

NGK Europe GmbH

a subsidiary of NGK Insulators, Ltd.

NAS batteries

World Bank Group - ESMAP

stakeholder consultation of the Energy Storage Partnership (ESP)

energy storage technology updates and feedback on global testing network

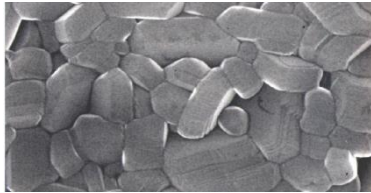
November 18th, 2020



NGK Insulators, Ltd.

TYO
5333 TOKYO
STOCK EXCHANGE

we create new value and contribute to the quality of life through ceramic technologies



material

- thorough familiarity with mechanical, thermal, electrical, and physical properties of ceramics
- controlling ceramic pore size, crystal orientation, thermal conductivity, ion conductivity, and electrical resistance



process

- molding, firing and processing a variety of ceramic structures
- binding differing materials
- develop and manufacture various configurations from fine and complex three-dimensional shapes to one of the largest porcelain in the world (11.5m)



production

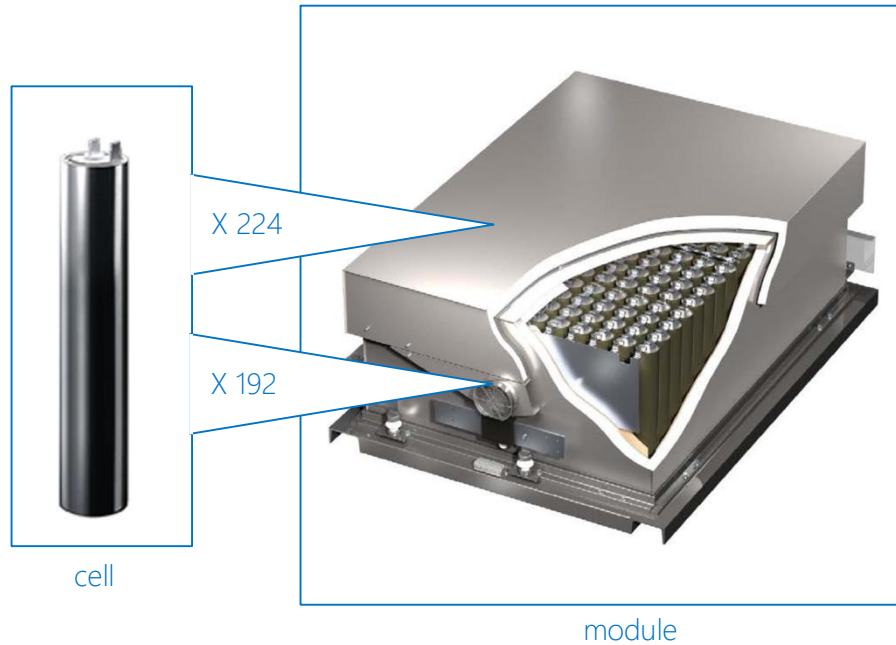
- development of our own techniques and equipment know-how for mass production manufacturing
- reduced power consumption by 30-50%
- analysis of big data into production management
- rapid incorporation of innovation in manufacturing



evaluation & analytics

- continuous learning from manufacturing experience
- advanced computer simulation
- image inspection for slightest defects detection

