Case note
World's Largest Battery Energy Storage System
Fairbanks, Alaska, USA

A Battery Energy Storage System (BESS) was one of Golden Valley Electric Association's initiatives to improve the reliability of service to GVEA members.

The BESS acts as an emergency power source that feeds energy into the grid until backup generation can come online.

Golden Valley Electric Association (GVEA), a rural electric cooperative in Fairbanks, Alaska, serves 90,000 residents spread over 2,200 square miles. The local population needs a reliable supply of electricity because many residents live in remote areas and winter temperatures can fall as low as minus 50 °F. Backup power therefore has to be available in the event of an outage.

GVEA choose a battery backup solution as a cost-effective and reduced carbon emission solution, and selected ABB to manage the design and controls engineering for the whole system. The BESS has the ability to pick up 26 megawatts of load for 15 minutes (or 40 MW for 7 minutes) in the event of power plant outage or transmission line equipment failure.

The switch from power line to battery and back to power line is seamless and goes unnoticed by users. The prime function of the BESS is to provide spinning reserve. At the end of the spinning reserve sequence, the BESS will automatically re-establish the operation mode, which was active prior to the event.

Main Technical Data
Plant: BESS GVEA, Fairbanks, Alaska, USA
Installation: Indoor (partly outdoor)
Environmental Conditions: -52°C +32°C
Primary Supply: 138 kV / 187 A / 59-60.5 Hz
DC link Voltage / Current: 3440-5200 V / 12000 A
Total AC Power: 46 MVA
Control System: ABB PSRII
Scada: ABB Microscada

Project awards and recognition
Guiness World Record for the world's most powerful battery, earned as a result of a test of its maximum limit, where it discharged 46 megawatts for five minutes.
EPRI technology award for leadership in electricity-related technologies.
Platts Global Energy Award for ABB's design and development of the BESS converter.

Power Conversion System (PCS)

The two primary subsystems in the BESS are the IGCT converter and the Ni-Cd battery. The battery is the energy storage medium. The IGCT converter is the interface between the DC battery voltage and the 60 Hz AC GVEA system voltage. The converter transformers match the converter output to the 138 kV system voltage. The main components of the PCS are:

- Ni-Cd Batteries
- DC-Filter Circuits
- Converter including Control and Cooling System
- Converter Transformers
- SCADA operator interface

Converter Transformer

There are three single-phase transformers, each rating 14.9 MVA. The secondary windings are connected to the converter. On the AC-side the single units are star connected.

Ni-Cd Batteries

There are four battery strings. Each string consists of 344 series connected battery modules. The batteries are monitored with a battery monitoring system (BMS).

Converter

On the AC line side the IGCT power converter consists of four paralleled twin connected three-phase units (total of 24 converter phases). On the DC side the battery is connected to the converter's DC link with an aluminum busbar system. Due to the power and the high number of phases, the converter is built of two converter frames (half converters). One of these converters includes a Voltage Limiting Unit (VLU).

DC-Filter Circuits

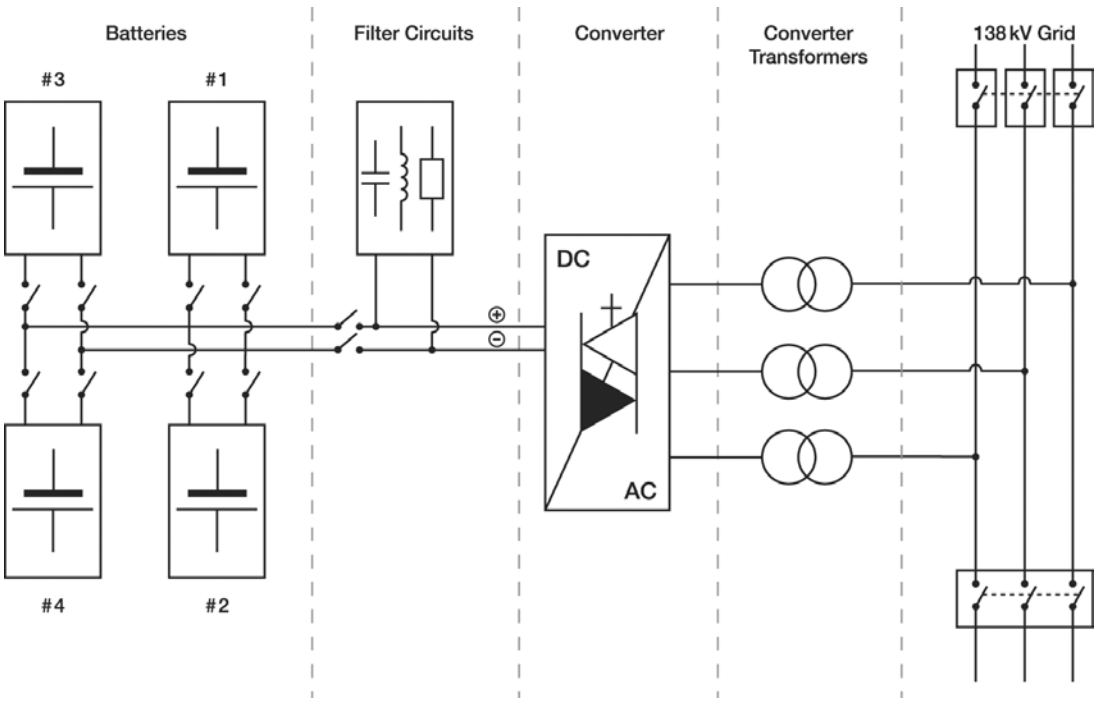
The purpose of the High Pass Filters is to balance the DC link voltage and to reduce the voltage ripple. The tuned Filters (60, 120 Hz) are designed in order to eliminate parallel resonances and to protect the batteries from harmonic current injection.

Cooling System

The challenging environmental conditions of Fairbanks have been given significant consideration. The IGCT converter is cooled with a closed-water cooling system. This design has two water loops. De-ionized water is used for cooling of the converter. A raw-water/glycol solution, which circulates in a secondary loop, removes the waste heat via outdoor radiators.

Control

The BESS system is controlled by an intelligent control platform, the PSR II (Programmable High Speed Controller). The PSR II is programmed to provide all required control modes. In addition, the PSR II provides the BESS system protection. In addition it interfaces with the GVEA SCADA system and has a local graphical human machine interface (HMI). Following operation modes are programmed: Spinning Reserve, Automatic Scheduling, Support for Scheduled Load Increase, Automatic Generation Control, Var Support, Power System Stabilizer, Charging, and Discharge Test.



Electrical diagram of the BESS power conversion system.

Seven Modes of Operation

– Var support, providing voltage support for the power system under steady-state and emergency operating conditions
– Spinning reserve, the BESS responds to remote generation trips in the Railbelt system
– Power-system stabilizer, included to damp power-system oscillations
– Automatic scheduling, for instantaneous system support in the event of a breaker trip on either a transmission line or a local generator
– Scheduled load increase, a frequency and voltage-regulation mode allowing it to respond to the addition of large motor loads
– Automatic generation control; operating by AGC, similar to that of rotating machinery
– Charging, for control of the MW rate at which the BESS will be charged and when charging is to start after a BESS discharge.

Images, clockwise, top left: The battery monitoring system allows the utility dispatchers to continuously monitor voltage, current, electrolyte level, temperature and presence of liquids. Top right: The foundations and rack were designed for Seismic Zone 3. Bottom right: The water skid purifies the water for the cooling system to prevent it from conducting electricity. Bottom left: workers install battery modules in the racking system.

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