A. Eberle Info Letter No. 24

Integration guide for the measurement of a generation plant according to Requirements for Generators (2016/631) RfG

After the expiration of the transitional periods for the certification of generation units according to the VDE connection guidelines in the German area, numerous questions repeatedly arise regarding the correct installation of the required fault recorder system to prove conformity according to the European Directive for Generation Units (2016/631). The following guide should help to become aware, on the one hand, which special features are required and, on the other hand, which components should be selected for a functioning system.

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Proof with highly accurate measurement technology is necessary

Planning errors in the construction of large-scale generation units often lead to increased costs and a delay in certification. Admittedly, this can also be traced back to a very complex subject. According to chapter 6.4 of VDE-AR 4110, fault recording and the monitoring of power quality is recommended for transfer stations in justified cases. For systems in the individual verification procedure, the requirement is formulated in more detail. In that case, a recorder must be installed in order "to be able to continuously check the requirements for dynamic grid support in live operation, if the fulfilment of the requirements for dynamic grid support could not already be proven by measurement during commissioning" [standard excerpt from VDE-AR 4110]. This measurement proof must, of course, be provided using highly accurate and suitable measurement technology tested in accordance with the standard.

The individual verification procedure required for some systems with the installation of a fault recorder for compliance monitoring, which must be carried out by an accredited certification body, demands a high degree of coordination between all involved players. First, the right measurement technology, which fulfils all requirements, should be selected for the verification procedure. Furthermore, the know-how for the correct installation of the measurement technology is required. In addition, certain requirements for the transducers used must be taken into account, as well as the necessary verification to ensure the required accuracies (DAKKS calibrations) of the technologies used. With regard to the subsequent compliance monitoring, a semi-annual data exchange that is easy to implement must be ensured.

This guide provides a practical overview of the most important components for ensuring and assisting a reliable measurement chain.

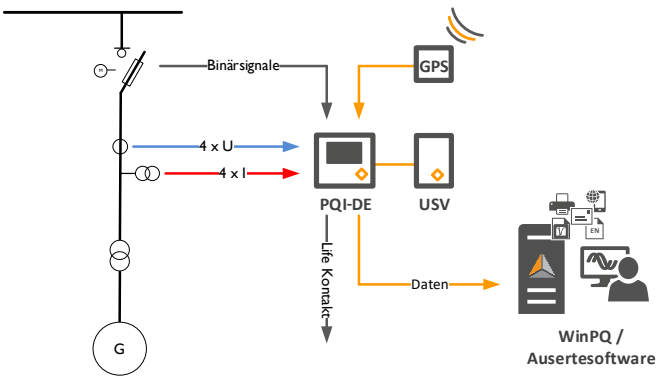


Figure 1: Required components for a generating plant in the individual evidence procedure

Requirements for the fault recorders

According to Annex F of the connection guideline, the fault recorder requires a certification according to Class A of IEC 61000-4-30 (Ed. 3) in order to guarantee the safety and accuracy of the measurement. Annex F asks for a sampling rate of the recorders to be at least 1 kHz. However, for the evaluation of the suprahar-monics of voltage and current in the range of 2-9 kHz frequency bands, which are subdivided into 200 Hz bands according to DIN EN 61000-4-7, it is indispensable to provide higher sampling rates for the measurement. In order to be able to carry out the required measurement according to FGW TR 3, a minimum sampling frequency of 20 kHz is therefore required. To ensure consistent data recording even in the event of a fault and power failure and to document the reaction of EZA even in the event of a power failure, a UPS system for the measuring device and the additional components, such as the communication infrastructure (switches, gateways, servers), is recommended in any case. Of course, there should be no loss of parameters and data in the power quality measuring device used, even in a powerless state. This must be guaranteed by the measuring device and the setup. Reliable data is required above all in the event of a fault. Time synchronization in particular plays a relevant role in this context. Therefore, an external synchronization, for example via GPS, is necessary, which guarantees a maximum accuracy in the overall system of up to 25 µs. The accuracy of the entire measurement chain is of great importance in the detection process. However, the accuracy of the measurement result does not only consist of a high-precision measuring device with a maximum deviation of 0.1% and the corresponding verification, but the total error of the complete measurement chain is significantly influenced by the transducers used. Thus, for example, the transformers used must also be capable of transmitting supraharmonics without error. In the medium and high voltage range, a wide variety of transformers are already available on the market, which can also transmit frequencies in the 2-9 kHz range with deviations <0.1%. Particularly in DCA systems with DC-link controlled supply, the dominant clock frequencies are often responsible for feedback effects such as increased noise generation, as can be seen in Figure 2.

