REGISTRATION PURSUANT TO SECTION 7
OF THE ENVIRONMENTAL ASSESSMENT ACT

For the

RAMEA WIND-DIESEL DEMONSTRATION PROJECT

Submitted by:
Frontier Power Systems

July 8, 2003

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1 NAME OF THE UNDERTAKING AND PROJECT PROPONENT

1.1 Name of the undertaking

Ramea Wind-Diesel Demonstration Project

1.2 Proponent

i) Name of Corporate Body: **Frontier Power Systems Inc.**

This venture is a collaborative project carried out with financial and technical support from:

- Frontier Power Systems Inc.
- Atlantic Wind Test Site Inc.
- Prince Edward Island Energy Corporation
- Natural Resources Canada

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1.3 Frontier Power Systems Inc

Frontier Power Systems Incorporated (the Company) was incorporated Sept. 10, 2002 under the Canada Business Corporation Act. The Company is a privately owned firm that designs, builds and installs village electrification systems using renewable energy resources. Located in Atlantic Canada, the company was formed specifically to serve as a vehicle to commercialize renewable energy based village electrification technologies developed in Atlantic

Canada. The technology that is being commercialized was developed at the Atlantic Wind Test Site, Canada's national wind energy testing and development facility. The company is focused on developing the wind-diesel market niche which uses relatively small wind turbines in parallel with diesel based electrical generating systems. The is based in Atlantic Canada, where it can draw on strong regional technical expertise and broaden existing research partnerships.

2 THE UNDERTAKING

The undertaking is a medium penetration wind-diesel demonstration project in Ramea, Newfoundland. The undertaking is proposed to take place on and near the property marked MC206-61 on the Newfoundland property map11P11-114 attached, in reduced format, in Appendix I. Wind-diesel, as the name suggests, is the use of wind energy on relatively small diesel powered electrical systems. This project is the first wind-diesel project in Newfoundland and the first medium penetration project installed in Canada. A brief introduction to wind-diesel technology is provided in Appendix II.

As a demonstration project, the primary objectives of the project are technical, not financial. There are three primary objectives to the project:

- Demonstrate, at low risk to the utility, that wind power is technically viable for use with diesel generators in isolated communities,
- Establish a reference project which can be used to study wind-diesel operational issues and to evaluate advanced technologies as they become available and
- Provide project developers with the practical experience to enable the replication of similar projects with improved economy.

Because the project is structured as a demonstration project, resources have been allocated to resolve unanticipated technical issues that are likely to arise. During the execution of this project, it is expected that a wind-diesel platform will emerge which is optimized, technically and economically, for deployment in many more of Newfoundland's isolated communities. As the developer and the utility better understand the integration issues related to the deployment of the technology, subsequent projects will be developed to more fully exploit the economic and environmental benefits of the technology.

Because this project is a demonstration project that has been funded, in part, by the Government of Canada, an Environmental Screening will be carried out to conform to the requirements of the Canadian Environmental Assessment Act (CEAA). This Environmental Screening will be carried out concurrently with this Environmental Registration.

2.1 DESCRIPTION OF THE UNDERTAKING

The project will include the installation of six 65 kW wind turbines and ancillary equipment, in Ramea, Newfoundland. The wind plant, with a total capacity of 390 kW, will be interconnected to Newfoundland and Labrador Hydro's utility grid. The wind turbines will operate, when the wind speeds are within the wind turbine's operating range of 5 m/s to 22 m/s (18 kph – 80 kph) and when the utility is in a condition to accept wind power. The wind energy delivered to the utility will displace diesel fuel from the existing diesel generating plant. The project, as a 'medium penetration' wind-diesel application, will mean the diesel generating plant will operate continuously to maintain control over the system voltage and frequency. Ancillary equipment will include distribution lines and transformers to connect the wind plant to the utility's 4160 Volt line and the necessary control equipment to ensure the diesels are not operated in an unacceptable load range.

2.2 RATIONALE FOR THE UNDERTAKING

This project is being developed as a 'flagship' project structured in a manner to resolve unidentified technical issues that may arise. The successful deployment of this project will enable subsequent wind-diesel projects to be more economically deployed. The timing for the deployment of wind-diesel technology is driven by the growing maturity of wind energy technology and by increasing concerns over the environmental impact of current electricity supply options for isolated communities.

