GovEnergy
www.govenergy.gov

· August 15-18, 2010 · Dallas, Texas ·
· Dallas Convention Center ·

USAF and INL Wind Development Activities at F.E. Warren AFB

Wind Energy Program at INL

- Regional Resource Assessment and Related Wind Development Support
- Regional Support to DOE Wind Powering America Program
- Focus Areas
  - Anemometer Programs (technical support to State Energy departments)
  - Wind Radar Interaction
  - Air Force/DOD renewable installations
  - Regional Transmission Expansion
  - Educational Outreach
  - Demonstration Projects
- INL has always maintained expertise in power systems and applied engineering; work on energy and general power engineering projects
- INL “cut its teeth” in wind energy feasibility studies and development with the U.S. Air Force and others beginning in the 1980’s and 1990’s
  - DOD wind projects include: Ascension Island, FE Warren AFB, Guam, Alaska, Vandenberg AFB, and many others.

Government Wind Projects Can Have Many Hurdles

- Operational and mission impacts reviews
- Environmental review processes
- Utility interconnect process and interactions
- Implementing wind data towers may take longer than expected
- FAA reviews and adjustments if impacts found
- Learning curve for each base and people involved; re-invent the wheel often times
- No economy of scale on small projects; often tough to justify economics
- Permitting, design and contracting strategies for success; government procedures and power struggles can slow down or kill projects

INL Capabilities for Government Project Development and Construction Oversight

- INL has performed most aspects of wind project development, design and construction management
- Many ways to manage a project and breakdown who performs what function
  - Feasibility studies
  - Project design (design-build, what level of design needed to go out for bid) and submittal reviews
  - Who purchases the turbines? Any other Government Furnished Equipment (GFE)?
  - Who procures the Balance Of Plant (BOP) construction contract and manages the project? We have done this multiple ways: sometimes Base CE, sometimes INL, or other.

FE Warren AFB Wind Project, WY

- ***First Air Force wind project in the continental U.S.***
- ***Expected to save the Air Force more than $3 million in energy costs over the next 20 years.***
- ***Phase One – 2-660 KW Vestas Wind Turbines, on-line in 2005.***
- ***Phase Two – 1-2.0 MW Gamesa Wind Turbine added, completed in Spring 2009.***

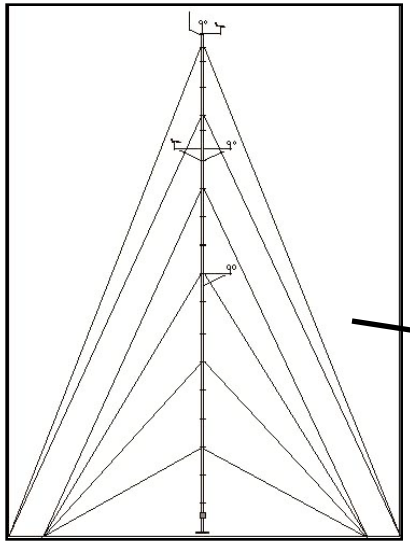
GovEnergy 2010

FE Warren AFB Wind Project, WY

- ***Preliminary wind data collection using one 50m and two 20m (for prospecting around base) met towers.***
- ***Allowances had to be made during preliminary design for base missions, easier accessibility, FAA requirements, etc.***

