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OPTYMALIZACJA PLANOWANIA PRACY I ROZWOJU

SYSTEMÓW DYSTRYBUCYJNYCH

*(ANG. OPTIMISATION OF OPERATION PLANNING AND DEVELOPMENT OF THE
DISTRIBUTION ENERGY SYSTEMS)*

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The aim of the dissertation is to present a new approach for long term planning of operation and development of distribution system but it also contains operational aspects of electric power distribution system. The goal was achieved by using a mixed-integer linear programming (MILP) and selecting four actions that are available in the optimization process:

- allocation and selection of new RES power,
- allocation and selection of the capacity of new energy storage,
- limiting the generation from RES,
- construction of new lines in the system.

Allocation and selection of the power of new RES allows for the deployment of new generation units in the network and the selection of their rated power, but use existing technical infrastructure without violating the technical standards of the distribution system operation.

The construction of new energy storages allows for the transfer of generated energy from the load valley to its peak.

Limiting generation allows to limit generation in periods when it is greater than demand, thanks to which it is possible to match generation to demand at these times.

Thanks to the construction of new lines, it is possible to reduce the load on elements of the existing technical infrastructure of the distribution system.

The newly developed method includes both technical and economic aspects of the system's operation. Technical aspects include:

- power flows, power loss,
- voltage levels,
- energy balance,
- power exchange with a 110 kV system,

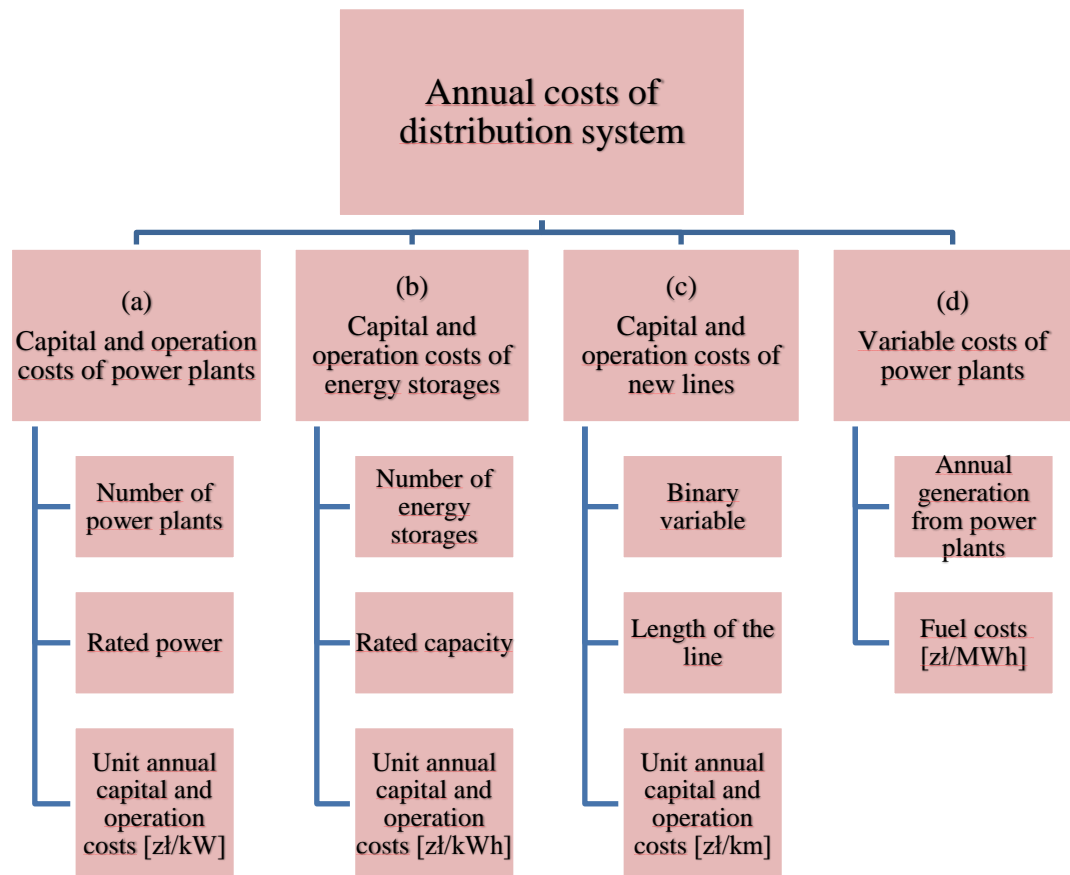
while to economic:

- investment and operational costs,
- including fixed and variable,

- generating units,
- capital and operating costs and costs of energy storage losses,
- capital costs of network development,
- operating costs,
- costs of network losses.

The objective function used in the optimization process is expressed as the sum of the

- annual costs of the distribution system, including:
- annual fixed costs of generating units,
- annual fixed costs of energy storage,
- annual fixed costs of new lines in the network,
- operational variable costs (fuel costs).



Graph 1. Scheme of the objective function.

The analyzed MV network is represented as a set of its nodes, each of which is described by means of fixed parameters whose values are predetermined and constant

parameters whose values are obtained in the optimization process. The constant parameters include:

- an existing connection in the analyzed network,
- a network of potential connections,
- distances between nodes,
- power and type of loads in the node, the factor of using the rated power,

the variable parameters include:

- power and number of RES units connected to the node,
- capacity and number of energy storage,
- new lines, power exchange with energy storage,
- generation of RES units.

Simulations were carried out for five scenarios differing in selected activities using the FICO Xpress optimization solver.

The obtained results of simulation scenarios show that it is possible to create a comprehensive method of optimizing work planning and development of the distribution system while minimizing the total costs of these activities.