



A Distributed Energy Systems Company

Ultracapacitor EnergyBridge™ UPS for Palmdale Water District

DOE/ESS PEER Review

November 3, 2006

Northern Power Systems
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Waitsfield, VT 05673

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Northern Power



- ◆ **Distributed Energy Systems Corp (NASDAQ:DESC)**
- ◆ **Energy Solutions since 1974**
- ◆ **Products, Systems and Services Divisions**
- ◆ **Hundreds of Projects around the World**
- ◆ **HQ and Manufacturing in Vermont**
- ◆ **Regional offices in NY, TX, CA, England, and Mexico**



Project Overview



- ◆ **CEC – California Energy Commission**
 - ◆ Funding agency
- ◆ **Palmdale Water District**
 - ◆ Award recipient, host site
- ◆ **Northern Power**
 - ◆ Technology provider
- ◆ **Black & Veatch**
 - ◆ Owner's engineer
- ◆ **Maxwell Technologies**
 - ◆ Ultracapacitor supplier
- ◆ **DOE and EPRI Solutions**
 - ◆ Performance review and data analysis

Test Site



- ◆ Palmdale Water District
- ◆ Clearwell Pumping Station

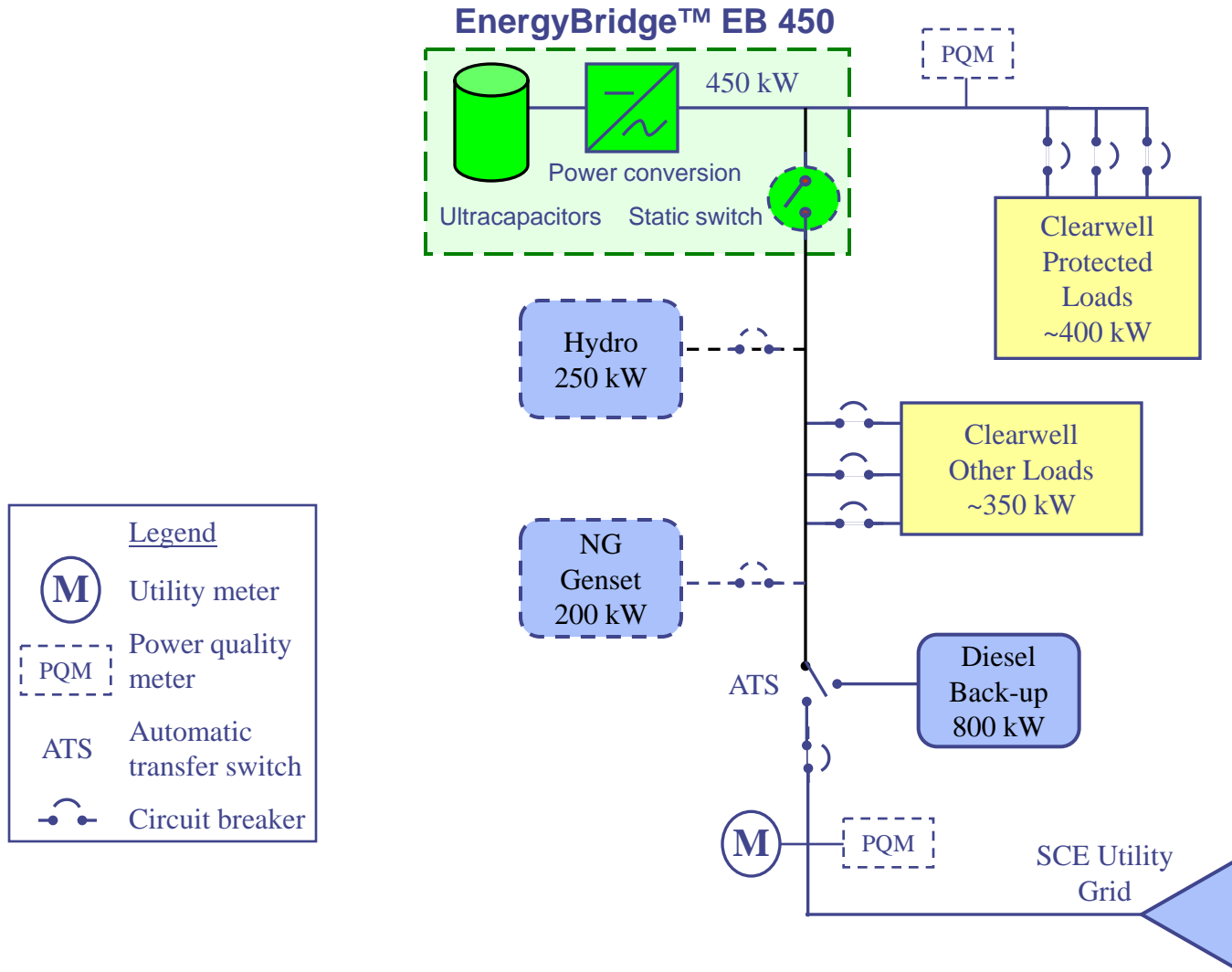


Loads: water pumps
Good test but not typical



Existing Electrical Panels
(no more room)

Palmdale Water District - Clearwell Site



Project Objectives



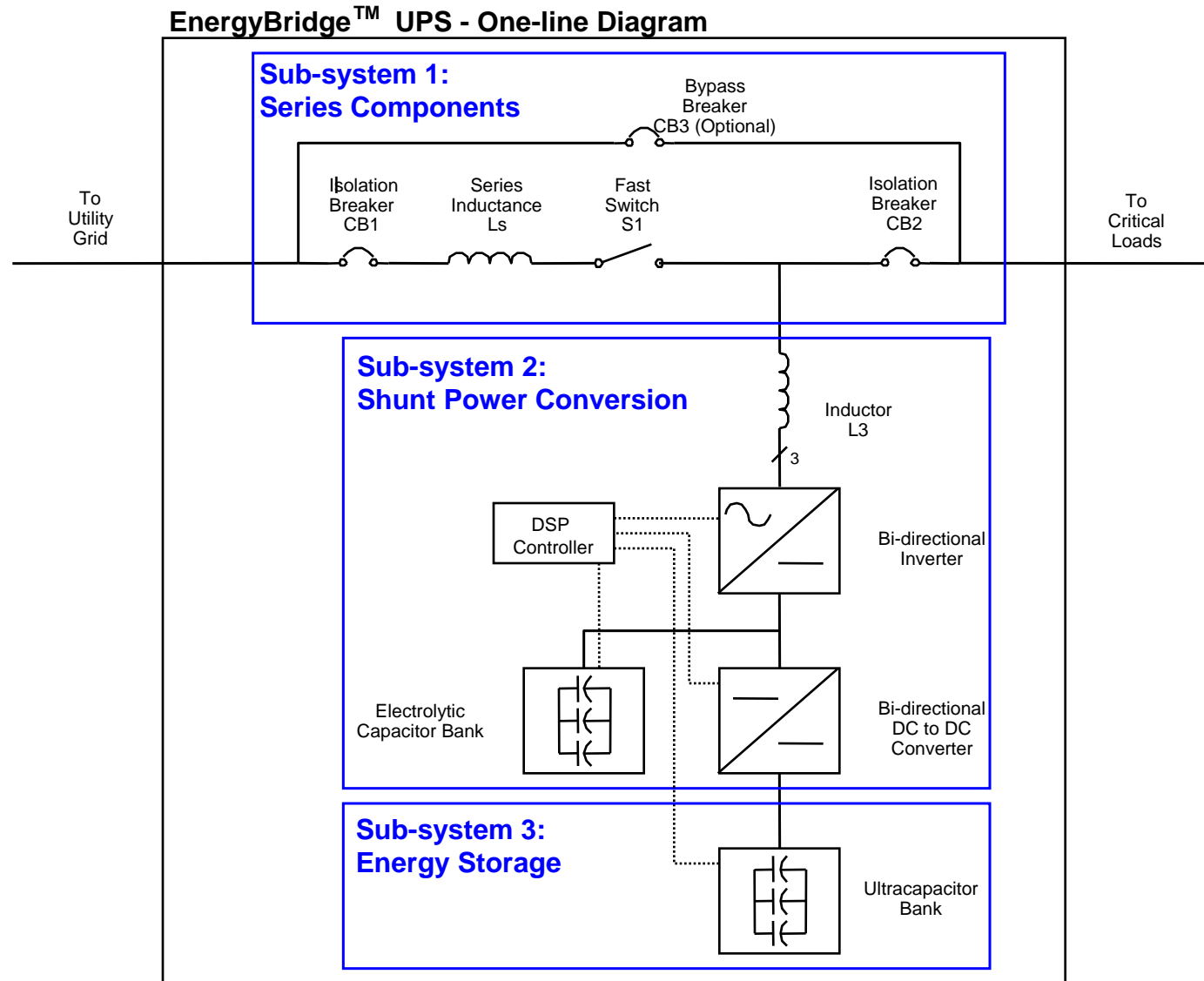
- ◆ **Maintain high power quality on protected loads at all times**
- ◆ **Provide power to protected load in event of a utility sag or outage**
- ◆ **Meet the ITI (CBEMA) curve during power quality events**
- ◆ **Resynchronize with backup power or grid as necessary**