2.2.1 The Maturing of Wind Energy Technology

The development of wind energy, over the last two decades, as a 'zero emissions' alternative for electricity generation, has been dramatic. Costs for utility sized wind technology have decreased from $0.18-0.20 $/kWh in 1980 to $0.06-0.08 $/kWh in 2000. It is widely accepted that cost decreases will continue and projections are for wind energy to be one of the lowest cost electricity supply alternatives by the end of this decade.

Most of the developments in wind technology have occurred on large utility scale wind turbines which cannot be utilized in small isolated communities, due to their large size and the limited infrastructure within these communities. Nonetheless, there has been significant progress made in the economy of smaller sized wind technology appropriate for use in these applications. As the technology matures to integrate wind turbines with diesel systems, the development of wind-diesel projects will accelerate.

2.2.2 Environmental Drivers

Environmental concerns over continued and growing reliance on fossil fuels are rising in Canada and around the world. Canada's isolated communities, which are almost exclusively reliant on imported oil for energy supply, are more exposed than any to the vagaries of energy cost escalation and environmental impacts. Growing communities require continuing expansion of diesel capacity and fuel storage facilities. The transport of increasing volumes of diesel fuel increases the risks of fuel spills and the resulting environmental damage. Increasing emissions from diesel plants limits the flexibility that utilities have in attempting to reduce emissions from their systems.

All of these environmental concerns can be mitigated by incorporating renewable energy resources within these communities. This project is designed to be the first of many similar projects across Newfoundland and Canada.

2.2.3 Developing Canadian Wind-Diesel Technology

This project will utilize wind-diesel control technology developed at the Atlantic Wind Test Site, Canada's national wind energy testing and development facility. This technology, WDICS (Wind-Diesel Integrated Control System), is designed to integrate wind turbines with diesel generators commonly used in isolated communities. This project is the first Canadian project using WDICS technology and the successful development of this project will enable Canadian technology to enter the growing Canadian and global wind-diesel markets. Appendix II summarizes the role of WDICS technology within a wind-diesel system.

2.2.4 The Potential for Wind-Diesel Technology in Isolated Communities

Wind-diesel technology can bring a number of benefits to isolated communities if the technology can be economically installed. Reduced consumption of fossil fuels, reduced environmental emissions, reduced risks of fuel spills, increased investment in rural areas and enhanced economic development opportunities are all benefits which can flow to isolated communities if sustainable technologies such as wind can be utilized. Newfoundland communities stand to derive all of these benefits and the advantages are higher to Newfoundland than to other jurisdictions, simply because the wind resource is so impressive along the coastal areas of Newfoundland where most isolated communities lie.

2.2.5 Why Ramea? - The Community Selection Process

The community of Ramea has been selected for this demonstration project, over a number of other isolated communities where higher project revenues would be possible, due to higher avoided fuel costs. Ramea was chosen for four reasons;

- ? The community is large enough to accept a relatively large amount of wind capacity.
- ? It has a premium wind resource which will increase amount of wind energy generated.
- ? It is reasonably accessible, reducing the costs and risks of project delivery and support.
- ? The community has confirmed an interest in exploring the use of renewable energy.

3 DESCRIPTION OF THE RAMEA WIND-DIESEL PROJECT

3.1 GEOGRAPHICAL LOCATION

As described in the Ramea web site "Ramea on the WWW" "Ramea is an island community of one thousand two hundred and fifty (1,250) located six (6) kilometres off the south west coast of Newfoundland, Canada. It is located on a group of islands containing ancient granite rock formations similar to those in northeastern Newfoundland and Cape Breton Island, Nova Scotia. The people who settled the islands early in the nineteenth century originally established several small independent communities on the islands. In the early 1940's, all inhabitants moved to Ramea, with its excellent harbour and strategic location for exploiting the fishery. Settlers also came from several communities along the south coast of Newfoundland and directly from England."

The islands of Ramea are located mid-distance along the south coast of Newfoundland, between Channel-Port aux Basques and the Burin Peninsula. Northwest Island is the main island, where essentially all of the local population resides.

3.1.1 Description of Site

The Northwest Island of Ramea is approximately 3 kilometers in length and lies in a northeasterly direction normal to the prevailing northwest winds. Figure 1 shows a map of the southern coast of Newfoundland in the region of Burgeo and Ramea. Figure 2 shows the Northwest Island of Ramea where the proposed development will be located.

