Wind Energy for Small Communities

Climate Change and Energy Workshop
Inukjuak, February 2006

John F. Maissan, P.Eng.

Leading Edge Projects Inc.
Outline of Presentation

• Background matters
• Wind technology review – turbines, towers, integration with diesel, icing
• Project factors – components, costs, siting, community, developers
• Starting out – practical, financial, subsequent projects
• Kotzebue – a good example
• Summary
Personal Background

• 15 years in mining industry
• 15 years in wind with hydro based utility
• Two wind turbines with heavy icing
• Managed wind-diesel feasibility studies for two Yukon communities
• Now consulting with main interests wind icing and wind-diesel
Conservation First

• Do not do wind instead of conservation
• Conservation is cheapest new capacity
• Consider lap tops, LCD monitors & TVs, Energy Star appliances, LED lights
• Bulk purchasing and transport
• Use government & utility programs
Wind Projects do not Make Many Jobs

- Wind energy is capital intensive
- Construction creates short term jobs
- O&M will require some skilled trades
- A three 60kW turbine project takes only about $30,000 per year in O&M
- Fuel supply and deliverers will lose some revenue

John F. Maissan, P.Eng.
Technology Review
Wind Turbines

- 50 to 300kW still limited, but increasing
- AOC 15/50 60kW
- Enercon E33 330kW
- Entegrity EW15 60kW
- Fuhrlander FL100 100kW, FL250 250kW
- Northern Power Systems NorthWind 100kW
- Wind Energy Solutions WES18 80kW, WES30 250kW
- Soon? Bergey XL.50 70kW

John F. Maissan, P.Eng.
Entegrity (AOC) 15/50 60kW turbine
photo courtesy Entegrity Wind Systems
Enercon E33
Photo from website
Bergey
XL.50
From
Web Site
Towers for Wind Turbines

- Present towers mostly tubular, require cranes, AOC and Entegrity hinged towers
- WES 18 80kW has 40m guyed tower
- Bergey says XL.50 guyed towers 28 to 82m
- Guyed towers can be designed to winch up reducing installation and maintenance costs
- Tubular towers need crane but provide maintenance comfort
- Increasing height from 25 to 50m increases energy 20% in 6 m/s wind (at 30m)
Turbine Erection - Wales
Wind Diesel Integration Equipment

- Low penetration ~10% diesel displacement, minimal equipment needed, good governors
- Medium penetration ~25% diesel displacement, requires more equipment – controls, dump loads, low load diesels
- High penetration ~40% (more in good wind) most complex – most controls, dump heating loads, synchronous condenser, diesel hot stand-by, short energy storage
- All options must have compatible diesel plant
Northern Power Systems High Penetration Controls
St. Paul Island, Pribilof Islands
Photo courtesy Northern Power Systems
Selawik, Alaska
Wind-Diesel System Architecture

(4) AEC 15/50 WIND TURBINES
4 x 65 = 260 kW
(480V, 3-PH)

WIND TURBINES TOTALIZING METER
04-430-083

7.2 KV, 3-PH DISTRIBUTION SYSTEM

WIND TURBINE CONTROL BUILDING

(1) 324 KW DIESEL
KOHLER/QD SERIES 60

(2) 506 KW DIESEL
KOHLER/MTU/QD 6492000

(3) 824 KW DIESEL
CUMMINS KTA 38

WIND TURBINES CONTROL BUILDING METER
25-519-249

VILLAGE LOADS INDIVIDUALLY METERED

MODULAR POWER PLANT HYDRONIC LOOP SECONDARY LOAD METER

STATION SERVICE METER
AS-0206A009-01

SELECTION MODULAR POWER PLANT

480V, 3-PH STATION SERVICE PANEL

MODULAR POWER PLANT SECONDARY LOAD CONTROLLER
Wales Wind-diesel System
Communication And Control

1. Existing Diesel Genset Control Panel
   - Analog Signals
   - Discrete Control Signals

2. Wind-Diesel Hybrid Power System Main Control Panel
   - PLC-PLC Network
   - Phone Connection for Remote SCADA Link
   - RS-485 I/O Network