EnergyBridge™ UPS Specifications



Rated power	450kW @ 0.8 pf
Back up time	30 sec.
Circuit voltage & type	480 Vac, 3 Phase wye, 3 or 4 wire
System efficiency	99% at rated load
Critical Bus Voltage	480 Vac +/- 2.5%
Critical Bus Voltage THD	<2% per harmonic, <3% total THD
Enclosure Dimensions	3'x20'x7' (DxWxH)
Operating temperature	0-40°C, de-rated above 40°C
Applicable Standards	IEEE 1547 & 519, UL1778, CBEMA

One Line Diagram

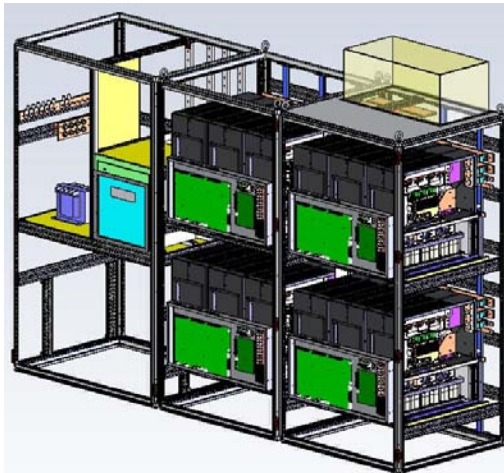
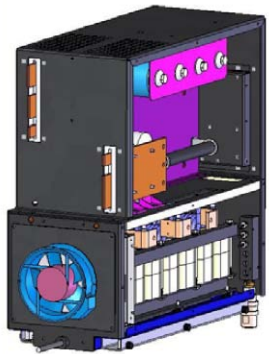


FlexPhase™ Technology



Northern's Power Converter Platform

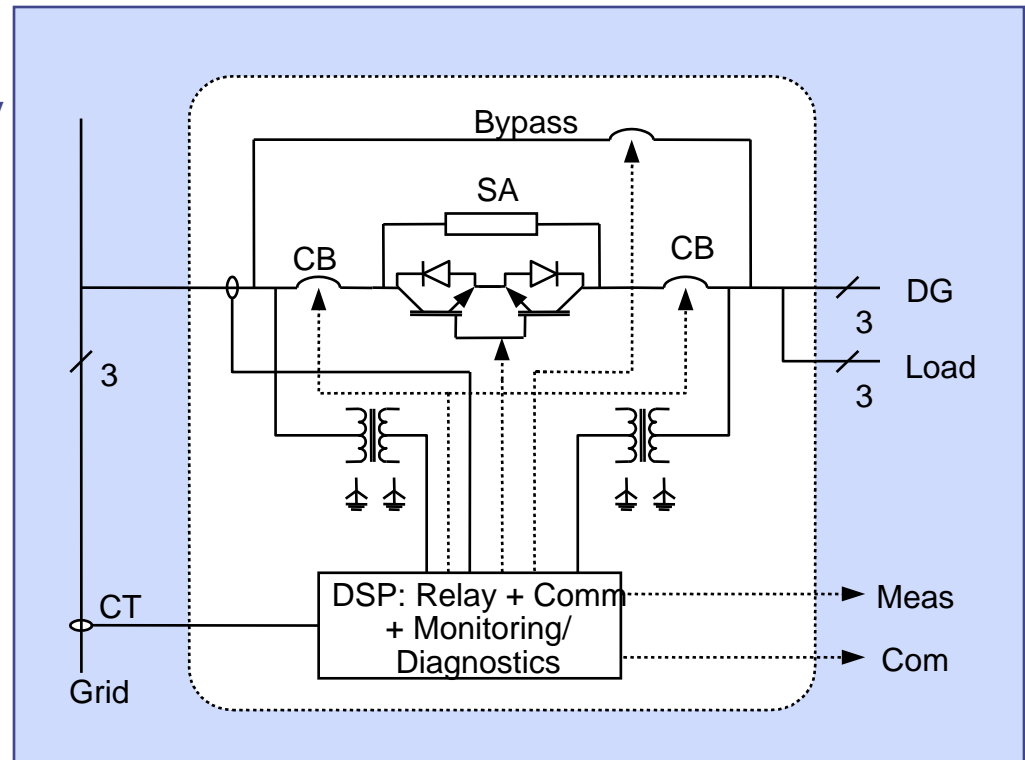
- ◆ **FlexPhase™ power modules**
 - ◆ Proprietary circuit enables high power density
 - ◆ Bi-directional AC-DC, DC-AC, DC-DC
- ◆ **PowerRouter® controls**
 - ◆ High speed DSP (digital signal processor)