Figure 1

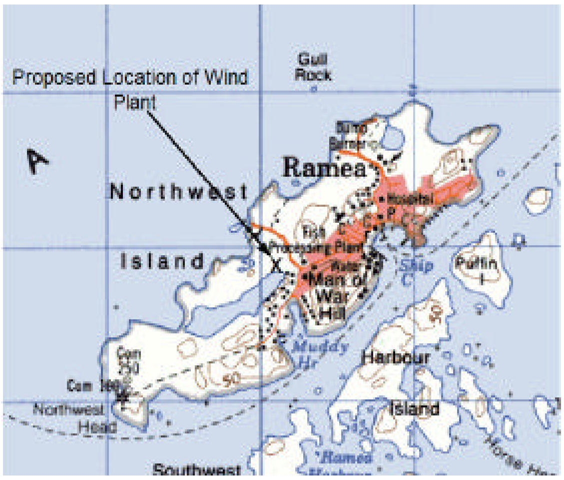


Figure 2

3.1.2 Location

Figure 3 shows a detailed map of the community with the location of the wind plant relative to the community. The turbines will be located on the north western section of the island adjacent to the community's water reservoir. The turbines will be located near existing roadways and will be several hundred meters from the nearest residence.

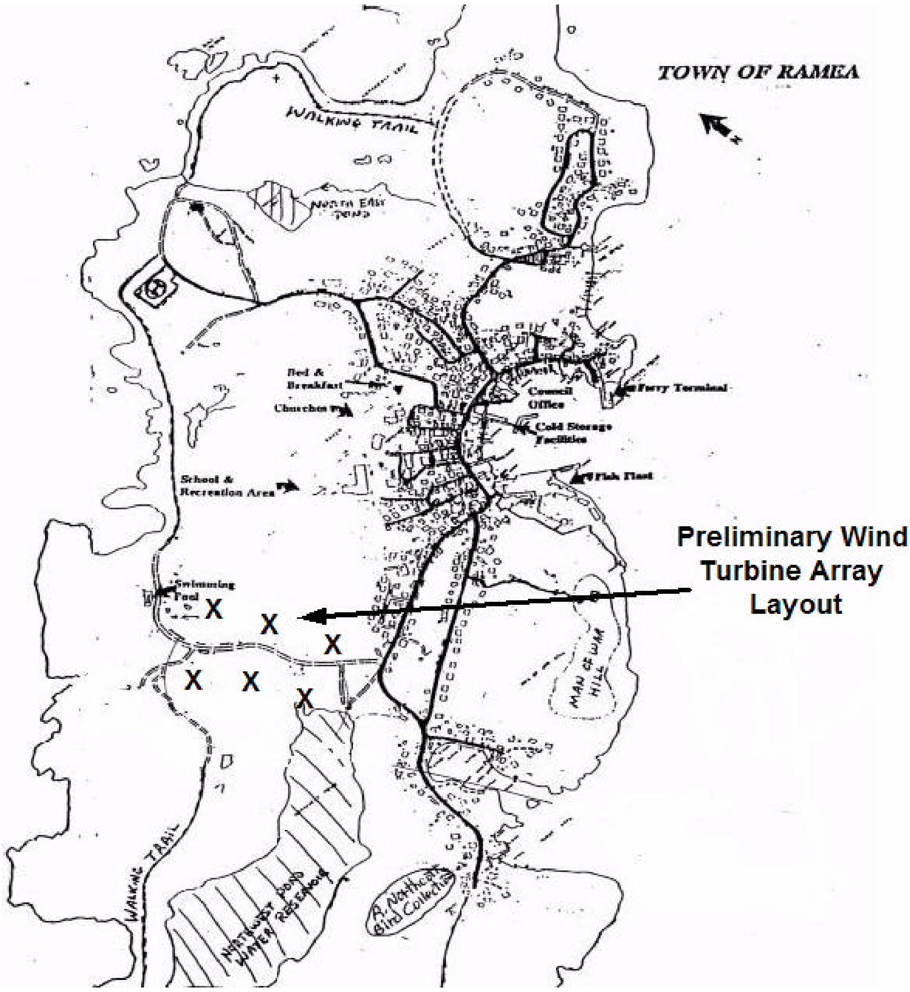


Figure 3

3.1.3 Access to Site

Access to the wind turbine sites will be from adjacent roadways where access is possible. There may be a need to construct local service roads for short distances from the existing roads to the turbine locations. Good soil conditions in the area should enable road extensions to be installed without difficulty.

