



**Registration Pursuant to Section 49
of *The Environmental Protection Act***

**Ramea Wind-Hydrogen-Diesel Energy Solution
Ramea, Newfoundland and Labrador**

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PROPONENT:

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THE UNDERTAKING:

(i) Nature of the Undertaking:

Newfoundland and Labrador Hydro (NL Hydro), in partnership with Memorial University, and the University of New Brunswick, and in collaboration with Natural Resources Canada (NRCAN), are proposing to develop a "Remote Community Wind-Hydrogen-Diesel Energy Solution" to integrate renewable energy supply into isolated electrical distribution systems.

The proposed energy solution is a research and development initiative designed to bring together commercial, or near-commercial, products into an environmentally friendly Energy Solution for relatively small isolated electrical distribution systems. The proposed project will combine hydrogen production, storage and electricity generation technologies with wind generation technology and diesel generation technology. Upon successful

completion, the project would allow excess wind power to be used to produce and store hydrogen. The hydrogen would then be used later to produce electricity through an internal combustion hydrogen generator. This would provide the option of turning off or reducing the operation of diesel generators when demand is low, and running solely on a combination of wind and hydrogen. An overview of the proposed energy solution is provided in Appendix A.

Success of the proposed project will put NL Hydro in a leading position in the Canadian and North American electrical industry, with respect to the ability to develop and implement a renewable energy supply to serve isolated and remote areas.

(ii) Purpose/Rationale/Need for the Undertaking:

NL Hydro, like most other utilities that operate relatively small isolated systems, rely on diesel fuel to generate electricity for such communities. The reliance on diesel fuel continues to be a source of concern for the utilities (and others) that operate such systems. These concerns relate to the cost, cost volatility, operational burden and environmental footprint associated with diesel technologies. Furthermore, in the absence of research and development activities targeting alternate sources of energy, utilities will have no choice but to continue to rely on existing non-renewable sources of supply.

The key objective of the project will be the development and implementation of an Energy Management System (EMS) to integrate the three sources of electricity generation: wind, hydrogen, and diesel. The project will also build upon NL Hydro's core competencies in diesel system design, construction and operation in remote areas as well as expand our expertise in alternative, renewable energy and its integration into existing systems. The addition of hydrogen to wind-diesel energy systems will enable NL Hydro to further reduce, and potentially eliminate the use of fossil fuels in isolated communities.

The proposed energy solution project is unique in that it will be the only wind-hydrogen-diesel project in the world with a focus on energy supply to small, diesel powered communities and the technology challenges that are unique to these systems.

DESCRIPTION OF THE UNDERTAKING:

(i) Geographic Location:

The proposed location for the project is the rural community of Ramea, Newfoundland and Labrador, Canada. Ramea is an island community located approximately 8 kilometers off the south west coast of Newfoundland. The town of Ramea used to be a thriving fishing community; however there has been a large decline in population since the ground fish moratoria. The community currently supports a population of approximately 754 (2001 census) residents. A location map is provided in Appendix B.

The community of Ramea was selected for the proposed project due to the presence of existing wind-diesel generation and distribution facilities, and its accessibility relative to other isolated communities. In the fall of 2004, Frontier Power Systems developed a 390kW wind farm in the community and in 2005 approximately 10% of the community's electrical needs were supplied by that facility. The proposed energy solution will build upon the existing wind-diesel generation and distribution facilities serving the community to refine and demonstrate the wind-hydrogen-diesel concept.

(ii) Physical Features:

The proposed project will include the supply and installation of the following major equipment components:

(a) Hydrogen Electrolyser/Storage Tanks/Generating Units

The primary components associated with the hydrogen aspects of the proposed project include a hydrogen electrolyser, storage tanks, and associated generating units. The electrolyser/storage tank combination provides a mechanism to store excess wind energy that can later be used to supply customer demand through the hydrogen generating units. All hydrogen related equipment will be located immediately adjacent to NL Hydro's existing diesel generating station. The existing diesel generating station yard will be extended, leveled, backfilled and fenced to accommodate the new hydrogen equipment which will be placed on new concrete foundations. The existing line storage trailer will be relocated to the fence nearest to the road. The site plan provided in Appendix C provides an overview of the proposed site layout.

