The modular energy storage system for a reliable power supply
New challenges – Our answer:
SIESTORAGE – Comprehensive competence for a reliable power supply

- Grid evolution creates new challenges
- Traditional power generation and distribution
- Modern grid: Integration of distributed/renewable generation
- The solution: The energy storage system SIESTORAGE
- Energy storage technologies
- Advantages of Li-ion batteries
- Our answer: SIESTORAGE Comprehensive competence to ensure a reliable power supply
- The advantages of SIESTORAGE at a glance
Grid evolution creates new challenges

Traditional grid

- Generation
- Transmission
- Distribution
- Large scale power plant
- Industrial power plant
- Hydroelectric power plant
- Residential
- Industry
- Building infrastructure

Modern grid

- Market deregulation
- Renewable penetration
- Prosumer* expansion
- Large scale power plant
- Wind power plant
- Solar power plant
- Biomass power plant
- Building infrastructure
- 230 kV*
- 115 kV*
- 34 kV*

Grid complexity increases the risk of instabilities in the grid

New stabilizing solutions are required

*contraction of producer and consumer

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Traditional power generation and distribution

Power supply generated with conventional generators ensures the stability of the grid:

- By providing adequate short-circuit power (the available short-circuit power is an indicator for the power system stability)
- Thanks to unidirectional power flow
- Through easily adapted load requirement due to centralized generation
Modern grid: Integration of distributed/renewable generation

Generation from wind and solar leads to instability of the grid

- Fluctuation of generation (unpredictable renewable generation)
- Imbalance between generation and load
- No adequate short-circuit power available

Possible solutions:

- Grid extension
- Smart grid technology (intelligent control of grid and consumers)
- Energy storage (as a buffer against grid instability)
The solution: The storage system SIESTORAGE

The optimum combination of power electronics and storage system based on Li-ion batteries provides power in milliseconds for:

- Sufficient available balancing power
- Additional spinning reserve
- Active and reactive power control
- Uniformly distributed network load
- Adequate short-circuit power
- Black start

Stability of the grid

Power reliability / quality

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Energy storage technologies

Technologies and application areas

CAES – Compressed Air Energy Storage

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Advantages of Li-ion batteries

- Constant availability to charge/discharge
- High C-rate* (2-4 compared to other batteries)
- High efficiency
- Low self-discharge
- No memory effect
- Operation temperature 0 °C to 40 °C
- Very high power & energy density
- Power in/out within milliseconds

* C-rates specify charge and discharge currents. At 1C, the battery charges and discharges at a current that is par with the marked Ah rating; at 0.5C the current is half, and at 0.1C it is one tenth. On charge, 1C charges a good battery in about one hour; 0.5C takes 2 hours and 0.1C 10 to 14 hours.
Our answer: SIESTORAGE
Comprehensive competence to ensure a reliable power supply

Consistent SIESTORAGE advanced technology

- Energy automation and grid integration
- Medium-voltage switchgear
- Transformer
- Power electronics
- Li-ion battery modules

Solution and implementation expertise

- Experience with network operators
- E-house manufacturing
- Power packaging solution expertise
- One of the leaders in smart systems
The advantages of SIESTORAGE at a glance

- **Consistency**
  Comprehensive energy storage, LV, MV components plus solution and implementation expertise from one hand

- **One-stop-shop**
  From planning to after-sales service in association with global experience in project life cycle management

- **Safety**
  Proven components, overall safety equipment and use of qualified and proven battery technology

- **Reliability**
  Providing power supply in milliseconds and high redundancy for more availability

- **Efficiency**
  Optimization and saving potential for your applications (e.g. spinning reserve, peak load management…)

- **Flexibility**
  Covering all needs of storage power and capacity thanks to modular system

- **Advanced technology**
  Storage system combining cutting-edge power electronics and Li-ion batteries

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Analysis of your grid – Saving potential with asset optimization

- Network planning and location analysis as a first step
- Applications of SIESTORAGE
- Cost analysis and asset optimization
- Application example: Spinning reserve
- Application example: Peak load management
- Application example: T&D deferral (grid relief)
- Application example: Offset diesel
Network planning and location analysis as a first step

Reliable network planning and operation for a sustainable business model

- Power flow calculation and reactive power analysis
- Contingency analysis
- Short-circuit current calculation
- Probabilistic reliability analysis
- Dynamic stability calculation
- Protection coordination
- Economic analysis and asset management
- Workshops and trainings for the client
Applications of SIESTORAGE
Combination of various applications leads to an economic solution

