To: docket@energy.state.ca.us
From: Harold Gotschall <gotschall@ti-sd.com>
Subject: CEC Efficiency Committee Workshop 3Mar08 - Sodium Sulfur (NAS) Batteries
Cc: Paul Kobayashi <paul@ngk.co.jp>, Dan Mears <mears@ti-sd.com>, Tak Eguchi <eguchi@ngk.co.jp>
Bcc:
Attached: C:\Documents and Settings\Harold\My Documents\!!QuickDrop\CEC_LoadMgt_3Mar08\$NAS_Overview&Status_3Mar08r1wAEPrls.pdf;

California Energy Commission Efficiency Committee

The attached/following information is submitted to enhance the committee's awareness of Sodium Sulfur (NAS) Battery technology developed by NGK Insulators, Ltd., and its potential to contribute utility load management both in Japan and the United States. This information is submitted on behalf of:

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By Technology Insights, US agent for NGK
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NGK INSULATORS, LTD.

Overview & Status of NGK's Sodium Sulfur (NAS) Battery

March 2008

TECHNOLOGY INSIGHTS

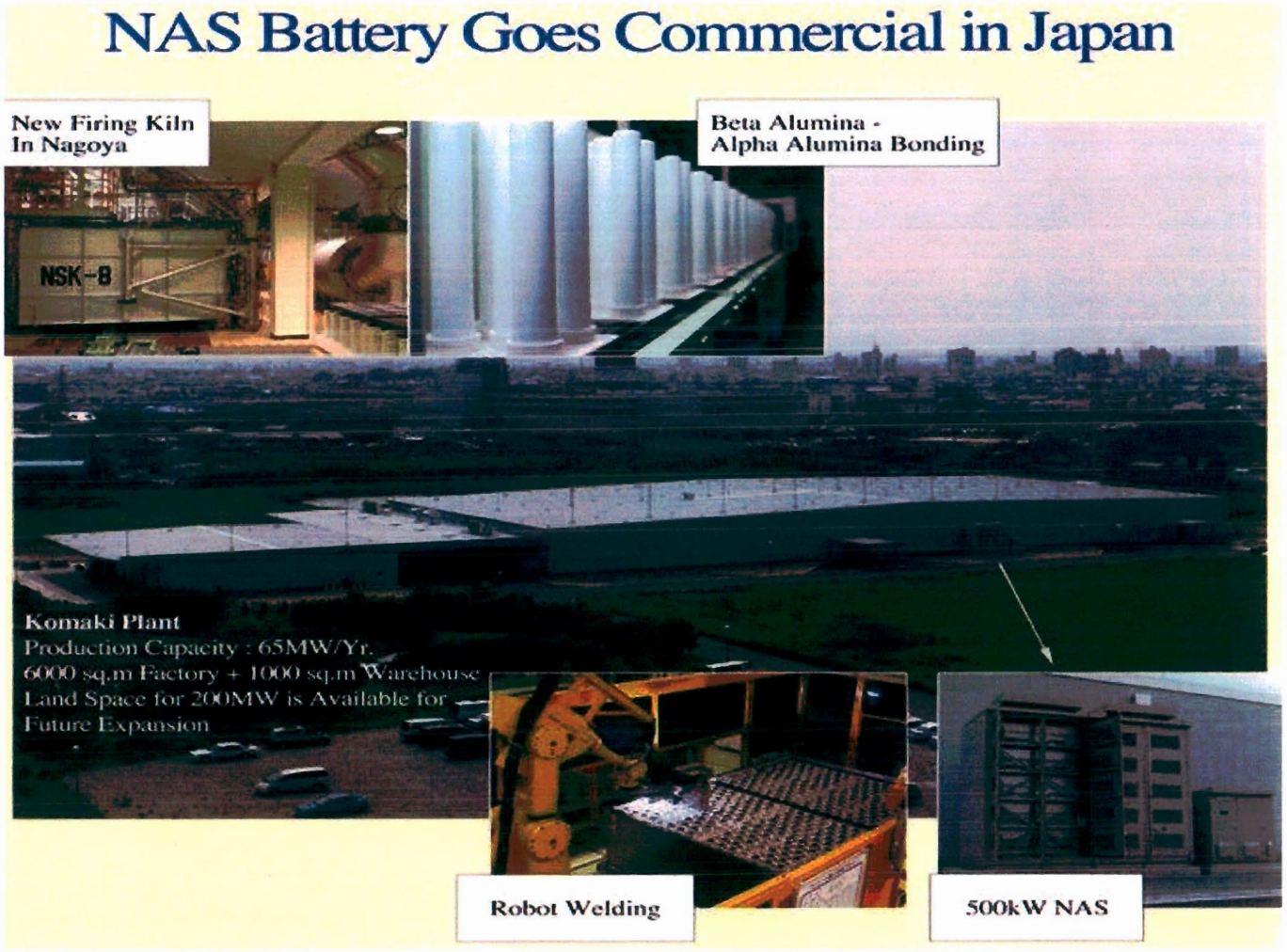
NGK INSULATORS, LTD.

