NAS Battery Performance

at

Charleston, WV

A Presentation to

DOE Peer Review Program

November 2, 2006

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American Electric Power

Partners

American Electric Power

- Owner & Operator of DESS
- Project Management
- Site Work
- Permits

NGK Insulators

- Manufacturer of NAS Battery System

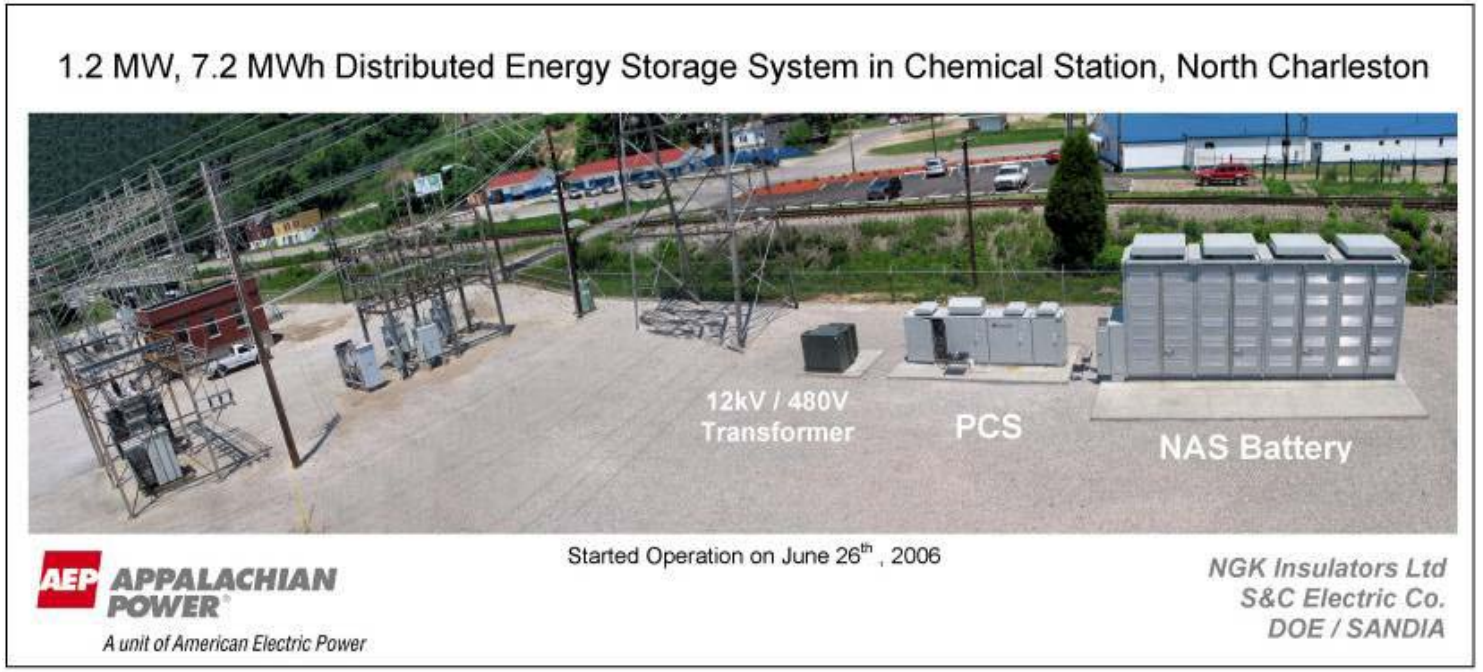
S&C Electric Company

- PCS
- System Integration

DOE/Sandia

- Partial Sponsor

Overview- First MW-Scale NAS Application Outside Japan



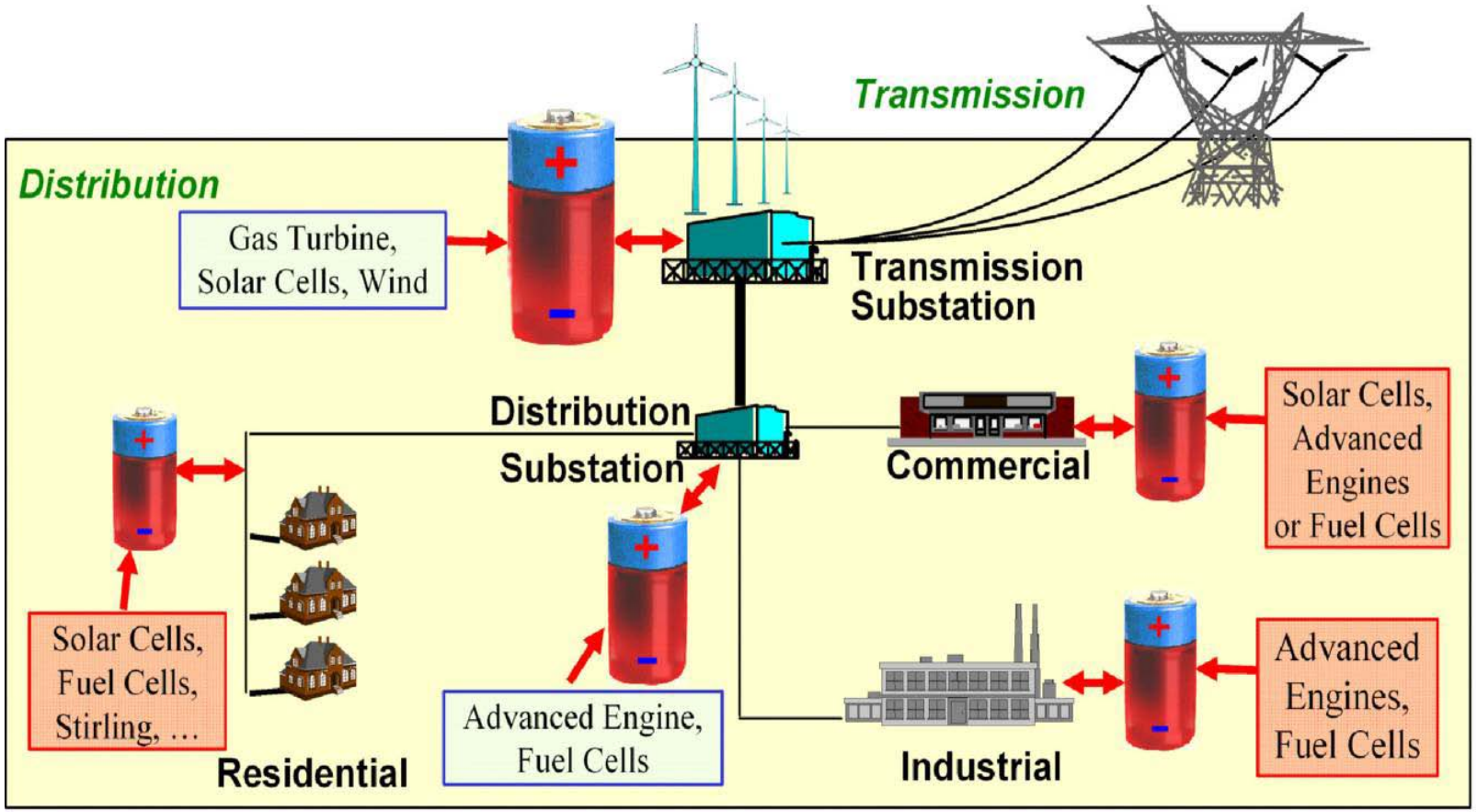
Went into Contract with NGK and S&C — Sept 2005
The Storage Unit Started Operation in — June 2006