Bulk Storage
- Resource Adequacy
- Frequency Regulation
- Time Shifting
- Renewable Firming

Ancillary Services
- Spinning Reserve
- Ramping Control
- Black Start
- Reactive Power

SIESTORAGE is also suitable for:
- Supplying continuous power for sensitive industrial processes
- Energy-efficient buildings
- Isolated sites with limited power access
- Autonomous microgrids supplied with diesel genset
- Public transportation
- Electromobility

Large field of application areas for utilities, network operators, industry and infrastructure
Cost analysis and asset optimization

- Cost analysis, simulation of load and generation
- Technical and financial proposal (ROI calculation)
- Business cases are also dependent on the local regulation and on financial incentives regarding the protection of environment

Saving potential with asset optimization

This depends on the application, which therefore has to be accurately assessed as the first step:

- Spinning reserve (power sale)
- Peak load management
- T&D deferral (grid relief)
- Offset-diesel optimization
Application example: Spinning reserve
Release of capped power for revenue generation

Net Power Gain

SIESTORAGE supplies power to the grid within milliseconds

~ 3 to 7%

Additional fuel to ramp generator up upon request

~ 3 to 7%

Generator rated power

~ 93 to 97%

100%

Optimum performance

Challenges

- Capacity of power plant is not always sufficient to cover the need of peak power demand
- Spinning reserve is required to maintain the system frequency (regulation)
- Generator operates below its rated value (non-optimal operation) by off peak time
- Additional fuel is necessary to ramp generator up upon request (incremental emissions and fuel consumption)

Solution and benefits

- Possibility for power plant operators to provide additional power with energy storage
- Increased system stability by providing power from SIESTORAGE to the grid within milliseconds
- Higher availability of standby power
- Assets for revenue by selling available power
Application example: Peak load management
Avoidance of incremental cost due to production peaks

Challenges

- Need of continuous available power (Industry, network operators…)
- Volatile load curve (production peaks, time shifting…)
- Need to prevent expensive peak loads (required by the supplying utility)
- Limits of the power capacity (regulation of permitted peak loads)

Solution and benefits

- Avoiding of the major surcharge for peak power (batch processing)
- Contract of power supply with lower feedback rates
- Protection of the components (transformers, cables…) and related cost saving
- Availability of power supply 24/7 for continuous operation
Application example: T&D deferral (grid relief)
Avoidance of the capacity extension of the grid by buffering power

Challenges
- Volatile infeed from PV or wind generation
- Overload capacity of the power plants at certain times
- Lost of power generated by PV or wind power plant
- Grid components are not designed for distributed generation: Grid capacity extension is necessary

Solution and benefits
- Power buffering: SIESTORAGE recognizes the unplanned peak load and provides the available energy at off-peak times (low-load periods)
- Avoidance of bottlenecks in the grid
- Protection of the grid’s LV and MV components
- No expensive grid extension and reduction of the related approval procedures and costs
- Additional power buffering for fast charging stations (e.g. e-car)
Application example: Offset diesel
Improvement of the size and efficiency of gensets

**Challenges**
- Grids supplied only by diesel generators (island grids, isolated grids, microgrids)
- Volatile load curve of supplied areas due to integration of renewables
- No regulatory power to improve efficiency
- High diesel prices
- Large diesel generators influence the environmental footprint (high fuel consumption and gas emissions)

**Solution and benefits**
- Optimization of the size of generators (SIESTORAGE as “range-extender” to smaller gensets) to operate at higher loads
- Switch off at lower loads
- Higher efficiency of diesel generator
- Reduced run time of diesel generator
- Reduced fuel consumption and gas emissions
SIESTORAGE modular concept
Four components into an innovative solution
SIESTORAGE modular concept
Design flexibility
SIESTORAGE modular concept
The solution for an efficient use of the battery capacity and for more reliability
SIESTORAGE modular concept
Four components into an innovative solution

1. Inverter cabinet
   (1,000 x 600 x 2,200 mm)
   - 4 inverter modules and related control equipment
   **Each module:**
   - V nominal: 400 V
   - I nominal: 170 A
   - S nominal: 118 kVA
   - P nominal: depending on the battery type

2. Grid connection cabinet
   (800 x 600 x 2,200 mm)
   - 400 V AC power distribution
   - Switching system
   - Power connection to the grid
   - Filtering system
   - Auxiliary transformer

3. Control cabinet
   (800 x 600 x 2,200 mm)
   - 1 x control unit (SCU)
   - 1 x HMI (Human Machine Interface)
   - 1 x Ethernet switch