FE Warren Wind Energy

Metereological Data Towers



PROVIDED BY DoD-WIDE RENEWABLES ENERGY ASSESSMENT PROGRAM

2 ANEMOMETERS – 50M

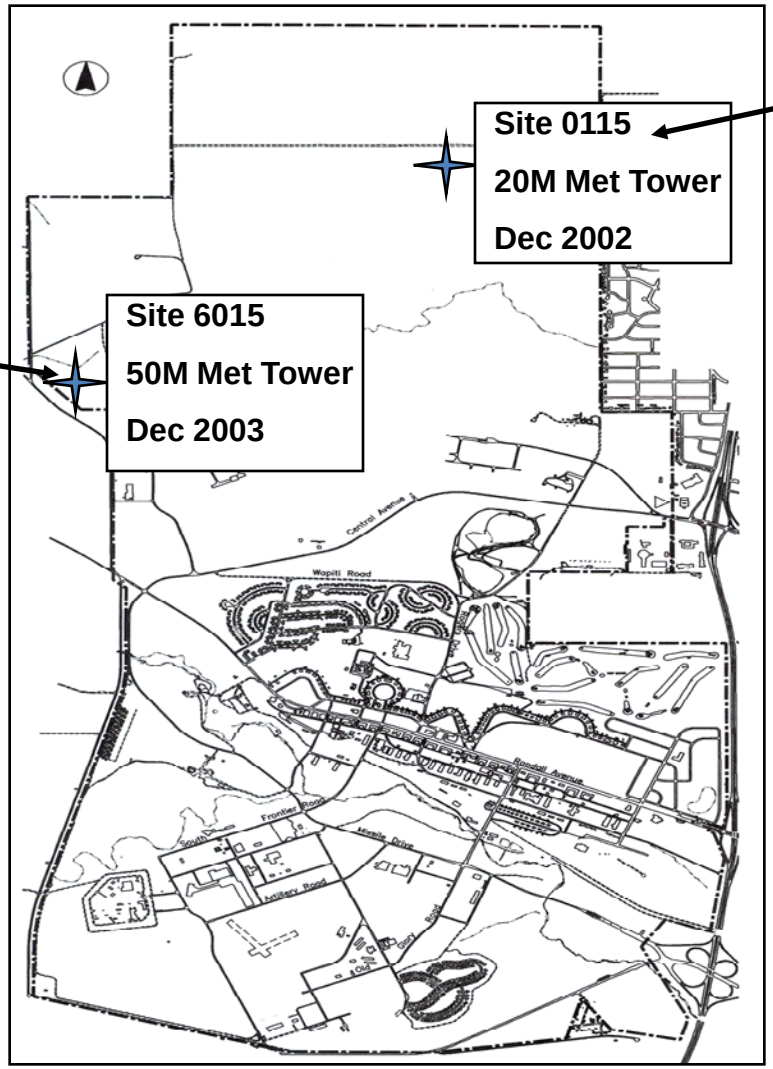
1 ANEMOMETER – 40M

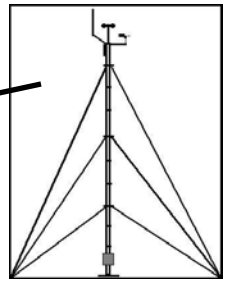
1 ANEMOMETER – 30M

1 WIND VANE – 50M

1 WIND VANE – 37M

IN SERVICE DEC 2003





LOANED FROM WAPA

1 ANEMOMETER – 20M

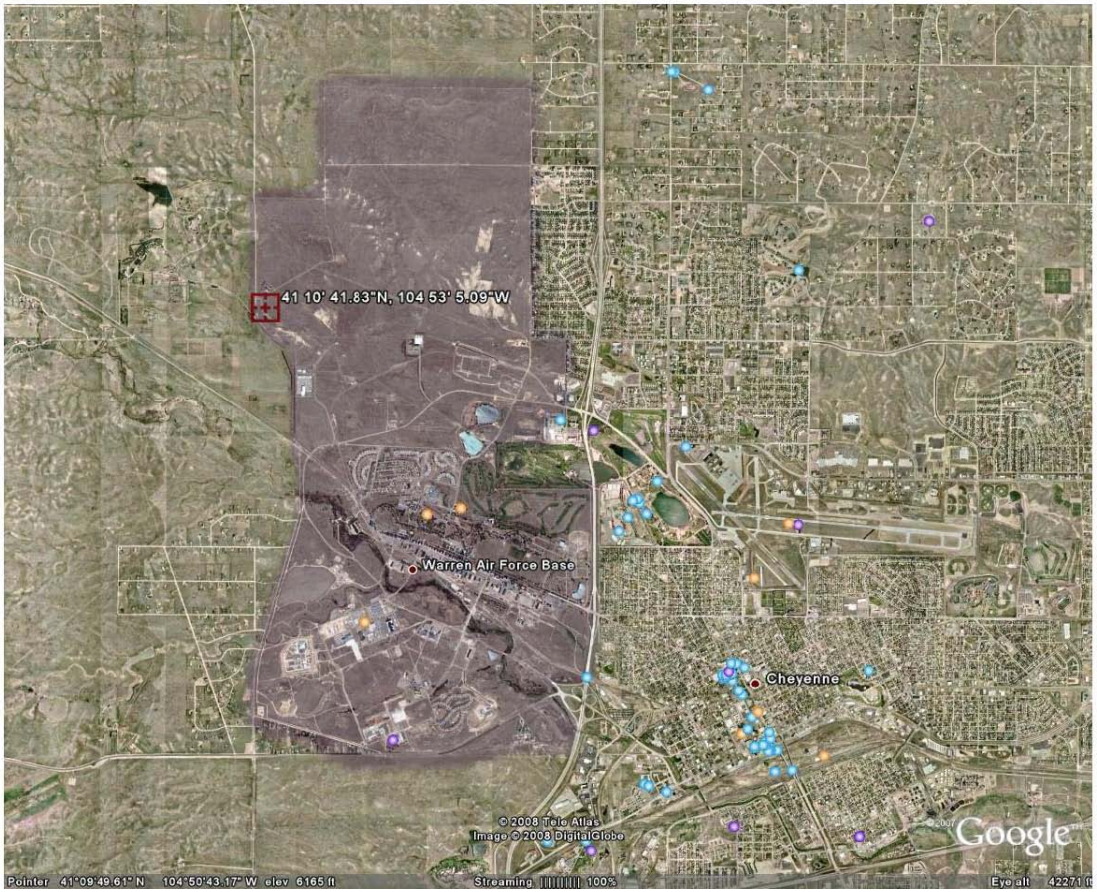
1 WIND VANE – 20M

IN SERVICE DEC 2002

GovEnergy
www.govenergy.gov

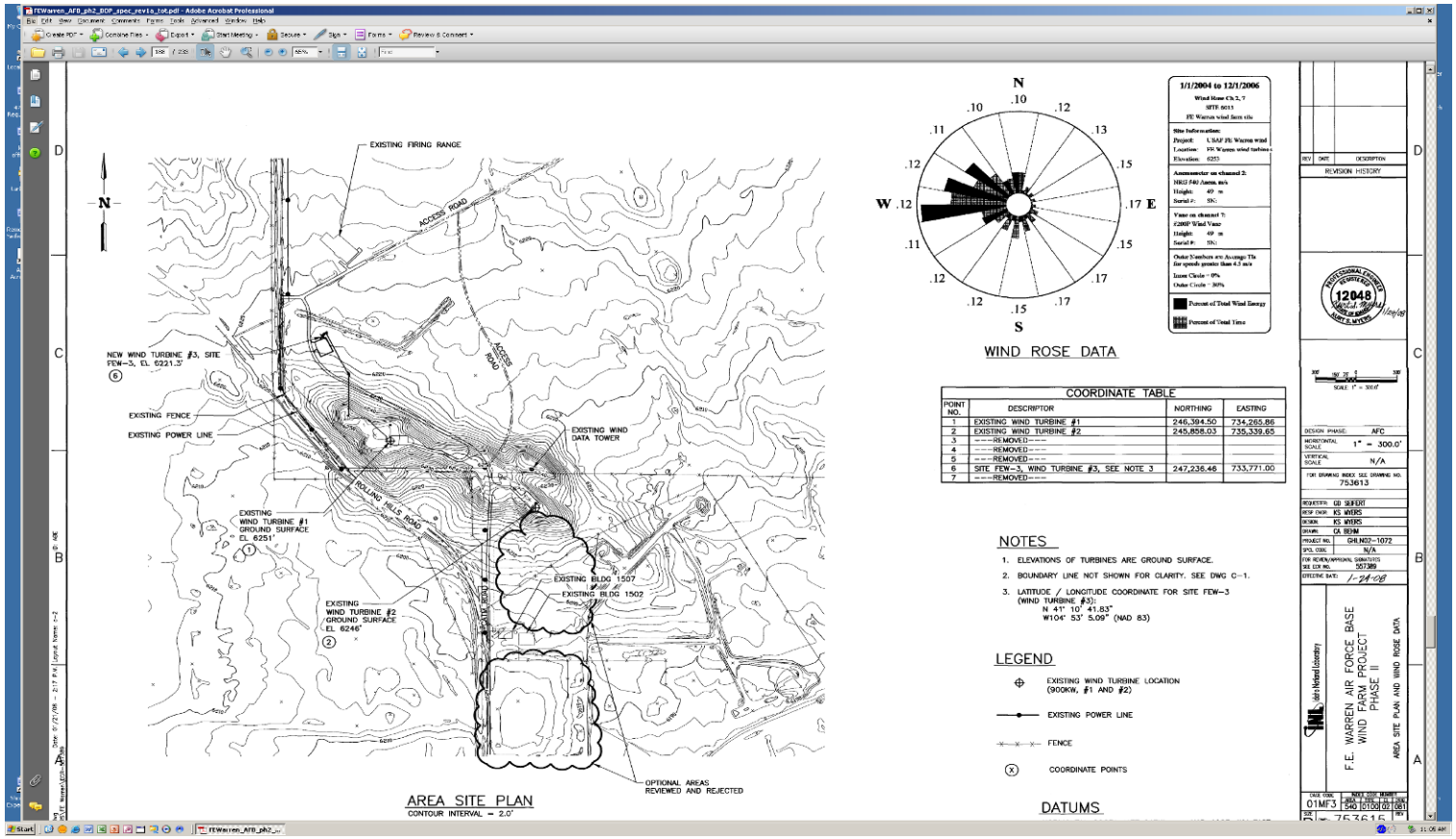
GovEnergy 2010

FE Warren AFB Wind Project, WY



GovEnergy 2010

Site Layout



Long-term projected annual average wind speed at hub height (50m Above Ground Level on hill, 67m at Gamesa): 7.7m/s

GovEnergy 2010

FE Warren AFB Wind Project, WY

- ***Phase I – INL design and technical oversight, Base CE performed contracting. Phase II – INL performed all aspects, with Base CE providing basic support for base interfaces.***
- ***Phase II includes an energy security test to be performed in 2009-2010.***

Phase II Project Scope

This project consisted of the following key tasks:

- **Project Planning**
- **Site Review, Inspection, and Data collection**
- **Site Selection and Final Project Planning**
- **System Design**
- **Wind Turbine Procurement and Installation**
- **Energy Security Plan Development**
- **Energy Security - Micro-Grid system design/integration**
- **Demonstration/Simulation of Wind/Micro Grid System**
- **Perform Energy Security Test**
- **Economic and Technical Analysis**
- **Project Reporting**

Foundation Hole, 32 Feet Deep

GovEnergy 2010

Foundation Bolts, Sleeves and Rings Into The Hole

Inner Corrugated Metal Pipe Form

Busy Day, Setting Transformer Vault and Pouring Concrete in Foundation

Poured, Capped and Ready for First Tower Section. Note Location for Leveling Shims