The proposed project will include the installation of a 162 kW hydrogen electrolyser. The electrolyser will use electricity (wind energy) to split water into hydrogen and oxygen, with the hydrogen being stored for later use. The existing community water distribution system will be used as the water source for the electrolyser. The electrolyser and associated controls will be contained in a new 6.1 metre by 2.3 metre ISO shipping container.

Upon generation, the hydrogen will be compressed and stored in two (2) 1000 Nm³ liquefied petroleum gas tanks. Each tank will measure approximately 19.8 metres long and 2.7 meters in diameter. Above ground pressure piping will interconnect the storage tanks to the associated hydrogen electrolyser and hydrogen generating units.

The hydrogen generating units will consist of five (5) 62.5 kW units for a total installed capacity of 312.5 kW. The hydrogen generating units will be installed in a new 4.3 meter by 7.9 meter quonset type building and will be interconnected with the existing diesel plant generation bus.

All hydrogen related equipment will be owned and operated by NL Hydro, except the hydrogen generating units which are being provided to NL Hydro by NRCan.

(b) Wind Turbines

In order to fully utilize the hydrogen components of the system, the existing wind capacity at Ramea will be augmented such that, at times, the installed wind capacity could exceed the community load.

The proposed project will include the installation of 300 kW minimum of new wind generation. The final selection of a wind turbine supplier will be based upon a competitive selection process following a detailed technical review of necessary wind turbine requests for proposals. Based on knowledge of available suppliers, it is anticipated that 1 to 3 wind turbines will be installed with a rated capacity of 100 kW to 330 kW each. This in conjunction with the existing 390 kW Frontier Power System capacity could provide an instantaneous wind penetration above 70%.

The proposed wind turbines will be installed within an area of approximately 4 hectares, bounded by NL Hydro's diesel generating station to the east, open peatland bog to the south, the coastline to the west, and the community waste disposal site and helicopter pad to the north. The primary vegetation cover in the area largely consists of low growing grasses and moss like vegetation. Exposed bedrock is prominent in the proposed wind turbine locations. The site plan provided in Appendix C, identifies six (6) potential wind turbine locations. The final selection of the wind turbine locations will be based on the number of wind turbines to be installed and further geotechnical investigations. Alternate locations within the community were considered, however the proposed location was selected due to its exposure to prevailing winds, proximity to the existing diesel generating station, suitable geotechnical conditions, and accessibility to the site.

Existing roads will be used to access each of the proposed wind turbine locations, with short service roads to be constructed for direct access to the base of each structure. Underground distribution lines will bring the power generated by the wind turbines back to the existing overhead 4160 volt distribution system.

Each turbine will sit on a 30-50 meter high tubular tower, and have three turbine blades with a rotor diameter of approximately 20-30 metres. A concrete foundation at the base of each wind turbine will support the structure. The detailed foundation requirements will be established through a geotechnical site visit during the fall of 2007.

In addition to the proposed wind turbines, a 30-50 meter high “lattice” type tower will be erected to support wind monitoring equipment that will be used to gather data on the local wind regime. This equipment will record wind speed and wind direction. The proposed monitoring tower will be installed at one of the proposed wind turbine locations, with final site selection depending on the potential wind turbine locations to be developed.

The new wind turbines and associated monitoring equipment will be owned and operated by NL Hydro.

(c) Energy Management System (EMS)

An EMS will be developed to integrate all of the above new major equipment with the existing diesel generators (3 units @ 925 kW each = 2775 kW total) and the existing wind farm (6 units @ 65 kW each = 390 kW total). The EMS will be configured to provide automatic dispatch of available generation in line with a new operating philosophy to be developed under the scope of this project. The EMS will also schedule interconnection of the hydrogen electrolyser in keeping with the philosophy of energizing it with available excess wind generation.

The new EMS hardware/software will be installed in the existing diesel generating station.

(iii) Construction:

(a) Schedule

Installation/construction work will be performed, for the most part, using external contractors with final inspections and commissioning to be performed by NL Hydro personnel. The wind turbine commissioning will be completed using internal forces under the supervision of the wind turbine supplier.

Initial preliminary engineering design, major equipment specifications/request for proposals and initial geotechnical investigations will commence during the fall of 2007. Detailed engineering design will be completed over the first quarter of 2008 and civil works will be completed by July 2008. Equipment installation will be completed by August 2008 with commissioning to occur during the Fall of 2008.

(b) Construction Works

Extension of the existing diesel station yard will be undertaken using typical construction equipment.

