

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



Ken Mattern, S&C Electric
Abraham Ellis, Public Service of New Mexico
Ali Nourai, AEP
Steven E. Williams, S&C Electric
Charles Edwards, S&C Electric
Dave Porter, S&C Electric



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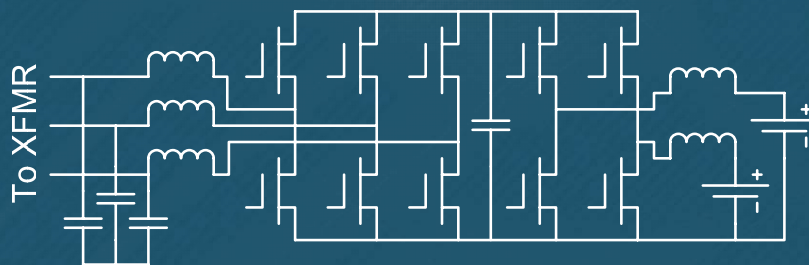
Case studies – Inverter-based Applications

- 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

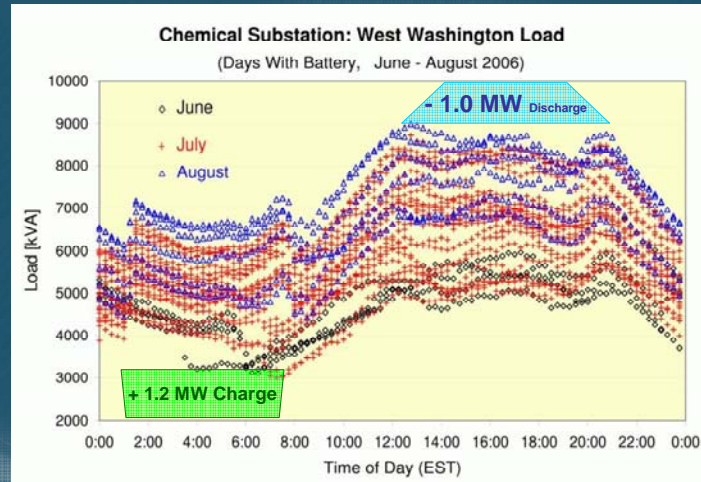
DESS

- 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

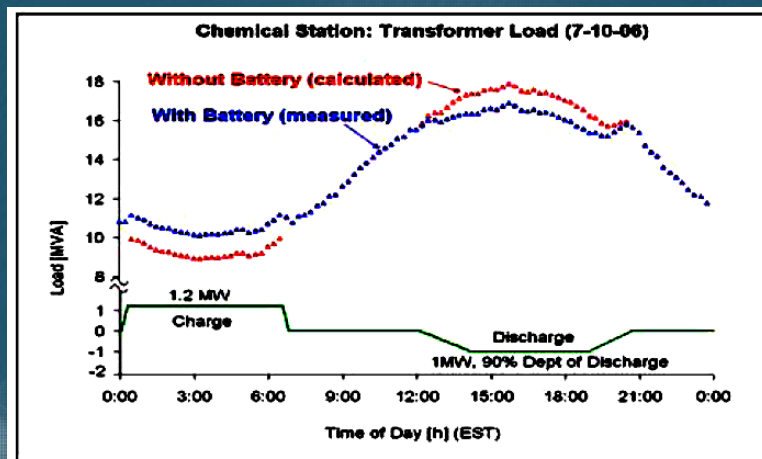
Simplified DESS Power Circuit



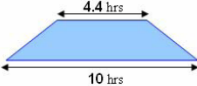
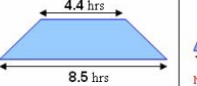


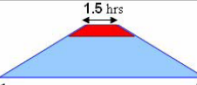
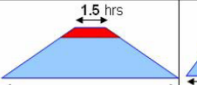
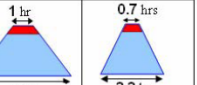

