Kotzebue Electric Association
Wind Projects

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Wind Diesel Conference
Anchorage, Alaska
Alaskan Statistics

- Area 586,000 square miles
- 1996 population 607,800
- Lowest recorded temperature -80° F on 1/23/71 @ Prospect Creek
- Largest cities: Anchorage 248,296
  - Fairbanks 33,281
  - Juneau 29,078
  - Sitka 9,052
- Approximately 67,000 Alaskans live in 160 rural communities
Energy is Expensive
In Rural Alaska

Urban kWh average cost $.10
Hub communities $.20
Villages $.40

Logistics

- No roads or interties
- Air and/or barge only access for freight
- Many coastal areas "iced in" most of the year
- Most electricity is diesel generated
- Very significant reserve generating capacity
History of Wind Development in Alaska

• In the early 1980’s there were 140 state and federally sponsored wind generators installed across Alaska
• The vast majority were out of commission within a year
• Wind as a technology was seen as unreliable and further efforts were abandoned
What was missing?

- Utility involvement
- Manufacturing support in Alaska
- Cold weather design features
- There was no supporting infrastructure
- Early equipment wasn’t ready for Alaska
Wind where does it **Plug In**?

The successful integration of wind in Rural Alaska will be the combination of wind and other forms of generation.
Kotzebue : pop 3705
30 miles north of Arctic Circle
KEA Background

- Consumer owned electric cooperative
- Member elected Board of Directors
- 1,200 consumers
- 11 MW diesel plant
- 17 miles of distribution
- 21 million kWh, annual sales
Kotzebue, Alaska

- Hub for 10 communities
- 30 miles above the Arctic Circle
- Population: 3,750
- 75% Inupiat Eskimo
- Located in the NW Arctic Borough, larger than Illinois
- UAF Branch Campus
- Alaska Technical Center
Kotzebue, Alaska
A Unique Environment

- North of the Arctic Circle on the tip of Baldwin Peninsula
- Access year round by air and 3 months by sea
- Low, flat terrain consisting of tundra and permafrost
- Annual average temperature -5.8°C (22°F)
- Average snowfall – 127 cm (4.2 feet)
- Winter wind-chill temperatures to -120°F
Wind Turbines Must be Reliable

- Winter maintenance is extremely challenging and at times impossible
- Minimal or no crane or tilt up towers
- Comprehensive training of local utility and/or operations personnel is essential to success
- Packaging for air / barge shipment is critical
- Cold weather materials and features
- Staging of spare parts is important
Kotzebue Wind Power Project

- 10 – AOC 15/50 turbines
  - 3 installed July 1997
  - 7 installed May 1999
  - 2 to be installed 2002-03
- Rated Turbine Capacity
  - 66 kW continuous rating
- 1 – Polar 100 turbine
  - installed April 2002
- Rated Turbine Capacity
  - 100 kW continuous rating
Kotzebue Wind Project

Goals

• To show that wind can work in Alaska
• Reduce diesel consumption for KEA and the community
• Develop high penetration wind projects that provide electric and thermal energy for communities
• Develop cost effective Arctic foundations
• Develop tilt up tower design for small villages
• Develop safety & training program for wind systems
• Document operations and maintenance costs
• Establish a cold weather technology center
Why Atlantic Orient Corp. (AOC) ?

- We were looking for a machine that would work in the cold, and smaller villages
- The predecessor of the AOC, Enertech 14/40, was a highly dependable machine that is still in use in California
- The AOC 15/50 was developed from a Failure Mode Analysis of the Enertech 14/40
- The AOC 15/50 was tested through the Advanced Turbine Design program at NREL
- There wasn’t anything else available that fit the need
Northern Power Systems
Polar 100 kW

Polar 100 is a direct drive wind turbine

• We were looking for a non-induction type turbine
• We wanted experience with other turbines
• Polar 100 uses a different foundation with a tubular tower
• KEA will compare performance with another unit housed at NREL
• Kotzebue wind regime will be used to test cold weather operation
Northern Power Systems
Polar 100 kW
Project Construction
Arctic Foundations
Tilt Up Towers
Rural Employment
Arctic Fashion

- Well Dressed Arctic Workers use
  - Seal or Beaver Hats
  - Goggles
  - Carhart Snow Suits
  - Bunny Boots
Results to Date

- Initial project operational since May 1997
- Initial turbines have operated through 5th winter
- With 10 operational turbines KEA has seen 39% penetration with no frequency issues and no negative effect to consumers
- Power plant has seen low power factor at low system loads with high wind production (low diesel)
- Project has produced over 3 million kWh to date
- Power quality research was positive
- Economic results looks positive
- Maintenance and operations costs have been low
KEA % WIND & DIESEL 5-02
Wind Penetration Peak 37%

DATE

% Diesel
% Wind
Community Acceptance

- Wind Energy Development has been a positive community relations tool
- Seen as a positive example of rural economic development
- For Kotzebue it is best available local resource, no local gas, coal, hydro availability
Wales Alaska
Located at the Tip of Seward Peninsula
Wales Alaska
KEA-AVEC ASTF/EPA NREL
Wales Wind Diesel Project

KEA and AVEC, State of AK., ASTF, EPA-Innovative Technology Program, contributions from NREL,

Up to 150% penetration with wind.

Project Scope - to use 2 wind turbines, to replace diesels electrically and thermally. System will use short term battery storage, rotary converter. A system controller (PLC) will be used to manage the wind and diesels.

Excess energy from project will heat school
Shipping - Wales
Turbine Erection - Wales
Turbines - Wales
System Controller - Wales
Wales Wind Diesel Project

- Wind turbines have been operational for a year
- Recovered heat boilers are operating at the school and the diesel plant
- The system controller is operational
- Battery bank and rotary converter are operational
- Testing of system will continue for one year
- Project ran diesels off for 100 hours in August
This was a huge effort by everyone involved

- Village was converted to 3 phase
- Diesel generators was converted to 3 phase
- School was converted to 3 phase
- Generator pitch was mis-matched between units
- Plant cooling system needed redesign and upgrade
- Fuel system needed to be upgraded
- The PLC program for the wind turbines was redesigned
Thanks to

- KEA staff – Matt Bergan, Steve Apgar, Mike Lawlor
- AVEC – Mark Tietzel, Jon Lyons, Brent Petrie, Bill Crisi,
- NREL – Steve Drouilhet, Mari Sharazi
- Thompson Engineering – Craig Thompson, Glen Pomeroy
- ITI – Malcolm Lodge
- AIEDA – Dennis Meiners

- Funders
- Alaska Science and Technology Foundation
- EPA
- AIEDA
- NREL
- KEA
- AVEC