

March 10<sup>th</sup>, 2021

DOE Long Duration Energy Storage Workshop

ENERGY STORAGE



## Sodium-Sulfur (NAS<sup>®</sup>) Battery



Tomio Tamakoshi

# Outline of NGK



Company Name **NGK INSULATORS, LTD.**

Date of Establishment **May 5, 1919**

Paid-in Capital **69,849 Million Yen**

Representative Directors  
 President  
**Taku Oshima**  
 Executive Vice President  
**Hiroshi Kanie**  
**Chiaki Niwa**

Number of Employees **20,000** ※Outside Japan employees **61%**  
 (consolidated) As of March, 2020

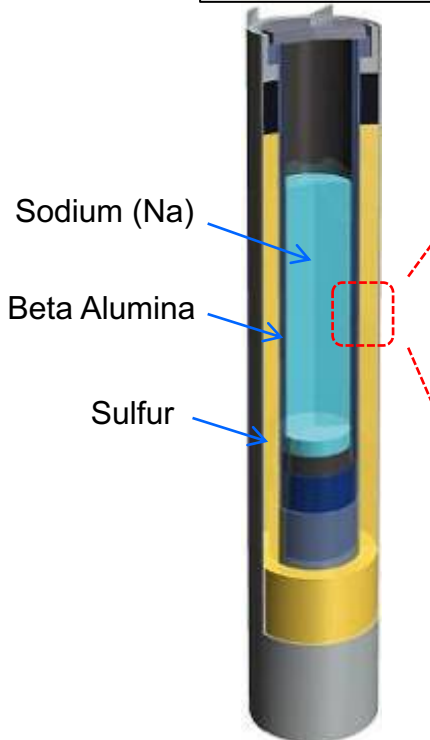
Consolidated Subsidiaries **55 companies** ※Outside Japan Subsidiaries **35**

As of March, 2020

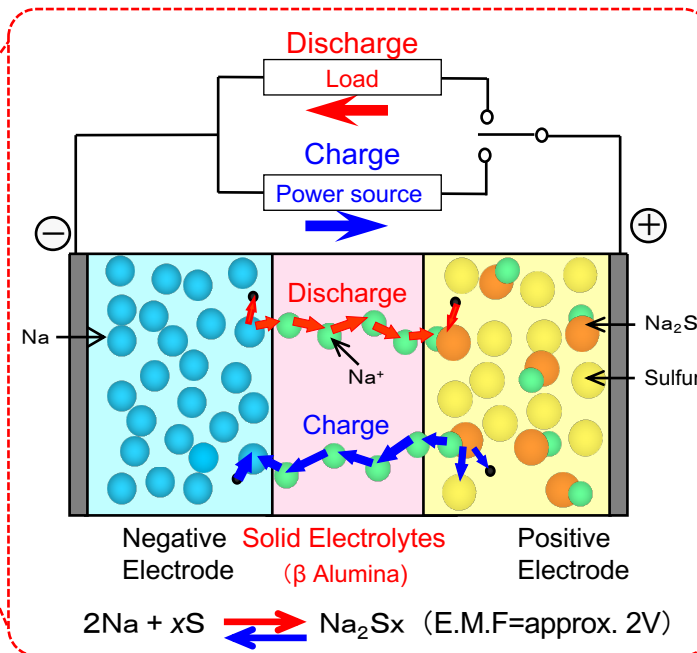
# Principle of Sodium Sulfur Battery

- Sodium Sulfur Battery is a high temperature battery which the operational temperature is 300-360 degree Celsius (572- 680 °F)
- Full discharge (SOC 100% to 0%) is available without capacity degradation.
- No self-discharge
- Best performed with long duration application for more than 6hrs.