NAS Battery Commercial Highlights

- **April 2002 – NAS systems offered commercially in Japan**
  - Tokyo Electric Power Company (TEPCO) sells/leases NAS systems to customers in their service area
  - NGK Insulators offers integrated NAS systems via teaming with Toshiba
- **September 2002 – AEP hosts first U.S. demonstration project**
- **April 2003 – NGK initiates commercial scale NAS manufacturing**
  - Initial capacity of 65 MW/yr, (90MW/yr in '07, 1800 modules/yr)

NGK INSULATORS, LTD.

April 2003 – Nagoya/Komaki, Japan
New NAS Battery Manufacturing Plant



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NAS Battery Commercial Highlights

- **July 2004 – Operation of then largest NAS system for load leveling by TEPCO**
  - 9.6 MW and 64 MWh/day – Municipal water plant
  - 9.6 MW and 57.6 MWh/day – Hitachi's auto systems
- **June 2006 – Operation of first commercial-scale project in the U.S.**
  - AEP - 1.2 MW and 7.2 MWh for load leveling

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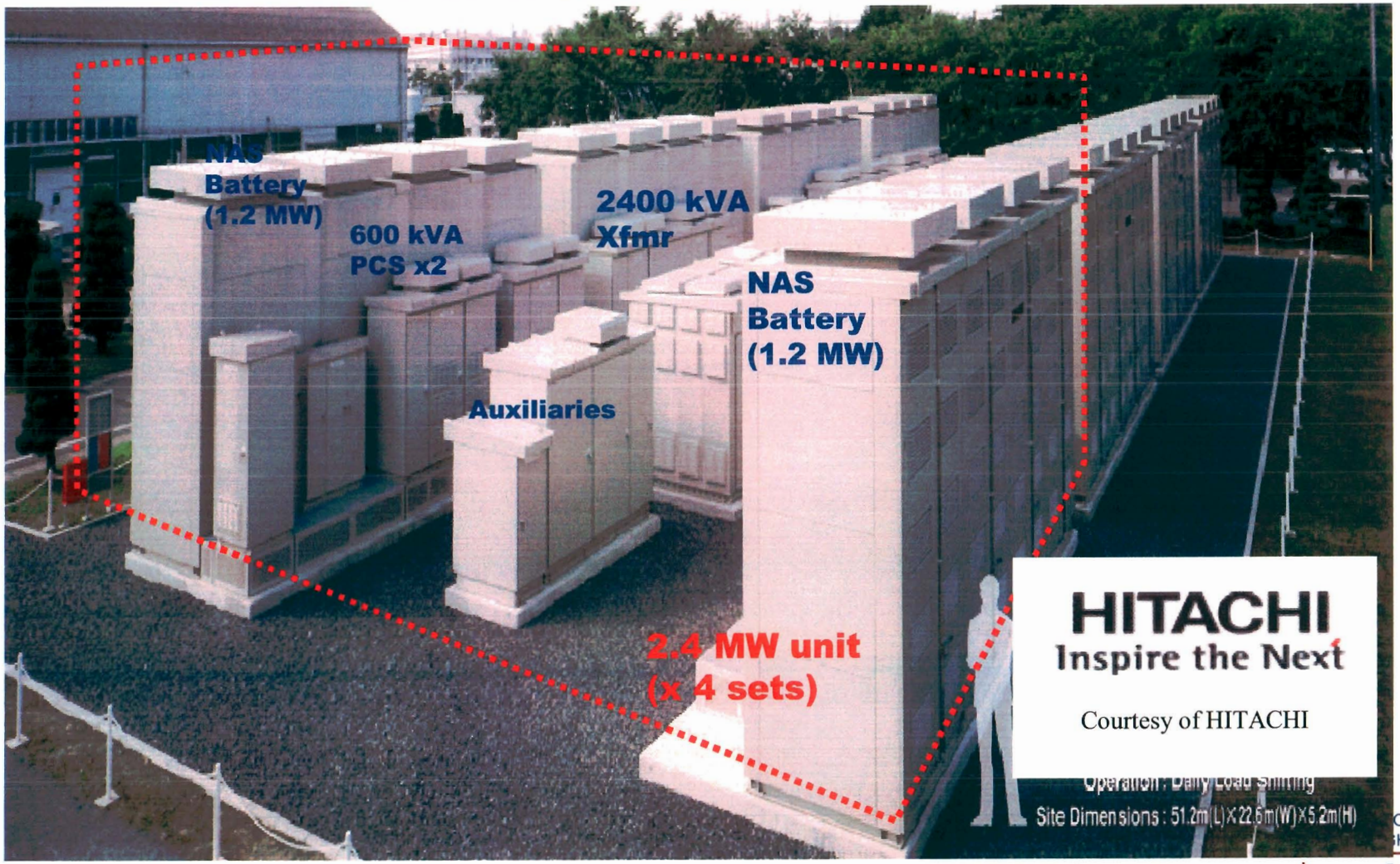
NAS Installation at Hitachi
9.6 MW, 57.6 MWh



