
Customer-Side Applications of NGK's NAS[®] Battery System

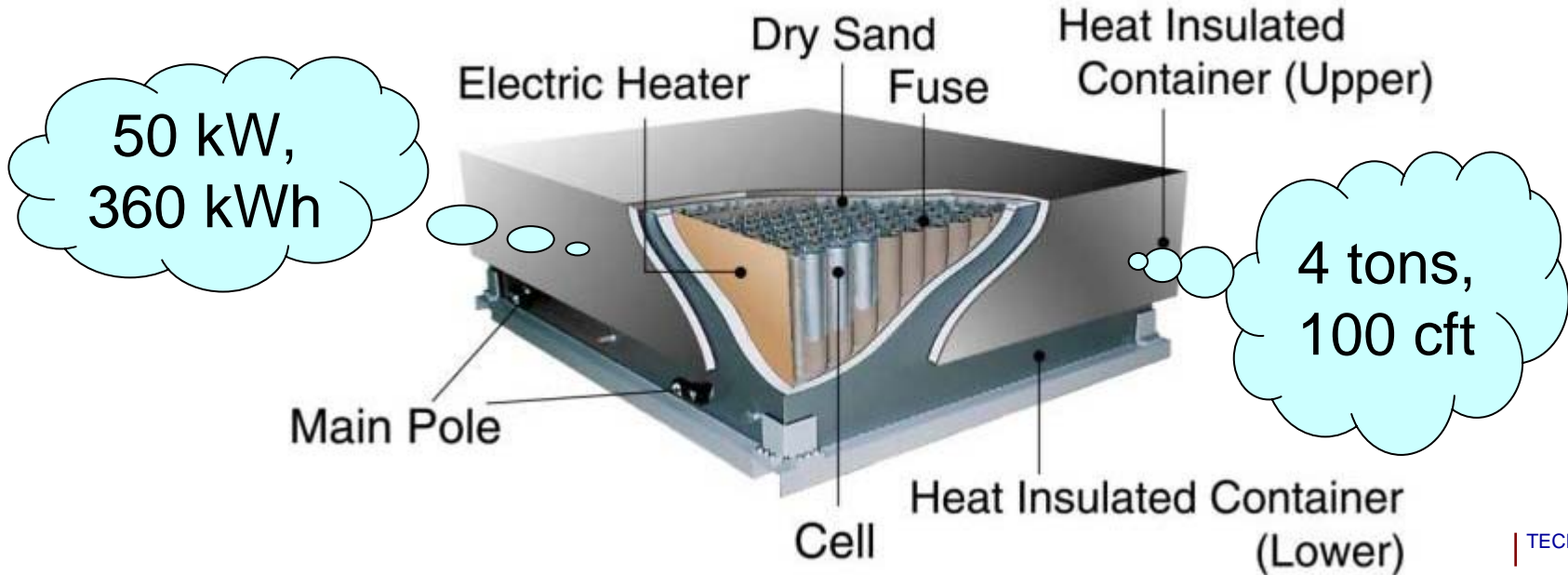
***~ First Customer-Side U.S. Application ~
MTA Long Island Bus Terminal
Garden City, NY***

CEC/NYSERDA Emerging Technologies Conference

October 2006

What is NAS?

- **It's a battery!**
 - A sodium (Na) sulfur (S) → "NAS[®]" Battery
- **... for megawatt-scale applications!**



What is NAS?

Jointly developed over two decades by

**Tokyo Electric Power Company (TEPCO) and
NGK Insulators, Ltd., (NGK)**

for large utility, commercial and industrial users

- Commercial in Japan since 2002
- Over 130 projects in Japan (totaling 150 MW, 900 MWh)
- Two 1.2 MW, 7.2 MWh projects in the U.S.:
 - AEP, Charleston, WV: June 26, 2006
 - NYPA, Garden City, NY: operational Dec 2006
- Largest to date: 8 MW, 58 MWh for Hitachi,
- Next large plant: 30 MW, 216 MWh for Tohoku area
(wind farm stabilization, generation shifting)

What Can NAS Do For Energy Users?

Today's Energy User Needs . . .

- **Lower Electricity Bills**
- **Improved Power Quality** → power for automation, communications
- **Higher Reliability** → power for use in emergencies
- **“Friendly” Power** → power with less noise, pollution, maintenance

NAS is able to ...