GovEnergy 2010

Hub and Blade Arriving

Nacelle with Logo

All but First Tower Section

Tower erection

Tower Erection - Mid Section

GovEnergy 2010

G87 Blade installed

All Done

Phase II Status as of June 2010

- First parts start arriving October 2008
- Large crane arrived November 2008
- Bottom tower section Due On Site December 2008
- Erection Starting Dec 2008
- Commissioning April 09
- SCADA on line May 2009
- Startup and run in April 2009 – March 2010
- Energy Security Test April 10
- Energy Security Test Report September 10

Energy Production and Payback

The turbines are “grid connected” directly to the on-base distribution system

•The power flows into the base distribution system, offsetting the power received from our energy suppliers
•The energy produced by turbines saves $0.052 per KWH, annual estimated energy production is ~ $575,000.00, simple payback period is 14 years

Maintenance (~ $100K / yr) funded through energy savings

Additional energy conservation projects are also funded through the utility dollars saved

Annual projected average gross capacity factor: 34% for the Vestas’, 38% for the Gamesa; net is about 0.9 times gross.

Energy Security Test

Energy Security Test Performed April 2010

Test assumed approximately 1/3 of Base load and created microgrid consisting of load, base infrastructure, diesel generators, and wind farm.

Test results highly successful;

- Data being analyzed and report being prepared
- Fuel reductions over 25.5%
- Able to extend Energy Security
- Frequency Stayed between 59.6 and 60.4 Hz
- All mission equipment stayed on line
- Stable system voltages
- Maximum wind penetration with Gamesa turbine was 82.7%
- Maximum wind penetration with Vestas turbines was 53.6%
- Total loads supplied varied between approximately 2.1 and 3.1 MW.
- Replicable at many bases around the world
- Can apply to Solar as well as wind