NGK NAS[®] systems



package unit 1.2MW / 8.64MWh



X 40



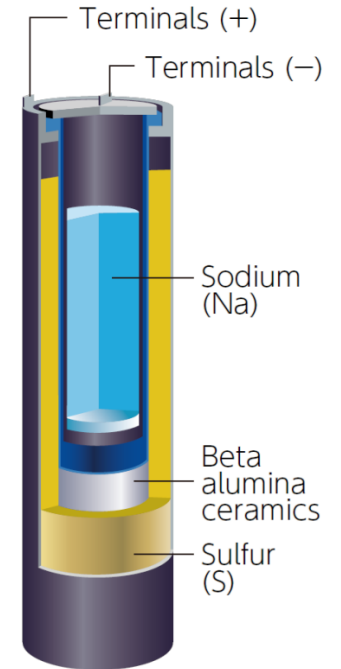
X 6

20 feet container 250kW / 1.45MWh

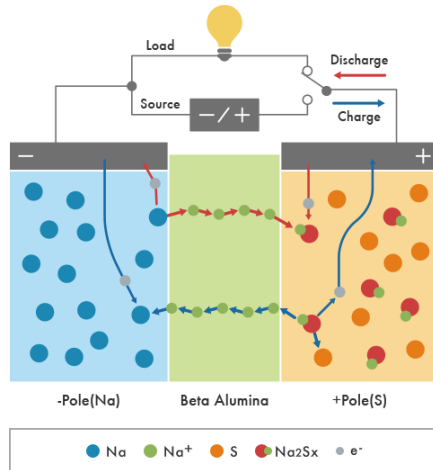
our cell



open circuit voltage	2.08V	
capacity	725Ah	1,420Wh
energy density	414Wh/l	268Wh/kg
theoretical max.	1000Wh/l	780Wh/kg
power density	38W/kg	
c-rate	1 / 6	0.17
optimal t° range	300°C	340°C
maximal t° range	290°C	360°C
expected life time	4500 cycles	15 years
partial cycle	no memory effect	
self discharge	heating when not discharged regularly	

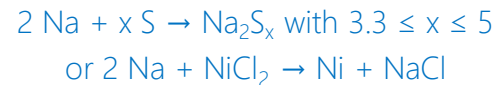


operation principle



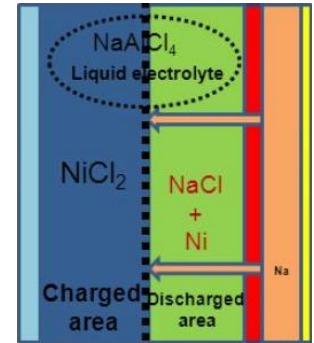
during discharge

- molten sodium donates electrons to the external circuit at the anode
- the resulting ions Na^+ migrate to the cathode through the β -alumina solid electrolyte that separates the two liquid electrodes and that acts as a superionic conductors
- the volume of liquid at the anode therefore decreases
- arriving at the cathode, Na^+ ions combines with molten sulfur or nickel chloride which reacts with the electrons coming from the external circuit
- the volume at the cathode therefore increases



