

Ancillary Frequency Control System Based on BESS and SATEC IEC 61850 Meter

Battery Energy Storage Systems (BESS) are becoming an important component in the modern electric network. These systems are often combined on-site with renewable energy sources for storing energy during peak production or low demand, and releasing the stored energy during peak demand.

Taiwan Power Company (Taipower) designed a BESS system, implemented at a distribution-substation level, in order to balance supply in local distribution networks. This is achieved by using the BESS to offset deviations in frequency, which also indicate surges or swells in the supply of energy.

In this case, these BESS are stored in containers (fig. 1), featuring between 1MW to 2MW capacity.



Figure 1: typical system storage

TPC Requirements for Frequency Stability

Taipower has set forth regulations for this kind of power auxiliary service: the monitoring system must poll the grid frequency ten times (or more) per second. The polled data is to be communicated over IEC 61850 protocol, which is becoming Taipower’s standard communication platform.

The acceptable frequency range is set at 59.98-60.02Hz, referred to as the deadband.

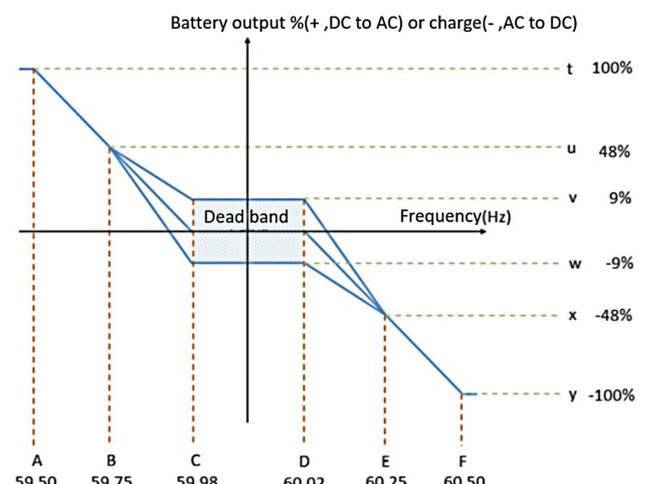


Figure 2: BESS capacity implemented vs. deviation in Hz

BESS as a Stabilizing System

When frequency drops below 59.98Hz, indicating a minor power shortage, the AFC system kicks in, augmenting the substation power supply with the BESS. Between 59.98-59.75Hz, the system introduces 9-48% of the BESS capacity (DC to AC). When frequency dips below 59.50Hz, indicating a more significant power shortage, the BESS will provide total energy output (fig. 2). The designated capacity percentage ("setpoint", see fig. 4) is reached within one second.

Conversely, when the frequency exceeds 60.02Hz, indicating overproduction, the power is diverted (AC to DC) to charge the BESS.

Intelligent Cloud Plus (ICP) is among Taiwan's largest system integrators, frequently commissioned by Taiwan Power Company (Taipower). Specializing in power systems and in IEC 61850 topology, ICP sought out to design the needed platform for metering and control of this system. Being familiar with SATEC and the PRO Series power meters' capabilities, ICP selected the PRO Series as backbone for this design.