3. Diesel Plant Hydronic Loop Dump Load Controller
   - Discrete Control Signals

4. AOC 15/60 Wind Turbine Controller #1
5. AOC 15/60 Wind Turbine Controller #2

4. PLC controllers
2. Radio modem links
2. Dump load controllers
Phone link
Icing Effect Mitigation

- Use ice detector during wind assessment
- Passive mitigation includes heated wind vane and anemometer if used
- Second step mitigation black coloured low ice adhesion coating – StaClean
- Active mitigation is blade heating – costly and only justifiable if losses more than 10%
- One blade heating supplier in Finland
- Potential US supplier needs customers to bring product to market
Rime icing on the mountain
Icing on wind instruments  courtesy Yukon Energy
Project Factors
Components of Projects

• Feasibility: project size, negotiations
• Siting
• Environmental considerations
• Geotechnical, turbine foundations
• Power lines and roads
• Integration engineering and equipment
• Transportation logistics
• Installation equipment and logistics
NPS NorthWind 100 Pile Foundation
Photo courtesy Kotzebue Electric Association
Costs of Projects in the North

- Cost of turbines per kW of capacity is lower in larger machines
- NWT $4,500 to $8,000 per kW
- Yukon $3,400 (660kW) to $5,000 per kW
- Alaska approx $10,000 per kW – issues
- H-Q planning $7,600 to $8,300 per kW
- Generally in $5,000 to $8,000 per kW range
- Small project O&M $0.05 to $0.15 per kWh
- Management and corporate in O&M

John F. Maissan, P.Eng.
Project Siting

• Use highest land available close by
• Respect spiritual, cultural, heritage values
• Airport zoning restrictions
• Environmental impacts
• Must have wind resource assessment at site
Wind Resource Assessment

- Use airport wind speed data (or wind atlas data) to do initial screening, look for >6m/s
- Put 30 or 40 m wind monitoring tower on actual wind turbine site with anemometers at 10, 20, and 30 meters (+vane, temp, press)
- Get 8 inch heavy duty tower in case of icing, be fussy on straightness and guy tension
- Monitor for at least one year for feasibility data – must be done well
- Have analyses properly done
30 meter wind monitoring tower use three anemometers
Community Support

• Projects must have community support to succeed

• The first “leader” projects need technical people and equipment in community
Project Developers

- Must have financial resources to build project and overcome problems
- Must have access to skilled people to plan, build, and operate the project
- Ideally will be entity with other technical “activities” for economies
Starting Out
Practical Side

• Start with “Leader” project with economies of scale
• Need community support
• Some people with technical skills
• Some equipment available
• Reasonable transportation access
• Reasonable wind resource
Practical Side

•Must own diesel plant or have good relationship with owner, and have PPA

•Start with simple project – low or medium penetration

•Grow project with time as experience and comfort gained

•Do projects in smaller communities once core experience is established

•Projects will take 2 to 3 years to do well
Financial Side

• Ensure adequate $ resources – big job!
• Green Municipal Funds if possible
• DIAND programs
• Inuit organization program funds if available
• Proposed ReCWIP and SWEIP, wait?
• Sell green power to federal or prov. depts.
• Sell Green Tags, green attributes, if possible
• Commercial lenders last resort, 10+%
Subsequent Projects

- Standardize and duplicate equipment
- Stay close to leader project
- Still need community support
- Some technical support from community; some from leader project, training
- Need good wind resource – assess properly
- Need transportation access
Kotzebue Alaska Example

• Community of 4000 on NW coast north of Arctic Circle
• Started in 1997 with 3 AOC 60 kW turbines
• In 1999 added seven, 2004, two, and this year will add three more
• NorthWind 100 added in 2002
• Since 2000 helping small village of Wales with 2 turbine high penetration project
• Since 2004 helping Selawik with 4 turbine medium penetration project
Wales                        Kotzebue                        Selawik
Wales Alaska
Photo courtesy Entegrity Wind Systems
Selawik Alaska
photo courtesy Entegrity Wind Systems
Summary

• Small wind energy is coming of age
• Need to plan projects carefully, thoroughly
• Start with simpler projects then grow
• Get as many favourable factors as possible, especially in financing
• It will take time and work to make successful wind projects
Why Stop Now?

- Nunavik has large wind resource potential
- Consider large grid connected wind projects to compliment hydro
- Use Inuit lands or rights of access to lands
- Will need to work more with large developers and financiers
- Example Ventus Energy and Metis announcement for Labrador wind farm
Thank You!

Rankin Inlet, photo courtesy Entegrity Wind Systems