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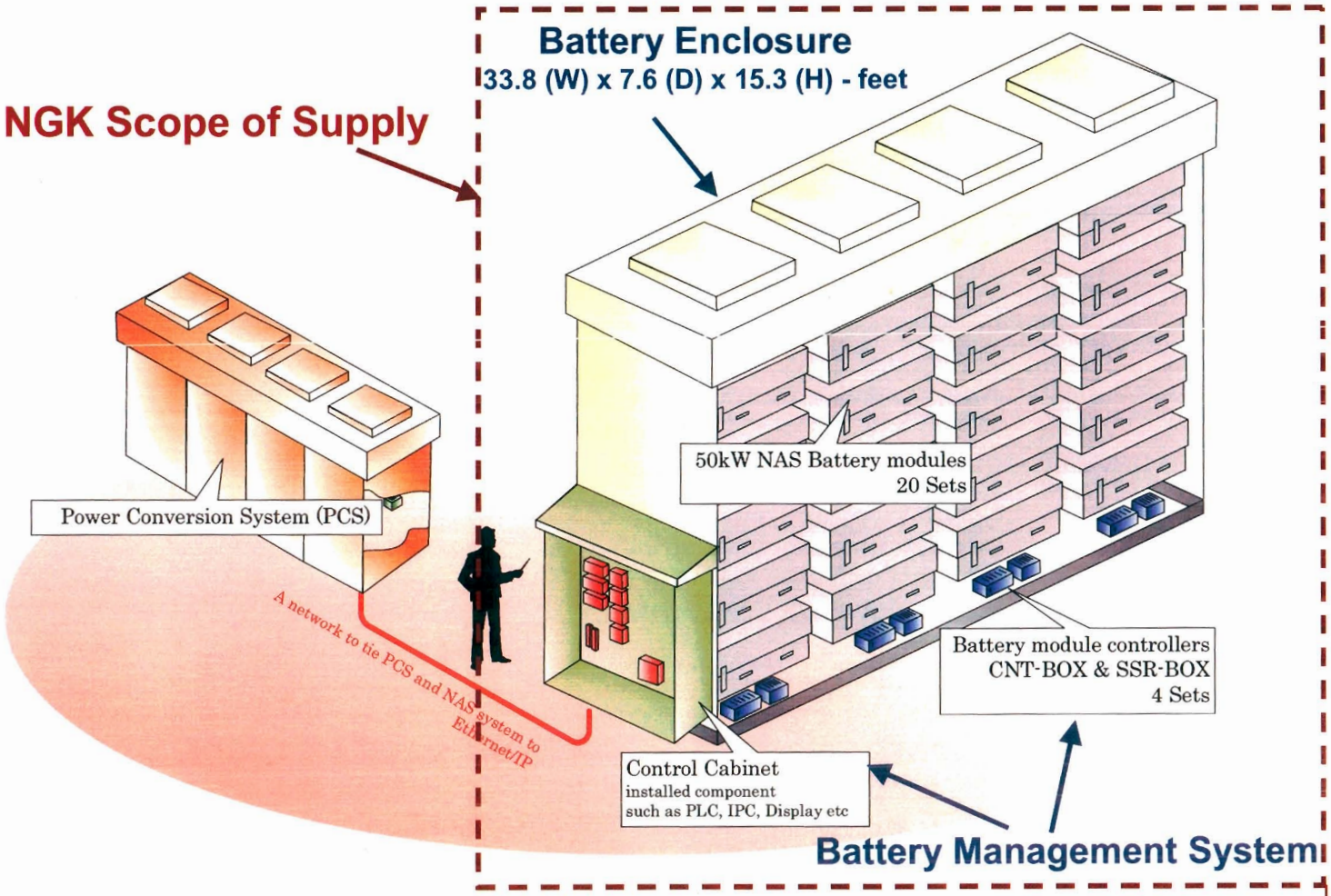
2008 NAS Battery Commercial Highlights