Nine Months to Deploy the First Unit

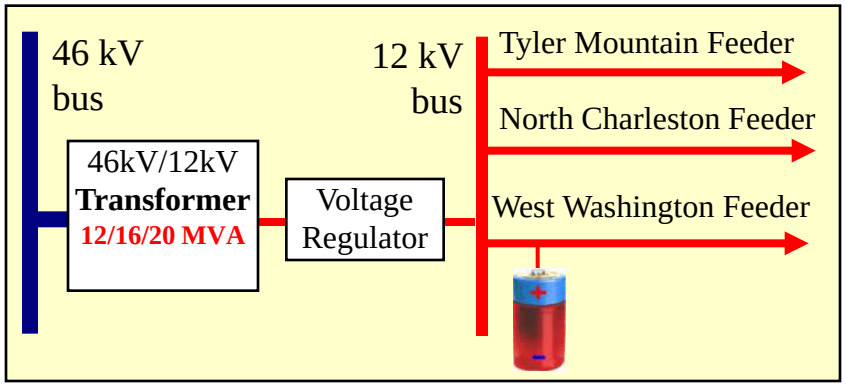
Distributed Energy Storage System (DESS) Project

Main Function	**1.2 MW Peak Shaving**
Justifications	**1) Corporate Strategy** **2) Distribution Capital Deferral** **3) A Relatively Quick Solution** **4) Relocate-able to other Sites**
Total Cost	**Under $2,400 / kW, *Installed***
DOE Support	**Covered Non-Repeat Expenses**

AEP Outlook on Future Grid



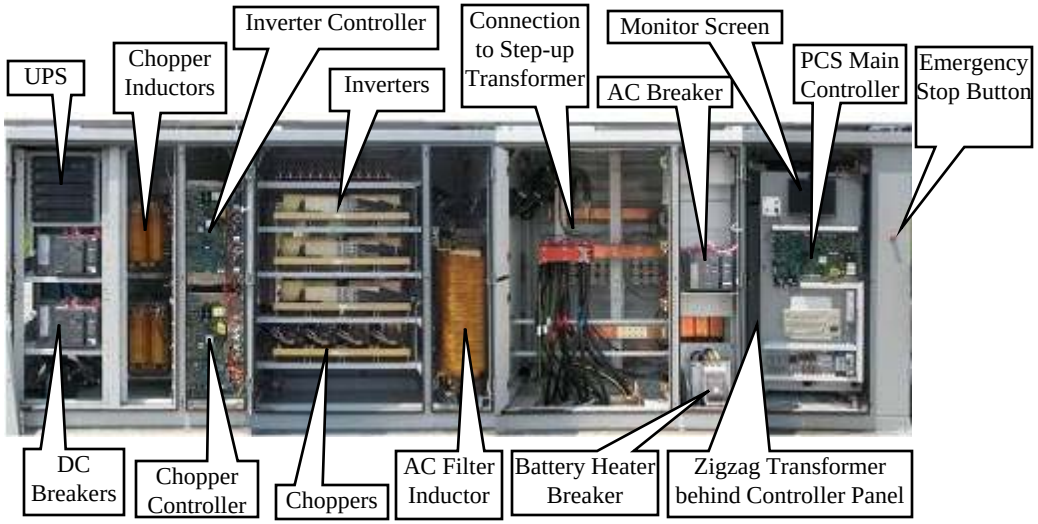
Charleston Site

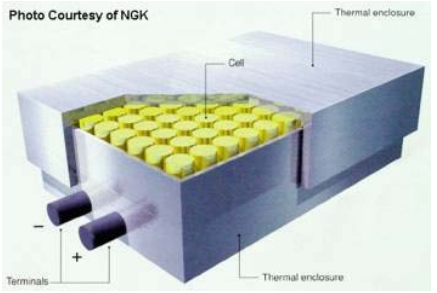


1. **Needed A Transformer Upgrade before Summer 2006**
2. **Internal Policy Required Building Another Substation with Feeders**
3. **Cost of New Substation was High ($2 million)**
4. **Could not finish the upgrade in time for Summer Peak**
5. **Conventional Solution Is Not Relocate-able**

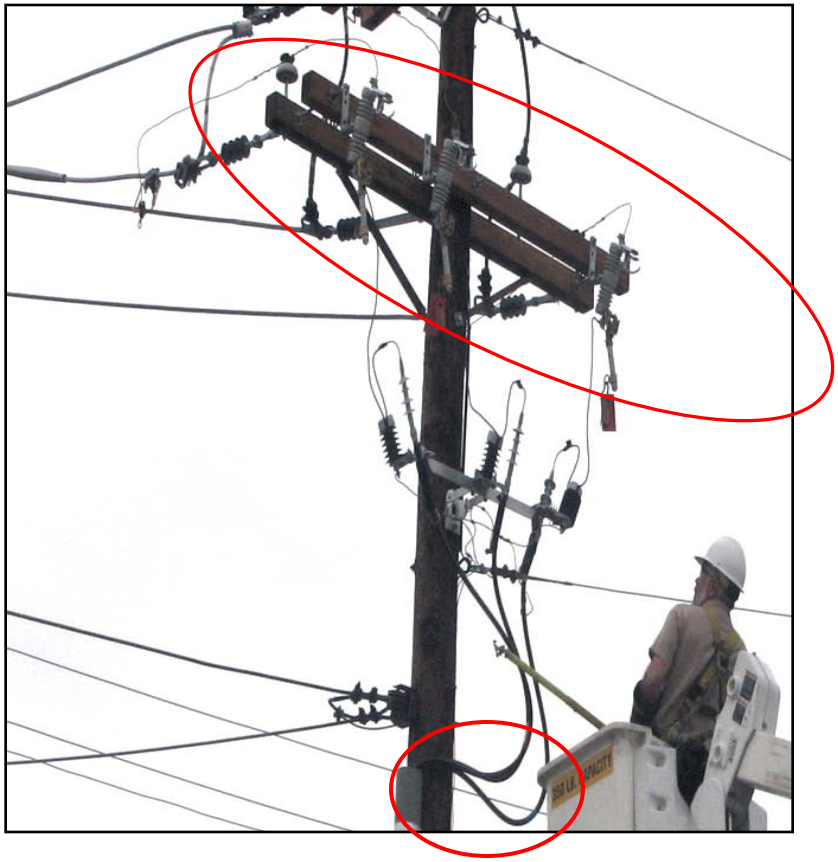
6. **A 1.2 MW, 7.2 MWh Relocate-able DESS was Authorized (< $2.4 million)**

