



# Solano Wind Project



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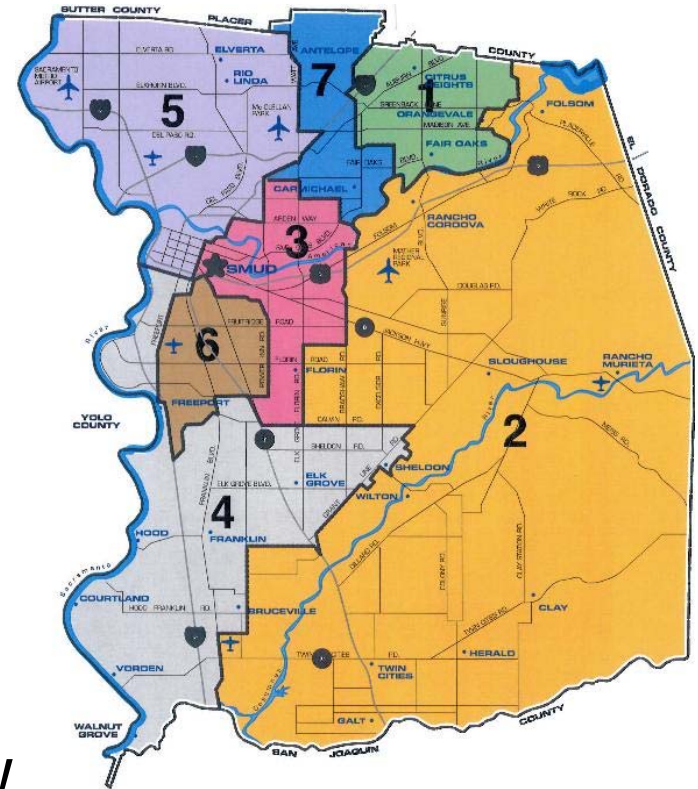
SACRAMENTO MUNICIPAL UTILITY DISTRICT

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# SMUD Background

- Municipal utility providing electric service only
- First provided service in 1946
- 7 Directors elected by our customer ratepayers
- Service area: 900 sq. miles
- Population served: 1.4 million
- Accounts served: 589,599
- 2009 budget: \$1.5B
- Peak load: 3300 MW
- Owned generation assets: 1790 MW



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# SMUD's Commitment to Sustainable Energy

- SMUD's vision is to empower our customers with solutions and options that increase energy efficiency, protect the environment, reduce global warming, and lower the cost to serve our region.
- Environmental leadership is a core value of SMUD. We provide leadership in the reduction of greenhouse gases through proactive programs and support of national, state and regional climate change initiatives.
- SMUD has established a goal to reduce long-term greenhouse gas emissions from the generation of electricity to 10% of our 1990 carbon dioxide emission levels by 2050.
- One of our near-term goals is to provide dependable renewable resources to meet 20% of our customer load by 2010, and 33% by 2020.



