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Summary of the doctoral dissertation by Bogdan Mól, titled:

" Assessment of the possibilities of improving the reliability and local energy security of MV and LV networks cooperating with distributed generation ",

prepared under the supervision of professor D.Sc. Ph.D Paweł Sowa.

The subject of the dissertation is the analysis and assessment of the impact of distributed generation connected to the MV and LV networks on the energy security of consumers and the operational reliability of a section of the MV and LV networks. The basic problem addressed in the dissertation is to find the relationship between the location and the value of power available in the power grid from various types of distributed sources, in relation to the possibility of maintaining the quality parameters of the power grid operation and ensuring an appropriate level of energy security for recipients.

The dissertation consists of 5 chapters relating to the issues raised in the topic.

Chapter 1. The author presented the main theses of the dissertation and referred to the concepts of energy security and reliability of power supply to consumers found in the literature. It was noticed that over the last several decades the understanding of the above-mentioned concepts has changed and subsequent generations have also changed expectations towards the so-called professional energy, while looking for their own solutions to improve their own security, including energy security. The author presented a compendium of knowledge about indicators and definitions describing the energy security of consumers and the reliability of MV and LV networks. At the same time, the author drew attention to the change in the scope of the above-mentioned concepts, i.e. from concepts understood at the global level (world, continent, country) to concepts understood locally (voivodeship, commune, district, home).

Chapter 2. The author presented technical solutions used by one of the municipalities of the Silesian Voivodeship, which improve the local energy security of residents and ensure the maintenance of reliability and appropriate operating parameters of the MV and LV networks supplying the main municipal loads. It was noted that the solutions used by the selected commune include, apart from technical ones, also organizational solutions, e.g. participation in energy clusters or other local energy entities. This is a non-technical way to improve local energy security and reliability of the MV and LV power grids.

Chapter 3. The possibilities of using the OeS IT tool, which enables comprehensive examination and optimization of the operating states of the power system, were presented. It was noticed that the OeS software together with the reliability assessment of a selected section of the network (model system) can be used to indicate the permissible quantitative and technical parameters of distributed generation occurring in this area, the presence of which does not affect the deterioration of the quality of operation of the power grid. The input data for analyzing the impact of distributed generation on the operation of the power grid of one of the Polish DSOs are the actual parameters of a section of the MV and LV power grid and randomly selected quantities and parameters of distributed generation sources.

Chapter 4. The issue of network adequacy, developed in the concept of network flexibility and the acquisition of flexibility services, was presented. The possibility of postponing appropriate investment goals aimed at improving the condition of the network was indicated, using flexibility services based on available local energy resources belonging to local communities. The basic requirements that municipalities must meet in order to use their energy potential and join the emerging local market for flexibility services, balancing and support for the professional power industry in maintaining a reliable supply of electricity to consumers were presented. It was noted that the current preparation of local governments to play the role of an aggregator is very difficult to achieve in the near future and requires communes to take costly technical and organizational actions. The author also presented the features of flexibility services obtained by DSOs in Great Britain.

Chapter 5

It was stated that the thesis put forward in the dissertation had been proven and the final conclusions were presented, which primarily focused on the practice of municipalities (LGUs) and distribution network operators (DSOs) demonstrating a positive but also measurable impact of network investments both on the side of the network and generation sources. (including cogeneration, photovoltaic and others). This impact is visible by improving the energy security of the examined areas and the operational reliability of power grid areas (better balancing of areas), as well as area and node reliability indicators, and, consequently, improving the continuity of power supply to consumers and reducing the costs of unsupplied electricity in an emergency. Thus, the flexibility of the network (global and local) is improved, understood as the power network's ability to respond (i.e. maintain or quickly rebuild basic functionalities) to changes in operating parameters on the receiving and generating sides. Thanks to this, appropriate current loads and voltage levels are maintained in the power grid, which allows the implementation of the basic task of the distribution network, i.e. reliable supply of electricity to consumers.