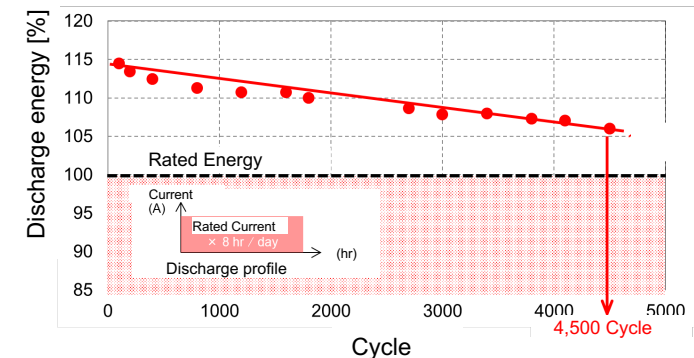
Cell Structure



Chemical Reaction

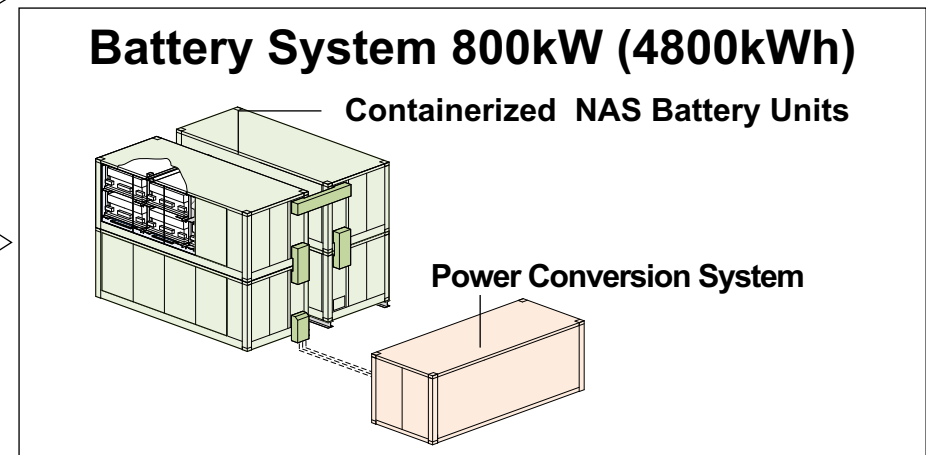
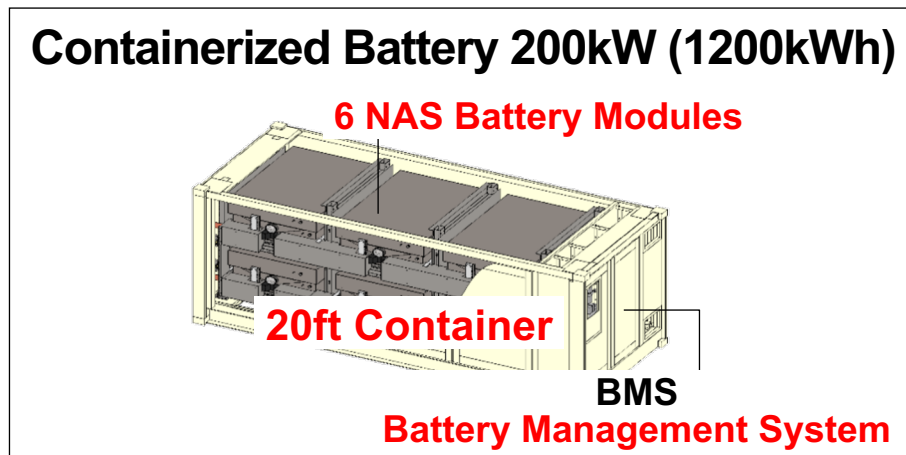
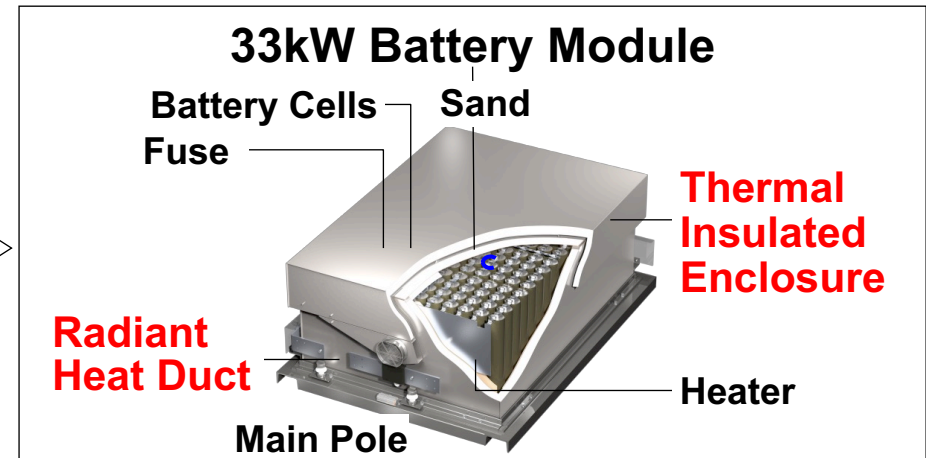
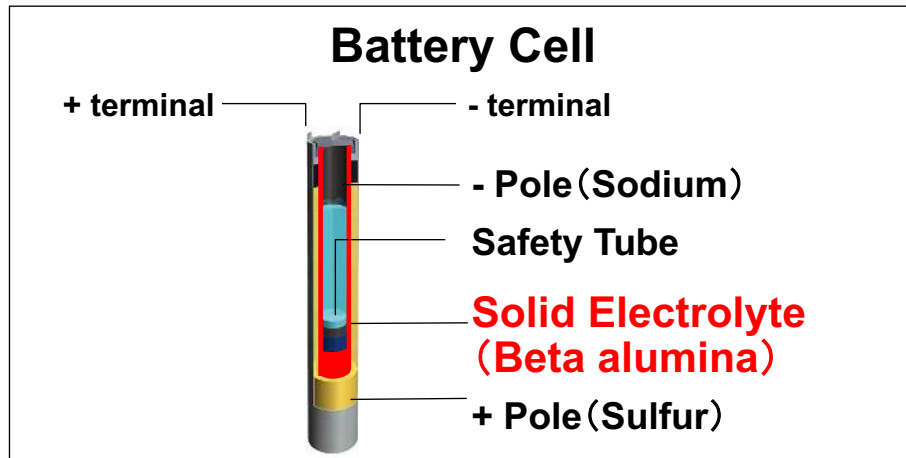