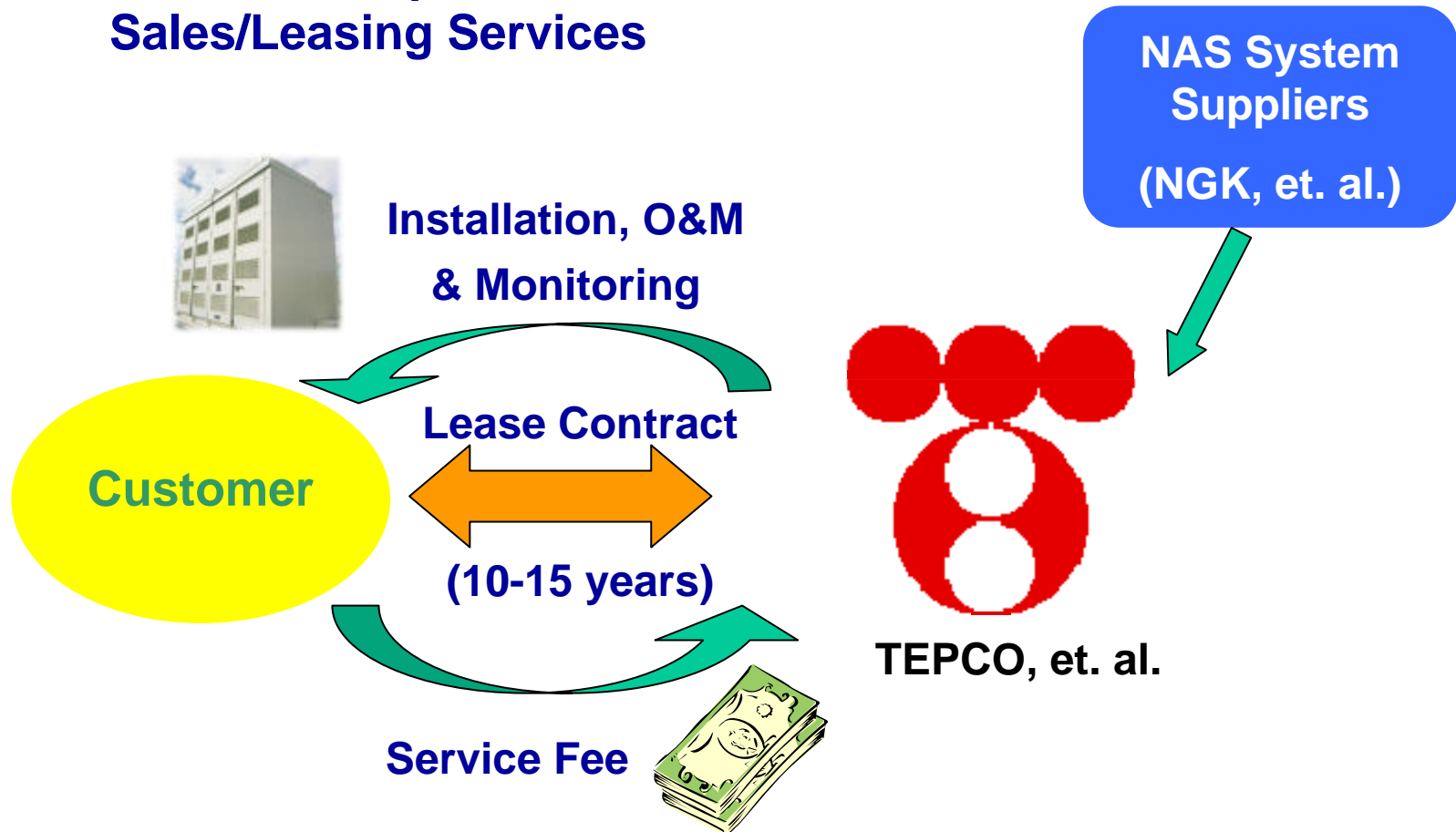
- Reduce Electric Bills
 - *Peak Shaving (use lower cost off-peak electricity)*
- Mitigate Power Disturbances (cycles)
 - *Power Quality Equipment*
- Increase Reliability (hours)
 - *Standby Power*
- Reduce Environmental Intrusion

NAS Advantages Over Gensets & Other Batteries Include. . .

- **Less Intrusion on the Environment (and Management)**
 - No Emissions (no fuel issues), Virtually Silent
 - Easier Siting, Shorter Lead Time
 - Small Footprint (due to high energy/power density)
- **Lower Operation & Maintenance (O&M) Costs**
 - Efficient, Long Service Life
 - Hermetically Sealed Cells, Modular Construction
 - Solid State Electronics
- **More Versatile**
 - Peak Shaving, Backup Power, and PQ Event Mitigation
 - Instantaneous, Precise Response
 - Readily Relocated

Distribution in Japan: Utility Market Channel

- Utilities In Japan Offer Sales/Leasing Services



Customer Applications in Japan

Case 1. Subway Facility [14.9 MW (peak), 60,000 MWh/y]

- 300,000 passengers/day
- Application: Peak Shaving

Case 2. Casino (Boat Racing) Complex [4.4 MW, 5,200 MWh/y]

