Wind-Hydrogen-Diesel Energy Project

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Safety Moment
Summary of Wind Development Strategy

- **Island Interconnected System – medium-scale wind**
  - Not connected to North America System - small wind potential
  - Focus - meet load growth and displace thermal production

- **Labrador Interconnected System – large-scale wind**
  - Ownership and control of valuable resource
  - Integration with Labrador hydro reservoirs
  - Focus - export markets

- **Isolated Diesel Systems - wind-hydrogen-diesel integration**
  - Reduce (and ultimately replace) diesel fuel
  - Focus - research & development activities
Hydro’s Isolated Diesel Systems

- 21 isolated systems in NL
  - 60kW to 1400kW
  - 15M litres diesel annually
- Focus on R&D activities to reduce diesel consumption
- Create a renewable future
Ramea Community Profile

- Island off Southwest coast of Newfoundland
- 354 customers/631 residents
- Peak load - 1,078 kW
- Annual energy - 4,201 MWh
- “Big” small community
  - right size for experimentation
Ramea Energy Supply – (Pre 2004)

- 100% diesel
  - 3 x 925kW generators
  - fuel consumption: 1 million litres/year
- Average 3300 tonnes of emissions/year since 2000

- Wind-Diesel Demonstration Project
- PPA with independent power producer to supply wind power
  - in-service fall 2004
  - 6 x 65 kW Windmatic turbines (390 kW)
  - medium penetration wind-diesel (15%)
Wind-Diesel Demonstration Project

- Wind power purchased to date approximately 10% of Ramea’s annual energy requirements
- Offset some fuel and emissions
- High wind periods do not match high load periods - resulting in excess wind energy not used; sent to “dump load”
- Without storage, wind generation could likely not achieve more than 15% of community requirements
Why Storage?

• Existing wind-diesel configuration
  – annual wind energy available 1025 MWh
    (based on 390 kW wind farm &
    30% annual capacity factor)
  – annual wind energy absorbed 420 MWh
    (based on 2005 operating statistics)

  Wasted Wind Energy 605 MWh

• > 50% of the wind energy in current configuration is
  wasted; can’t be absorbed into isolated diesel grid
  – this energy, and more, will be used to power the hydrogen
    creation system & contribute to Ramea’s firm power
    requirements
Ramea – 2010 and Beyond

- Site of Wind-Hydrogen-Diesel Energy R&D Project
- Installed high penetration wind system
- Excess wind energy producing hydrogen
- Hydrogen
  - burns emission free in internal combustion engine
  - dispatchable, similar to diesel, but without the environmental impacts
- When the wind dies down Ramea will have a renewable energy source
Equipment Siting

100kW Wind Turbine

Hydrogen Electrolyser Building

Hydrogen Storage Tanks

Hydrogen Genset Building
WHD Project Equipment

- Wind turbines
- Hydrogen Electrolyser
- Hydrogen Storage
- Hydrogen Genset
- Energy Management System
Wind Turbines

• 3 Northwind 100kW Turbines
• Turbines designed for northern and extreme environments
• Three turbine blades use different coatings to test ice accumulation:
  – normal coating (white blades)
  – normal coating (black blades)
  – specialized anti-stick coating (black blades)
• 40M Metrological Tower has been installed for monitoring environmental conditions
Hydrogen Electrolyser

- Hydrogenics HyStat A Hydrogen Electrolyzer
- Rated power input is 162kW
- Efficiency is approximately 50%
- Rated output is 27\(m^3\) per hour
- Town water supply
  - de-mineralized

* All volumes measured at standard temperature and pressure
Hydrogen Storage

- Three storage tanks built by SteelFab Tanks
- Total Storage Capacity of 1000 m$^3$ @ 235psi
- At full electrolyser production, it will take approximately 37 hours to fill tanks
- Full storage will provide enough energy to meet the average load of the entire community (without any other form of generation) for 2 hours
Hydrogen Generator

- Hydrogen Engine Centre (HEC) 4+1 Hydrogen Generator
- Rated power input is 250kW
- Minimum demand before dispatch of Generator is presently set at 100kW for 10 minutes
- Unit will shut down if demand drops below 0kW for 30 seconds
Energy Management System (EMS)

Safety Control System

Hydrogen Control System
Energy Management System (EMS)

- Provides automatic control & monitoring of wind turbines; hydrogen electrolyser, genset & storage; and diesel plant
- Dispatches each piece of equipment
- Designed and built by Hydro; Nalcor will retain intellectual property rights to this software
  - builds on Hydro’s experience in the design of automated diesel plant control systems
Opportunities and Challenges

• Opportunities:
  – be one of the first in world for isolated wind/hydrogen/diesel solution
  – intellectual property development
  – reduce and potentially replace reliance on diesel fuel
  – reduce pollution

• Challenges
  – effective integration of multiple energy sources
  – commercialization
Current Status and Next Steps

- All equipment operating
- Commissioning activities are ongoing
- EMS in “manual” operation mode
- Automated EMS projected by end of 2010
- The goal is to prove that the technology works and that these three components can be integrated to create an energy solution that can be either used by us throughout our system or sold to others.
WHD Project Highlights

• One of the first projects in the world to integrate significant wind and hydrogen components in isolated diesel community

• Potential to eventually replace diesel with zero-emission power; has commercial prospects around the world

• Nalcor seeking to position itself as world-leader in its ability to provide a sustainable and environmentally-friendly alternative to diesel generation for isolated communities
Project and Contributing Partners

Atlantic Canada
Opportunities Agency
Questions?

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