

## Application of Inverter-Based Systems for Peak Shaving and Reactive Power Management

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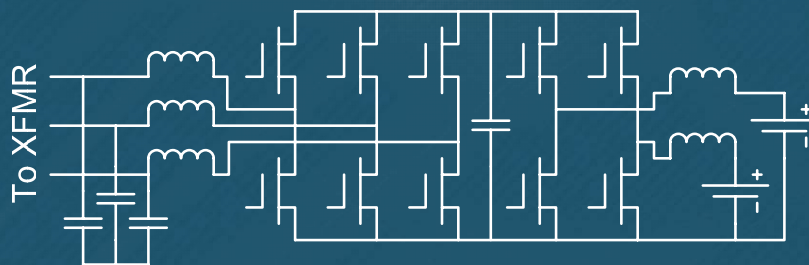
### Case studies – Inverter-based Applications

- Distributed Energy Storage System
  - AEP system
  - Peak shaving
  - NaS batteries
- Reactive Power Compensation for Wind Power Plant
  - 90 MW WPP on PNM system
  - Zero reactive power exchange at POI

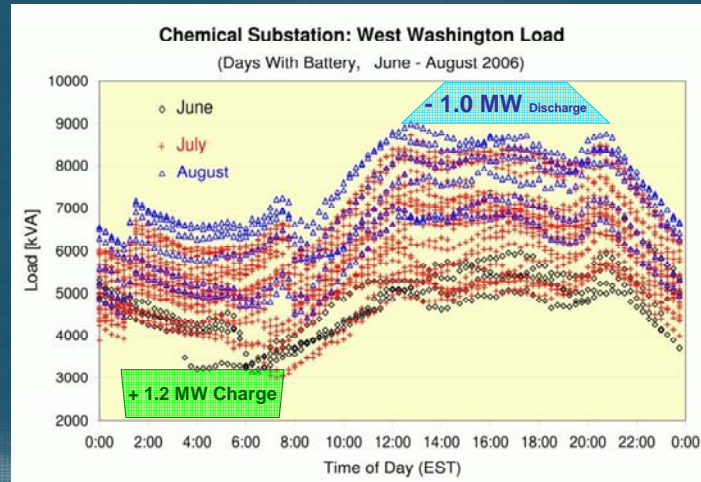
## DESS

- Distributed Energy Storage System
- AEP Charleston Energy Storage Project
- Sodium-Sulfur (NaS) batteries – NGK
  - 1.0 MW with 1.2 MW short time rating, 7.2 MWh
  - 300°C to 360°C operating temperature
  - Vacuum enclosed
  - 20 x 50 kW modules
  - 2500 to 4000 cycles, 15 year life
- 12-kV feeder, peak shave an overloaded substation transformer to defer upgrade to larger substation

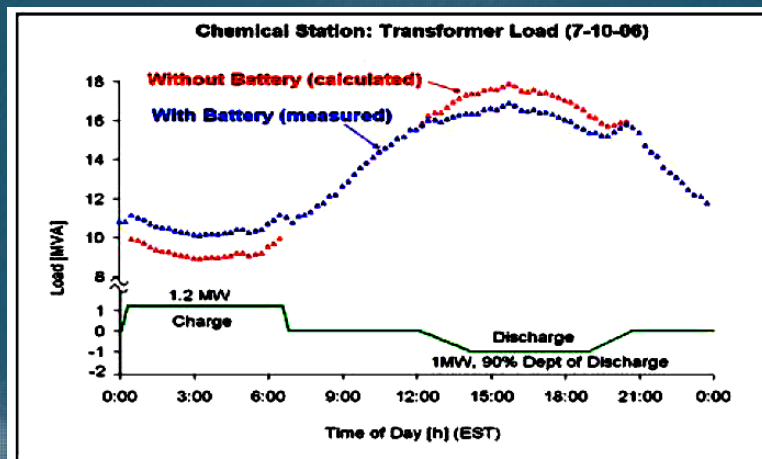
## Simplified DESS Power Circuit



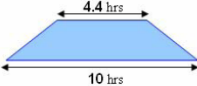
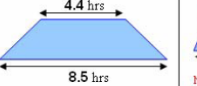


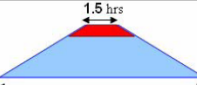
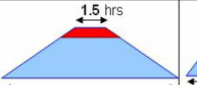
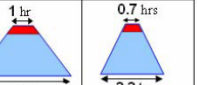


## Load and DESS Power Profile



## Example Profile from First Day of Operation



## Predefined Profiles

		<b>100% Capacity</b> 7.2MWh , 2500 Cycles	<b>90% Capacity</b> 6.48 MWh, 4000-5000 Cycles	<b>50% Capacity</b> 3.6 MWh (2 discharges)	<b>33% Capacity</b> 2.4 MWh (3 discharges)
<b>Discharge</b>	Rated Power <b>1 MW</b>				
	Maximum Power <b>1.2 MW</b>				
<b>Charge</b>	Rated Power <b>1.2 MW</b>	Until fully charged (less than 10 hours) 			

