Load shedding for industry grids

**ENEAS load shedding: an integrated solution for industry grids**

Load shedding maintains the stability of electrical grids, especially in critical situations such as a sudden loss of generated power.

The load shedding function establishes and monitors the balance of generated and consumed loads by shedding consumer feeders with low priority. Automatic load shedding is the only way to prevent deep drops in system frequency or frequency collapse following a large disturbance.

Load shedding uses a distributed system architecture and the IEC 61850 standard. At the plant level, the central load shedding controller is based on a single or redundant SICAM 230 server. At the bay level, the intelligent electronic devices (IEDs) are based on SIPROTEC devices for protection and control. Operator access is provided by the human-machine interface (HMI) on SICAM 230.

**Main functions**

**Fast power-based load shedding (FPLS)**
During critical events, low-priority consumer power must be shed very fast to restore the balance of generated and consumed power. To determine how much power must be shed, the balance of the active power is calculated periodically for each contingency. The calculation determines which feeders will be shed in case of a critical event based on the available power, spinning reserve, and actual topology. If the critical event happens, fast load shedding will occur within < 70 ms. FPLS automatically recognizes multiple islands of the grid and operates separately for each island.

**Dynamic power-based load shedding (DPLS)**
When the grid operates in island mode, the load balance is calculated periodically. If the spinning reserve falls below an operator-defined threshold, consumed power is shed until sufficient spinning reserve is regained. This figure is calculated and mapped to the priority list of consumer feeders, defining the feeders to be shed. Load shedding also provides load inhibition that monitors large consumers whose equipment is not currently operating. If the typical power consumed by these loads is larger than the current reserve, the loads are prevented from starting. DPLS occurs separately for each recognized island grid.

**Frequency-based load shedding (FBLs):**
FBLs provides a backup shedding function. It works independently of power-based load shedding and uses a distributed architecture. One frequency relay per busbar section supervises the frequency for up to four thresholds. When a threshold is reached, fast shedding of predefined feeders is initiated automatically. Every stage of the frequency relays includes a time delay to prevent unwanted shedding. In addition, the rate of change (df/dt) can be monitored for faster reaction.

Answers for infrastructure and cities.
**Range of operation**

Load shedding is configured using distributed IEDs that communicate via the IEC 61850 protocol. Very fast GOOSE messages ensure a short reaction time. Up to 150 loads can be shed based on the assignment of 50 priority levels. Feeders with the same priority are treated as a group and shed together.

Up to 30 contingencies can be defined as critical events that trigger load shedding. The response time of FPLS is faster than 70 ms. This figure measures the time from recognition of a contingency to the activation of the trip signal for the affected loads.

**System requirements**

- A load shedding controller based on SICAM 230 server with Ethernet connection to all IEDs via IEC 61850.
- IEDs with IEC 61850 interface and capability of fast functional plan.
- SICAM 230 version 7.0 or higher, including option for automatic topology calculation.
- Multiple monitors per workstation with a resolution of WUXGA (1920x1200) are supported.

**Benefits of ENEAS load shedding**

- Fully integrated into the ENEAS substation automation system; no additional hardware is needed.
- Power-based load shedding of minimum number of feeders necessary in any situation.
- Very fast response time (less than 70 ms) for power-based load shedding.
- Grid topology, for example for multiple islands, is calculated automatically with no need for complex logics.
- Based on the IEC 61850 standard to ensure communication between all included automation devices. This significantly reduces parallel wiring, increases system availability and provides a future-proof solution.
- Very high availability: Redundant controllers and independent FBL5 as a backup ensure system availability.