- **March 2008 (planned) – Operation of 2nd comm'l-scale US project**
  - NYPA – 1.2MW, 7.2 MWh for load leveling and reliability
- **April 2008 (planned) – Operation of the next largest storage system in Rokkasho, Japan**
  - Japan Wind - 34 MW, 245 MWh for wind stabilization
- **Jun-Oct 2008 (planned) – Operation of 3 separate units**
  - AEP – Three, 2 MW, 14.4 MWh units for load leveling and reliability
- **October 2008 (planned) – Operation of first US direct wind connected installation**
  - Xcel Energy – 1MW, 7.2 MWh for stabilization and time-shifting
- **Pending 2008? – Project development underway**
  - PG&E – 6 MW, 43.6 MWh for reliability and renewables support

1 MW NAS Installation: Major Systems



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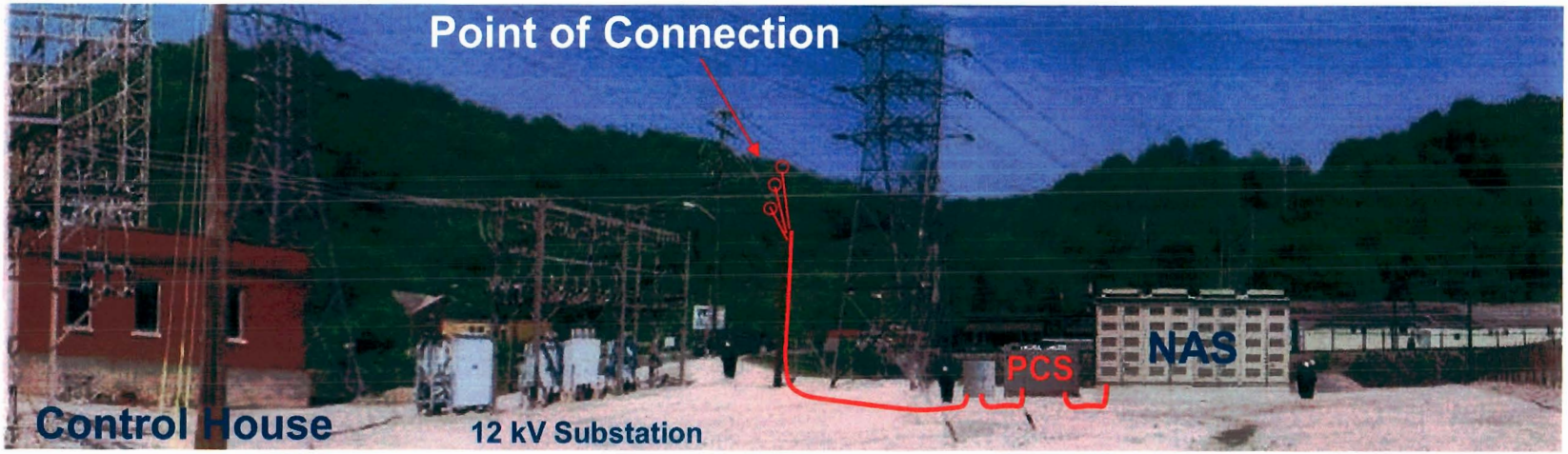
AEP's First Peak-Shaving Distributed Energy Storage System (DESS)

