Kotzebue Wind Project Expansion / Integration

Rural Energy Conference
Fairbanks, Alaska

Brad Reeve
General Manager
Kotzebue Electric Association Inc.
Kotzebue Electric Association

- 1991 - began looking seriously at wind
- 1992 - installed met tower
- 1994 – K E A invested $250 K to develop wind
- Difficulty finding wind equipment
- 1995 - Ordered turbines
- 1997 installed first
Wind Integration

- Kotzebue like most Rural Communities is faced with overwhelming fuel cost increases
- Diesel requirements are increasing to deal with additional infrastructure i.e. school additions, water and sewer system upgrades
- Wind can help answer part of the question, but can create system stability issues that must be dealt with
- The higher the penetration the higher the system capital cost
Annual Fuel use in Gallons

<table>
<thead>
<tr>
<th>Year</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>1,420,000</td>
</tr>
<tr>
<td>2003</td>
<td>1,440,000</td>
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<tr>
<td>2004</td>
<td>1,460,000</td>
</tr>
<tr>
<td>2005</td>
<td>1,480,000</td>
</tr>
<tr>
<td>2006</td>
<td>1,500,000</td>
</tr>
</tbody>
</table>

Gallons: 1,511,059
Rising Fuel Cost
Fuel Price Trend

Annual Fuel Bill

- 2002
- 2003
- 2004
- 2005
- 2006

$0
$1,000,000
$2,000,000
$3,000,000
$4,000,000
$5,000,000

Fuel Bill
Fuel Cost

- World consumption of energy is on the rise, surpluses that previously existed are no longer available
- US refineries are not keeping up with demand
- Joint fuel buying helps - Western Alaska Fuel Group – K E A, Nome Naknek, Dillingham, Unalakleet, B uckland combine the buying power of 7.5 m i l l i o n g a l l o n s
What Role Does Wind Play for KEA

- Reduces the amount and cost of fuel
- Provides jobs instead of buying fuel
- Reduces emissions from power plant
- It is the best local energy resource
- It diversifies our energy resources
Construction
Construction Issues

- Foundation design is critical.
- Different parts of the state will need different foundations.
- Safety & training programs are critical.
- Cranes are expensive.
- KEA has designed a tilt up tower system for smaller communities.
- All KEA wind turbine construction is done in the winter.
Arctic Foundations
Why in the Winter?

- Primarily to protect the tundra
- Construction is done in the winter when the ground is frozen in order to move heavy equipment onsite
- Working on frozen tundra does not damage the vegetative layer
Wind Equipment
Entegrity 15/50

15 – Entegrity 15/50 turbines
  – 3 installed July 1997
  – 7 installed May 1999
  – 2 installed April 2005
  – 2 installed April 2006
  – 1 installed in 2007
  – Rated Capacity - 66 kW
Northwind 100

Northwind 100
installed April 2002

Rated Capacity
100 kW
Vestas E-15

installed April 2006

Rated Capacity 65 kW
Vestas V-15 Turbine
Kotzebue Wind System

15 – Entegrity Wind Sys.15/50 turbines - 66 kW rating
   ➢ 3 installed April 1997
   ➢ 7 installed May 1999
   ➢ 2 installed April 2005
   ➢ 2 installed April 2006
   ➢ 1 installed April 2007

1 – Northwind 100 turbine - 100 kW rating
   ➢ installed April 2002

1 – Vestas V-15 turbine - 65 kW rating
   ➢ installed May 2006
   ➢ 17 TOTAL

Wind Capacity – 1155 kW
What’s the Big Deal With Wind?
How is Wind Different?

- Utilities normally schedule firm generation to meet a variable load
- Now utilities need to integrate variable generation with a variable load
- More need to understand load characteristics with and without wind
- Need to realize that wind behaves more like load than generation (origin of the concept of “negative load”)
Changing Perceptions

- Wind plants are different from conventional power plants
- Wind plant technology is constantly evolving towards better performance
- Question has changed from “Can wind plants be integrated into utility systems?” to “How much does it cost to integrate wind plants?”
Impacts of Wind Generation on Distribution Systems

- Distributed wind generation falls outside the body of conventional distribution system engineering practice
- “Rules of thumb” and associated analytical tools for distribution system planning, design, and operation with radial distribution feeders may no longer be valid for feeders interconnected to wind generators
- Additional steps must be taken to safeguard system performance, reliability, and safety
- Each distributed wind installation must be evaluated to determine specific impacts
Penetration Issues

- KEA reached a level of penetration that required new operating procedures and equipment
- Heavy wind penetration drives up the cost and increases system stability issues
- KEA has installed a new SCADA system that will move us into higher penetration levels
Wind Diesel Integration