The hydrogen components of the proposed project will be delivered to site fully assembled; however the quonset type building which will house the hydrogen generating units will be constructed on site using typical construction equipment. Assembly and installation of the hydrogen components of the project will take approximately 12 weeks to complete.

The wind turbines will be delivered to site, assembled and erected on newly constructed concrete foundations. It is anticipated that some localized blasting will have to be undertaken to prepare the proposed wind turbine locations for the concrete foundations. The wind turbines will be assembled at the base of each tower and lifted into place using a 100 tonne crane. Assembly and installation of each wind turbine will take approximately 5 days.

(c) Potential Sources of Pollutants

The potential sources of pollutants during the construction period would be noise pollution, air pollution, and hydrocarbon leakage from construction equipment. Noise and air pollution are anticipated to have minor and short term impact, as normal construction equipment will be utilized.

All equipment will be inspected routinely to ensure that no hydrocarbon leaks occur. Any spill incidents or leaks will be addressed in accordance with the NL Hydro's Environmental Emergency Response Plan (EERP).

(d) Potential Land-Use Conflicts

All new equipment associated with the proposed project will be located on or adjacent to NL Hydro's existing diesel generating station.

NL Hydro has had initial consultations with the Town of Ramea regarding the proposed project and the proposed wind turbine site options in relation to the community. The Town Council, nor the community residents, have identified any concerns to date.

NL Hydro has also consulted with Transport Canada regarding the proximity of the proposed wind turbines in relation to the adjacent helicopter pad. Transport Canada identified no objections to the proposed locations, provided each wind turbine is equipped with adequate aviation lighting.

(iv) Operation:

(a) Description of the Operation

The existing wind-diesel generation system has demonstrated some success with the reduction in the reliance on diesel fuel for energy production. However because of the unpredictability of wind the addition of hydrogen generation to the system can pose considerable potential to go beyond the initial expectations of the wind-diesel generation system by using excess wind energy to produce a renewable and clean fuel (hydrogen) to use in energy generation.

The incorporation of the hydrogen technology provides a way to store the excess wind energy when it is available but cannot be used to supply the customer load. The hydrogen electrolyser will be energized via excess wind energy to convert water into its hydrogen and oxygen constituents. This operation will be based upon a new operating philosophy such that the electrolyser will only be energized via excess wind generation, thereby providing a mechanism to store the wind energy as hydrogen. This stored hydrogen would then be used to fuel the hydrogen generating units as dictated by system conditions.

The proposed project is a 5 year research and development initiative (2007-2011), with operation to commence during the fall of 2008.

(b) Potential Sources of Pollutants

While hydrogen produces little or no pollution when converted into useful energy, it can be produced from a wide variety of energy sources. The proposed system will make use of wind energy only to generate hydrogen fuel without producing any air emissions. The objective of the proposed energy solution will increase the use of renewable energy sources (i.e. wind energy and hydrogen generated using wind), thereby reducing the dependency on diesel fuel for energy production.

Using hydrogen in the generation of electricity results in virtually zero emissions. Since the fuel is pure hydrogen, the only carbon based emissions are from a minuscule amount of burned and unburned oil present in the combustion chamber. Nitrogen Oxide emissions, which are most prevalent from diesel generation, are expected to be certified as zero.

The addition of wind turbines and hydrogen generating units to the operation of the existing diesel generating units is not anticipated to significantly increase noise levels. Noise will be considered in the location, design and layout of the proposed project components. Any concerns or issues related to

noise will be addressed through NL Hydro's Noise Management Plan for diesel plant operations.

All equipment will be inspected routinely to ensure that no hydrocarbon leaks occur. Any spill incidents or leaks will be addressed in accordance with the NL Hydro's Environmental Emergency Response Plan (EERP).

(c) Potential Resource Conflicts

The community of Ramea and the surrounding islands are known as an interesting location for the study and observation of birds. They provide nesting habitat for several seabird species, including two colonies of puffins. Other seabird populations include eider ducks, harlequin ducks, storm petrels and cormorants. The community area is also known to be the nesting area of several songbird species.