Chemical Station in Charleston, West Virginia
1MW – 7.2MWh



Operational in June 2006

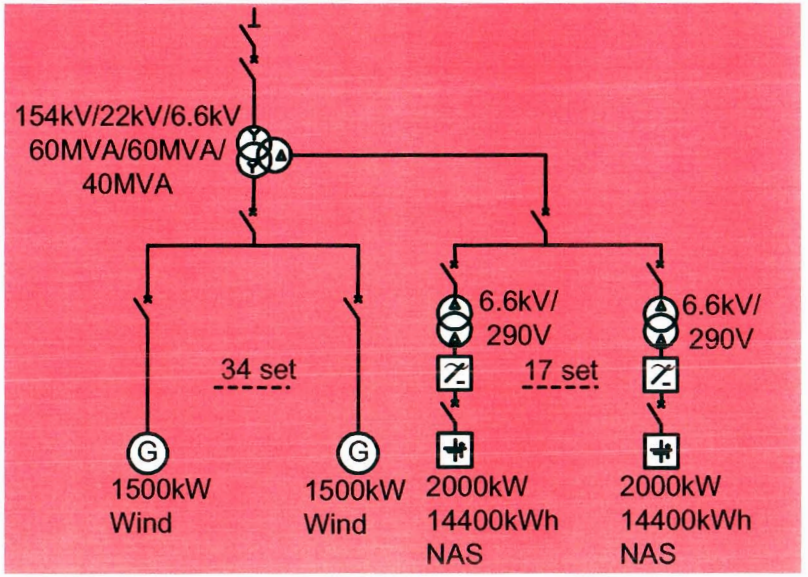
DESS connected directly to 12 kV Distribution Feeders

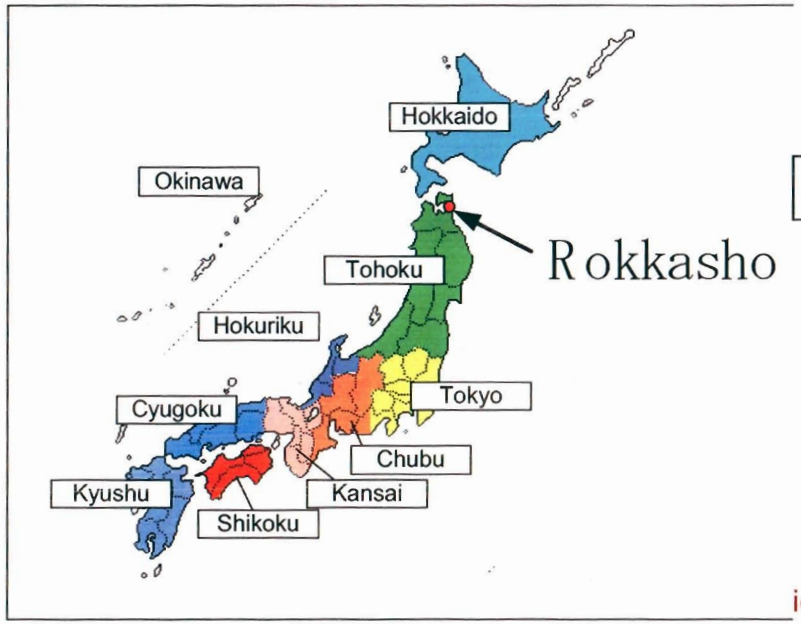
NGK INSULATORS, LTD.

