Communication from the project consortium

“NAEEA+ – Grid and system protection for the optimal and safe integration of decentralised energy generation systems in the distribution grid”

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From September 2022 to June 2024, the NAEEA+ project carried out investigations regarding the need for external grid and system protection (German NA-Schutz, NA protection) for power generation systems (PGS) in low-voltage grids, with a focus on photovoltaic inverters. As every inverter already has an internal NA protection function, the core question of the project is whether additional external NA protection is required.

The NA protection (external or internal) disconnects generation systems from the grid if the voltage or frequency are outside the specified characteristic curves over time. The correct function and setting of the NA protection ensure that, on the one hand, the PGS are safely disconnected from the grid in the event of a local grid fault and, on the other hand, that the PGS behave correctly in the event of faults in the higher-level grid and are not disconnected "too early".

The Swiss Federal Office of Energy is funding the project through the pilot and demonstration programme (P+D programme, project number SI/502500). The project consortium consists of representatives from four academic partners (ETHZ, BFH, TU Graz, FHNW), the company Kühn - Netz und Systemschutz, Swissolar, the Association of Swiss Electricity Companies (VSE), the Association of Swiss Electrical Controls (VSEK), 18 distribution grid operators, Swissgrid and manufacturers of NA protection devices. In addition, the expertise of protection experts, inverter manufacturers and specialist groups from Switzerland and abroad was obtained through meetings and training sessions.

All project partners were actively involved in workshops, meetings and within individual work packages in order to identify concerns regarding NA protection and the potential consequences of a malfunction. In addition, surveys were conducted by the VSE, Swissolar and the VSEK to obtain the industry's perspective. Based on the findings, the following questions were formulated and analysed in four work packages led by the academic partners:

- What are the relevant standards for the NA protection function of inverters?
- What are the possibilities and probabilities of incorrect inverter settings and the consequences for the NA protection function?
- How does the practical disconnection behaviour of inverters with and without external NA protection differ in the event of short circuits, permanent voltage dips or frequency deviations?
- What is the effect on safe distribution grid operation if external LV protection is not used? Is there an increased risk of non-compliant behaviour, in particular continued feed-in after voltage loss and possible islanding?

The following **recommendations** were derived from the analyses:

1. Based on the experimental investigations, the risk of non-compliant behaviour with type-tested and correctly set inverters can be estimated as very low. All tested PV inverters fulfil the NA protection task with high quality and low risk of non-conformity when set correctly. The NA protection function (external or internal) also has no causal influence on the risk of stand-alone grid formation or further feed-in in the event of permanent voltage loss or high frequency deviations.

Therefore, in the low-voltage grid, the **use of additional external NA protection for PV inverters connected to the grid can be dispensed** with if the inverters have standard-compliant internal NA protection.

2. In order to minimise the risk of incorrect settings or incorrect installations as far as possible, it is recommended that distribution **grid operators define the requirements for PV systems, the setting specifications for inverters, the commissioning processes and the test protocols** as clearly and uniformly as possible. In addition, it is recommended that **Swissolar creates and maintains a reference document** that shows **how the required setting specifications are implemented** for different types of inverters.
3. It is recommended that the correct setting of the inverters is documented by the installer or an authorised inspector when the PV system is commissioned or when the inverter is replaced and that the DSO is proactively informed. Due to the expected increase in PV systems, documentation should be automated as far as possible and integrated into existing processes, for example in combination with the safety certificate for electrical systems in the low-voltage grid.
4. **No statements** are made on the following aspects, as they were not part of the targeted analyses in the project:
    a. Effect of grid-forming inverters on grid protection
    b. IT security of the inverters, e.g. risks of remote parameterisation
    c. Protection of inverter-based generation systems in the medium-voltage grid

The following **next steps** are planned:

- The results are published in a report in the ARAMIS database of projects supported by the federal government.
- The results will be taken into account in the revision of the VSE's "Industry recommendation for grid connection of power generation systems to the low-voltage grid NA/EEA-NE7 - CH". Until the revised edition is published, the existing 2020 edition will apply as the state of the art. The revised industry recommendation is expected to be published at the beginning of 2025.
- A survey on the acceptance of the project recommendations will be conducted at the end of 2024 to conclude the project.

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