during charge

- the reverse process takes place



characteristics

abundant and cheap material



no self discharge
no memory effects



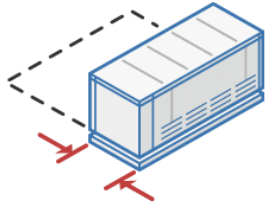
long life
very low degradation



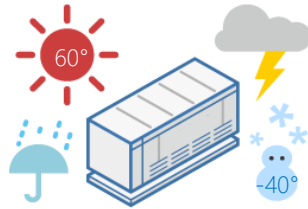
fast response



high energy density
compact system



climate resilient
no air conditioning



minimal maintenance

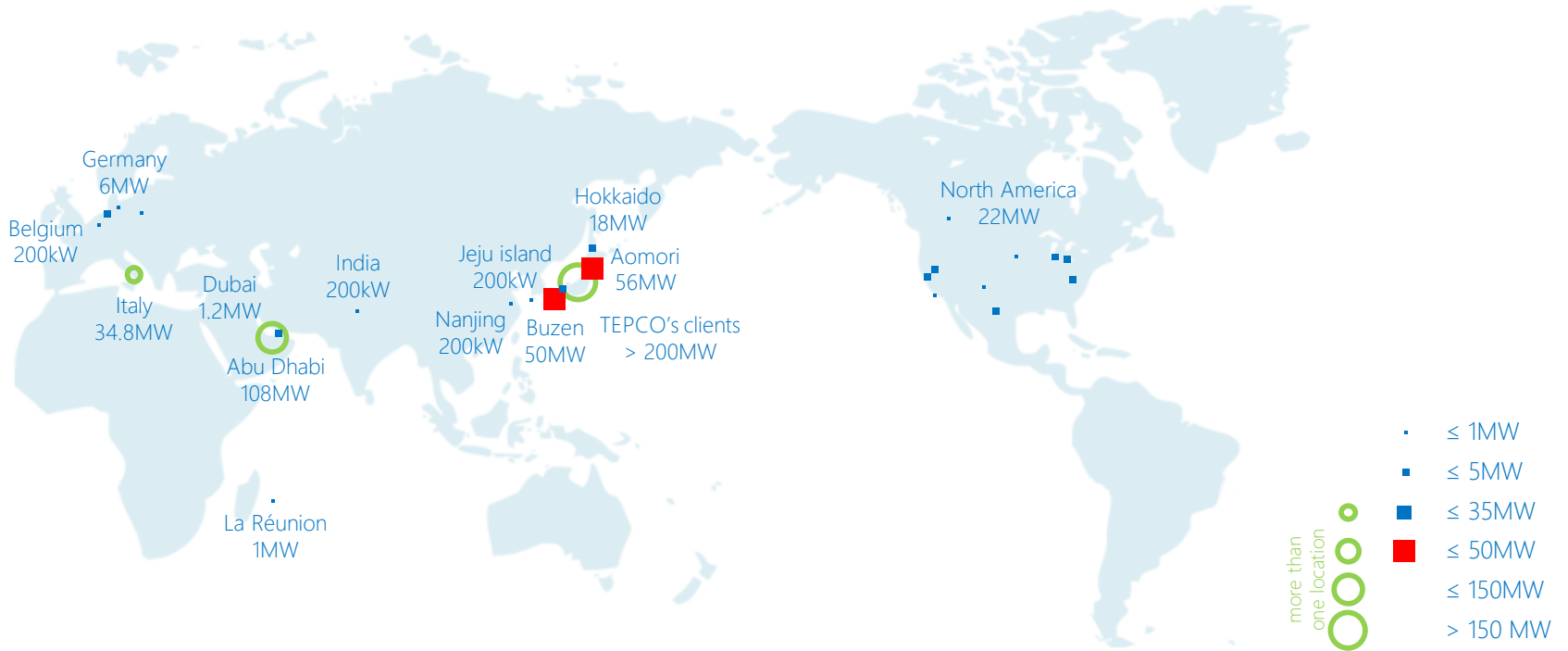


fully recyclable
or reusable



references

600 MW / 4 GWh



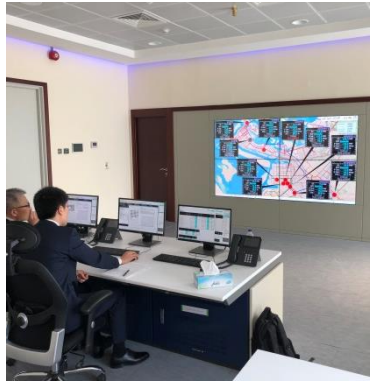
Abu Dhabi

108MW / 648MWh



- 12 x 4MW + 3 x 20MW
- 15 systems
- 10 locations
- 11 ISC

centralised control



- Centralized Integrated System Controller (CISC)
- monitors and controls all systems as one single plant
- multipurpose

national strategy



- long duration storage is a strategic component of the smart grid
- and contribute to the sustainability ambitions of the Emirate

the landmark system



- 2 x 20MW in one location
- 240 MWh
- 65 x 120m (fence)
- PV contributing to auxiliaries supply

NAS helps to produce 100% green hydrogen in South Korea

- to provide stable power supply to electrolysers from 100% wind energy
- NAS was preferred to locally manufactured lithium-ion batteries because it
 - is safer
 - has demonstrated longer life time and lower degradation in many projects over the last 16 years
 - is price competitive



With ceramics,
we can create a brighter future for energy.
we can safeguard the environment and society.

日本ガイシ



 **NGK INSULATORS, LTD.**

thank you for your attention

gauthier dupont
gdupont@ngk-e.de