- 9,000 seats
- Application: Power Quality, Reliability, Peak Shaving

Case 3. Office Building [650 kW, 1,400 MWh/y]

- Government Offices
- Application: Peak Shaving, Emergency Power

Case 4. Fujitsu – Semiconductor Manufacturer

- Highly automated, PQ sensitive, manufacturing
- Application: PQ Event Mitigation, Peak Shaving

Customer Applications in Japan: Subway Facility

Subway Facility Application

- **NAS Installation: 1,000kW,**
Peak Shaving,
1,000kW × ~ 7h per day

Benefits

- **Peak Period Load Reduction:**
14,900 kW → 13,700 kW (▲1,200kW)
- **Electric Bill Reduction**
\$ 7.4 million /y → \$ 6.9 million /y (▲6.7 %)



Customer Applications in Japan: Casino (Boat Racing) Complex

Casino (Boat Racing) Application

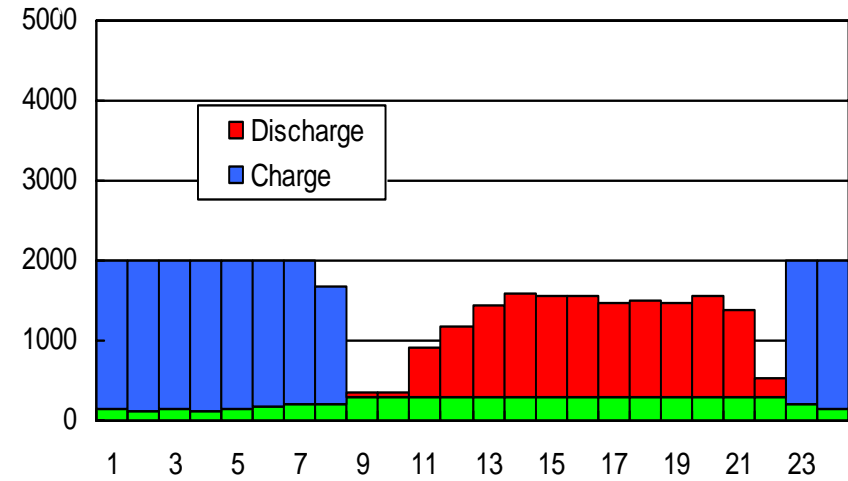
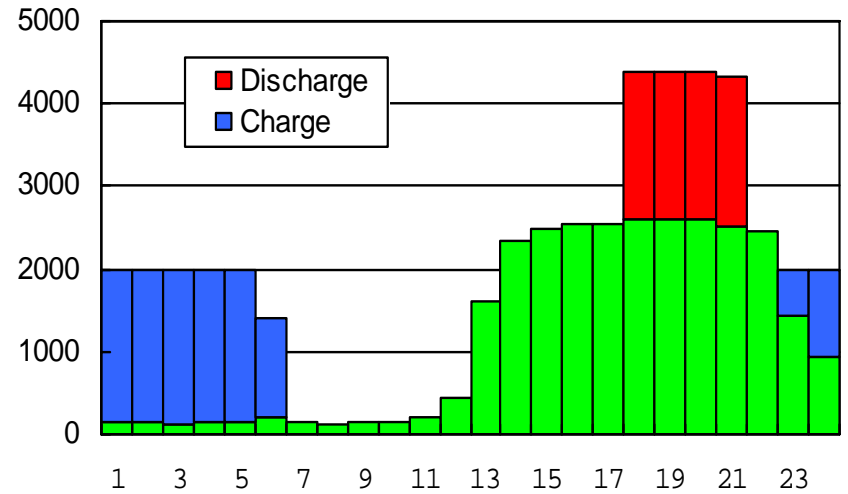
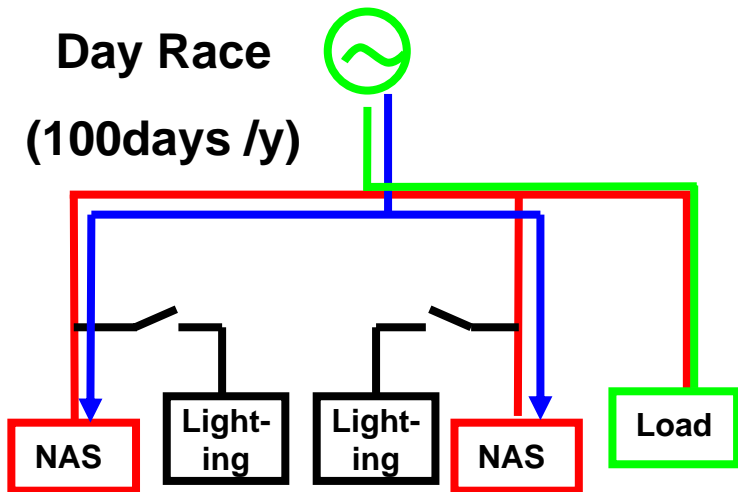
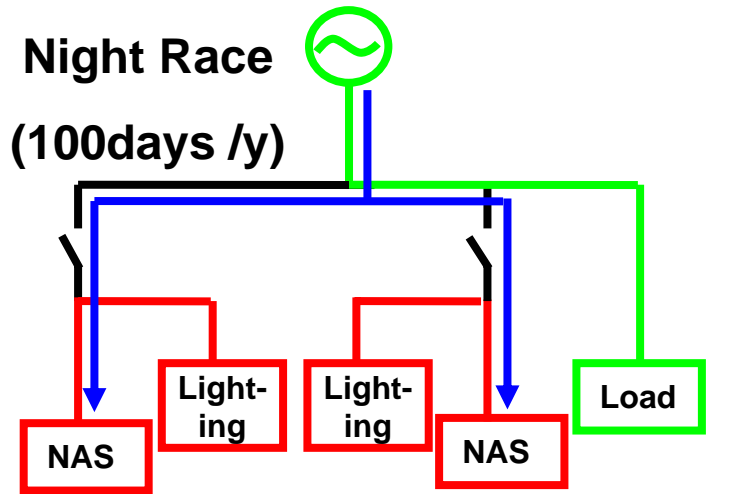
- **NAS Installation: 2,000 kW**
Peak Shaving
Lighting System Reliability
(for night racing)
2,000kW × ~ 7h per day