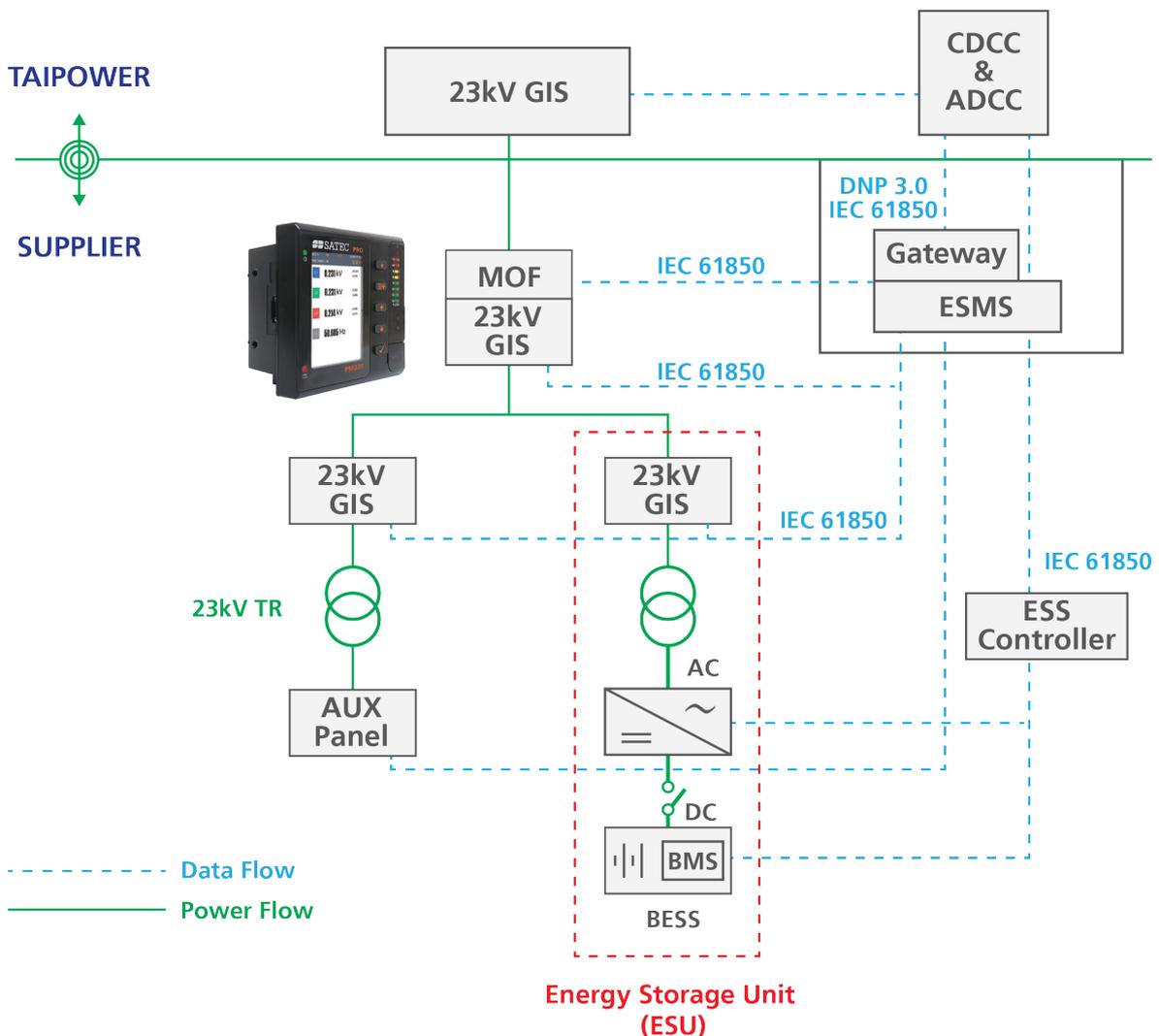


Figure 3: BESS scheme

Metering, Communication & Control

The substations implementing BESS are based on IEC 61850 topology for communication. To answer the above requirements, ICP designed a solution based on SATEC's PM335 PRO meter. Featuring frequency resolution of 0.001Hz, it is used to sample frequency every 20ms and communicate a calculation of the average value of 4 such samples every 100ms, per system requirements, with accuracy exceeding requirements.

SATEC then created an IEC 61850 logical node to host the value of the above calculation, available for communication also via GOOSE messaging.

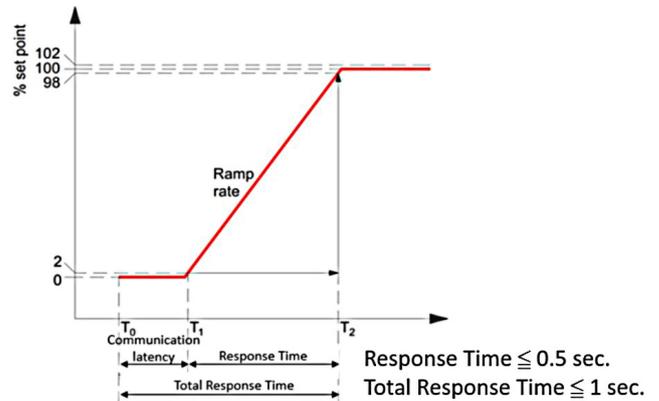


Figure 4: response time achieving designated system capacity ("setpoint")

SATEC Devices used in this Solution



PM335 PANEL MOUNT

EM235: DIN RAIL

PRO SERIES - ADVANCED POWER METERS

The PRO Series is SATEC's cost-effective line of power meters for advanced power monitoring applications. With waveform recording capabilities and 16GB of storage it is a powerful power-quality analyzer and event recorder.

Featuring multiple protocols (IEC 61850, DNP3 and IEC 60870-5-101/104) and dual port ethernet, it is the ultimate solution for power monitoring, meeting and exceeding the most current requirements in utility and industrial applications.