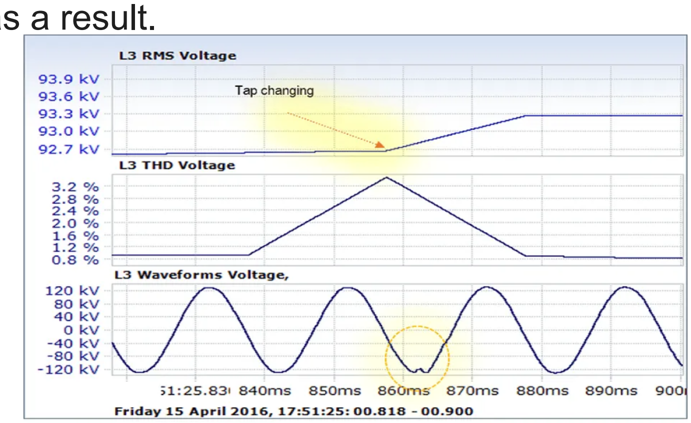


Figure 1: Records of tap changer operation in three steps

Figure 2: Zoom in on the first change

CONSEQUENT VOLTAGE DROPS

Figure 3, shows recording of 3 phase high voltages and currents of a photo-voltaic system. In these measurements one can see two consequent voltage drops . The values in the graph are RMS values based on a cycle by cycle basis.

There are two consecutive 3 phase voltage drops (420 ms apart), each one for approximately 520ms. None of them exceeded more than 90% drop from the nominal voltage.

During the first drop, the current also dropped by some 50% and returned to almost the same as it was before this drop. The second voltage drop did not exceed the 90% drop level; however IT SHOWS that during this period the current changed and continue dropping although the voltage drop did not exceed the permitted level.

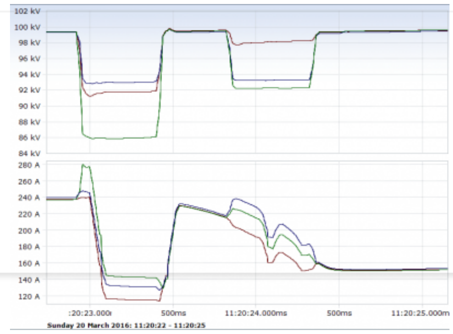


Figure 3: Voltage and Current changes in a photo-voltaic farm recorded in HV during 3 seconds window

VOLTAGE CHANGES AS A RESULT OF PROBLEMS IN THE PHOTO-VOLTAIC SYSTEM

This example illustrates the effect of the generated power (KW) on the voltage level in a 50KW photo-voltaic system connected to a LV network. Daily fluctuations of power