Benefits

- **Peak Period Load Reduction:**
4,400 kW → 2,600 kW (▲1,800 kW)
- **Electric Bill Reduction:**
\$ 1,170,000 /y → \$ 842,000 /y (▲28%)



Customer Applications in Japan: Casino (Boat Racing) Complex



Customer Applications in Japan: Government Office Building

Office Building Application

- **NAS: 500 kW**
Peak Shaving, Backup Power
500 kW × ~ 7h per day

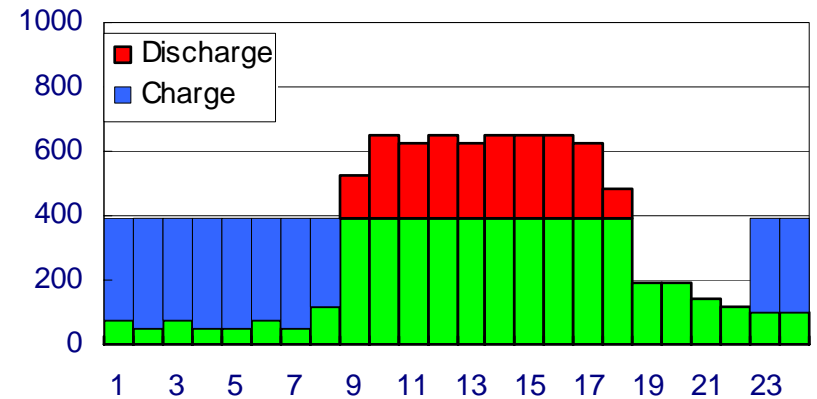
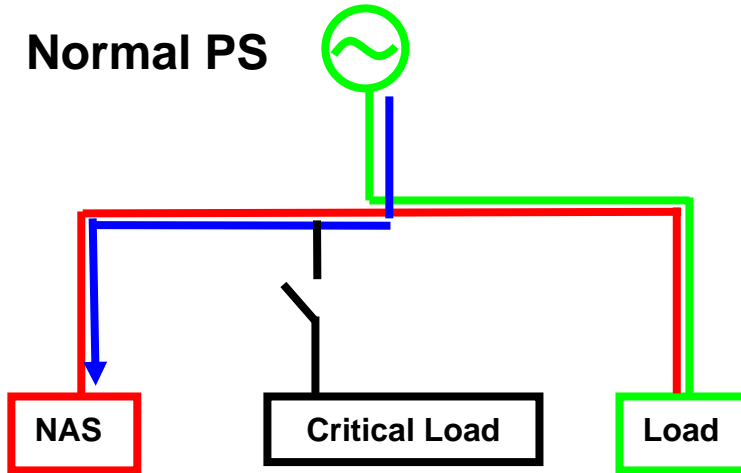
Benefits

- **Peak Period Load Reduction:**
650 kW → 400 kW (▲ 250 kW)
- **Electric Bill Reduction:**
\$ 255,000 /y → \$ 196,000 /y (▲23%)