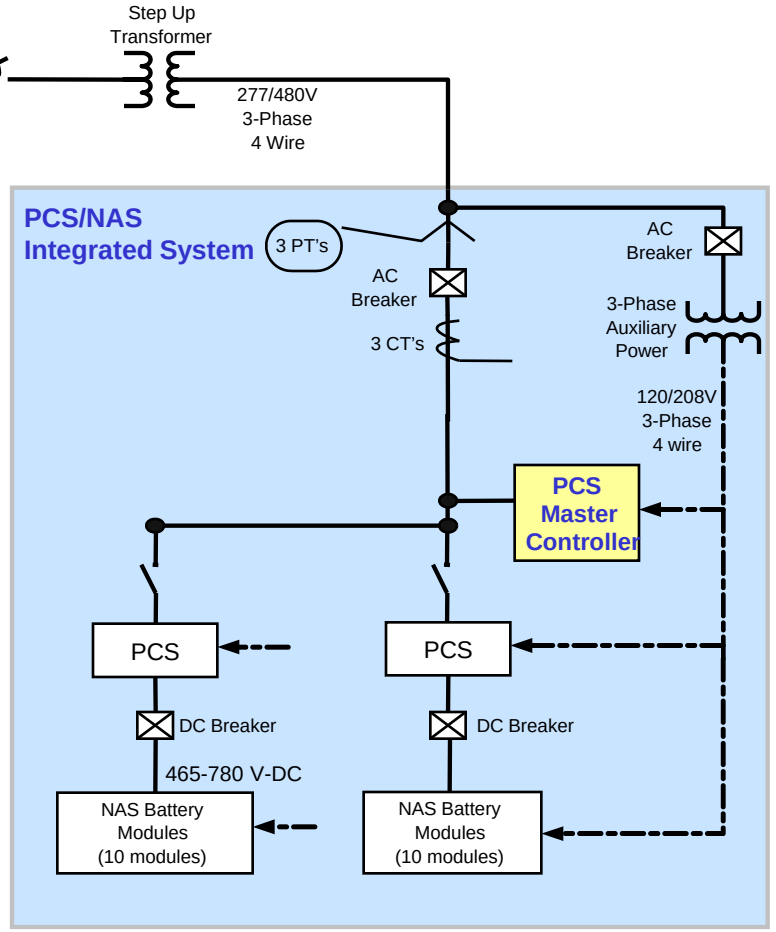
Installation of DESS Parts





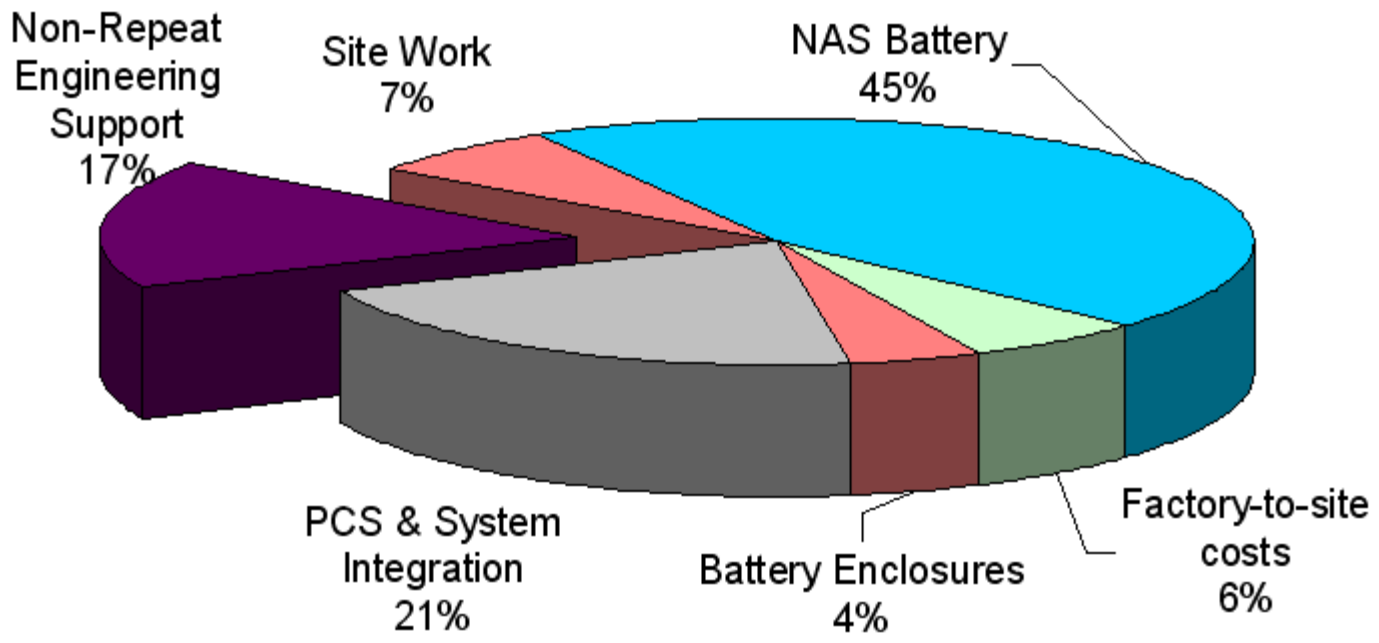
DESS Sketch and Connection to Grid





DESS Cost – DOE/Sandia Role in Removing the Initial Deployment Hurdles

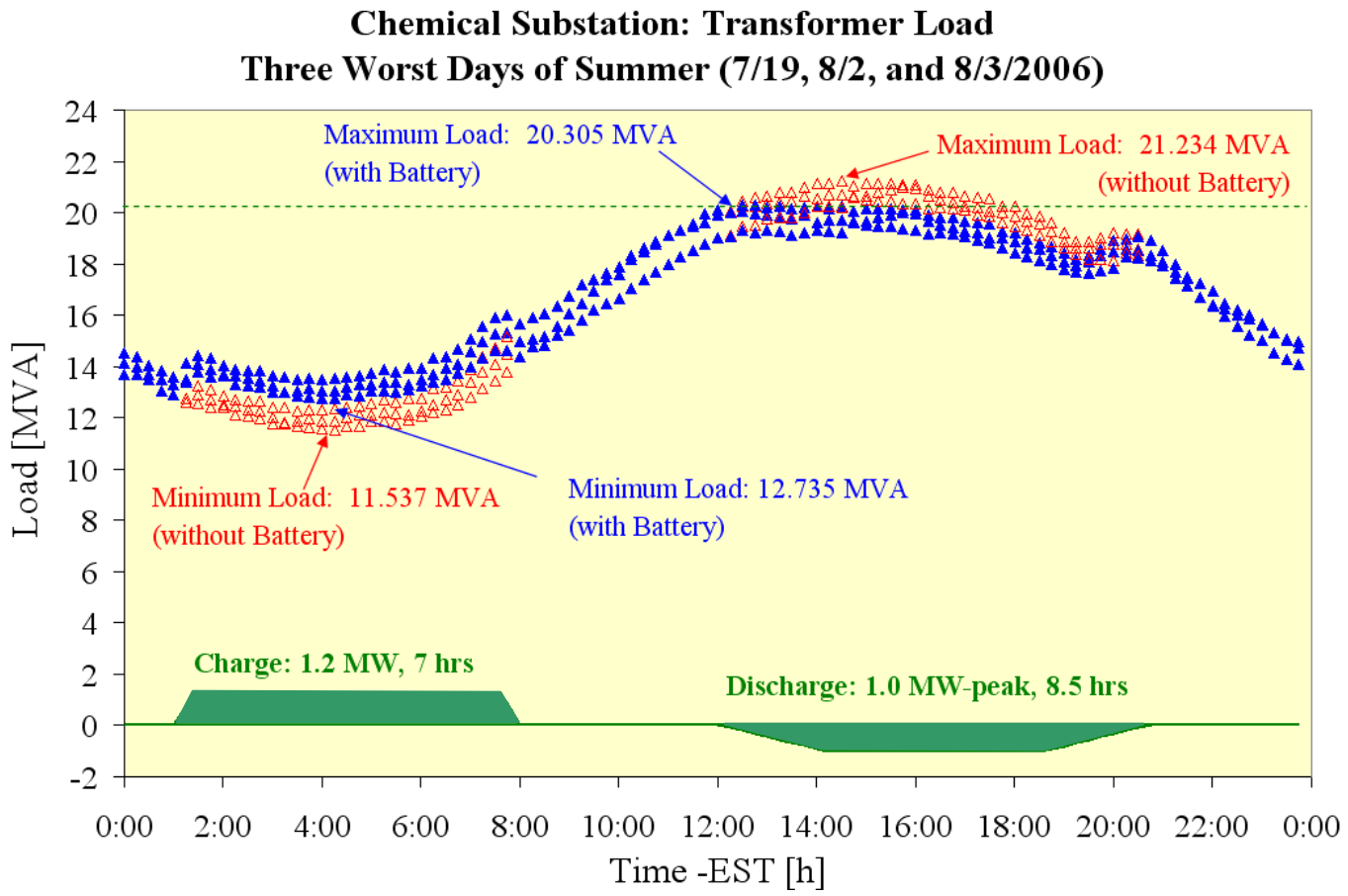