DER Utility Interface Switch



- ◆ Flexible, universal interface for connecting DER systems
- ◆ Proprietary Northern controls may be applied to CB, SCR, or IGBT
- ◆ Enables
 - ◆ Critical load support
 - ◆ Intentional islanding
 - ◆ Enhanced power quality
 - ◆ Fault current protection
 - ◆ Anti-islanding protection



Series Switch Cabinet



Energy Storage



- ◆ **Maxwell Technologies ultracapacitors**
- ◆ **48 V module**
 - ◆ 18 x 2600 Farad, 2.7 Volt cells
- ◆ **EnergyBridge™ system consists of 4 banks with 20 modules per bank**



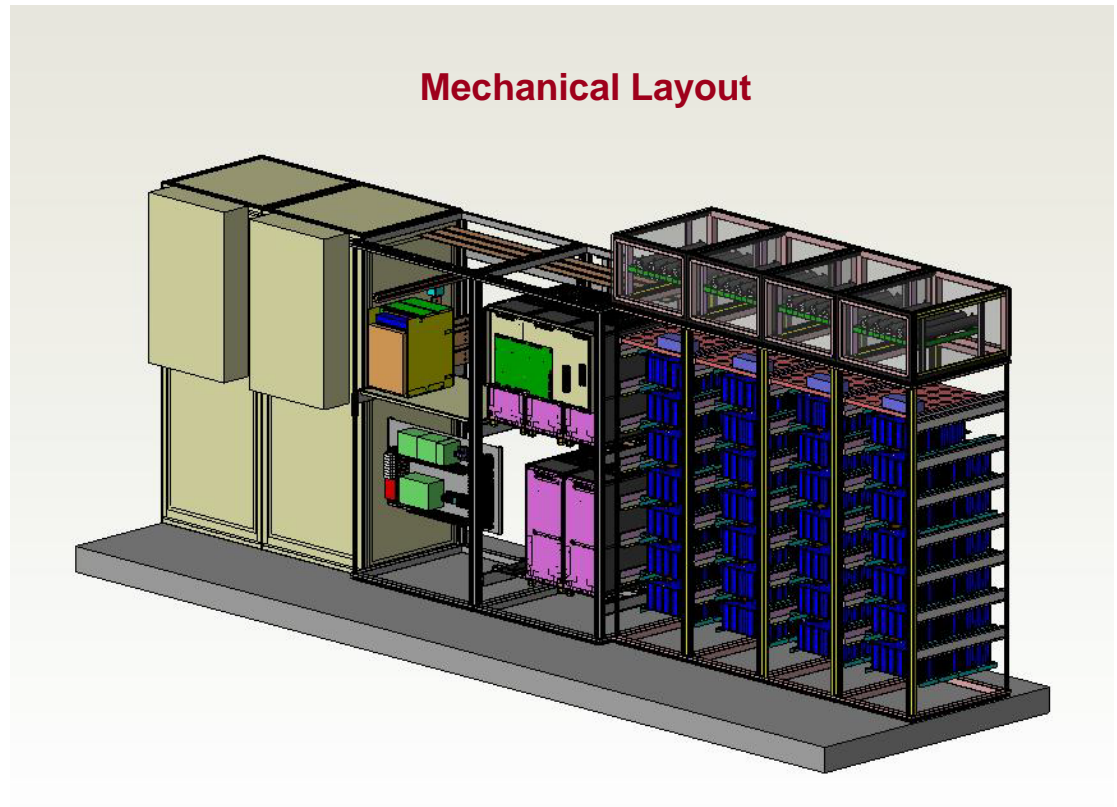
Ultracapacitor Cabinets



Advantages



- ◆ Efficiency
- ◆ Footprint
- ◆ Life-time cost
- ◆ Environmental impact

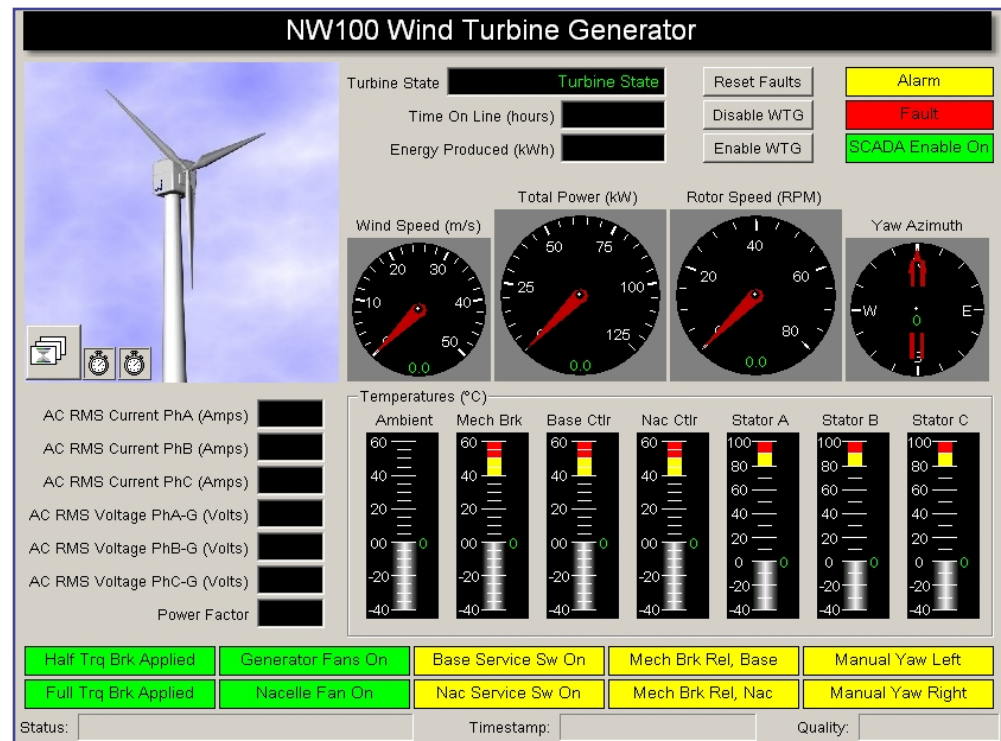


SmartView® Monitoring System



A system of hardware and software that provides the capability to monitor and control geographically distributed assets from anywhere in the world

