

# Maximizing Reliable Service by Coordinated Islanding and Load Management

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## Motivation

- ❑ **Quantity, quality and willingness to pay** for reliable service are three "dimensions" of electrical energy supply that should be satisfied today.
- ❑ **Direct load management (DLM)** is becoming a common practice to reduce the system peak demand.
- ❑ **Distributed generators (DG)** located close to consumers may reduce the number of un-served consumers and decrease outages duration.
- ❑ **Combined approach** of direct load management and islanding as a possibility of maximizing reliable service is not studied.
- ❑ **Partial load shedding (PLS)** which allows all customers to be provided with the minimum service under extreme conditions is not used.

## The main idea

- ❑ Find **the optimal number** of customers to be served for given:
  - distributed generators locations,
  - remotely controlled switches locations,
  - demand characteristics.
- ❑ If total load can not be served, direct load management is used to **partially reduce load**.

## Approach

The problem of the optimal load management is posed as a mixed integer quadratic optimization problem with quadratic constraints:

$$\max_{s_i, P_i} \sum_i N_i \cdot s_i - \left( \sum_i P_i^{\max} \cdot c_i \cdot (1 - s_i) + \sum_i (P_i^{\max} - P_i) \cdot c_i \cdot s_i \right)$$

$$s.t. \quad \sum_i P_i \cdot s_i \leq P_{Gen} \quad (\text{Real Power Balance for an Island})$$

$$P_i^{\min} \leq P_i \leq P_i^{\max} \quad (\text{Direct Load Management})$$

where:  $N_i$  – number of consumers,  $s_i$  – binary variable is equal to 1 if consumption is supplied,  $c_i$  – interruption costs, and  $P_i$  – power consumption)

## Example

Three cases:

1. Islanding without DLM,
2. Islanding with DLM,
3. Islanding with DLM and interruption costs

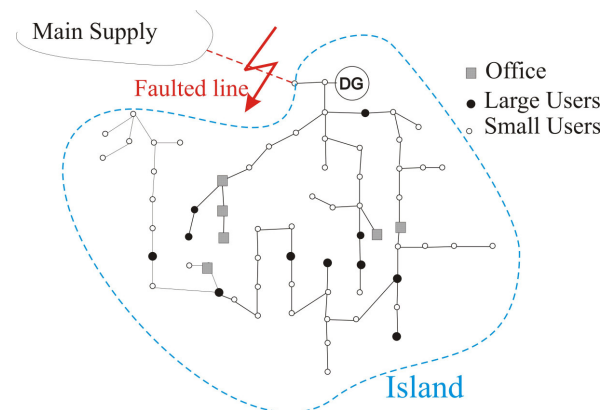
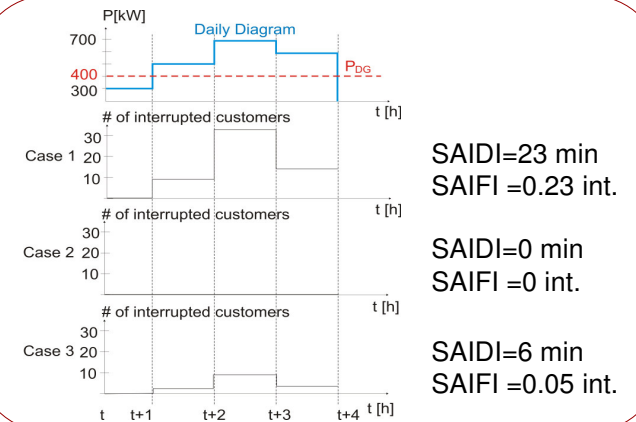


Figure 1 - Modified real USA distribution feeder (64 consumer groups with 138 consumers)



## Future Work

It is critical to implement coordinated protection schemes to support the implementation of the optimization results.

Our future work concerns development of protection schemes that could become an inherent part of local distribution system integrity protection schemes.

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