Cost Components



Installed under $2,400 / kW

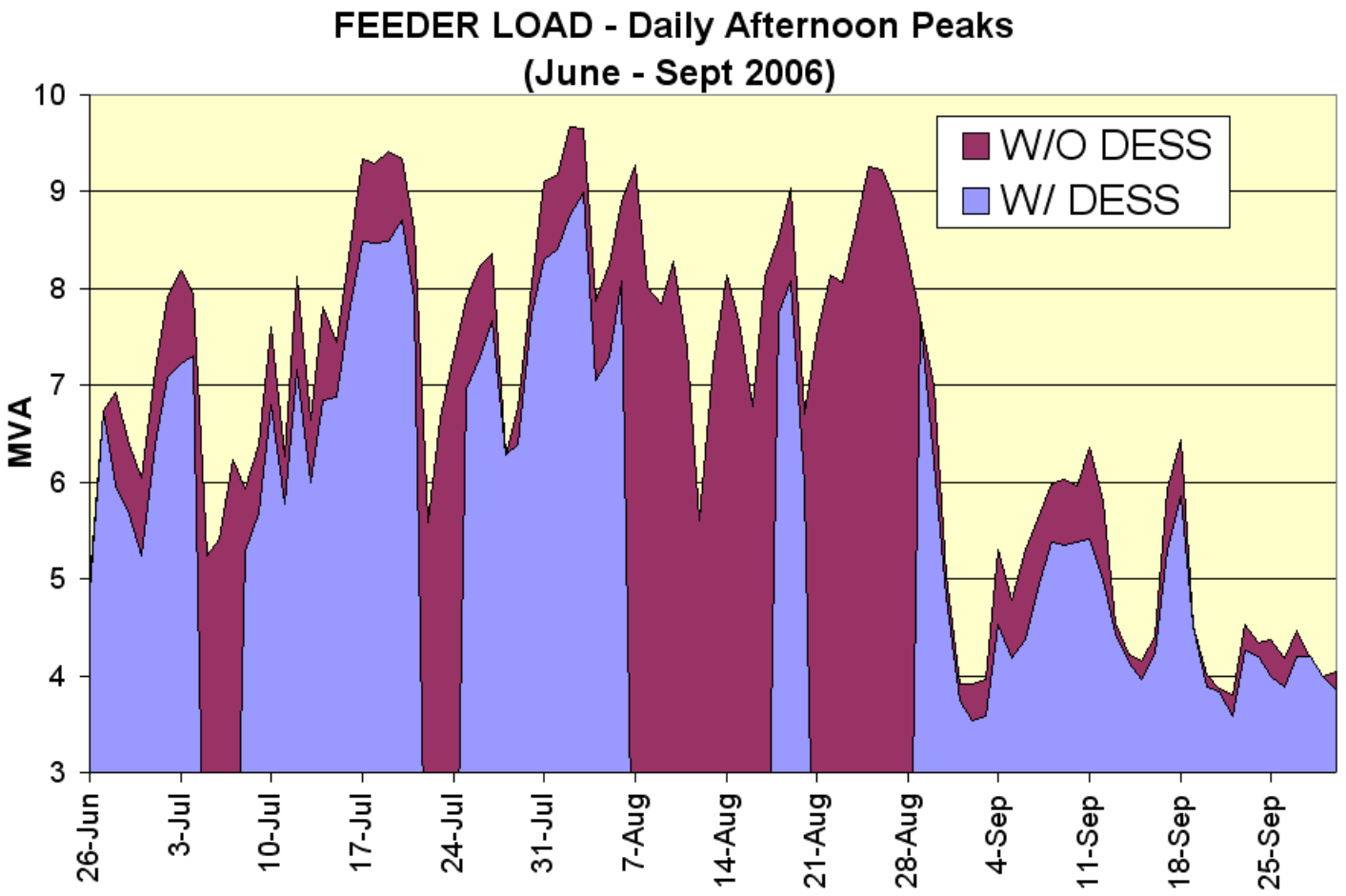
Immediate Benefits – Reduced Peak Load

Three Highest Peak Days

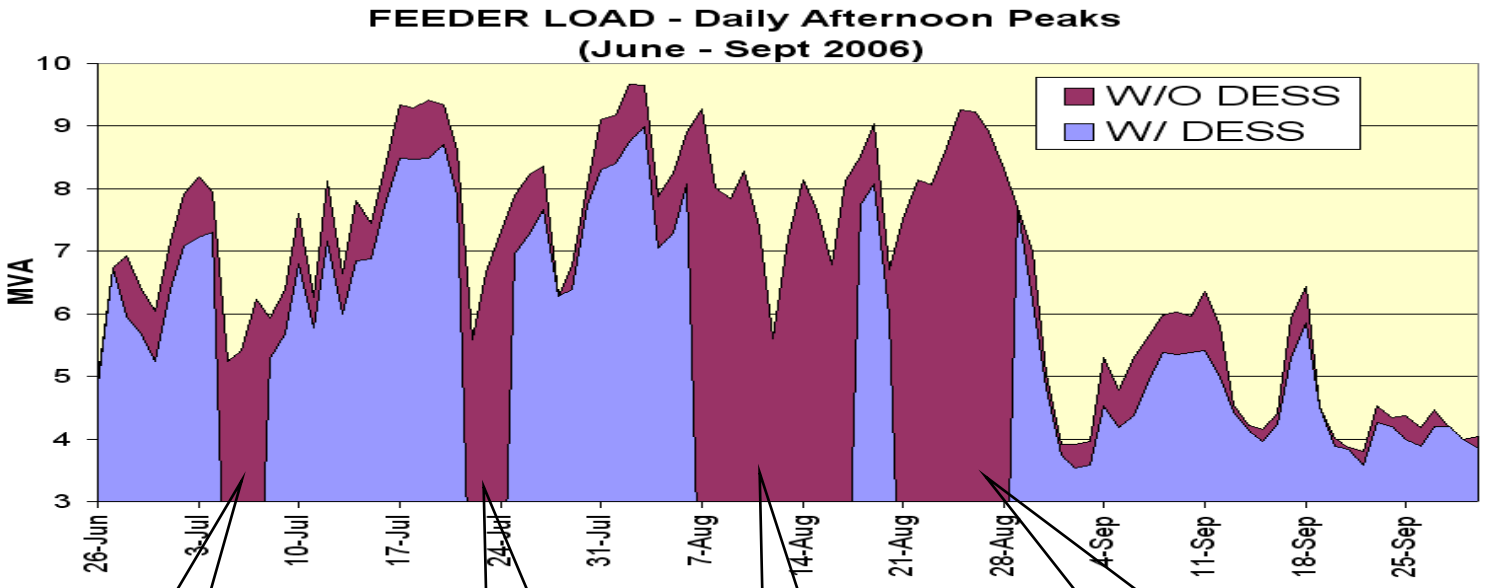


DESS Lowered the Peak Load Down to the Transformer Rating