NL Hydro has been in consultation with the Wildlife Division of the Department of Environment and Conservation and the Canadian Wildlife Services of the Department of Environment, regarding the potential requirements for a bird monitoring program. LGL Limited, on behalf of NL Hydro, conducted a nesting season bird survey at the proposed wind turbine site in June 2007. The study noted that bird use of the proposed wind turbine site was low. Birds nesting at the site were limited to a small number of pairs of songbirds, mostly Savannah Sparrows, and two pairs of sandpipers, Least and Spotted Sandpipers. Small numbers of gulls loafed on the nearby helicopter pad, bathed in a nearby pond, or flew to and from the adjacent community waste disposal site. Small numbers of other species foraged occasionally on the site or flew over. However, there was no high traffic corridor over the site. A copy of the consultant's report is provided in Appendix D. Discussions with respect to additional monitoring requirements are on-going.

Frontier Power Systems presently operates a 390kW wind farm (six 65 kW wind turbines) in Ramea. A bird interaction and mortality study conducted by Frontier Power Systems in 2005 and 2006 concluded that the wind farm had no apparent impact on the local bird population. During the two year study period, no bird mortalities were observed, and the bird utilization rate of the wind turbine area was very similar to the control areas used in the study. It was reported that the local bird population does not appear to display any level of avoidance of the existing turbines, and that there is little potential for bird mortality, and if such an event occurs, the numbers would not be significant. It is suggested that the study findings are a reflection of the wind turbine location, which is not known as an area frequently used by birds.

NL Hydro has also been in contact with the Wildlife Division of the Department of Environment and Conservation, regarding the potential requirements for a rare plant survey of the area. NL Hydro is presently working with the Department in assessing the area for potential rare plant habitat.

No other resource conflicts are anticipated.

(v) Occupations:

Installation and construction work will be performed, for the most part, using local contractors with final inspection and commissioning to be performed by NL Hydro personnel. The wind turbine commissioning will be completed using NL Hydro personnel under the supervision of the wind turbine supplier.

The occupations required for the construction of the proposed project include:

- (a) Engineering Managers
- (b) Civil/Mechanical/Electrical/Protection & Control/Telecontrol Engineers
- (c) Biologists and Related Scientists
- (d) Land Surveyors
- (e) Civil/Mechanical/Electrical Technologist and Technicians
- (f) Construction Inspectors
- (g) Industrial/Power System Electricians
- (h) Mechanics
- (i) Trades Helpers and Labourers
- (j) Diesel System Representatives
- (k) Communications and Shareholder Relations

(vi) Project-Related Documents

The following project-related documents have been generated for the proponent:

LGL Limited, 2007. Nesting Season Bird Survey at Proposed Wind Turbine Site on Northwest Island, Newfoundland and Labrador (LGL Report SA948) – Appendix D

APPROVAL OF THE UNDERTAKING:

The following is a list of permits, approvals and authorizations that may be necessary for the proposed project:

- (a) Approval by Public Utilities Board, Public Utilities Act, Board of Commissioners of Public Utilities;

- (b) Release of the Undertaking under the Environmental Assessment Provisions of the Environmental Protection Act, Department of Environment and Conservation;
- (c) Approval to proceed under the Canadian Environmental Assessment Act, Canadian Environmental Assessment Agency;
- (d) Building Permit, Town of Ramea;
- (e) Crown Lands Permit, Crown Lands Act, Department of Environment and Conservation.
- (f) Certificate of Approval for the Installations and Operation of generating units under the Approvals Provisions of the Environmental Protection Act, Department of Environment and Conservation.
- (g) Registration of the plant under the Registration Provisions of the Boiler, Pressure Vessel and Compressed Gas Regulations under the Public Safety Act, Department of Government Services.


SCHEDULE:

It is anticipated that construction will start in early May 2008, pending the acquisition of appropriate permits and approvals, and be completed by December 31, 2008.

FUNDING:

The project will be funded under NL Hydro's Capital Budget as approved by The Public Utilities Board. Additional funding for the project will be provided by the Government of Canada through Natural Resources Canada (NRCan) and the Atlantic Canada Opportunities Agency (ACOA). As a result this, an environmental assessment which conforms to the requirements of the Canadian Environmental Assessment Act will have to be undertaken prior to commencing the project.

Oct 25 / 07
Date


E.J. Martin
President and
Chief Executive Officer

Appendix A

Remote Community Wind-Hydrogen-Diesel Energy Solution Community of Ramea System Overview

Appendix B

Ramea, Newfoundland and Labrador Location Map

Appendix C

Ramea Wind-Hydrogen-Diesel Site Layout – Proposed

Appendix D

Project-Related Documents