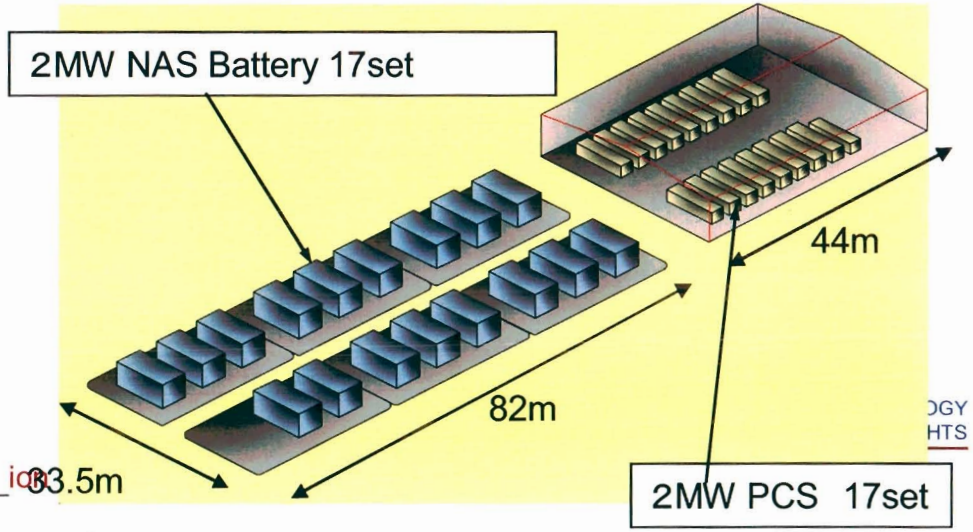
日本風力開発株式会社
JAPAN WIND DEVELOPMENT CO., LTD.

51MW Hybrid Wind-NAS Project at Rokkasho

- Constant Power Control
- Wind Turbine : 1.5MW * 34 sets
- NAS Battery: 2MW * 17 sets







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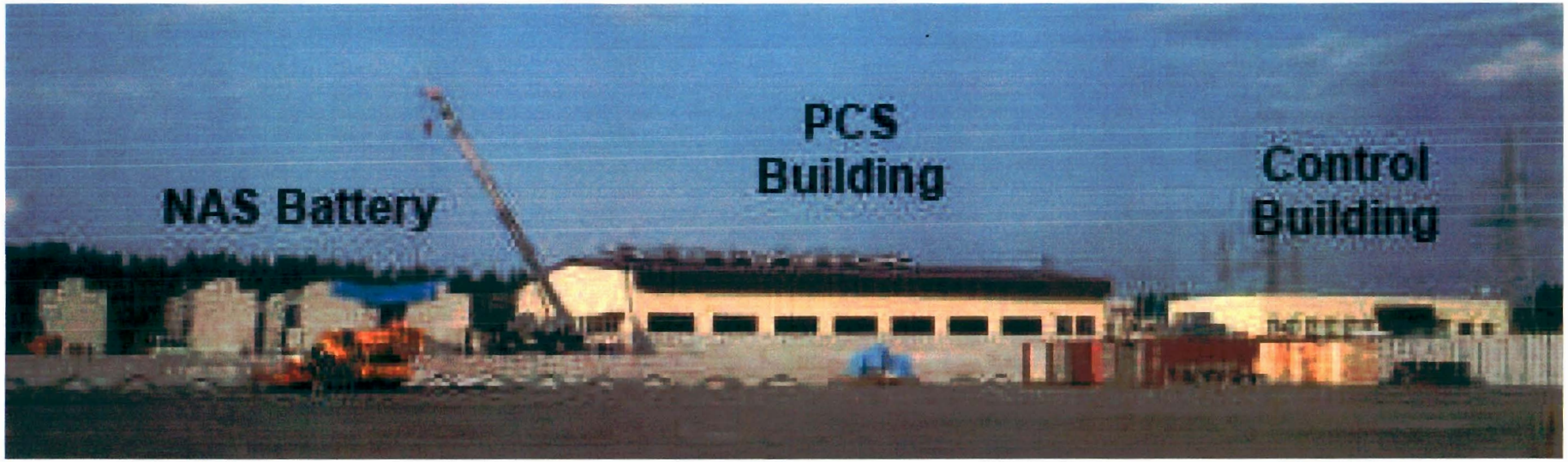
日本風力開発株式会社
JAPAN WIND DEVELOPMENT CO., LTD.