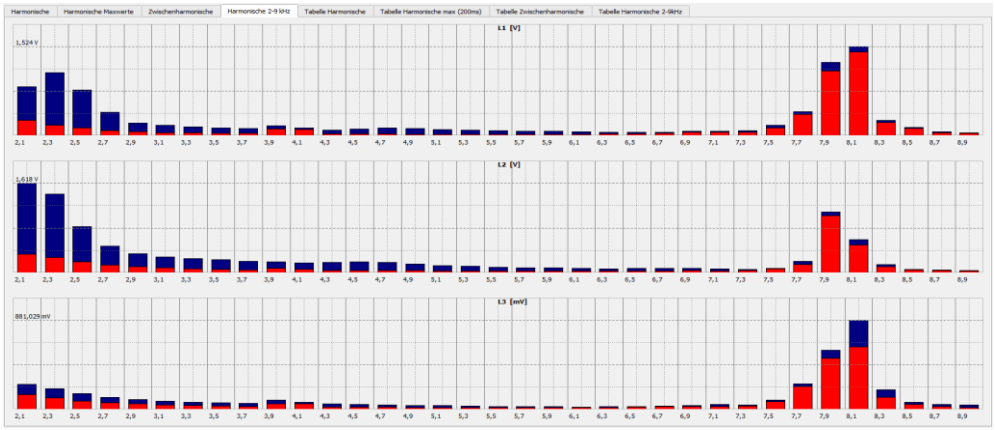


Figure 2: Fingerprint of a wind power plant in the range of 2-9 kHz

For this purpose, it is necessary for the fault recorder to support a wide variety of transducer technologies with regard to the input signals. For example, transducers that can capture the higher frequency range of 2-9 kHz are often equipped with outputs of 3.25 V / root 3 instead of 100 V / root 3. In any case, the impedance ratio between transducer output and encoder input must be matched. It is therefore necessary to check the respective impedance requirements before procurement and to clarify the necessary data for the measuring instrument and the selected measuring input in advance with the supplier of the transducer to be used.

Measuring with sensors – Simple and highly accurate!

The PQI-DE supports a wide range of combinations and installation situations, both in the area of voltage measurement and through the diverse possibilities of current measurement, also in the area of retrofitting, e.g. through the highly accurate Rogowski inputs for current measurement.

- 100 V 2 MOhm || 25 pF
- 100 V / 400 V / 690 V 10 MOhm || 25 pF
- 3,25 V 2 MOhm || 50 pF for small signal transducers according to IEC 61869-11 (SELV)
- 4 current inputs for transducers 1 A/5 A (MB max. 10 A)
- 4 Current inputs for protection transformers 1 A/5 A (MB max. 100 A)
- 4 Current inputs for Rogowski clamps (350 mV Input)
- 4 AC current inputs for current clamps (0,5 V Input AC Converter)

DAKKS-Calibration is required

To ensure and guarantee the accuracies, a DAKKS calibration is required before delivering and installing the measuring device. The standard factory calibration is not sufficient for certification.

For this reason, A. Eberle GmbH & Co. KG an extended DAKKS calibration via a certified laboratory, also in the field of supraharmonics for the measuring instruments.

According to the connection guideline, the certification body has the task to evaluate the measurement data at least every six months. For this purpose, a simple and seamless data exchange must be ensured. Furthermore, the system must be able to provide an appropriate software solution to evaluate the data. It is important to use a system with simple, flexible and open interfaces, which can be adapted to the conditions and communication solutions on site.

System requirements

Simple: In the simplest case, data transfer from the measuring device to the certification body should be ensured by inserting a SD card and copying the entire internal memory. The reading into a power quality evaluation software works similarly in a plug & play procedure.

Flexible: From simple data transfer via insertion of an SD card to automated data transfer via mobile radio, SHDSL via Ethernet - always seamless, even with poor connection quality. Diverse and customizable system solutions should be possible.

Open: Comtrade or PQDIF as standards via IEC 61850, IEC 60870-5-104 or Modbus. The measuring instruments and the WinPQ system from A. Eberle GmbH & Co. KG have many open standard interfaces

and protocols for the transmission of measurement data.

WinPQ: Check Generation Plants for Conformity via FRT Curves Automatically

Generation plants have to conduct a dynamic grid support according to the European Grid Code. This requirement applies primarily in the event of faults and indicates that generating plants must meet the following requirements in the event of both symmetrical and asymmetrical faults in the grid:

- There shall be no disconnection of the generating plant in case of under- or overvoltage events within the specified limits according to plant type and (FRT curve).
- The requirement of grid support also applies in case of several consecutive faults
- The plants must support the grid voltage during the grid fault by feeding in a reactive current (reactive power). The reactive current must be provided in the positive-sequence system as well as in the negative sequence system according to the type of fault.

In order to check the requirement in the diverse systems, the WinPQ Power Quality system software from version V. 6.2 offers an optional AddOn for the automatic classification of the faults via the FRT curves already present in the system. It is possible to store each measuring point with an FRT curve corresponding to the plant type. On one hand, this offers the possibility to classify the faults directly over a period - e.g. one year (Figure 3). On the other hand, it also allows an active alarming. In this case, the system sends only one alarm to the plant operator or the appointed certifier via e-mail when the value falls below or exceeds the specified characteristic curve, as seen in Figure 4. In general, all curves for plant type 1 as well as for plant type 2 are invocable in the WinPQ.