Immediate Benefits – Reduced Peak Loads



DESS Down Times - Unscheduled



Down 2 Days
Main Impeller Malfunction.
It was Replaced

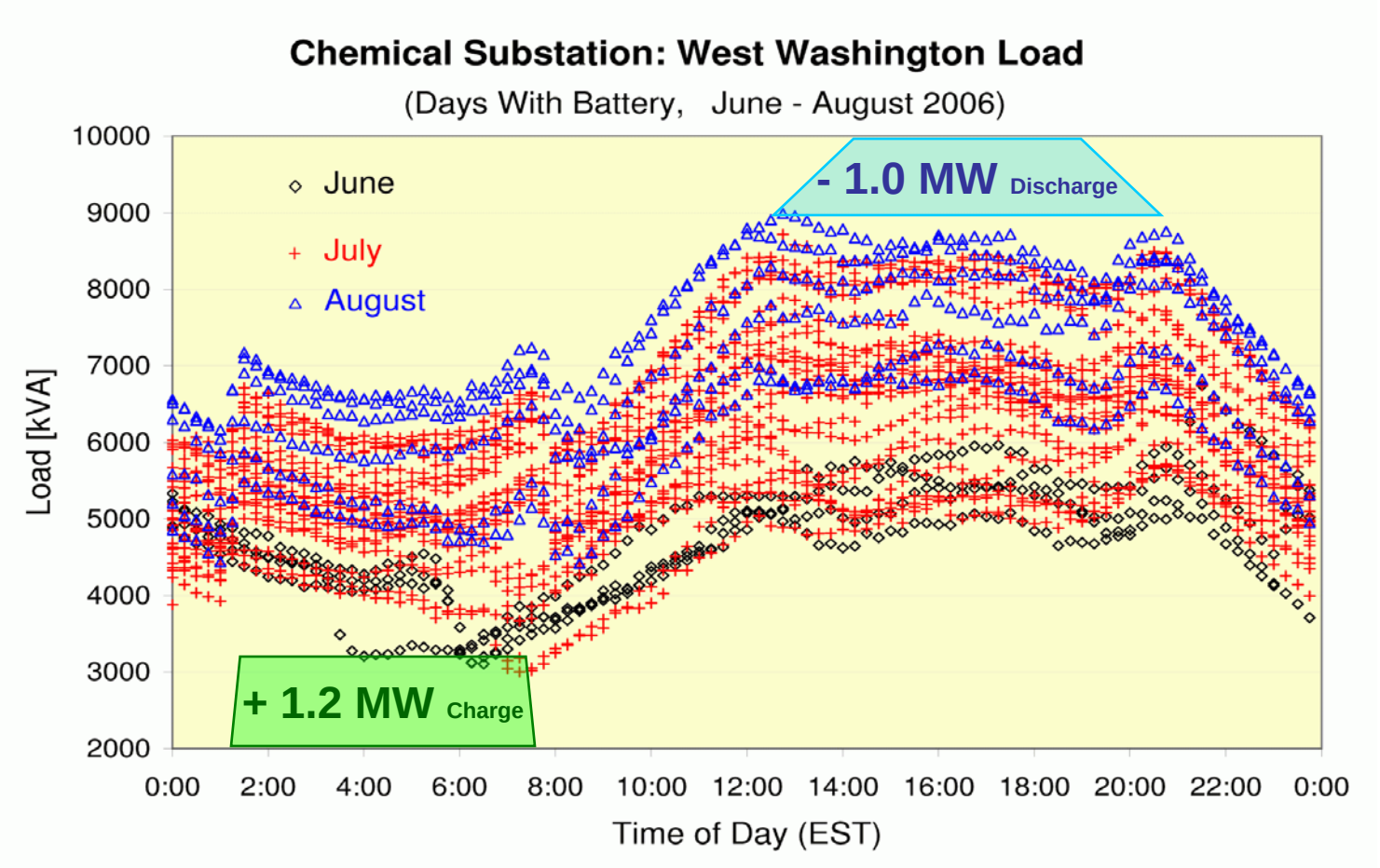
Down 3 Days
Ethernet communication software glitch.
System reconfigured to be more tolerant.