3.2 PHYSICAL FEATURES

3.2.1 Equipment to be installed

The equipment to be installed includes six wind turbines, the necessary electrical equipment to enable the turbines to be connected to the utility grid and a control building to house the control systems, which will supervise the grid interconnection.

3.2.1.1 Wind turbines

Six Windmatic WM15S wind turbines will be installed. The turbines are horizontal axis wind turbines that operate upwind of the tower and use a forced yaw system to orient the turbine into the wind. Each turbine has three blades and a rotor diameter of 15 meters. The turbines start generating power when winds increase above 5 m/s (18 kph) and they reach rated output of 65 kW in 14 m/s (50 kph) winds. When winds exceed 22 m/s (80 kph), the turbines automatically shut down until wind speeds decrease to 19 m/s (70 kph). The turbines will be installed on 25 meter high, freestanding, lattice towers

3.2.1.1.1 Description of Turbines

The 65 kW Windmatic turbine is a generic Danish design that has been widely used across Europe and in California. They are one of the most rugged and reliable wind turbines available in this size range. A Windmatic 65 kW has been operating at the Atlantic Wind Test Site (AWTS), since 1992, with high reliability. Figures 4, 5 and 6 show photos from the wind turbine at AWTS.

The turbine is a three blade, stall regulated (the blades are fixed rigidly to the rotor hub and power is limited by aerodynamic stall in high winds), forced yaw (it has a motorized gear drive to orient it into the wind) design. The two speed unit has two generators, a 13 kW unit that operates in low wind speeds and a 65 kW unit that operates in high winds. For the Ramea project, operation may be limited to single speed operation.

Figure 4 Windmatic WM 15S at the Atlantic Wind Test Site

Figure 5 The fiberglass blades are rigidly connected to the hub. This fixed pitch design reduces costs and simplifies maintenance.

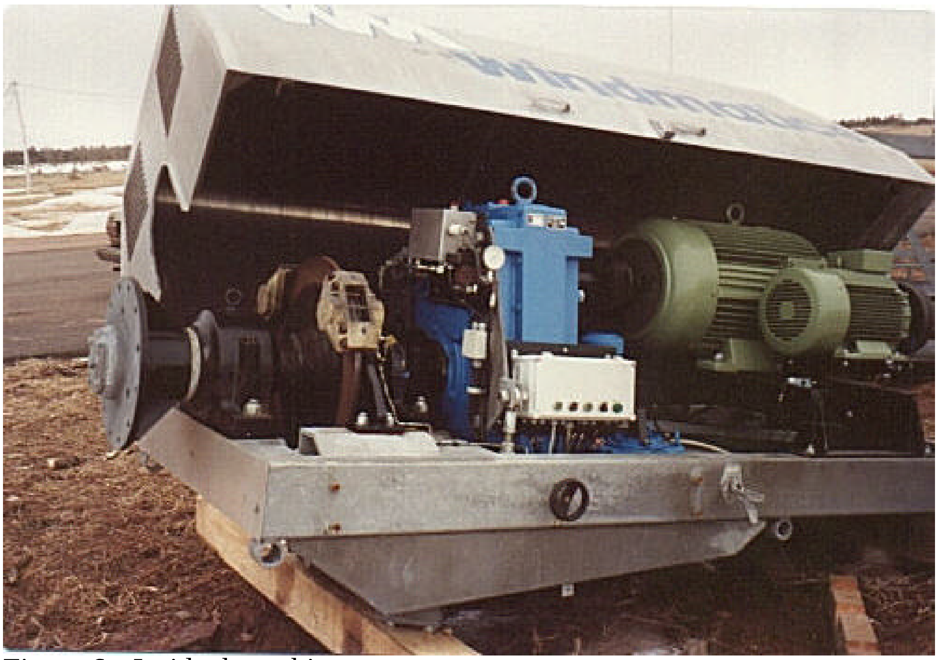


Figure 6 - Inside the turbine

The turbine nacelle contains a number of electrical and mechanical components. The top cover swings open and a work platform is on the side to provide access to the turbine. The major components of the turbine are visible. The blade hub attaches to the front of the rotor shaft. A large bearing is located near the front, just behind the hub, to take the load from the rotor. The low speed shaft goes through the brake assembly and into the gearbox (the blue unit). At the back of the turbine are two generators. The small generator, which may not be used on the Ramea project, operates in low winds (up to about 8 m/s and 13 kW it allows the rotor to turn at 39 RPM). The large generator operates in higher and allows the rotor to rotate at 60 RPM and generate up to 65 kW. Under the turbine is a yaw gear assembly that allows the entire nacelle to be pointed into the wind. The yaw drive motor (in blue) can be partly seen behind the gearbox.