4. Battery cabinet
   (600 x 650 x 2,200 mm)
   **Content example**: 
   - 14 modules
   - 1 BMS (Battery Management System)
   - Power: 90 kW
   - Energy: 45 kWh
   * Depending on supplier

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SIESTORAGE modular concept
Design flexibility

Flexibility to address all needs of storage power and capacity

### 4 Power Stacks – Content
- 1 inverter cabinet
- 1 control cabinet
- 1 grid connection cabinet
- X battery cabinets (max. 5 connected to one inverter module)
- Scalable to max. power of 472 kVA
- Scalable to max. capacity of 900 kWh

### 12 Power Stacks – Content
- 3 inverter cabinets with max. 4 inverter modules
- 1 control cabinet
- 1 grid connection cabinet (for up to 3 inverter cabinets)
- X battery cabinets (max. 5 connected to one inverter module)
- Min. rated power: 1080 kW (scalable)
- Min. rated capacity: 540 kWh (scalable)

### e.g. 45° containerized solution: 2x12 Power Stacks
incl. HVAC control, fire detection and extinguishing system….
- Rated power: 2160 kW
- Rated energy: 1080 kWh
- Containerized solution scalable to each power and capacity needs
SIESTORAGE modular concept
The solution for an efficient use of the battery capacity and for more reliability

Solution with parallel connection

On the DC side

- One DC circuit-breaker 1
- One inverter 2
  - Single points of failure leads to low reliability of the system
  - Need of additional balancing between the battery cabinets:
    - Increased expenses and maintenance

On the AC side with SIESTORAGE

- Parallel connection of the inverters on the AC-side:
  - No synchronization between the battery cabinets
  - Very high redundancy (single point of failure has no influence on the availability of the storage system)
    - High availability and power reliability
  - Individual balancing of battery cabinets 2
    - Best use of the available energy content and installed battery capacity by lowest maintenance

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One-stop shop

- Solution from a single source
- Planning
- Engineering
- Integration into container and delivery
- Installation and commissioning
- Service – After sales service
Solution from a single source

We attend you within all the phases of the project, from engineering to installation and commissioning, and we ensure a reliable and competent local support – from planning to after-sales service

- Global experience in project life cycle management
- Single source from engineering to installation and commissioning
- Application expertise

**Project life cycle management**

- Planning
- Engineering
- Integration into container and delivery
- Installation and commissioning
- Service
Planning

- Reliable network planning and operation
- Sustainable business model
- Efficiency optimization
Engineering

Definition of the most efficient design for your application

- Test of alternative designs
- Global sourcing
- Comprehensive range of products and systems
- Innovative and proven components
- Power management system

Components

- SIESTORAGE components
- Battery cabinet and battery management system
- LV + MV components
- HVAC*, fire fighting and safety equipment

* Heating, Ventilation and Air Conditioning
SIESTORAGE components

- Inverter cabinet 1
- Grid connection cabinet 2
- Control cabinet 3

Battery cabinets incl. battery management system

- Battery cabinet 1
LV + MV components

- 8DJH 1
  gas-insulated medium-voltage switchgear
- SIVACON S8 2
  low-voltage switchboard
- GEAFOL 3
  Cast-resin rectifier transformer

HVAC*, fire fighting and safety equipment

- HVAC 1
- Fire detection and extinguishing system 2

* Heating, Ventilation and Air Conditioning

For more information please check out the PDF under the following link: interactive datasheet SIESTORAGE
Engineering

Power management system including renewable energy generation and SIESTORAGE

- Standardized communication interfaces for connection with your SCADA system
- Analysis and improvement of energy efficiency
- Remotely controlled equipment
- View of all equipment in real time
- More transparency (e.g. energy mix) thanks to operational data
- Possibility to create a virtual power plant
Integration into container and delivery

Possibility of integration into prefabricated container (e.g. 45´) or existing building

- Integration from one hand
- E-House manufacturing
- Power packaging solution expertise: MV equipment (switchgear, transformers…), utilities access control, HVAC, fire detection and extinguishing system
- Delivery
- Ready to install: completely developed, manufactured, assembled and pre-tested
Installation and commissioning

- Reduced construction risks and reduced installation time
- Power supply solution including substation equipment (transformers…)
- Energy automation and integration into the grid

SIESTORAGE installation at the grid of ENEL (Italy’s largest energy supplier) – Installation and commissioning 2012 – 1MVA/500 kWh
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