- ◆ Local or browser-based HMI
- ◆ Fleet-level monitoring
- ◆ Standards-based design
- ◆ Local and remote execution of manual control
- ◆ Automated alarm notification
- ◆ Automated data reporting





Next Steps

- ◆ **Fabrication – Nov'06**
- ◆ **Testing – Dec'06 - Jan'07**
- ◆ **Site Prep (Palmdale) – Jan'07**
- ◆ **Installation – Feb'07**
- ◆ **Follow-on projects**
- ◆ **Commercialization**

Target Applications



- ◆ **Seamless Reliability (UPS)**
- ◆ **VAR Support (Power Quality)**
- ◆ **Mobile Trailer Configuration for Utilities**
- ◆ **Wind Farm Stabilization**
- ◆ **Village Power Systems**
- ◆ **MicroGrid Networks**

Northern's Wind Business



Wind Energy Capabilities

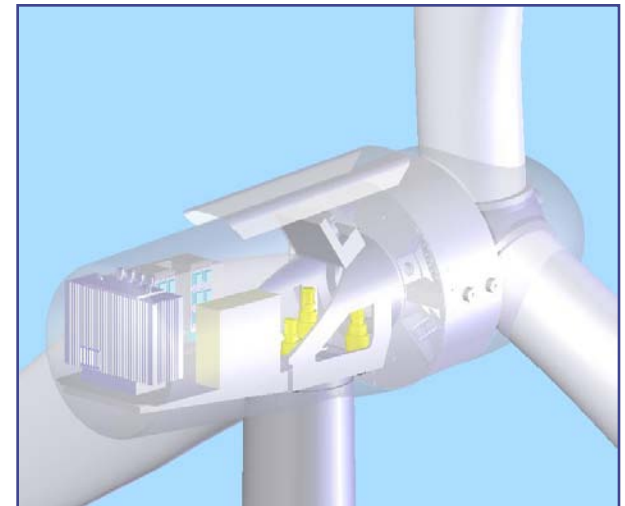
- NW100 wind turbine
- 2.X MW wind turbine
 - PM generator in test
 - FlexPhase™ power converters in production
 - Full turbine development w/ DOE & NREL support
- Wind-Diesel Integration and Controls