## DESS Installation



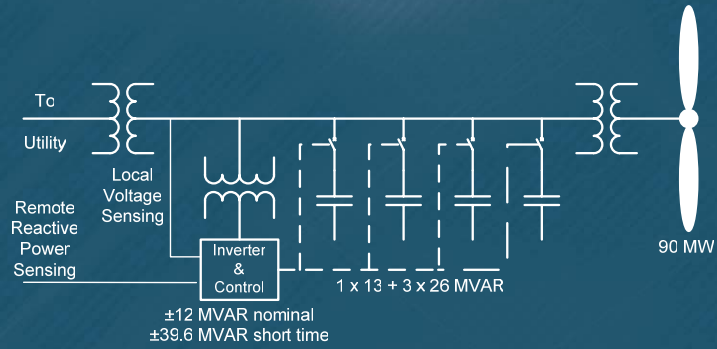
## Current DESS Activity

- Direct control of real and reactive power with local override based upon frequency and voltage
- Distribution feeder support in coordination with S&C IntelliTeam system
- Operation with wind generators
- 1 MW in service
- 5 MW in process
- Expect a total of 9 MW in 2008
- 1 – 5 MW unit sizes with larger systems in discussion

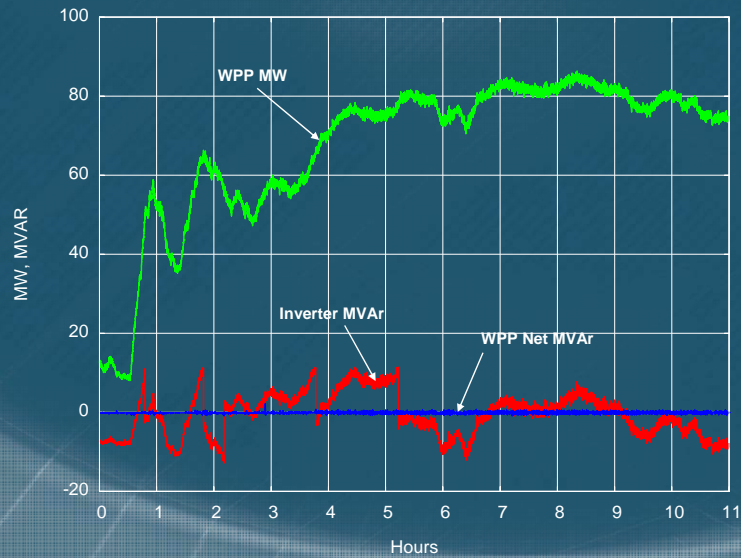
## Dynamic Compensator

- Distributed **STATic COM**pensator (DSTATCOM)
- 90 MW Windfarm on PNM system, Type 1 wind generators
- Voltage stability limited 345 kV transmission with 200 MW HVDC and 204 MW WPP
- No reactive power exchange at the POI
- $\pm 12$  MVar DSTATCOM, 4 x 34.5-kV Capacitor banks total 91 MVar
- Short time rating of 3.3 per unit

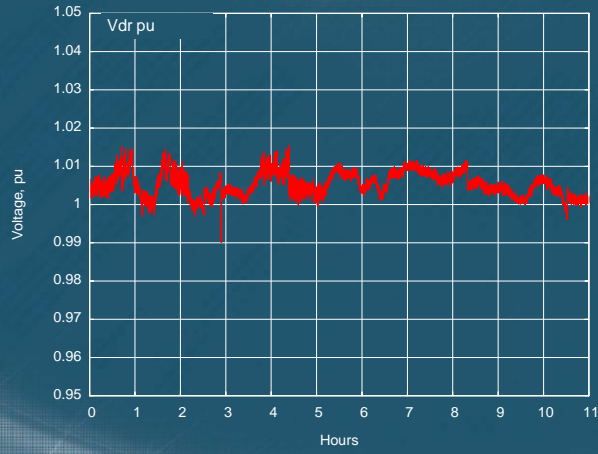
## One-Line Diagram of Compensation System



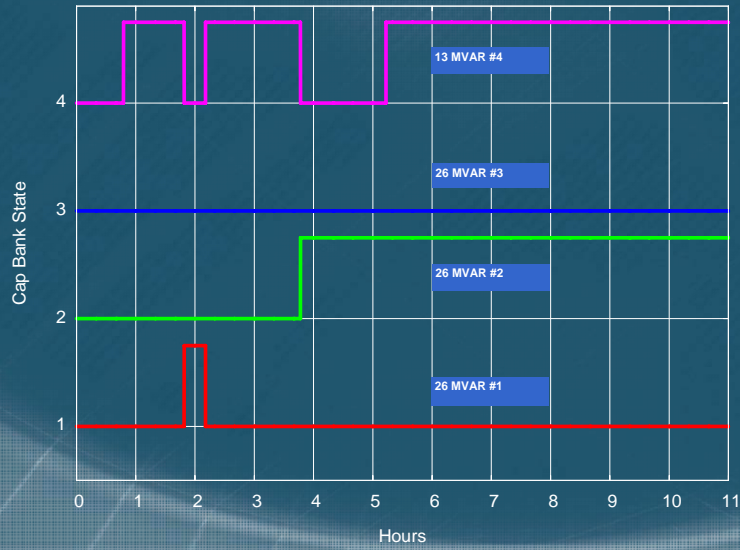
## WPP MW, Inverter VARs and Net VARs at POI



## Wind Power Plant Collector Voltage



## Capacitor States



## Dynamic Compensator Installation



Questions?