- ✓ Cycle Life : 4500 full discharge
- ✓ Calendar Life : 15 years
- ✓ Round Trip Efficiency : 75-80%
- ✓ Easy Installation with containerized system



# Structure of NAS<sup>®</sup> Containerized Battery System

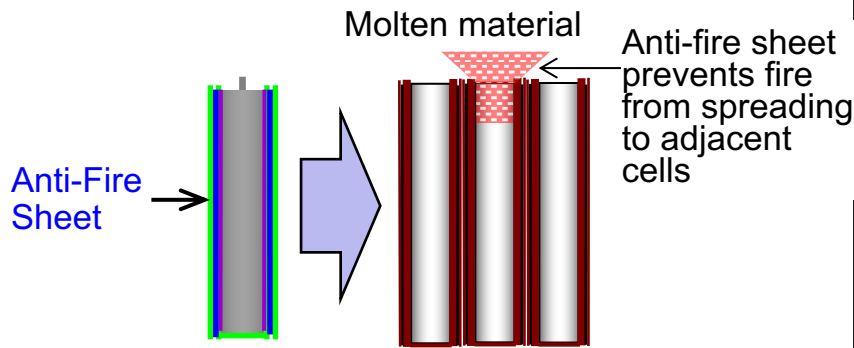
- **High efficiency** achieved by combination of vacuum thermal insulation and cooling
- **Plug & Play battery of 20ft container** with modules and battery management system



# Safety of NAS<sup>®</sup> battery

- Anti-fire sheet applied to every cell prevents fire from propagating, even in the worst case of a cell catching fire.

- Japanese Fire and Disaster Management Agency (FDMA) defines the fire safety requirements for Sodium Sulfur batteries.
- Japanese Hazardous Materials Safety Techniques Association (HMSTA) witnessed the test and validated the testing methods and results