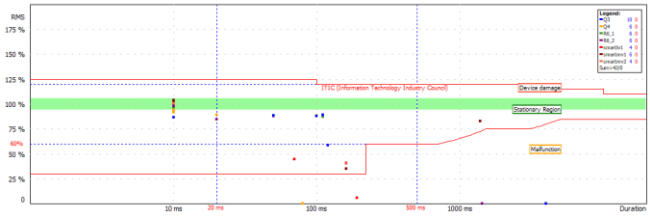
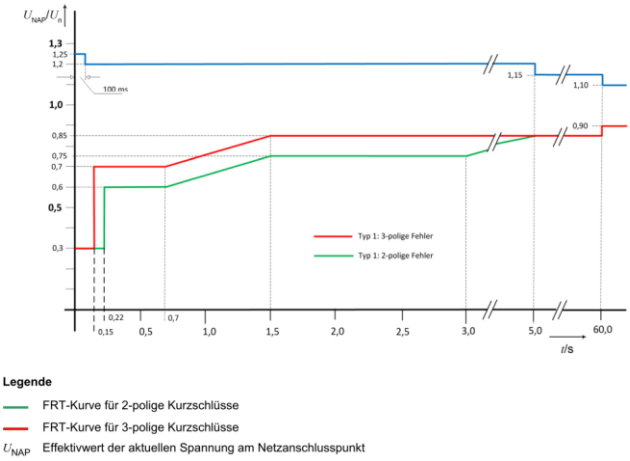


Figure 3: Interactive classification according to FRT curve type 1-2 pole error



Legende

FRT-Kurve für 2-polige Kurzschlüsse

FRT-Kurve für 3-polige Kurzschlüsse

U_{NAP} Effektivwert der aktuellen Spannung am Netzanschlusspunkt

Figure 4: FRT curve for plant type 1

It should be noted, that the FRT curves provide for an evaluation of the faults up to 60 s. Thus, the fault recorder used must be able to supply the measurement data as a 10 ms RMS value in any case and that in any case even in the case of several consecutive faults, as this is expressly required in the Grid Code. In this context, it is highly recommended that to calculate the RMS value in accordance with the IEC 61000-4-30 - Class A Ed. 3 standard in order to enable normatively comparable and uniform evaluations.

Example of an implementation of a DCA according to VDE-AR

The certification body involved in this project relies on an automated transfer of data in a standard Comtrade format for the automated evaluation of faults. Figure 5 shows that in the event of a network fault, the data from the fault recorder are recorded in the measuring device using the VDE-AR 4110 template approved by the certifier. Subsequently, the data is automatically generated by the WinPQ system software installed on-site (SSH) and sent directly to the server of the certification body. In an event of a fault, the server evaluates the data directly and checks whether the generation plant is functioning in a way that serves the grid.

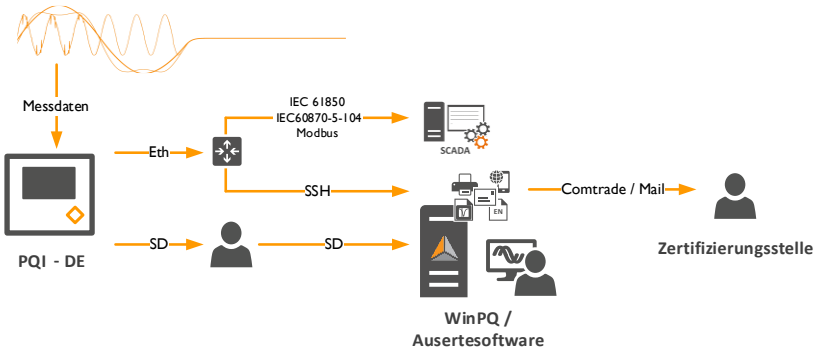


Figure 5: Implementation of a generating plant according to VDE-AR

The customer also has the option of displaying and evaluating the measured power quality values via a clear report at any time. In the event of communication difficulties due to a non-buffered network, the customer has the option of reading the data directly from the measuring device via SD card and providing this data.

In parallel, the highly accurate measured values U, I, P, Q as well as the daily statistics of the PQ events are transmitted via a standard protocol - in this case IEC 61850 - to a SCADA system for on-site visualization and also alarming.

Conclusion

A high degree of cost savings and efficiency can be achieved for both the certifier and the operator of the generation plants by a uniform and coordinated procedure of all persons and companies involved.

We are happy to support you during this process with our safe and class A (Ed. 3) certified measuring devices PQI-DE and PQI-DA smart in combination with the power quality system software WinPQ as well as our experience in the field of services for the operation and installation of the measuring devices!

Contact us in good time before selecting the components - we will be happy to assist you.

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