Installing Sodar Prior to Energy Security Test

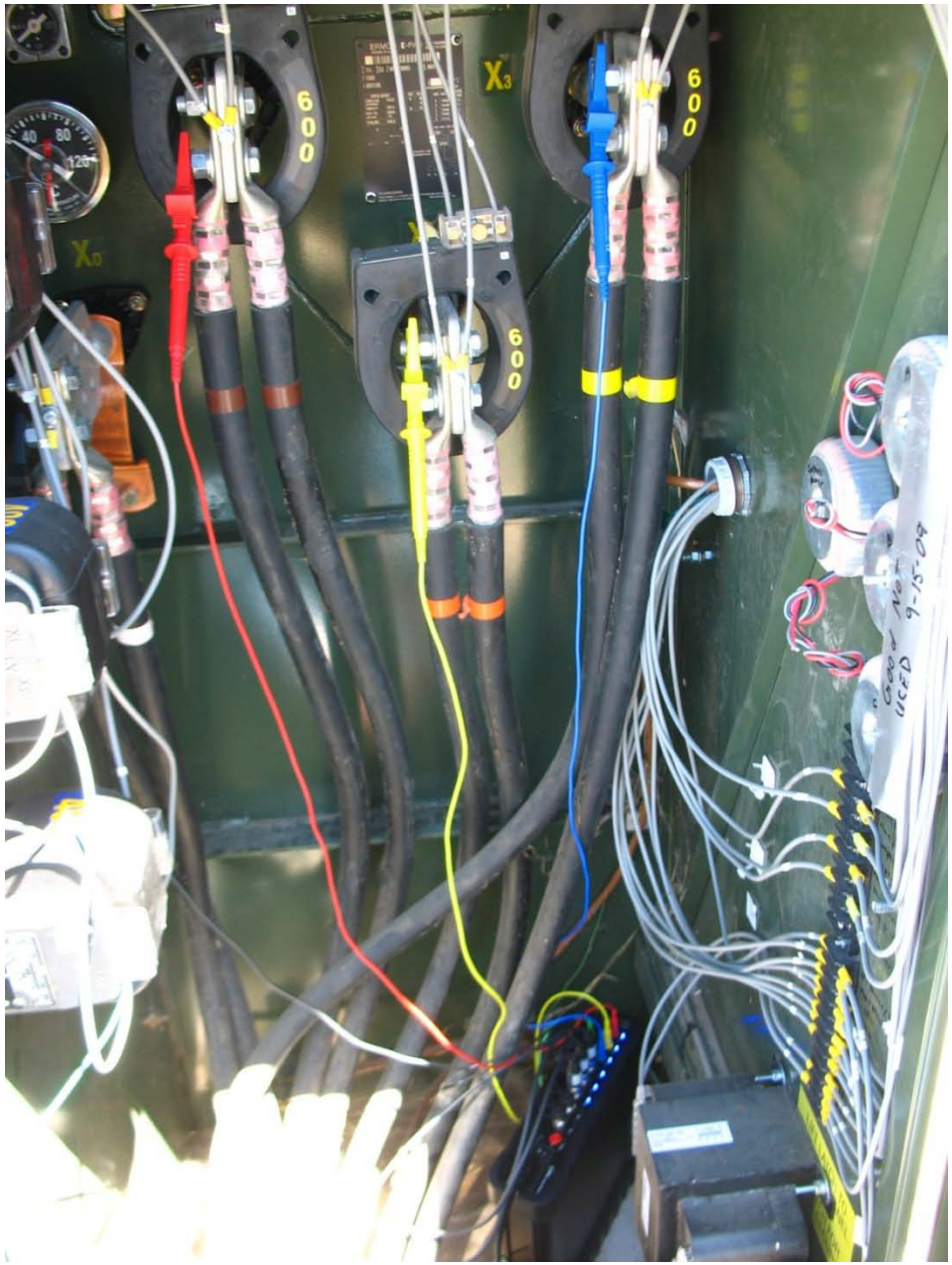
GovEnergy 2010

GovEnergy
www.govenergy.gov

Temporary Diesel Genset Arrangement for Test

GovEnergy 2010

Power Meter #2 Test Equipment at Wind Turbines



GovEnergy 2010

Inside of One of the Diesel Gensets

GovEnergy
www.govenergy.gov

GovEnergy 2010

Monitoring Wind Turbines During Energy Test

GovEnergy 2010

Siting Considerations

Besides the wind resource

Proximity to Occupancies, Utilities and Public Safety

Local regulations – "setback"

Failures, Fires and Ice

FAA OEAAA

DoD Preliminary Screening Tools on FAA OEAAA website

- **Long Range Radar**
- **Military Operations**

Grid connection considerations

Grid reliability and Installation Security

GovEnergy 2010

GovEnergy
www.govenergy.gov

Siting Considerations

Environmental Assessment / Environmental Impact

- Impact of turbine manufacture – Energy Return On Investment
- Wildlife – avian impacts
- Viewshed considerations
- Noise and flicker

Crane Pads

Access Roads and Crane Walks

Layout Optimization

Permits

- NPDES - National Pollutant Discharge Elimination System
- DOT
- FAA

Point of Connection and Power Delivery

LESSONS LEARNED

- Perform resource assessments
- Partner at the beginning
- Performance-based specifications
- System design and integration crucial
- Integrate proper controls and systems for stability and planned penetration levels
- Plan and model loads up front
- Wind/Diesel systems are very compatible
- You can have penetration above 25%, but plan and design for high penetration
- Distributed generation systems require good grounding/design
- Long-term O&M, Operating contracts and knowledge base are critical

INL Contacts

Biofuels & Renewable Energy Technologies Department
J. Richard Hess
(208)526-0115; JRichard.Hess@inl.gov

Gary D. Seifert
(208)526-9522; Gary.Seifert@inl.gov

Kurt S. Myers
(208)526-5022; Kurt.Myers@inl.gov

INL Wind Program information www.inl.gov/wind

INL/CON-10-19417
REV. 1

USAF and INL Wind Development Activities at F.E. Warren AFB

(and Other Government Power Projects)

Kurt Myers, MSEE, PE
Gary Seifert, Program Manager, PE
Biofuels & Renewable Energy Technologies

August 2010

GovEnergy
www.govenergy.gov

GovEnergy 2010

Appendix Slides

Some Current Government Wind Projects with INL Involvement

- Galveston, TX, Marine Corps Reserve
- Brooklyn, NY, Marine Corps Reserve
- Great Lakes, IL, Navy
- Twentynine Palms, CA, Marines/Navy
- Barstow, CA, Marines/Navy
- Bridgeport, CA, Marines/Navy
- AUTEC, Bahamas, Navy
- Basic support to Navy projects in Guam, San Nicolas Island, Dam Neck, VA and others.
- DOE Pantex: INL wind analysis and design
- INL Site: INL wind prospecting and analysis, NEPA and mission integration process, etc.

FE Warren AFB Project Details

FE Warren AFB is the proud home of three commercial scale wind turbines. The wind farm consists of two Vestas V47, 660 KW, and one Gamesa G87, 2,000 KW, turbines for a total of 3,320 KW.

The two 660 KW turbines were funded by Energy Conservation Investment Program (ECIP) funds in Aug 05.

The third (2 MW) wind turbine generator installation was funded for testing “microgrid” capabilities; that is, disconnecting the base from commercial power supply and operating with wind and diesel gensets and brought on line April 09.
Total investment in the FEW Wind Farm is ~8,300,000$.

The project was designed and accomplished in partnership with FEW AFB, Idaho National Laboratory (INL), and Air Force Civil Engineer Support Agency.

The wind energy farm’s total of 3.32 MW capacity is capable of generating 10 million Kilowatt-Hours per year, enough to power 1300 households.

The FEW AFB Wind Farm is supporting Executive Order 12902, Sec 304, to use “renewable energy technologies” as well as help F. E. Warren meet its energy conservation goals.

The turbines’ energy production will offset the equivalent of 15.2 million pounds (7,600 tons) per year of carbon dioxide emissions if the same amount of energy were produced with coal as the fuel.

The turbines are expected to save the Air Force more than $11.4 million in energy costs over the next 20 years with maintenance costs of about $2 million.

Air Force has ownership of the two V47 wind turbines and associated transformers and will acquire ownership of the G87 in FY11.

