Paris Session 2022

A Hybrid Heuristic Optimization Algorithm for the Rolling Day-Ahead Scheduling of NIIs in Greece

SC6 - ACTIVE DISTRIBUTION SYSTEMS AND DISTRIBUTED ENERGY RESOURCES

PS3, Question 3.5: To what extent can optimization techniques help in the planning and operation of islanded or remotely operated power systems and microgrids? What type of approaches are required? Are there other experiences and lessons learned with islanded and remotely operated power systems in addition to those that are reported in the corresponding papers?

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Optimization Techniques as Planning Tool

To facilitate the planning and operation of islanded microgrids, it is essential that the optimization approach takes into consideration several parameters and/or constraints in the calculations:

- Meeting the load demand and keeping safety margins
- Technical requirements in the amount of spinning reserves that are needed to guarantee frequency stability and maintain power quality
- A portion of the thermal production capacity must be provided as spinning reserve
- Maintaining balance between active power and reactive power through optimal power flow operations
- Ensuring cost effective operation to minimize the production costs and CO_2 emissions of conventional thermal units via economic load dispatch
- Maximization of RES penetration and HPS production within certain limits
- Reliable load and RES generation forecasting are critical

Possible Approaches

The necessary approach in a multi-objective optimization problem where contradicting objectives and constraints must be considered, involve finding non-dominated (Pareto optimal) solutions and computing the trade-offs to satisfy the different objectives. There are two possible approaches:

- A priori preference information + single-objective optimization techniques
- Multi-objective optimization techniques + a posteriori preference information

Methods proposed:

- Algorithmic approaches
- Mixed-Integer Linear Programming
- Dynamic programming
- Artificial intelligence-based methods (e.g. swarm optimization, genetic algorithm, neural networks)
- Heuristic techniques (e.g. evolutionary algorithms)

Experiences and Lessons Learned

The planning and operation of isolated islanded microgrids has led to the following additional lessons learned:

- Each islanded microgrid has it own special features and distinct constraints (distribution network size, thermal generating units number/size/type, presence or not of wind farms and PV stations), a fact that sometimes mandates a unique configuration of the optimization approach to provide satisfactory planning and operation results
- A significant factor in producing optimal microgrid planning results is good quality load and RES generating forecasts
- Islanded microgrids are prone to unforeseen disruptions (e.g. grid failures, outage of power generating units) that sometimes hinder proper planning and operation