Sodium Sulfur Batteries NAS® for Large Stationary Storage Applications: The time is right!

Florian Dötz – BASF Stationary Energy Storage

NAATBatt

Sodium Zinc Battery Workshop

Houston, Nov30th 2023

BASF

We create chemistry

BASF Stationary Energy Storage GmbH

- Our mission: We develop and market NAS® batteries for large stationary energy storage applications.
- Founded Oct1st 2022, 100% affiliate of BASF group
- Employees: About 30 and growing!
- Present in: Ludwigshafen (headquarters), New Jersey, Melbourne, Mumbai, Dubai, Jakarta, Kuala Lumpur, Seoul and Tokyo

Joint forces for a brighter future
Strategic cooperation on sodium-sulfur (NAS®) batteries

April 2019
Sales Partnership Agreement

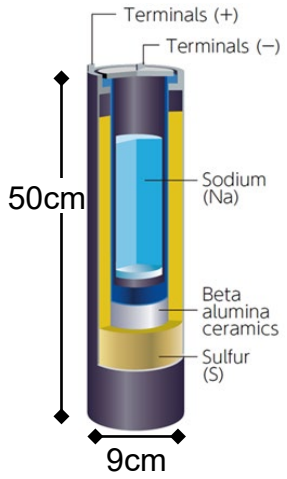
June 2019
Joint Development Agreement

NAS® Battery system design

NEW PRODCUT RELEASE 2024

- Significantly improved heat management system
- Superior capacity degradation rates over lifetime

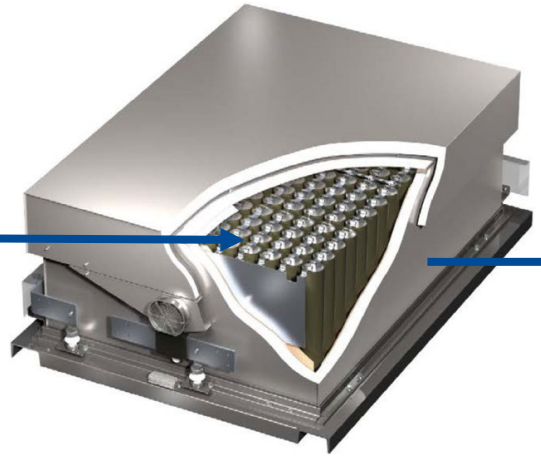
Battery cell



- 1.2kWh / 5.3kg
- ~2V
- C-rate 1/6 (0.17)
- T-range: 290°C – 360°C
- Life time: 7300 cycles or 20 years

X 192

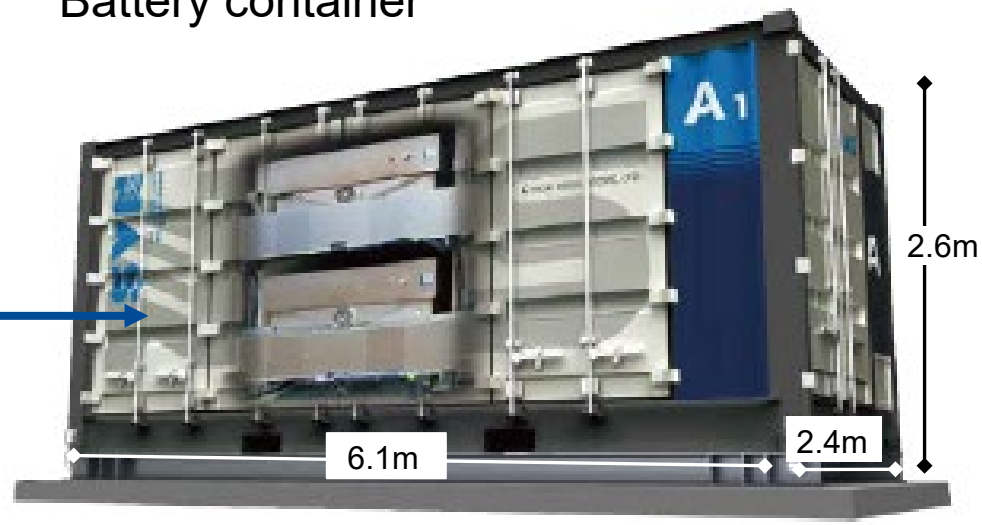
Battery module



- 40kW / 245kW

X 6

Battery container



- 20 feet container / 21 ton
- 250kW / 1.45MWh

Why NAS?

- High energy density (220 Wh/kg, comparable to Li ion)
- Top ratings for degradation and lifetime (≥20y) among battery storage technologies
- Mature technology → 20 years of track record in the field. In terms of installed global capacity, NAS (5GWh until 2021) is most mature battery technology after Li ion (55GWh).
- Easily scalable to >500 MWh size projects without geographic constraints
- Excellent safety record with ~ 5GWh installed globally
- Environmentally benign and abundant raw materials with secured supply line and low price volatility (Na, S, alumina ceramics)
- Lowest initial CAPEX and levelized cost of storage (LCOS) for 6-10h projects

▶ NAS is competitive in the 6-10h market segment

Photo: Courtesy of NGK

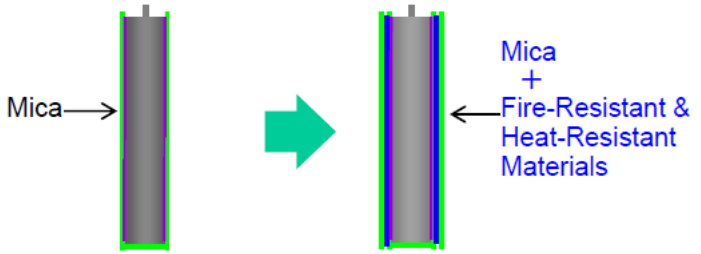
location	Buzen City, Japan
capacity	50MW / 300MWh
containers	252
footprint	100 x 140 (m^2)
commission	March 2016