Energy security demonstration test April 2010

Transformer Arriving for FE Warren Wind Turbine #3

GovEnergy 2010

Benefits to the Air Force and F. E. Warren AFB

The Air Force saves energy dollars

F. E. Warren “reimbursable” customers such as MWR, AAFES and the Commissary receive green energy

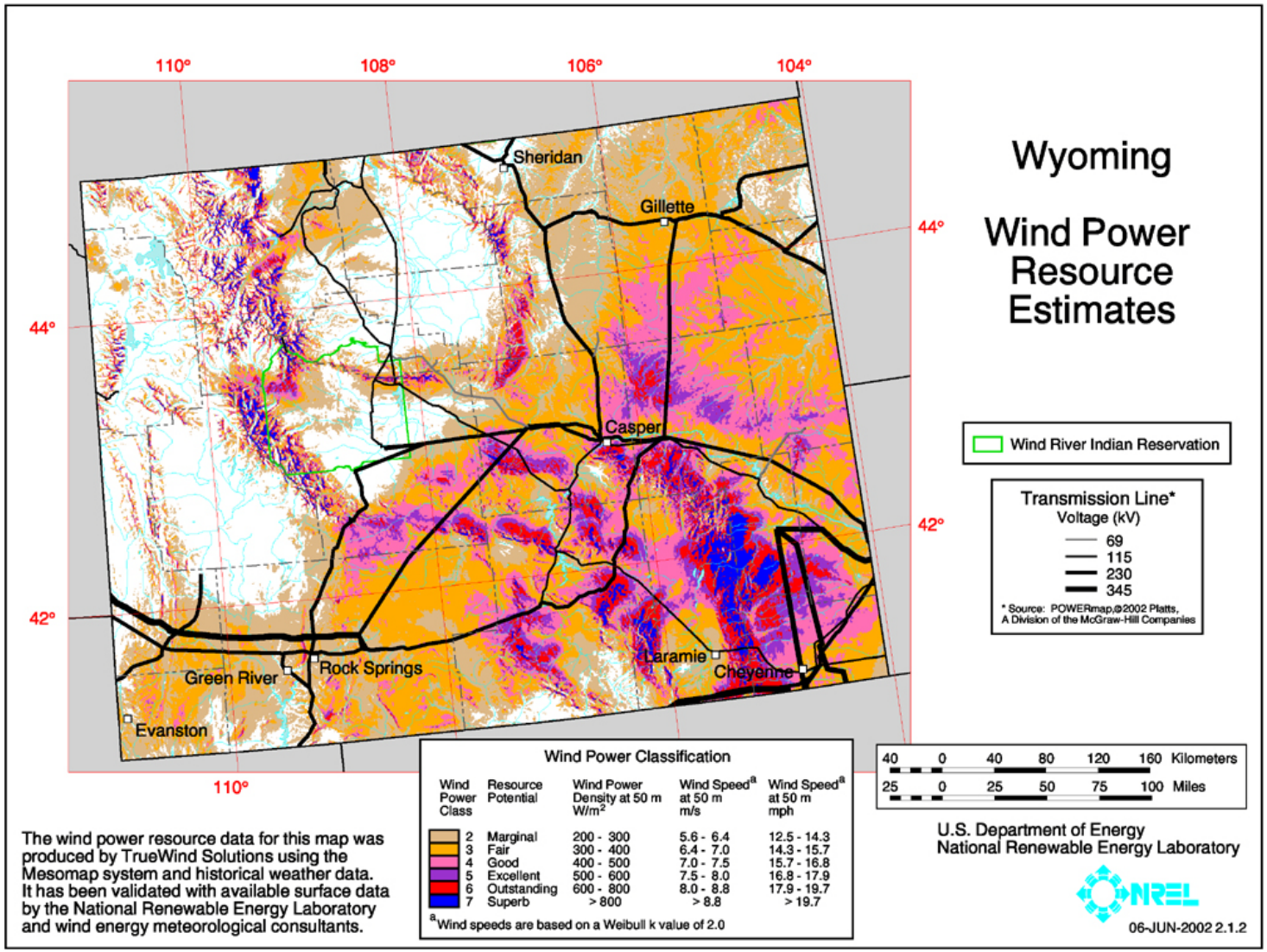
The Executive orders, Energy Bill of 2006, and American Clean energy and Security Act of 2009 all requires energy reduction, encourages the purchase of green power and on-base generation of green power

The wind turbines meet these three requirements.

Renewable installations on government property get double credit, i.e. clean energy and REC’s both counted

Wise use of O & M dollars realized through energy savings will help the base meet the energy reduction goals