Down 8 Days
Recall of an element used on the Control Board
Replaced the board

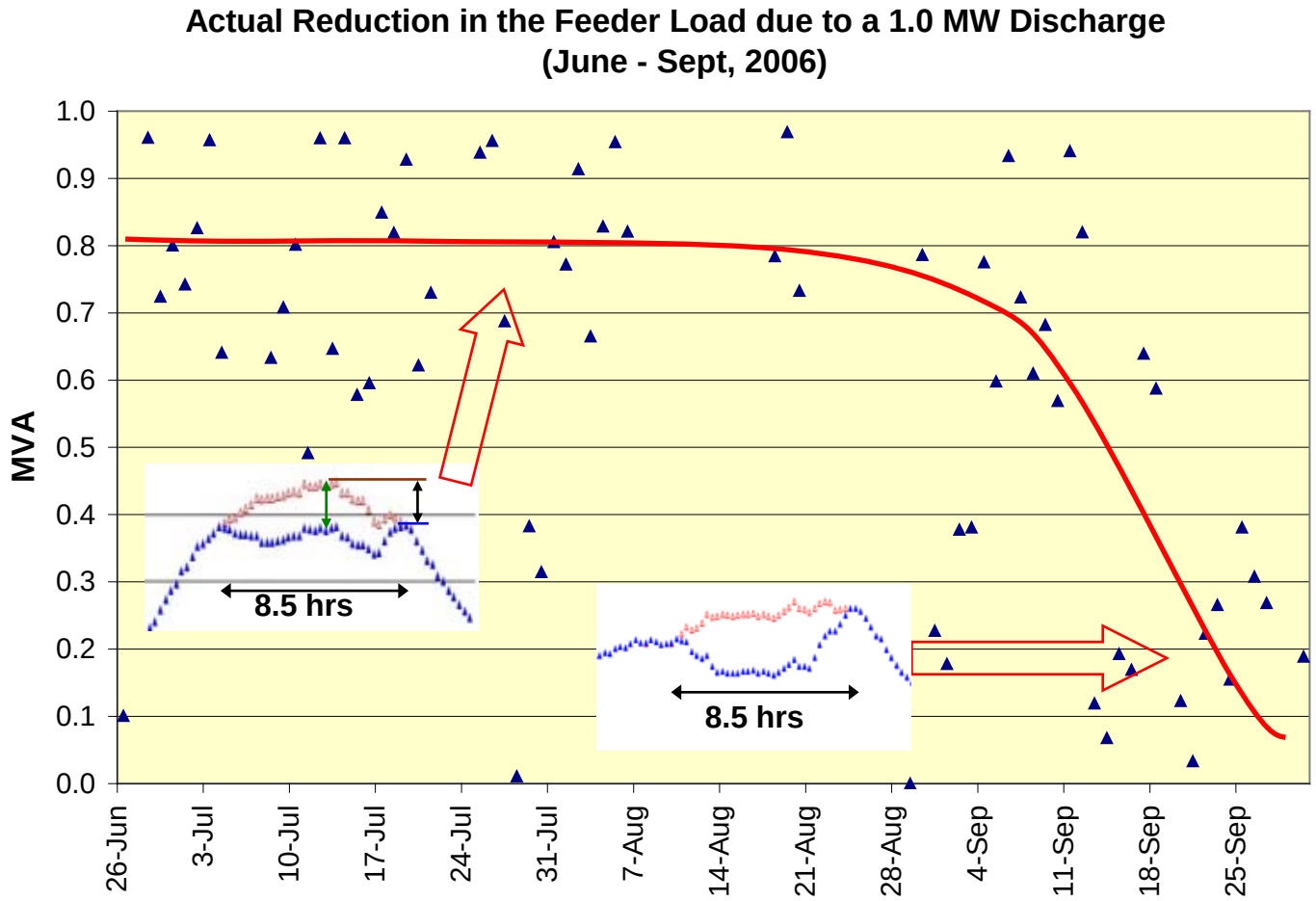
Down 5 Days
Intermittent activity caused by change in metering of pulse-like battery heater load
Removed the heater load from the metering & control circuits