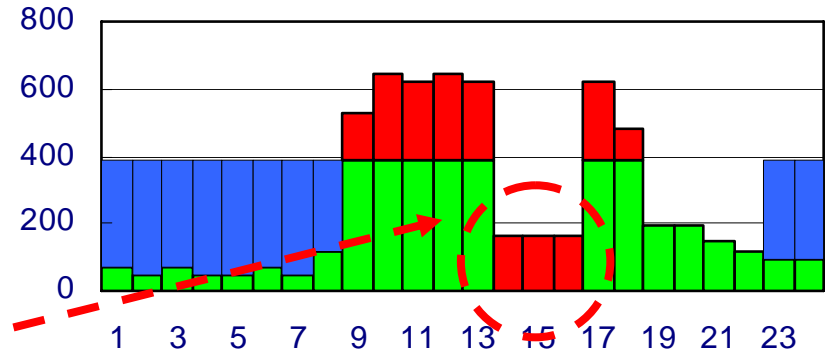
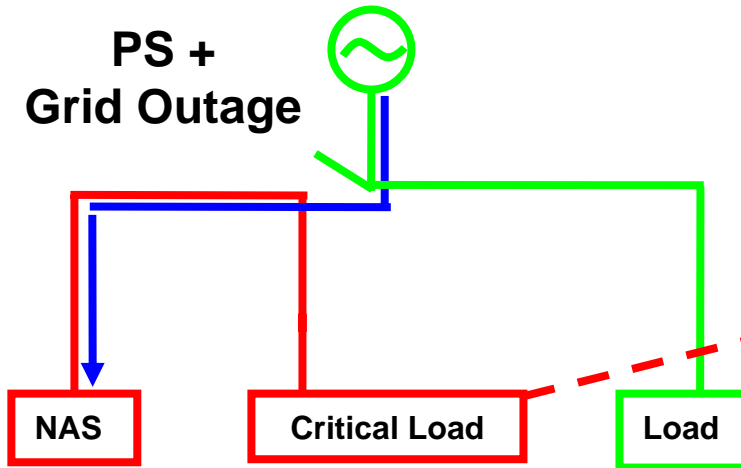


Customer Applications in Japan: Government Office Building

Normal PS



PS +
Grid Outage



Customer Applications in Japan: Fujitsu Semiconductor Manufacturer

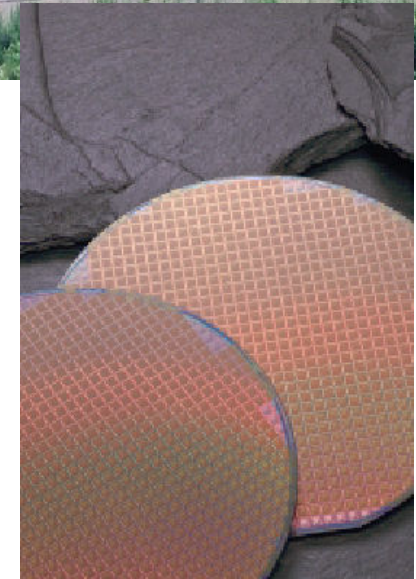
Representative Fujitsu Semiconductor Manufacturing

- **NAS: 3000 kW (PQ) / 1000 kW (PS)**
PQ Protection, Peak Shaving
3,000 kW × 13.5 sec, 20 ms transfer*
1,000 kW × ~ 7h per day
- **Seven Installations at Two Factories**