Engineering study identified 3 different system alternatives

- PLC Based Systems
- Proprietary Hybrid PLC System
- Industrial PC Based

No one system met all of KEA’s requirements

Some systems were proprietary, no rights to work on control software

We chose a GE PLC product and supplier Electric Power Systems an Alaska Company for the project
SCADA
Supervisory Control And Data Acquisition
SCADA

- KEA has upgraded the power plant from 600-800 amps output to 1200 amps. This almost doubles our power plant capacity.
- KEA completed the automation of the power plant and controls for the wind system.
- This gives us better information and control of our power system. It also gives us better information on all of our systems.
SCADA

- The SCADA system has made the power system more efficient, provided better fuel economy, better maintenance, easier trouble shooting.
- The system gives information about all electrical characteristics of the engines, feeders, fuel levels and fuel inventory control, radiator performance, city water heat system performance, system metering, and controls for the wind system.
SCADA – Powerplant Upgrade
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# Wind Turbine Detail WT01

## Current
- **A Phase**: 1 Amps
- **B Phase**: 2 Amps
- **C Phase**: 0 Amps

## Potential
- **A Phase**: 274 V
- **B Phase**: 277 V
- **C Phase**: 278 V

## Real Power
- **A Phase**: -0.3 kW
- **B Phase**: 0.0 kW
- **C Phase**: 0.0 kW
- **Total kW**: -0.3 kW
- **Average**: -0.1 kW
- **Peak**: 91.3 kW

## Wind
- **Wind Speed**: 4.0 m/s
- **Wind Speed Avg**: 3.7 m/s
- **Wind Speed Peak**: 26.1 m/s

## Frequency
- **A-B**: 60.00 Hz

## Miscellaneous
- **Generator 1 RPM**: 0 RPM
- **Generator 2 RPM**: 0 RPM
- **Total kWH**: 71693.0 kWH
- **Energy Hour**: 3013 Hours

## Status
- **System State**: Free Wheeling
- **System Error State**: System Ok
- **System Mode**: Automatic

## Clock
- **Time**: 09:50:45
- **Date**: 04/21/07
Fuel Efficiency - kWh Sold

- 2002: 13.4
- 2004: 13.5
- 2006: 13.6

Fuel Efficiency - 14.26
Economic Development

- Renewable energy projects provide local employment opportunities
- Projects require seasonal workers and represents a good opportunity for rural residents
- Development of technical, construction & engineering skills
Local Training - Work Force Development
Wind is Ready to Take Off
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Wind Energy Generated

![Bar Chart](chart.png)

- kWh Generated
- Years: 1997 to 2006
- Values: 0, 200,000, 400,000, 600,000, 800,000, 1,000,000, 1,200,000
Wind Energy Savings

Total to Date - $724,249

Wind Energy - $105,751

$0
$20,000
$40,000
$60,000
$80,000
$100,000
$120,000
$140,000
$160,000

1997 1999 2001 2003 2005
Other Benefits

- Selling Green Tags through Bonneville Environmental Foundation and the Renewable Energy Alaska Project REAP–Denali Green Tags
- Renewable Energy Production Incentive (REPI)
- Community goodwill
Reality Check

- Wind without storage will not completely replace diesel
- Wind under the right conditions can displace 20-30% of diesel
- Wind currently provides 5 - 7% of all the energy for Kotzebue
- This represents about 90k gallons annually
Conclusions

- Rural Alaska needs new energy solutions
- Experience and skills are being built in Kotzebue, and elsewhere in the state
- There are economic, technical, and operational obstacles to overcome, through persistence they will be
- Diversifying generation sources helps rural Alaska build a balanced energy future
Educational Outreach

- KEA has developed a teacher/student guide on wind energy for middle school that has been approved for use by the NW Arctic Borough School District Curriculum Committee
- Wind Monitoring Buckland Alaska Science Class
Wind is Ready to Take Off
Bird Issues

- KEA has worked with the Fish and Wildlife Service to document activity.
- The species of concern are the Spectacled Eider and the Stellar Eider, both considered endangered.
- KEA site monitored since 1997.
- No avian mortalities.
Compact Florescent Lights (CFL)

- **Energy Efficiency**
- **CFL**
- **60 watt equivalent**
  - 14 Watts
- **75 watt equivalent**
  - 20 Watts
- **100 watt equivalent**
  - 23 Watts
- **Sold over 800**
Change a Light – Save the World

• KEA is a member of the EPA Energy Efficiency Program "Change a Light Save the World" campaign
City Heat Project
City Heat Project
City Heat Project

- The City contracted KEA to provide the heat for the water system
- The agreement provides a 30% savings on fuel cost to the city for heating the city water supply
- Fuel profits that previously left the community now stay in Kotzebue
- This is a new revenue stream for KEA
Wind is Taking Off