Status of Construction at Rokkasho (34MW, 245 MWh)



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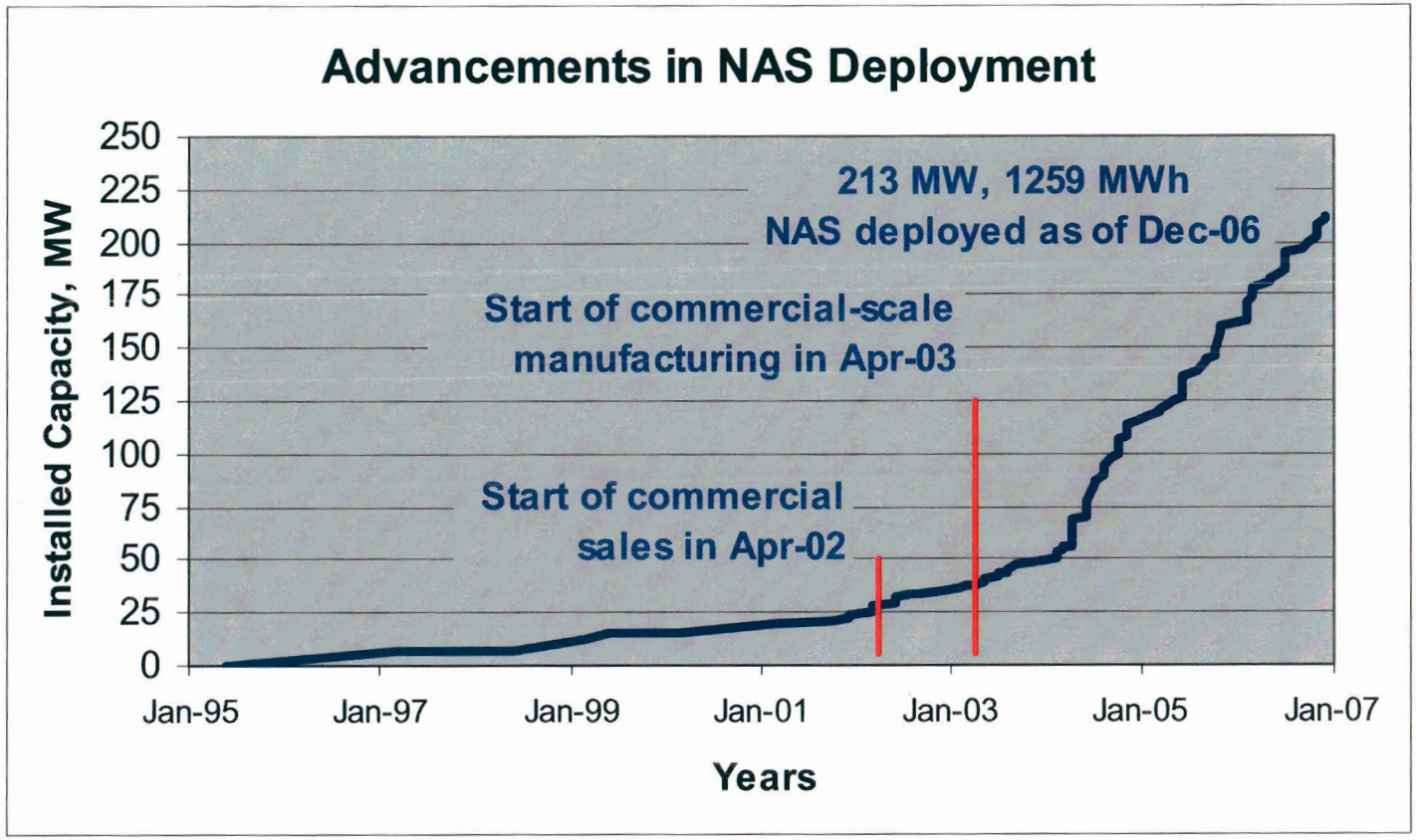
NAS Cumulative Deployment