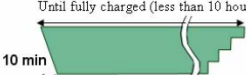
Load and DESS Power Profile



Example Profile from First Day of Operation



Predefined Profiles

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

DESS Installation



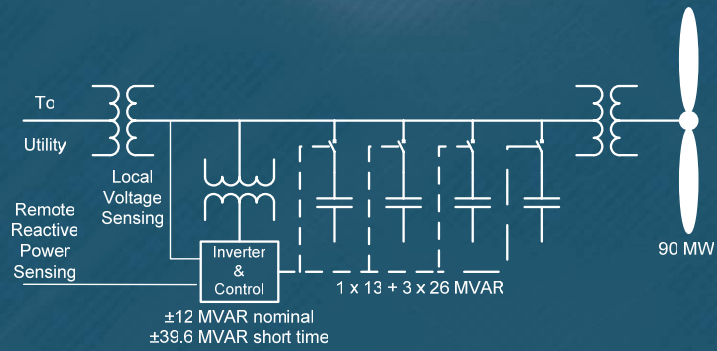
Current DESS Activity

- 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

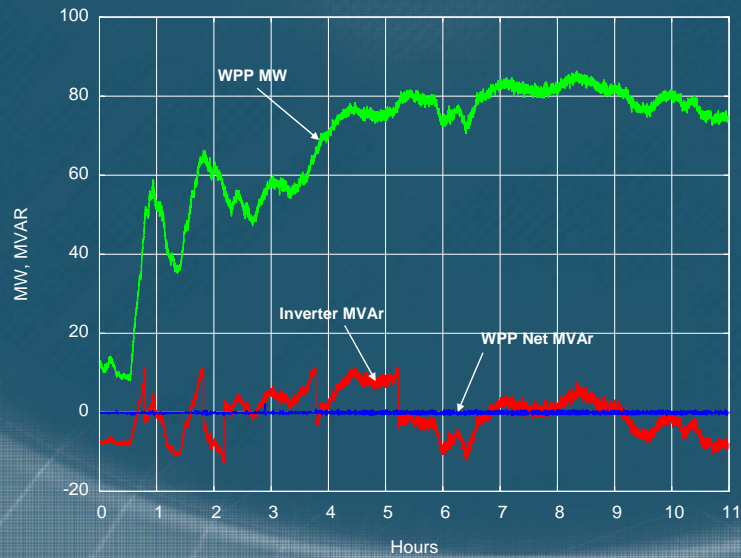
Dynamic Compensator

- 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
- ± 12 MVar DSTATCOM, 4 x 34.5-kV Capacitor banks total 91 MVar
- Short time rating of 3.3 per unit

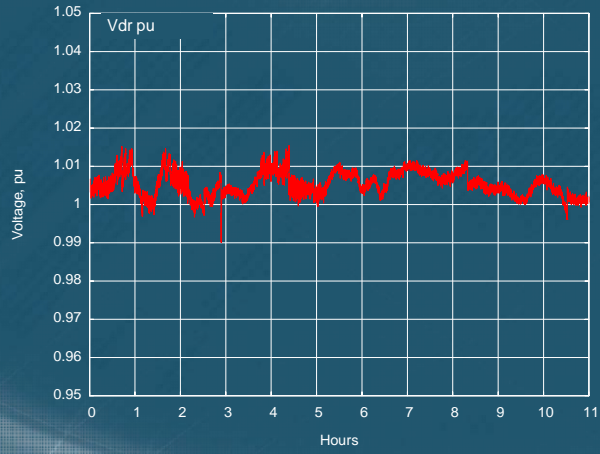
One-Line Diagram of Compensation System



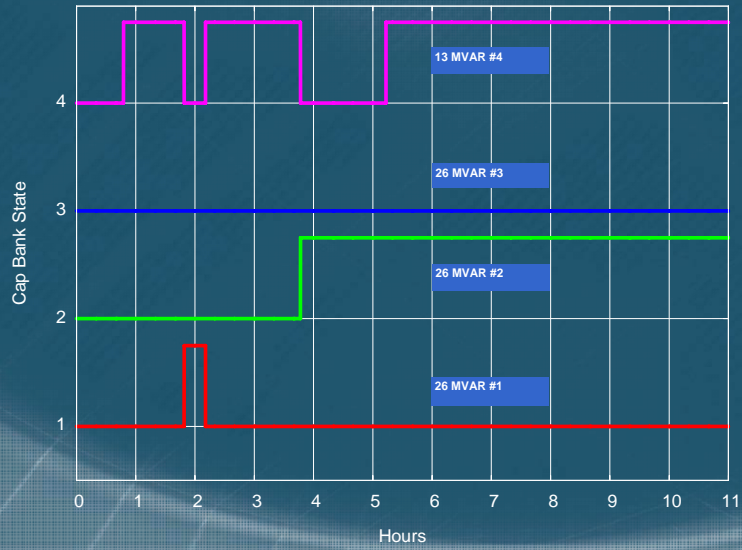
WPP MW, Inverter VARs and Net VARs at POI



Wind Power Plant Collector Voltage



Capacitor States



Dynamic Compensator Installation



Questions?