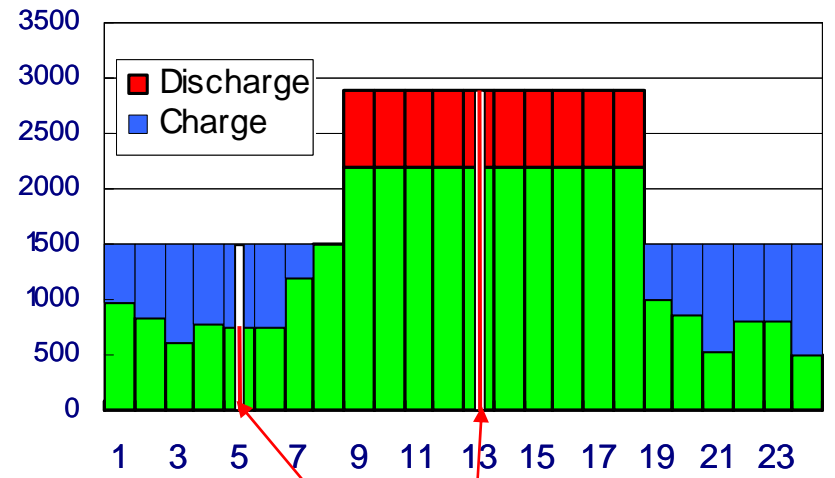
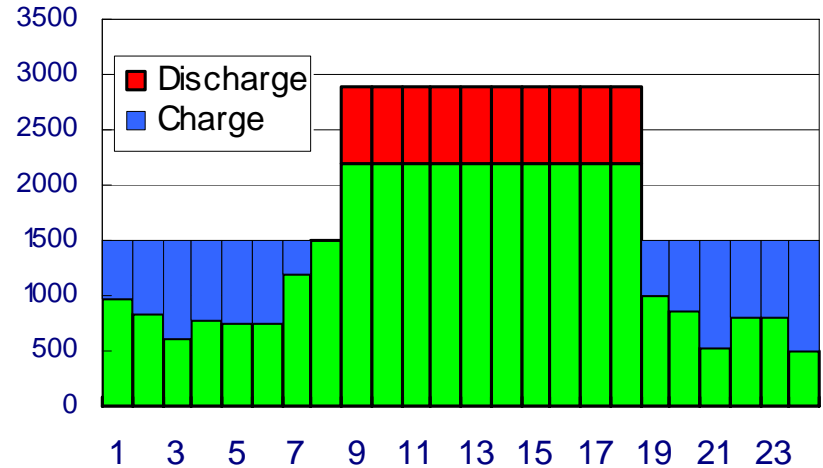
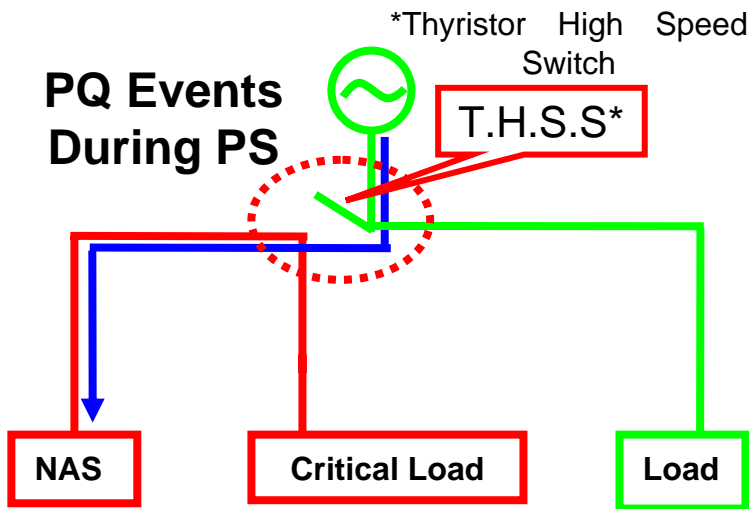
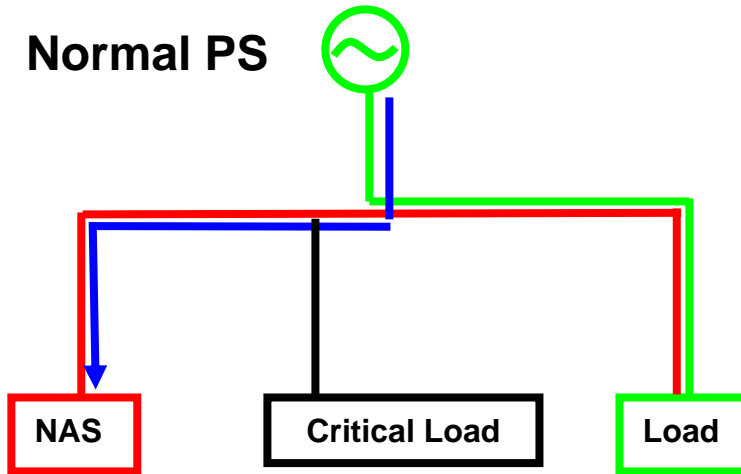
Benefits

- **Avoided Process Trip on PQ Events
(voltage sags, momentary outages)**
- **Peak Period Load Reduction:**
▲ 1000 kW

* Load transfer to NAS within 1 cycle



Customer Applications in Japan: Fujitsu Semiconductor Manufacturer



PQ events < 13.5 sec

1st NAS Battery System Customer-Side Application in the U.S.

- **MTA Long Island (LI) Bus Terminal – Status**
 - Fleet of 220 compressed natural gas (CNG) buses
 - Three 600 HP electric natural gas fueling compressors
 - Currently fueled off peak to avoid high demand charges
 - Served by dedicated LI Power Authority (LIPA) feeder
- **Project Goals & Objectives**
 - Reduce demand charges, eliminate 3rd shift
 - Increase backup power for entire facility
 - Reduce peak demand on heavily loaded utility grid
 - Demonstrate long term, commercial environment, high efficiency energy storage operation