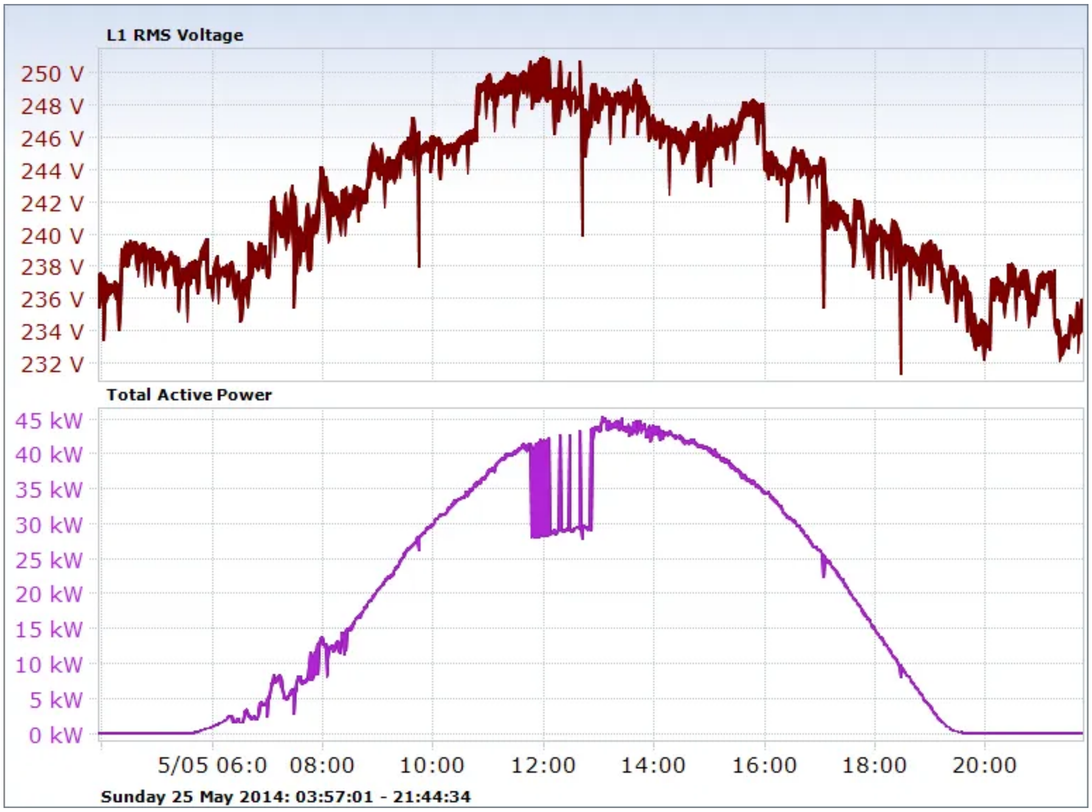


Figure 4: daily changes of power

In order to better understand the changes, we zoomed in to 5 minutes range as can be seen in Figure-5.

When the voltage is ranging between 250.2 V to 250.6V, the converter's power is going down from 41 KW to 28 KW and as a result the voltage is going down by 1.7V. After one minute, the power is going up again and the voltage is followed suite. When the voltage is reaching up to a 250.2 V again, the power decreases immediately to 28 V. In order to better understand the process of these changes.