Summary of Deployed NAS Projects

- **Total NAS projects deployed since 1992 through Dec 2006:**
  - Nearly 160 projects deployed, including demonstrations
  - 92 projects >500kW have cumulative capacity of ~210 MW, ~1,260 MWh
  - 2 projects rated at 9.6 MW and ~60 MWh
- **Breakdown by market:**
  - Electric power companies, e.g., substation support: 17%
  - Water treatment plants, e.g., sewage handling: 10%
  - Industrial, e.g., manufacturing: 48%
  - Commercial, e.g., data handling: 25%
- **Breakdown by application:**
  - Load Leveling (LL): 65%
  - LL + Emergency Power Supply (EPS): 23%
    - *EPS for multi-hours of backup power*
  - LL + Uninterruptible Power Supply (UPS): 4%
  - LL + UPS with pulse PQ protection: 8%

Most deployed by TEPCO and other utilities

The New York Times
nytimes.com

September 11, 2007

Utility Will Use Batteries to Store Wind Power

By MATTHEW L. WALD

WASHINGTON, Sept. 10 — American Electric Power, a coal-burning utility company that is looking for ways to connect more wind power to its grid, plans to announce on Tuesday that it will install huge banks of high-technology batteries.

The batteries are costly and their use at such a big scale has not been demonstrated, but they may be an essential complement to renewable power, experts say.

"We're looking at what we believe the grid of the future is going to be," said Carl L. English, president of A.E.P. "We're going to need a significant amount of storage if for no other reason than to take greatest advantage of alternative energy sources like wind power."

The investment would position the company well if any of the 11 states in its service territory establish a minimum quota for renewable energy, or if Congress sets a national standard, company executives said; it would also help if carbon controls were instituted and wind power were to gain a financial advantage over coal.

An expert not involved in the program, Edgar DeMeo of Renewable Energy Consulting Services, said, "They must think there's enough potential there so they want get a better handle on how it works." But Mr. DeMeo and others said that wind energy had substantial room to grow before storage became necessary.

American Electric Power's batteries will be used to smooth the power delivery from wind turbines. They can charge at night, when the wind is strong but prices are low, and give the electricity back the next afternoon, when there is hardly any wind but power prices are many times higher, company officials said. That strategy would reduce the amount of power generated from inefficient peak-demand units.

The batteries can also insert energy into the grid during brief voltage drops, reducing the chance of a blackout and stabilizing the grid for all users. They may also delay or eliminate the need for transmission upgrades in some areas, the company said.

At least at this stage, saving money by storing a windmill's production for peak-price hours will be difficult. The cost is very high, $27 million for six megawatts of capacity, or about $4,500 a kilowatt, including the price of substation improvements. Building a gas turbine of that size to meet peak needs would cost substantially less. But

the battery system would be able to store power made from wind, a form of generation that does not produce any carbon dioxide.

The batteries can each deliver one megawatt of power — enough to run a medium-size shopping center — for a little more than seven hours. Replenished nightly, they give back about 80 percent of the electricity put into them. Each is the size of a double-decker bus, and installation is not permanent; they can be moved to another site as the need arises.

The batteries will be built by NGK Insulators Ltd. of Japan. They use a sodium sulfur chemistry and operate at temperatures of more than 800 degrees Fahrenheit.

And while the batteries are large by the standards of previous installations, they are small relative to wind production; one battery would hold about as much energy as a single large wind machine could produce in a day, Mr. DeMeo pointed out. And they are small relative to total energy demand.

But, he said, "If we ever really do get cheap storage, and that's a possibility, that's a game changer."

A.E.P. intends to have 1,000 megawatts of energy storage on its system in the next decade, according to the company, and at least 25 megawatts from batteries of this type.

A range of options is available for the remainder of the storage, including the use of plug-in hybrid cars, Mr. English said. The idea behind plug-in hybrids is that the owner of a car would charge the batteries every night when demand and cost of electricity were low. The next day, under a contract between the utility company and the driver, the car would be left plugged when not in use, and the power company could reverse the flow of electricity and draw power out of its batteries during times of peak demand. Enough power would be left in the batteries to start the engine, so that a driver returning to a drained car could still run it on gasoline until the batteries could be charged again at night. It would take more than 1,000 such vehicles to equal one of the sodium-sulfur batteries, however.