Cell ignition test



No damage to the surrounding cells

## Safety tests conducted on NAS module

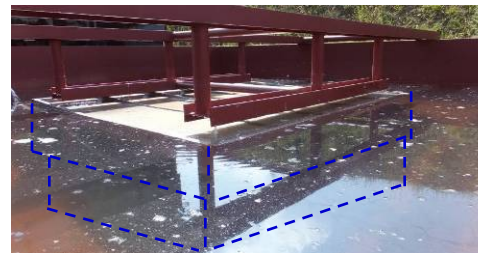
Short circuit



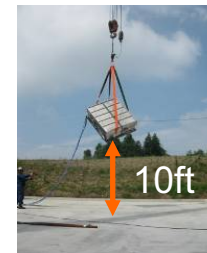
Fire Exposure



Submerge



Drop

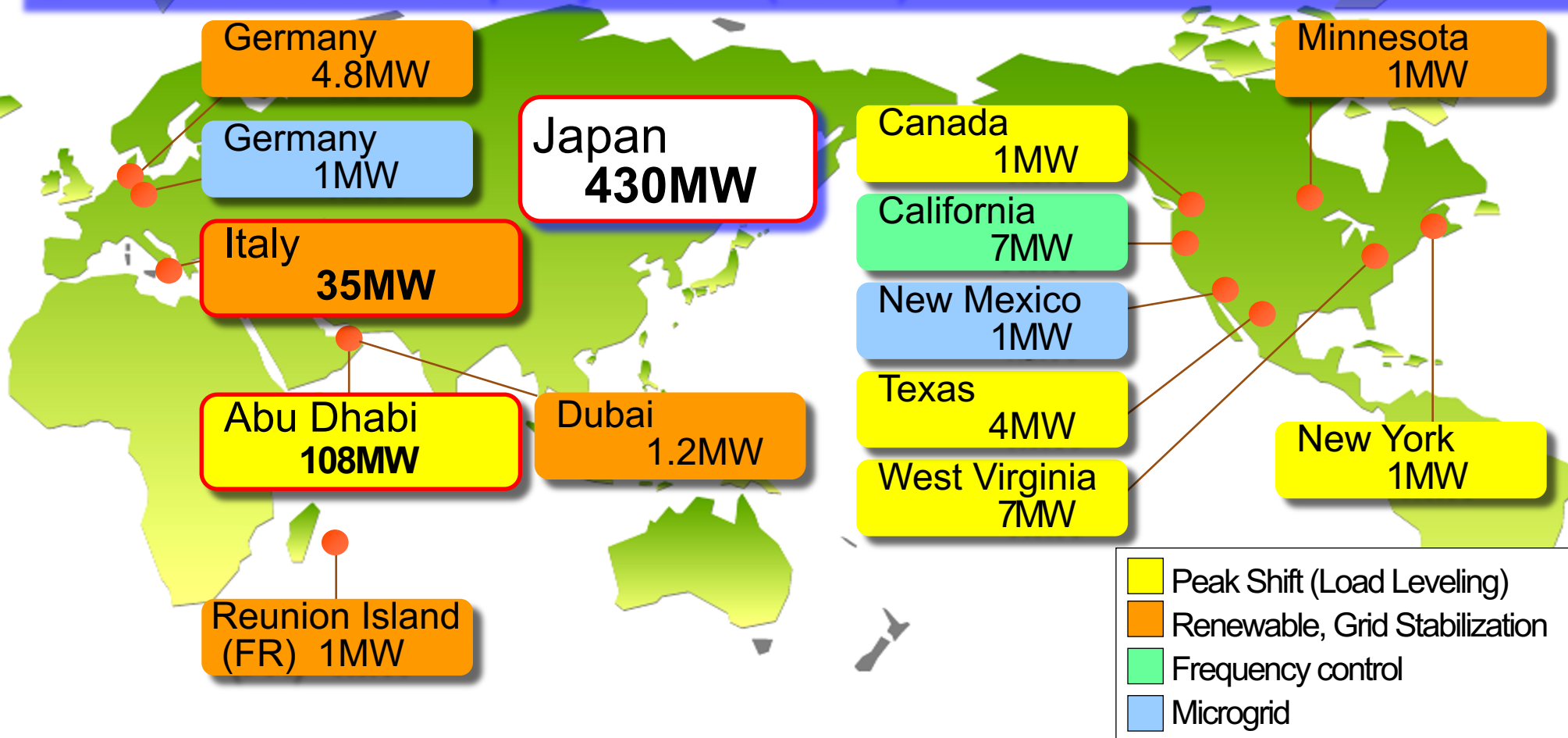


After the Test



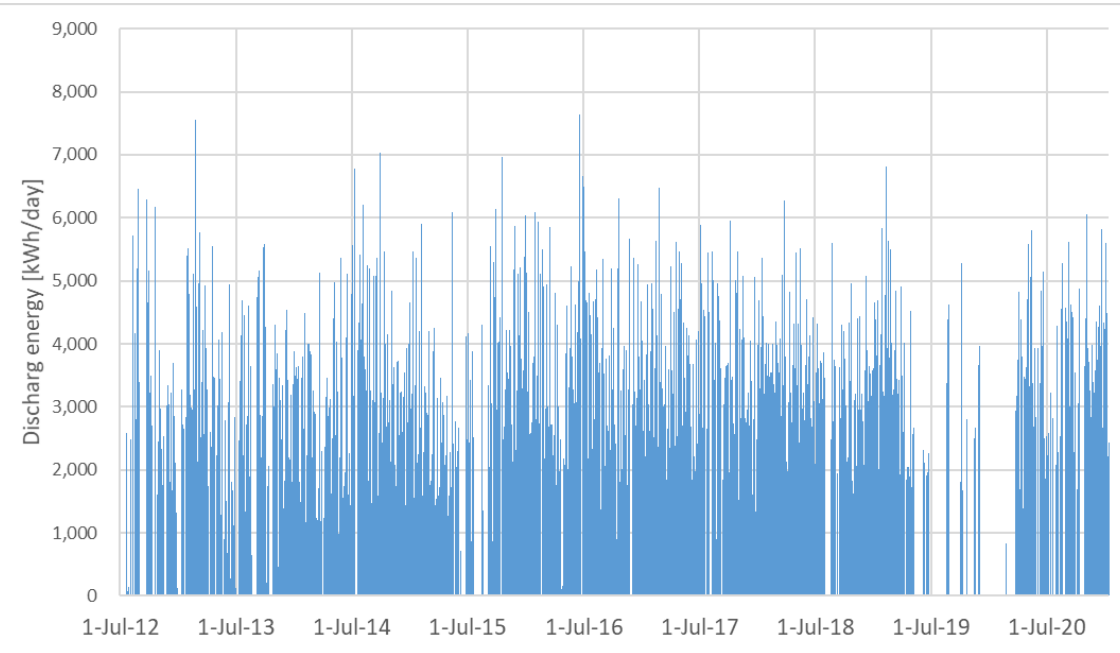
# NAS<sup>®</sup> Battery Installations around the World

- Outstanding supply record in Large Scale Battery Energy Storage  
Total Installation Record of 600MW (4,100MWh)
- Annual Production Capacity 150MW (1GWh)



# Example of Long Term Operation

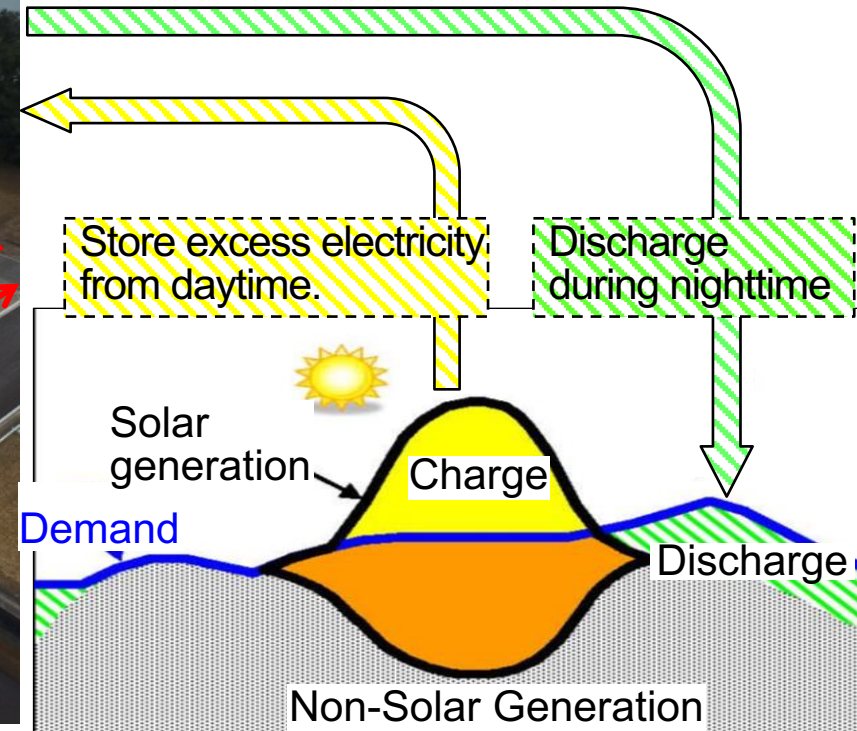
- 1MW/7.2MWh NAS<sup>®</sup> Battery system is in operation since July 2012. (9 years)
- No major failure
- No battery replacement since commencement of system operation
- Maintaining enough capacity after 9 years of operation



1MW/7.2MWh NAS<sup>®</sup> Battery system at Catalina Island  
(SCE Pebbly Beach Generating Station)

# 50MW/300MWh NAS battery system

- 50MW/300MWh NAS® Battery start operation from March 2016.
- Main usage is to store over-generated PV energy and utilize it during nighttime.
- The system is intermittently operated to contribute to Load Frequency Control (LFC).