Wyoming Wind Map



GovEnergy
www.govenergy.gov

GovEnergy 2010

Wind Turbine Performance

Turbine Specifications

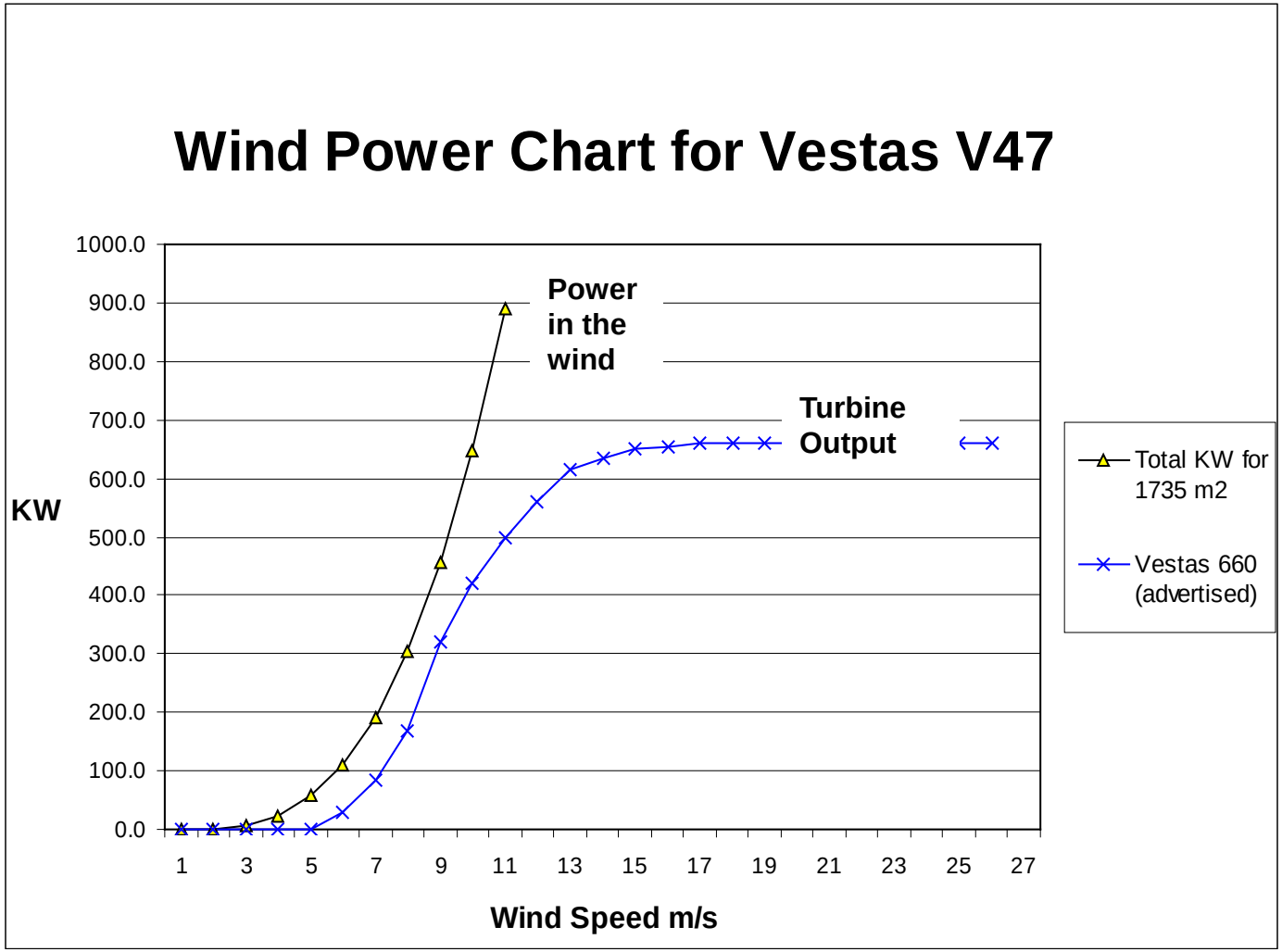
Vestas V47's

- Nameplate Rating 660 kW
- Rotor Diameter 154 ft = 47m
- Tower Height 164 ft = 50m
- Swept Rotor Area 18,765 sq ft = 1,735m2
- Cut-in Wind Speed 9 mph
- Cut-out Wind Speed 55.9mph
- Rotational Speed 28.5 rpm
- Yearly Est. kWh - Generated for 2 turbines 4 million kWh
- Carbon Dioxide (CO_2) - Offset Yearly 6.7 million lbs (3,344 tons)
- Annual Energy Provided Equivalent to that required for 522 households

Gamesa G87

- Nameplate Rating 2 MW
- Rotor Dimeter 285.4 ft = 87 m
- Tower Height 220 ft = 67 m
- Swept Rotor Area 63,991.5 sq ft = 5,945 m2
- Cut-in Wind Speed 9 mph
- Cut-out Wind Speed 55.9mph
- Rotational Speed 9 - 19 rpm
- Yearly Est. kWh - Generated 6 million kWh
- Carbon Dioxide (CO_2) - Offset Yearly 8.5 million lbs (4,250 tons)
- Annual Energy Provided Equivalent to that required for 783 households

Wind Turbine Performance



Turbine Output

GovEnergy 2010

Siting Considerations

Obstacle Evaluation and Airspace
FAA OE/AAA Web site "Notice Criteria Tool"

Federal Aviation Administration
Bringing Safety to America's Skies

https://oeaaa.faa.gov/oeaaa/external/portal.jsp

Obstruction Evaluation
- Home
- FAA OE/AAA Offices
- View Determined Cases
- View Proposed Cases
- View Supplemental Notices (Form 7460-2)
- View Circularized Cases
- Search Archives
- Circle Search for Cases
- Circle Search for Airports
- Discretionary Review FAQs
- Notice Criteria Tool
- DoD Preliminary Screening Tool
- Distance Calculation Tool
- Competition for the Sky

OE/AAA Account
- Login
- New User Registration

Information Resources
- FAA Acronyms
- Forms
- Regulatory Policy
- Relevent Advisory Circulars

Notice Criteria Tool

faa.gov Tools: Print this page

The requirements for filing with the Federal Aviation Administration for proposed structures vary based on a number of factors: height, proximity to an airport, location, and frequencies emitted from the structure, etc. For more details, please reference 14 CFR Part 77.13.

