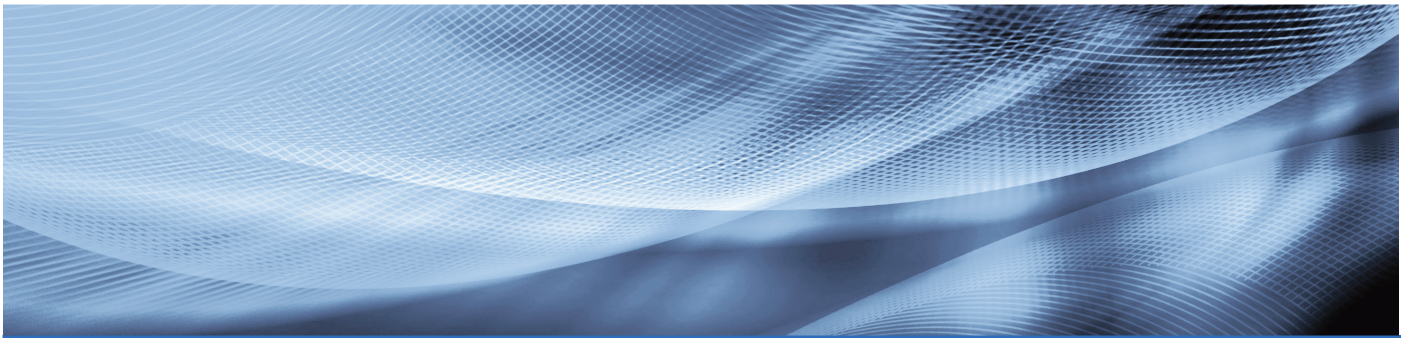
Sodium Sulphur Battery

European Association
for Storage of Energy



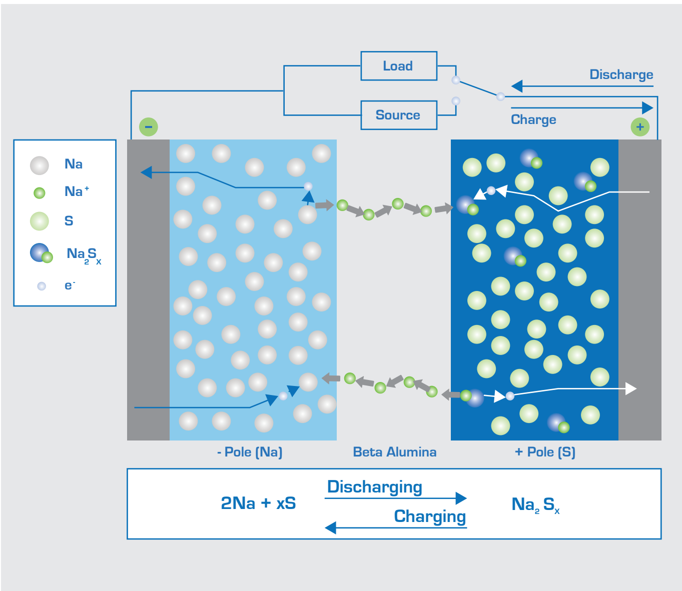
Electrochemical Energy Storage

1. Technical description

A. Physical principles

A Sodium-Sulphur (NaS) battery system is an energy storage system based on electrochemical charge/discharge reactions that occur between a positive electrode (cathode) that is typically made of molten sulphur (S) and a negative electrode (anode) that is typically made of molten sodium (Na). The electrodes are separated by a solid ceramic, sodium beta alumina, which also serves as the electrolyte. This ceramic allows only positively charged sodium ions to pass through. The battery temperature is kept between 300° C and 350° C to keep the electrodes in a molten state, making independent heaters an integral part of the battery system.

Illustration: Charging principal of NaS



B. Important components

The main components are the following:

- Elementary cell composed of electrodes, electrolyte and separator
- Modules
- Battery systems composed of a large assembling of modules and of a control system
- Power Conversion System (PCS)

C. Key performance data

Power range	0.5 to 50 MW
Energy range	Up to 350 MWh
Discharge time	6-7 h
Cycle life	2,000 - 5,000 cycles
Life duration	<15 years
Reaction time	Some millisec (if hot)
Efficiency	75 - 85 %
Energy (power) density	100 - 120 Wh/kg
CAPEX: energy	400 – 600 € / kWh
CAPEX: power	3,000 – 4,000 € / kW

D. Design variants (non exhausitive)

Different battery systems are possible according to the size, ranging from a case up to a container.

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2. State of the art

Since the early 90s, NaS batteries have been manufactured in Japan. Twenty modules of typically 50 kW and 300 to 360 kWh are combined into one battery, resulting in a minimal commercial power and energy range in the order of 1 MW and 6-7 MWh.

NaS battery technology has been demonstrated at over 190 sites. More than 350 MW of stored energy suitable for 6-7 hours of daily peak shaving have been installed. The largest NaS installation is a 34 MW, 245 MWh units for wind stabilisation in Northern Japan. In 2010, American utilities deployed 9 MW for peak shaving, backup power, firming wind capacity, and other applications.

3. Future developments

In order to prevent fire incidents, a number of safety enhancement measures are implemented, reaching from fuses and insulation boards to fire prevention and firefighting measures.

4. Relevance in Europe

Whilst most of the installed base of NaS batteries is in Japan and the USA, the first European projects took place on Reunion Island (France), in Germany and in the UK.

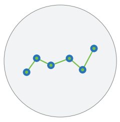
The entire installed base was taken offline in 2012-2013 to be upgraded with safety enhancement measures defined after a fire incident in September 2011. The system was commissioned to go back online in 2013.

The strategic relevance of the NaS technology remains peakshaving or other energy intensive applications. Those applications are essential for transmission and distribution investment deferral or avoidance in continental grids, and to avoid fuel costs of peak generation units in island on-grid applications.

5. Applications

Because of the operating temperature and the highly corrosive nature of the sodium polysulphides, NaS batteries are primarily suitable for large-scale non-mobile applications such as grid energy storage. Main applications include:

Stabilisation of wind farms and solar generation plants



Peak shaving

Time shifting

6. Sources of informations

- EASE Members
- ISEA RWTH Aachen
- A Review of Energy Storage Technologies (David Connolly University of Limerick)

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