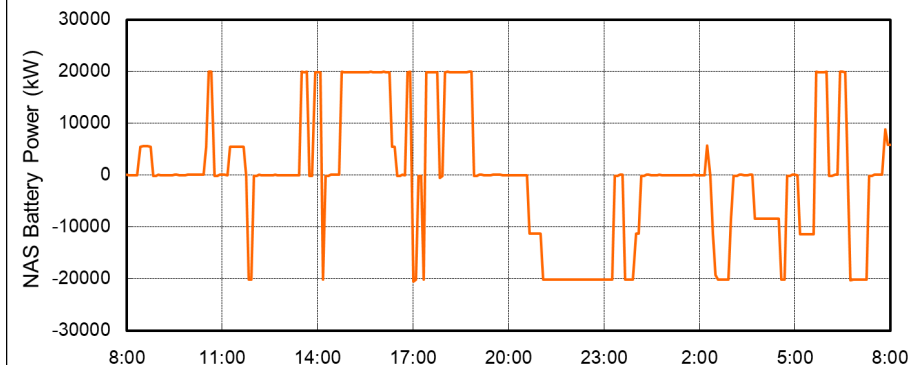
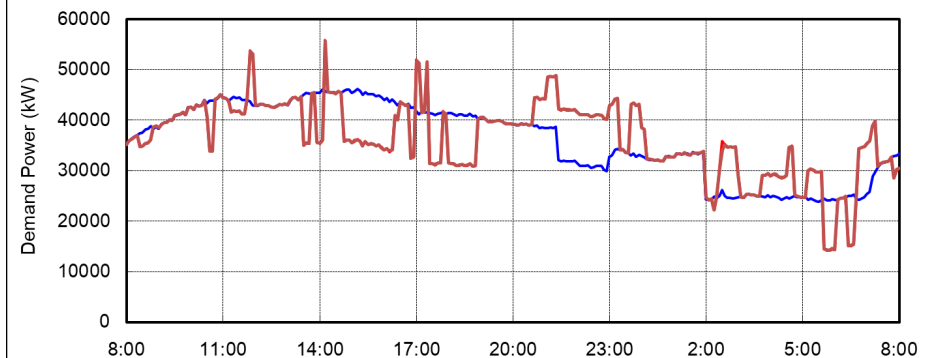
Buzen Power Plant, Kyushu Electric Power Company



# 108MW/648MWh NAS battery system

- 4 to 20MW size of NAS<sup>®</sup> Battery are installed in 11 substations in Abu Dhabi.
- Abu Dhabi has 1GW of PV to extend 6.5GW PV in 2026.
- 5.6 GW Nuclear power operation is planned from 2026.
- Energy storage will be necessary for frequency control and energy shifting.

## 20MW/120MWh NAS Battery Operation Example



Grid Scale  
Policy  
Products  
Technology

## UAE integrates 648MWh of sodium sulfur batteries in one swoop

Published: 28 Jan 2019,  
15:10

By:  
Andy Colthorpe



One of the three 20MW NGK NAS (sodium sulfur) battery energy storage systems deployed as part of the project. Image: NGK Insulators / Google Maps.

Sodium sulfur (NAS) batteries produced by Japan's NGK Insulators are being put into use on a massive scale in Abu Dhabi, the capital of the United Arab Emirates.

# NGK Battery Products

## Nickel-Zinc Battery (ZNB)



High safety battery targeted for indoor usage currently under field test stage.

In addition, **Zinc-Air battery** under development.

## EnerCera® Lithium-ion battery



### Applications of EnerCera battery



Wearable Devices



On-board power source



Smartcard  
(Credit Card, ID Card)

Coin and Pouch type lithium-ion rechargeable battery for smart card and various IoT devices. (Commercialized)

# END

URL : <https://www.ngk.co.jp/nas/>

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