Immediate Benefits – Load Shape

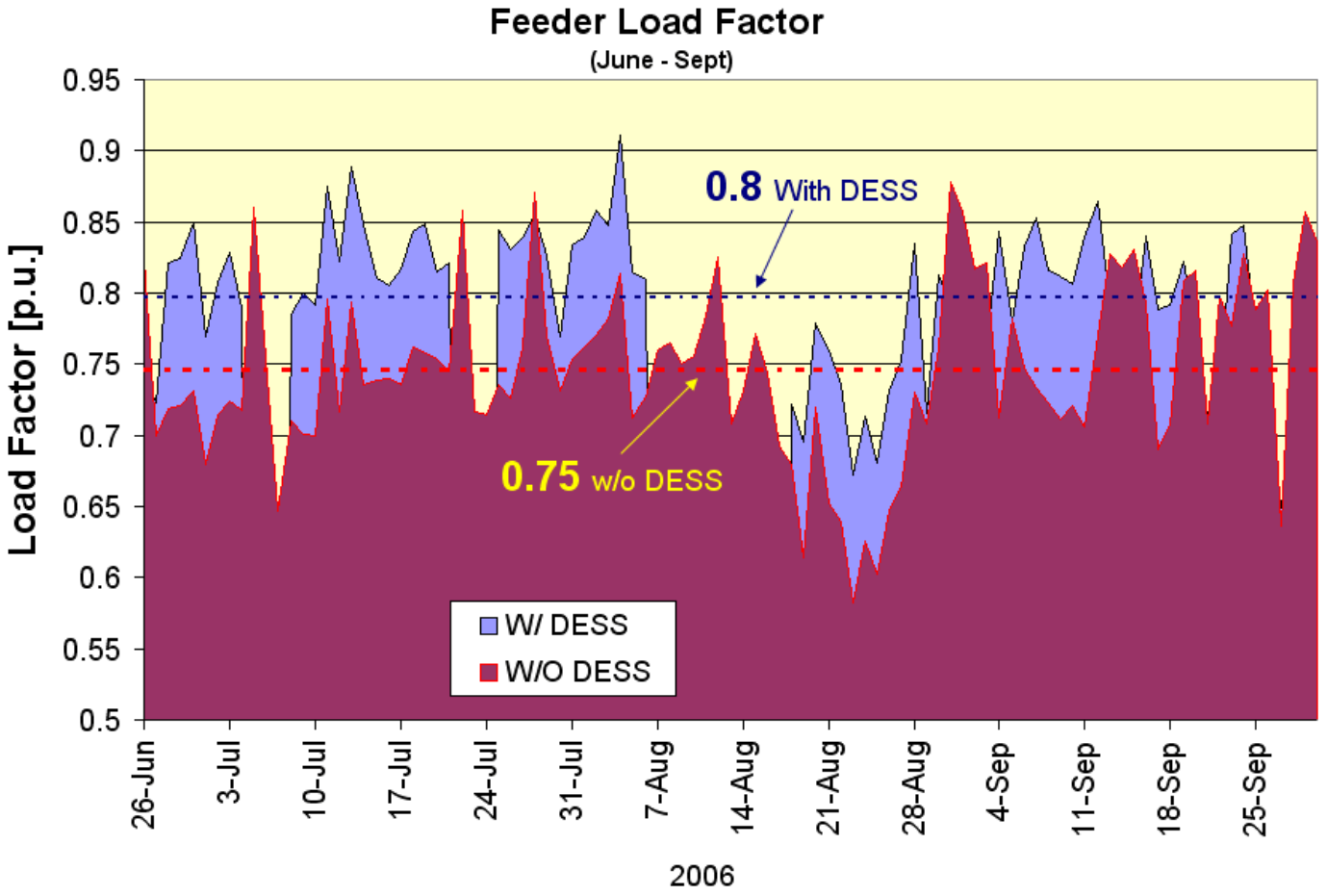
Three Worst Months



Effective Peak Load Reduction – Less than 1MVA



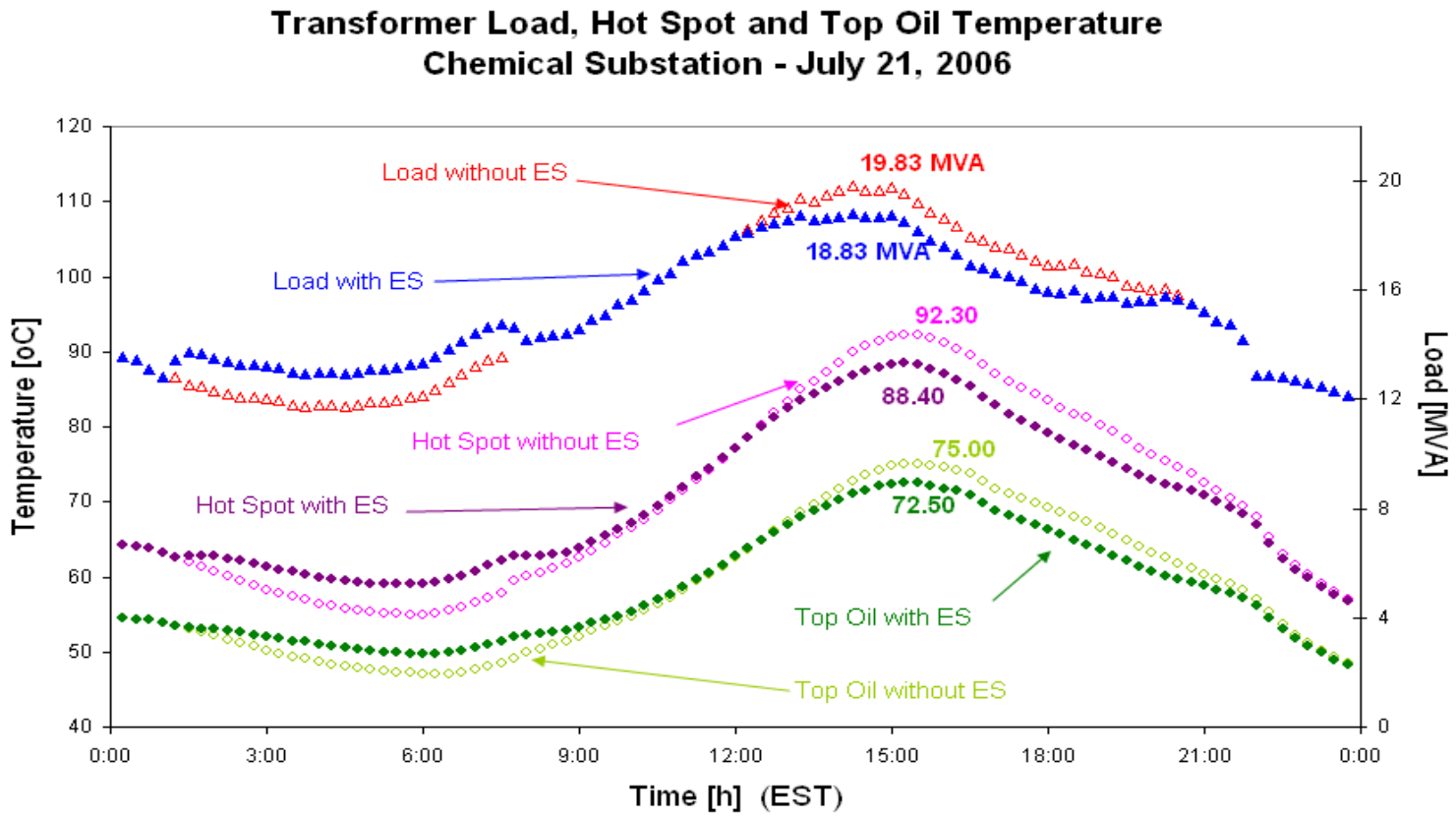
Immediate Benefit – Load factor Improvement



DESS Increased the Feeder Load Factor by 0.05

Immediate Tangible Benefits of the First AEP DESS

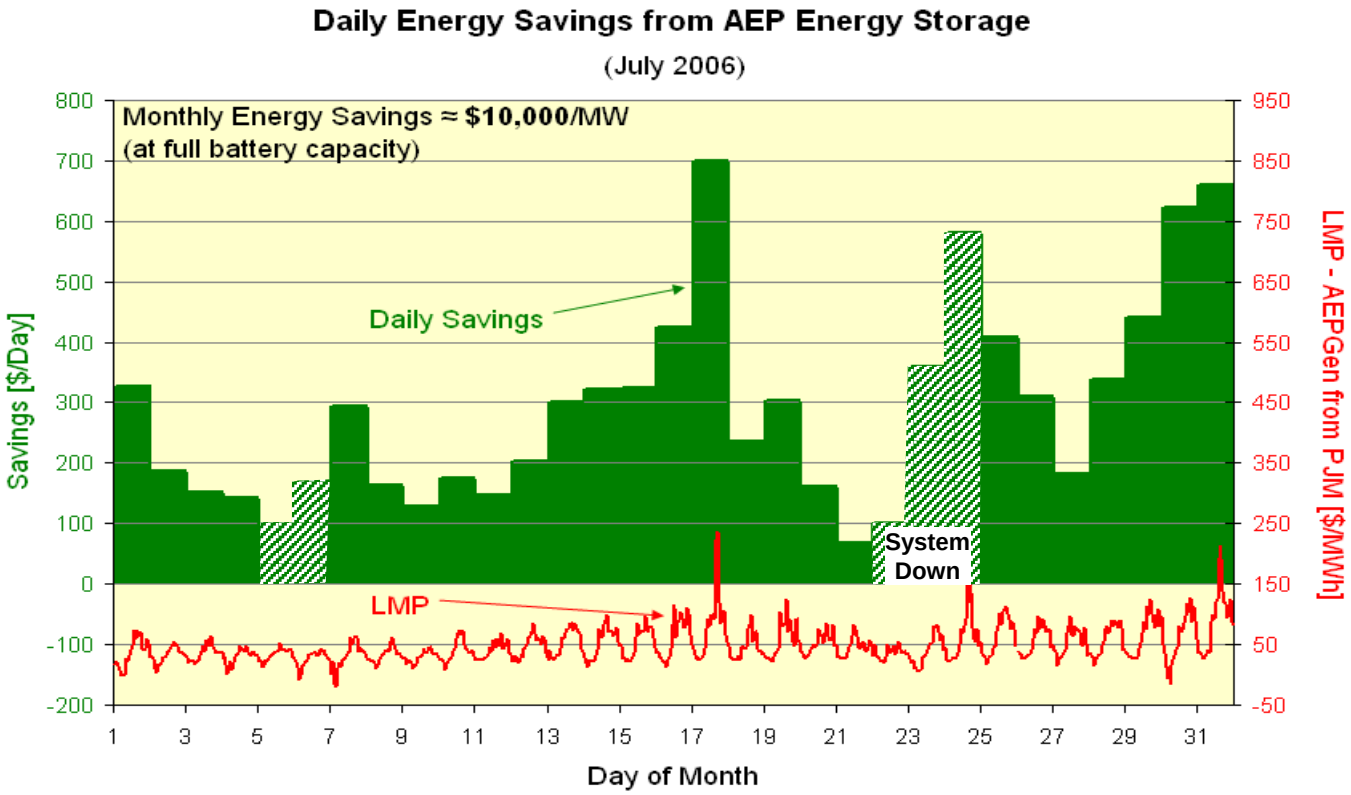
Transformer Temperature Control



*Based on measured/calculated load and measured ambient temperature, Hot Spot and Top Oil temperature are calculated by using PTLoad 6.1, EPRI software.