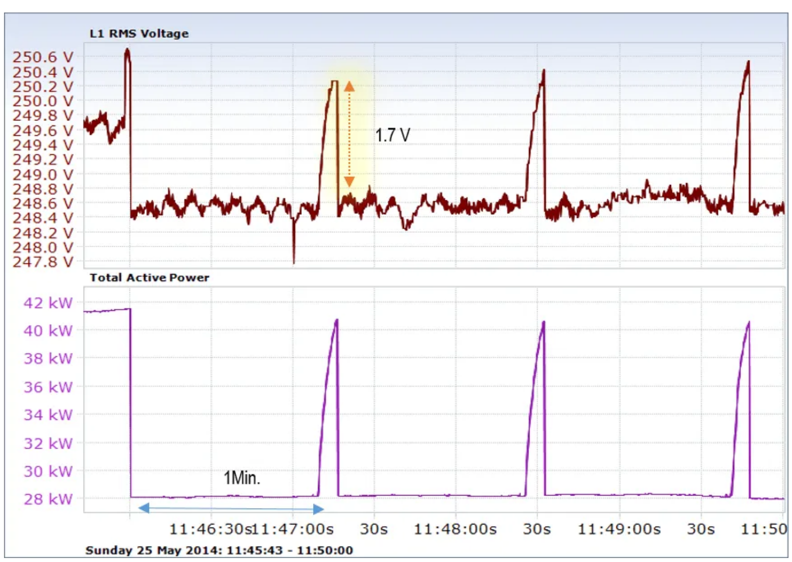
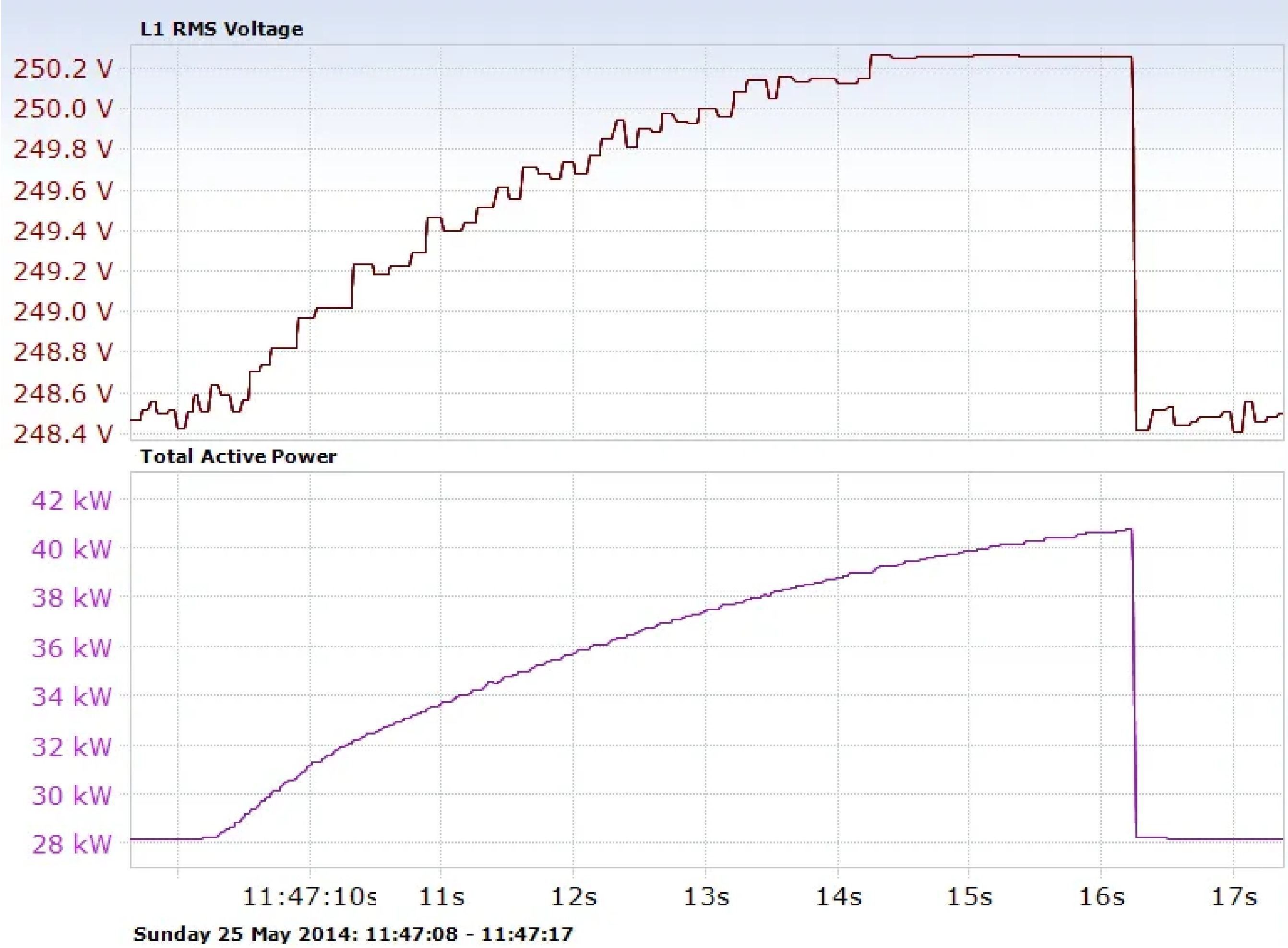


Figure 5: five minutes zoom in of the daily

we zoomed in to 9 seconds window as shown in the following Figure – 6. The shape of voltage and power raise is caused by a malfunctioning of the photo-voltaic system that causes unnecessary voltagE changes.


L1 RMS Voltage
250.2 V
250.0 V
249.8 V
249.6 V
249.4 V
249.2 V
249.0 V
248.8 V
248.6 V
248.4 V
Total Active Power
42 kW
40 kW
38 kW
36 kW
34 kW
32 kW
30 kW
28 kW
11:47:10s
11s
12s
13s
14s
15s
16s
17s
Sunday 25 May 2014: 11:47:08 - 11:47:17