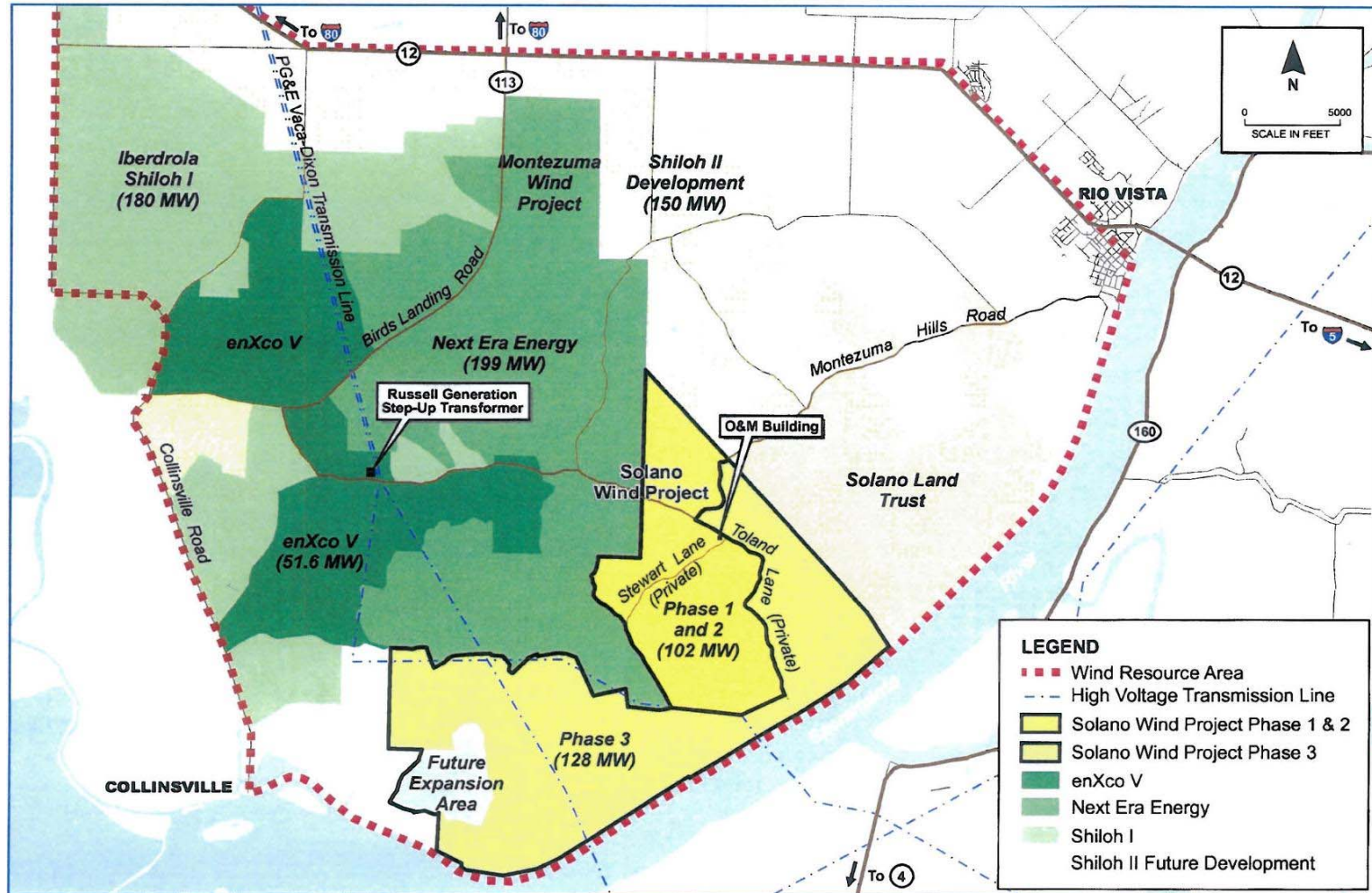
# SMUD's Wind Generation Assets

## The Wind Plant Resource:

- 5,800 acres of District-owned land in the Montezuma Hills WRA of Solano County
- Wind speed of more than 20 miles per hour at 80-meter hub height (average for peak months)
- Existing ancillary facilities: Four meteorological towers, Step-up transformer station, collection system, Operations and Maintenance (O&M) Building
- 230 MW of wind resource potential



# Montezuma Hills Wind Resource Area



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# Phase 1 Project (1999-2004)

- Vestas V47 (660 kW)
- Single WTG installed in 1999 for evaluation
- 15 WTGs added in 2003 at 50-meter hub height
- 7 WTGs installed in 2004 at 65-meter hub height
- Total Phase 1 capacity: 15 MW



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# Phase 2 Project (2005-2007)

- Vestas V90 (3 MW)
- Phase 2A: 8 WTGs installed in May 2006 (24 MW total)
- Phase 2B: 21 WTGs installed in December 2007 (63 MW total)
- Total Phase 2 capacity: 87 MW



# Phase 1 and 2 O&M Agreements

- 10-year full service Operations and Maintenance agreement through 2017
- Current values:
  - Phase 1 = \$5.9M
  - Phase 2 = \$24.2M
- Balance of Plant (BOP) included for Phase 2
- Performance incentives/penalties based on availability
- Potential for site services



# Performance

- 2008 Availability:
  - V47 = 98.97% (outstanding!)
  - V90 = 93.93
  - contractual target is 95%
- Key Issue – V90 Gearbox
  - 17 of 29 failed in first 3 years of service
    - 9 units in 2008
    - 8 units to date in 2009



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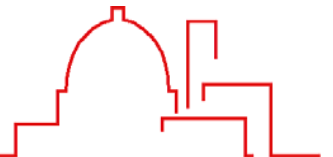
# V90 Gearbox

- Current Vestas policy is to replace upon condition
  - Limited replacement units in rework pipeline
- Unfortunately:
  - Failures occurring during high wind season
  - >50% cf in July, <15% cf in January
  - Substantial lost generation
  - Crews/equipment on site but idled due to high winds
- Plan being developed for systematic replacement of all down revision gearboxes.



# Site Staff Resources

- Knowledge/expertise of on-site staff is top notch
  - Both technical and administrative support
- Site supervision and communication to SMUD is excellent
- Customer service from site staff has been high quality
- Diligent conformance to scheduled maintenance has been effective and is appreciated



# Lessons Learned Collection System

- Replaced portion of collection system.
- 7 Underground Splice Failures



# Failed Splice June 07



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# Failed Splice June 08



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# Design Changes

- No underground splices. All above ground in a junction box.
- No cross-bonding, larger cable installed.
- Lower compaction of back fill, due to larger cable.
- Strand blocking complied with SMUD standards.



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# Strand Blocking Standard

## 5.2.4 CONDUCTOR SEALANT

- a) In order to prevent water propagation through the insulated conductor and to alleviate water (electromechanical) treeing of the insulation, a strand blocking shall be applied to the inner layer(s) of all stranded conductors in accordance with ICEA S-94-649.
- b) This material shall be compatible with the conductor, conductor shield materials and the insulation in accordance with ICEA T-32-645.
- c) It shall be capable of withstanding a water penetration test pressure of 5 psi for qualification and production testing in accordance with ICEA T-31-610.



# Lessons Learned SCADA / Fiber

- Locater cable not installed.
- Logic for fiber loop coordination with feeders.
  - No correlation to feeders and fiber loop.
  - Powered WTGs lose comm. when other feeder are off line.
- Home run to met towers not originally specified.
  - Have modified fiber system when feasible.



# Lessons Learned Site Services

- Resources available
  - 3 Site Services Contractors
  - SMUD Staff (DS, Hydro, etc.)
  - Metering Contractor
  - O&M Contractor



# Lessons Learned Site Services

- Considerable effort is expended managing and coordinating site work.
- Difficult to determine what resource to use for a specific task.