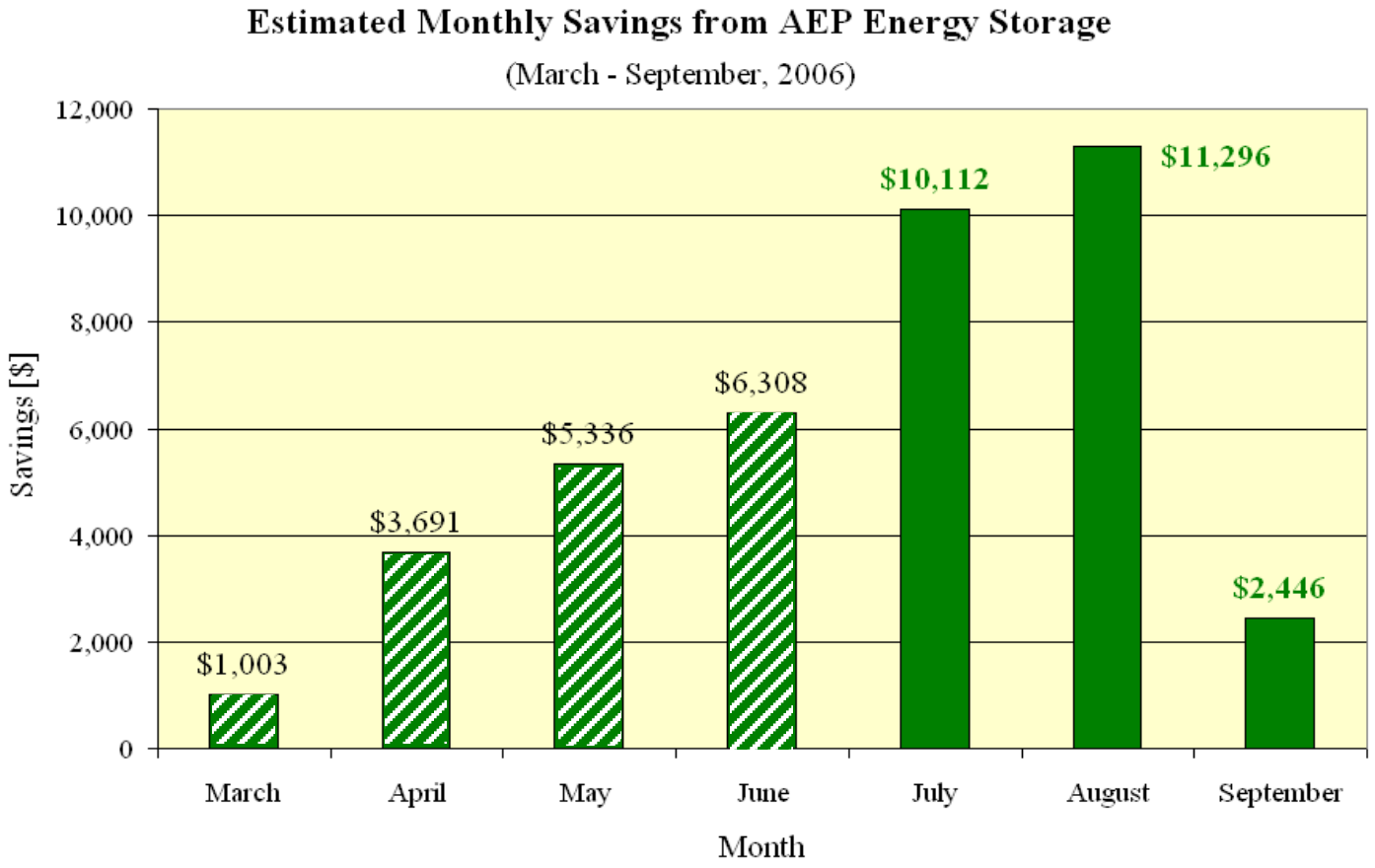
Transformer Temperature was Dropped by Several Degrees C

Energy Savings in the PJM Market



DESS was not put on the Market but made other generators more available

Energy Savings in the PJM Market



$24,000 in the First Three Months

Conclusions

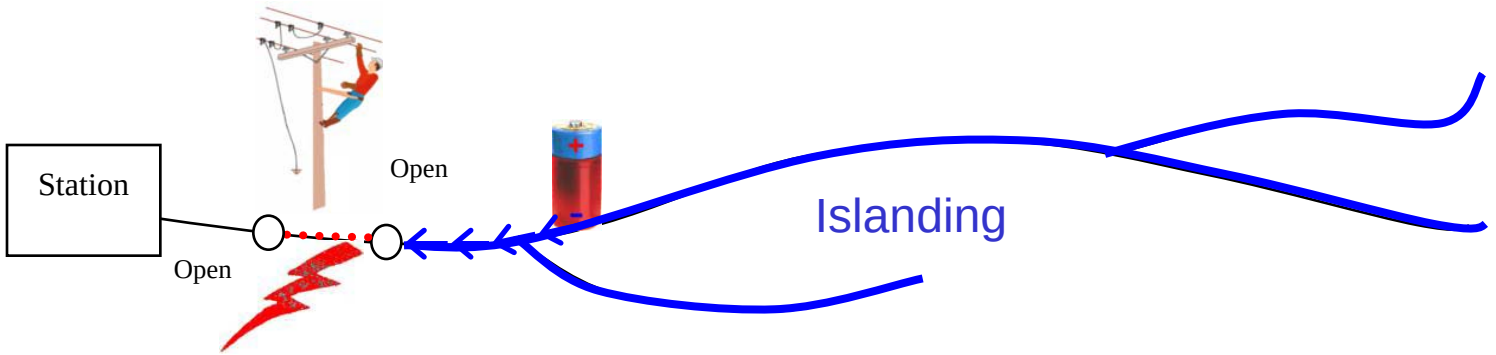
- WAS Installed and Operational in Just 9 Months
- Helped Shave Transformer Peak Loads for 8.5 hours a day
- Kept Transformer temperature down by several degrees C
- Improved the Feeder's Load Factor from 0.75 to 0.80, in average
- Potentially provided a PJM Market Energy Value of $24,000 in 3 months
- Up and running 85% of days during its first three months
- Helps AEP build more Confidence on this Energy Storage Technology

Going Forward *- On this Project*

1. Have already changed the DESS schedule to a **Double-Discharge** profile for winter load

2. Continue to provide **Performance Data** and its analysis to DOE/Sandia until October 2007

Going Forward *- Next Project*

Work with DOE/Sandia for using DESS to improve **Electric Service Reliability**

- DESS may be an effective way to address **reliability issues** associated with the aging utility infrastructure
- In many cases, deployment of DESS would be much quicker than using conventional solutions