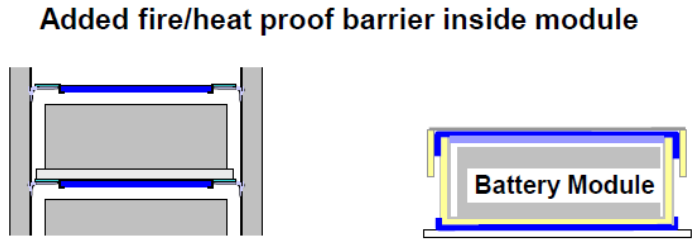
Safety of NAS Battery Systems

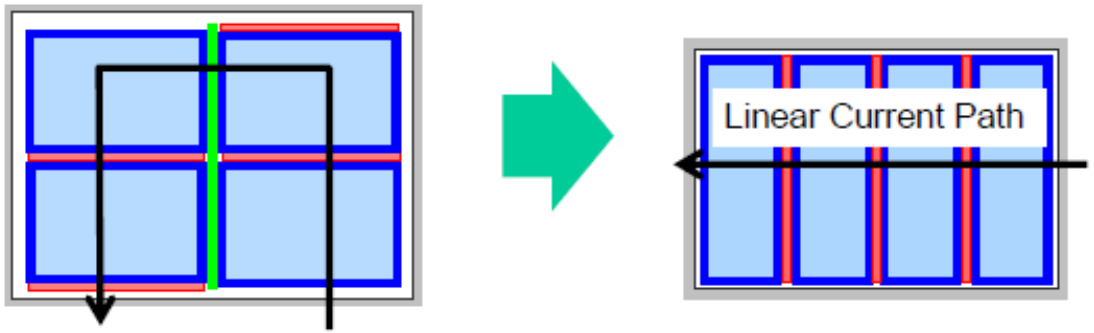
- NAS battery history
  - In Sept 2011, a fire incident of NAS battery was reported at Tsukuba Site, Japan
  - All NAS operations were suspended until June 2012 when the cause of the fire was identified in an official investigation with state authorities.
  - Several anti-fire measures were implemented as consequence from the investigation report. This actually led to NAS redesign with improved safety features.
- So far, no further incidents have been reported since. Globally, NAS batteries with ~5GWh have been installed. Pure statistics of NAS are clearly superior to lithium ion systems which have suffered many more comparable incidents.
- BASF has completed own safety assessment of NAS systems by TÜV Rheinland which confirmed the high safety standards implemented. This report can be shared upon request.
- NAS batteries compliant with UL standards
  - UL 1973 (general tests, safety analysis): Completed
  - UL9540a (thermal runaway tests): Completed
  - UL9540: In preparation

Safety Features implemented

- Individual cells are wrapped with fire and heat resistant sheets to prevent fire spreading.
- Fire and heat resistant barriers are inserted on module level.
- Number of cells per module is reduced, cells are separated by sand for better fire suppression.
- Current path through module is changed from U-shape to linear to avoid large differences in voltage of adjacent cells.
- Several fuses introduced in each cell string to prevent overcurrents.



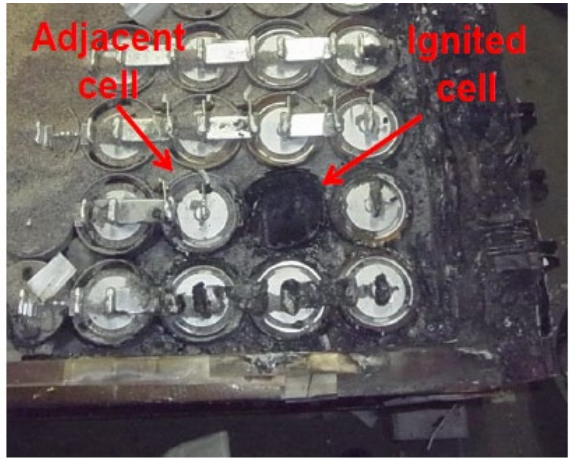




Thermal Runaway Test successfully completed

- A thermal runaway test is one of the most critical tests in battery safety assessment. It demonstrates the stability of the full battery system in case of a single cell failure.
- An individual cell in a full module was contacted and deliberately ignited by large overcurrents.
- No thermal runaway of adjacent cells was observed, no fire spreading occurred.
- No molten material was released to external from the module.
- NAS batteries compliant with UL9540a (thermal runaway tests): Cell + module + container level

Battery module during the test



Battery cells inside the module after the test

Photo: Courtesy of NGK

Summary – key messages

- Market for stationary storage does exist, is huge – and growing fast!
- Currently, there is a window of opportunity for new storage technologies as lithium ion suffers from increasing raw materials prices and safety concerns.
- BASF and NGK have joined forces to develop and market NAS batteries globally.
- NAS batteries are mature and solid technology with excellent safety records in the field.
- NAS Batteries are now being increasingly deployed also outside of Japan. BSES' recent projects include installations in Europe, Australia, South East Asia and Africa. Our project pipeline has a total capacity of ~1.5GWh.

NAS Installation at BASF Antwerp, Belgium, 2021

BASF

We create chemistry