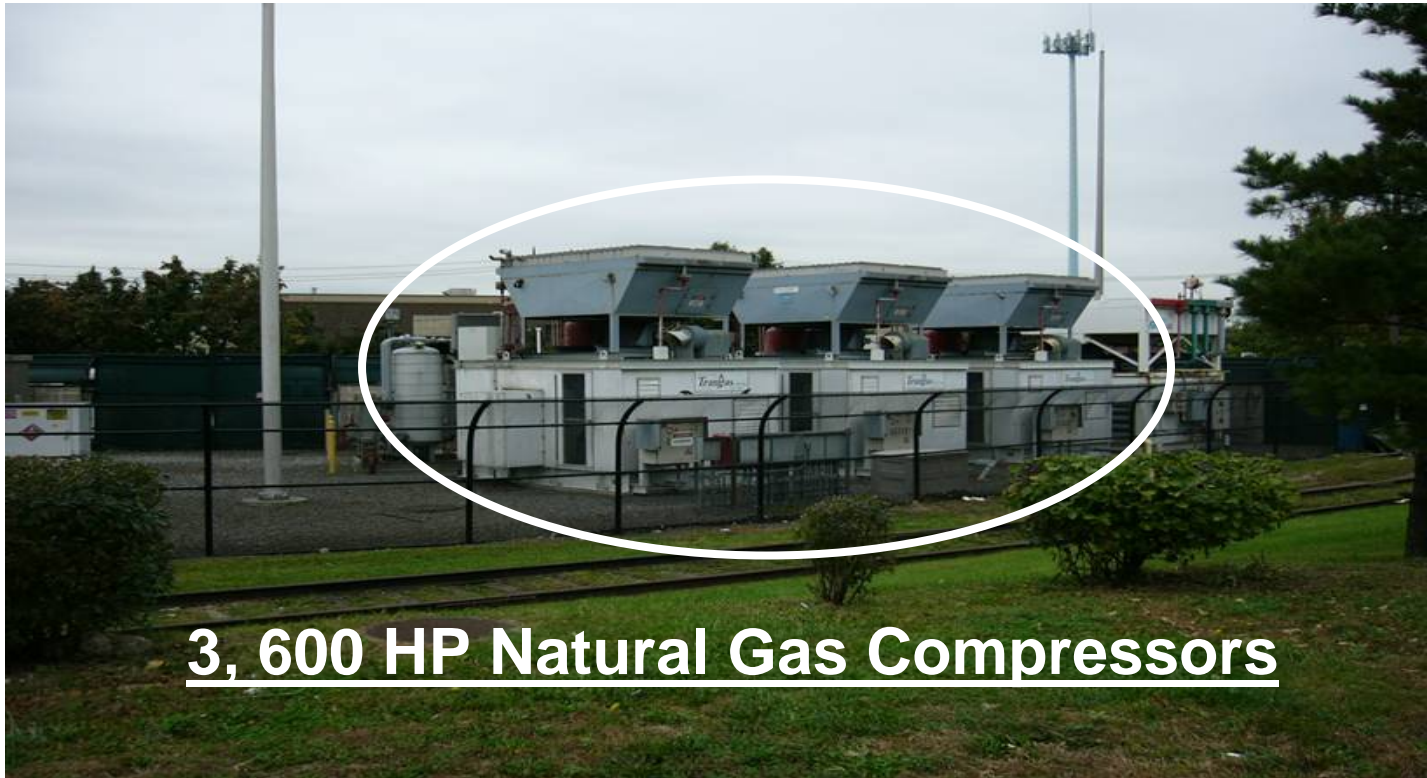
1st NAS Battery System Customer-Side Application in the U.S.

- **LI-Bus Project Team**

- NYPA - Project Implementation
- MTA/LI Bus - Host site, end user
- NGK - NAS battery manufacturer
- ABB - Power conversion system, controls & integration
- Hawkeye - Site contractor, equipment Installation
- DOE/NYSERDA - Performance monitoring
- EPRI - Technical Expertise, Co-funding

1st NAS Battery System Customer-Side Application in the U.S.

LI Bus Project Site, Garden City, NY



3, 600 HP Natural Gas Compressors

1st NAS Battery System Customer-Side Application in the U.S.

LI-Bus Application

- **NAS: 1200 kW (peak)**
Peak Shaving, Backup Power
1000 kW (nominal) × ~ 7h per day