11/03/2006



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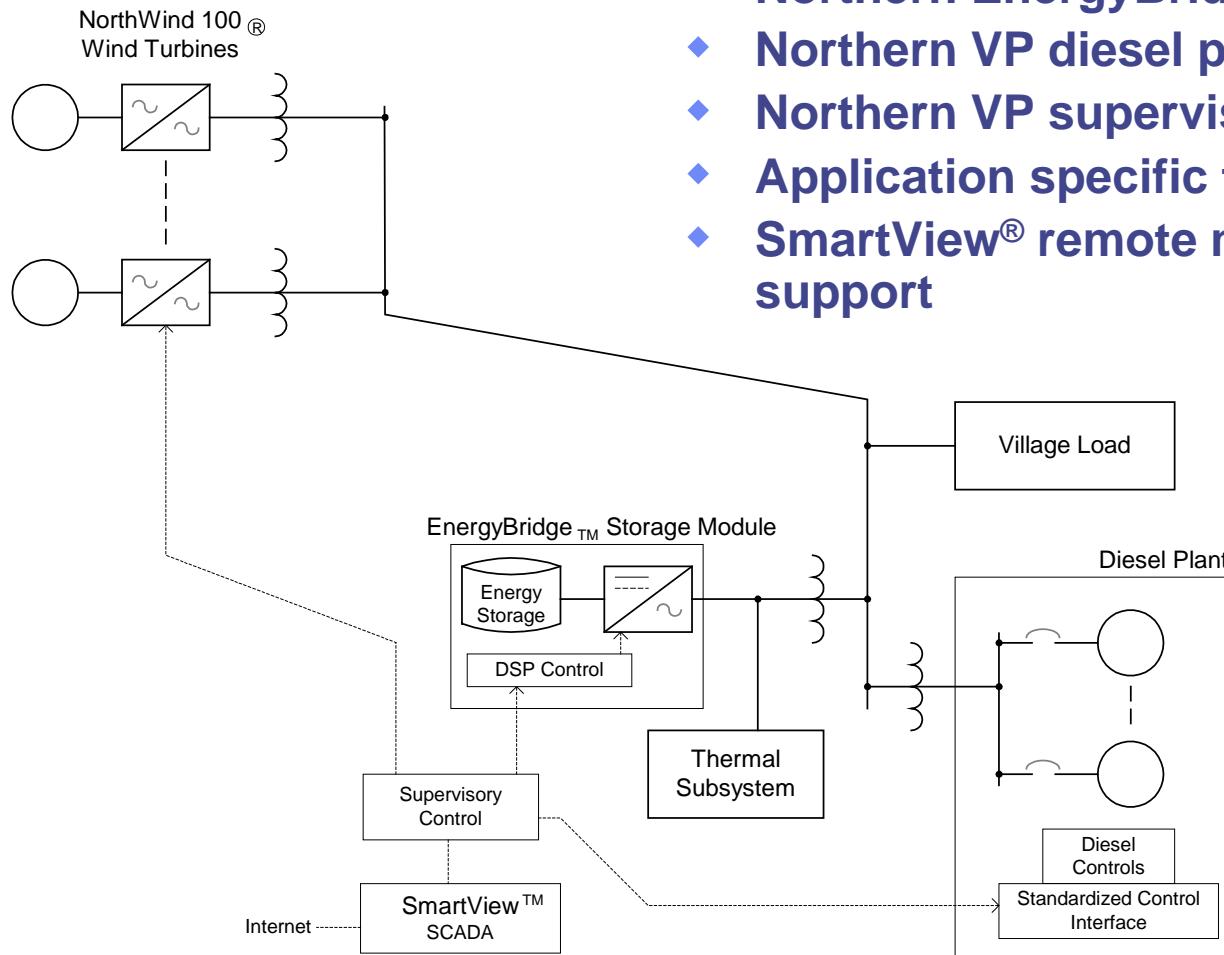


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Northern's Village Power Architecture



- ◆ Standard NW100[®] wind turbine(s)
- ◆ Northern EnergyBridge[™] storage system
- ◆ Northern VP diesel plant control interface
- ◆ Northern VP supervisory controller
- ◆ Application specific thermal balancing load
- ◆ SmartView[®] remote monitoring and site support





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