You must file with the FAA at least 30 days prior to construction if:
- your structure will exceed 200ft above ground level
- your structure will be in proximity to an airport and will exceed the slope ratio
- your structure involves construction of a traverseway (i.e. highway, railroad, waterway etc...)
- your structure will emit frequencies, and does not meet the conditions of the FAA Co-location Policy
- your structure will be in an instrument approach area and might exceed part 77 Subpart C
- your structure will be on an airport or heliport

If you require additional information regarding the filing requirements for your structure, please identify and contact the appropriate FAA representative using the Air Traffic Areas of Responsibility map for Off Airport construction, or contact the FAA Airports Region / District Office for On Airport construction.

The tool below will assist in applying the appropriate slope calculations per part 77.13(a)(2)(i) through (iii)

Latitude:	41	Deg	10	M	32.74	S	N
Longitude:	104	Deg	52	M	50.6	S	W
Horizontal Datum:	NAD83						
Site Elevation (SE):	6236	(nearest foot)					
Structure Height (AGL):	365	(nearest foot)					
	Submit						

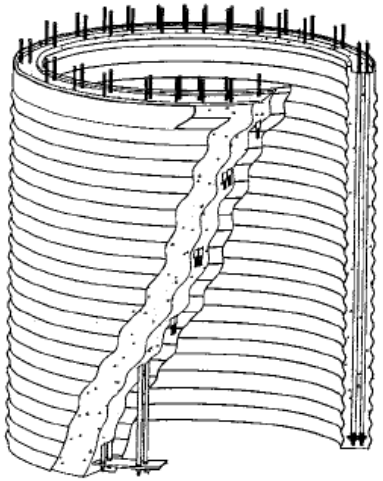
Results

You exceed Notice Criteria by 287.0 feet. The nearest airport is CYS, and the nearest runway is 13.

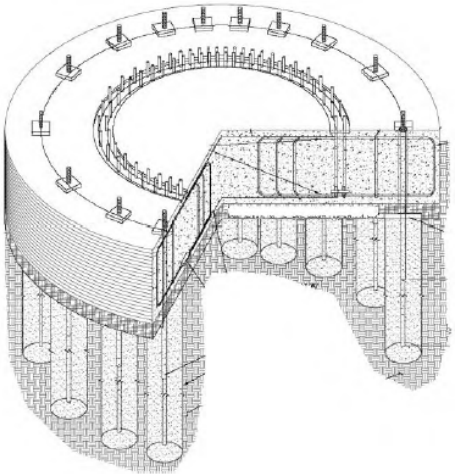
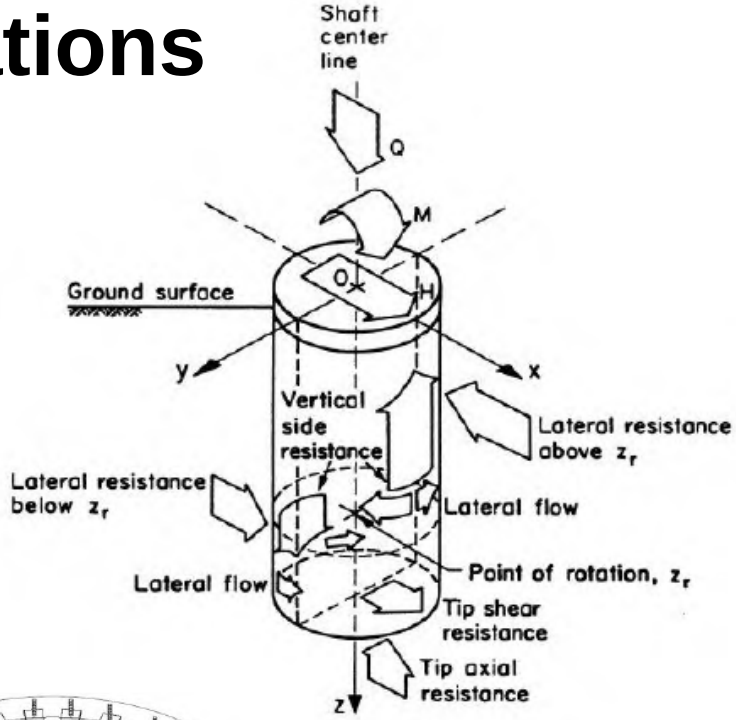
Siting Considerations

Foundation Types

Gravity Spread



Patrick and Henderson (P & H)
Tensionless Pier



P & H Rock or Pile Anchor