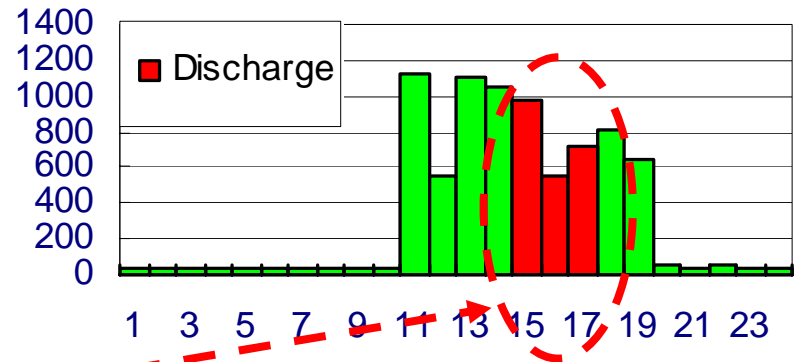
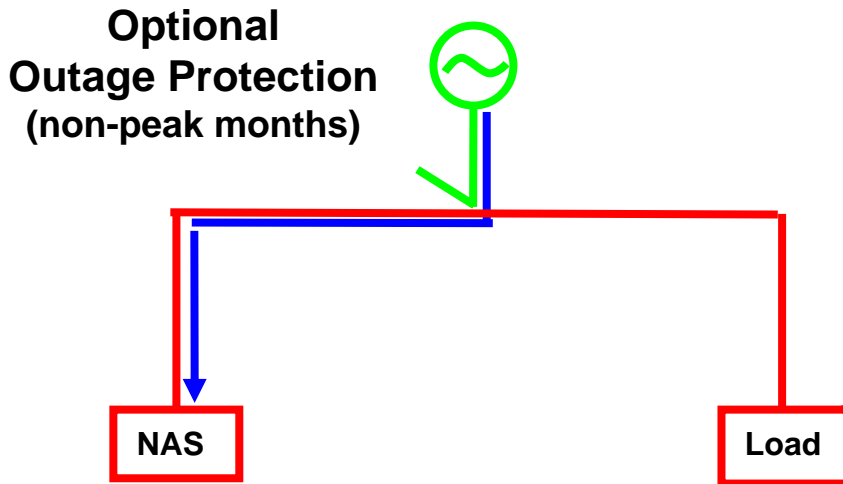
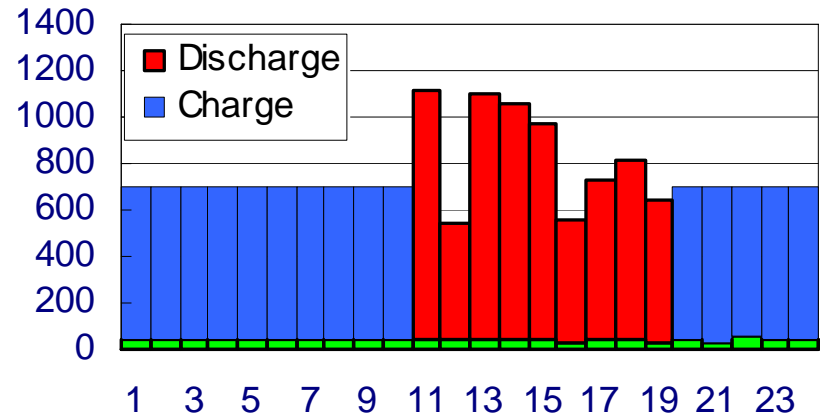
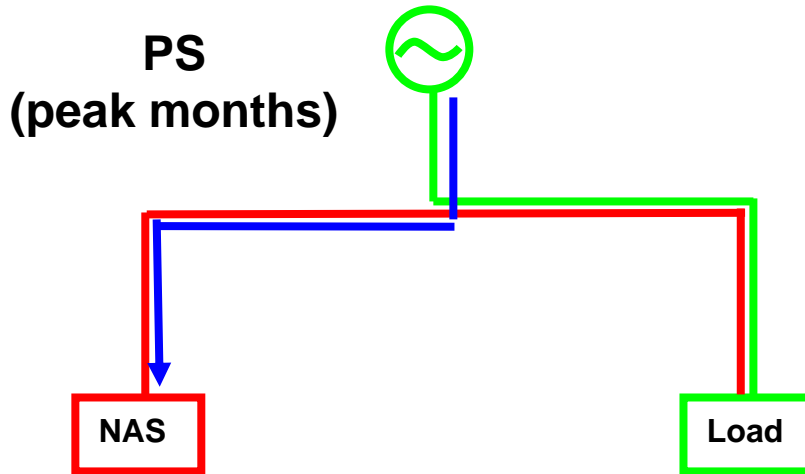
Benefits: (target)

- **Peak Period Load Reduction:**
1200 kW (peak) → 40 kW (▲ 1150 kW)
(during peak months)
- **Grid Outage Protection:**
(during non-peak months)



NAS Installation at LI-Bus
(Operational, Dec 2006)

1st NAS Battery System Customer-Side Application in the U.S.



NAS Poised for Global Deployment

- **Performance, reliability and safety amply demonstrated in a range of utility, commercial and industrial settings**
 - Multi-megawatt installations typical
 - 10 MW “building blocks” planned
- **Prototype commercial manufacturing plant ready for expansion**