Wind Turbine Operation

Table 1, following, summarizes the turbine power output as a function of input wind speed. The turbine operates when the wind speed is over 5 m/s (about 18 kph or 12 mph). When it is operating the amount of power it generates depends on the wind speed. Below 5 m/s there is not sufficient power in the wind to generate electricity. At 10 m/s (36 kph or 23 mph), it will generate around 40 kW and in high winds, 14 m/s (50 kph / 30 mph), it will generate 65 kW. Above 22 m/s, the turbine will be turned off automatically. In Ramea, the wind speed is expected to be within the operating range for about 75% of the time.

Wind Speed m/s	Power kW
0…4	0
5	4
6	9
7	15
8	23
9	32
10	41
11	50
12	57
13	62
14	65
15	66
16	66
17	65
18	63
19	59
20	57
21	57
22	58

Table 1

3.2.1.1.2 Installation of Turbines

The turbines will be installed on free standing towers (no guy wires) at distances of 75-150 meters from adjacent turbines and several hundred meters from the nearest residence. Foundations will be designed to meet the requirements of the application and installed by local contractors.

The controller usually sits at ground level and connects the generators, located at the top of the tower, to the utility electrical line. In Ramea, the controllers may be installed in a central control building to simplify operation and maintenance. The control system will continuously monitor key operating variables on the wind turbine and on the utility grid to ensure the turbine is safely disconnected in the event of a problem within the wind turbine or within the utility system.

The turbines will be installed within a fenced enclosure for safety and security reasons.

3.2.1.2 Control building

A permanent building will be installed, within the wind turbine array, to house the control systems necessary for the utility interconnection and for data acquisition and monitoring.

3.2.1.3 Roads

Roads will be installed, to a quality adequate to enable year round access to the wind turbine sites, where necessary. Road construction is expected to minimal since there are local roads adjacent to the wind plant site.

3.2.1.4 Electrical Interconnection

The wind plant will be connected to the utility in a manner that conforms to utility standards. This will require the installation of additional utility poles and distribution equipment. The wind generators which operate the 480 Volts will be connected to the 4160 Volt utility distribution system through pole mounted transformers, commonly used by the utility.

3.2.1.4.1 Wind Turbine Connections

The individual wind turbines will be connected, using underground cabling, within the wind plant to the wind plant control building where it will be collectively connected to the utility system.

3.2.1.4.2 Utility Connection

Interconnection to the utility will take place at 4160 Volts on the output of the proponent's pole mount transformers. Utility metering is expected to be installed, within the proponent's control building, using secondary metering.

3.2.1.5 Telecommunications

A telecommunication link will be established between the existing Newfoundland and Labrador Hydro diesel plant and the wind plant to enable high speed data transfer. This will enable Hydro to provide supervisory control on the wind plant to ensure the operation of the wind plant does not negatively impact the operation of the diesel plant and to provide control signals to the wind plant controller to regulate wind power input to the electrical system. The telecommunication link will be a leased line telephone connection or a wireless connection.

3.2.2 Area to Be Affected by the Undertaking

There will be an area of approximately 2.5 hectares directly occupied by the wind plant. This area is required to ensure that wind flowing through a turbine does not affect the adjacent turbines. There will also be an extension to the utility distribution system to enable the wind plant to be interconnected to the utility. Additionally the area outside of the project could be affected, to a lesser degree, by a number of factors. Because the impact of each issue is highly site and technology specific, each issue must be evaluated individually for each project. These issues are discussed below.

3.2.2.1 Noise

Wind turbines are rotating mechanical devices and the aerodynamic movement of the blades through the air and the drive train, located on the tower top, emits noise. The noise level for wind turbines can vary slightly depending on the size and the design of the turbine but, for most commercial designs the noise emissions tens to be fairly constant with source noise emissions in the area of approximately 100 dB(A). The noise drops at a distance of about 250 meters, to about 45 dB(A), the equivalent noise level of a kitchen refrigerator. The Windmatic wind turbine uses three blades, each with an imbedded aerodynamic spoiler, and has relatively low tip speeds. The aerodynamic design coupled with a two speed helical gearbox, makes the Windmatic turbine one of the quietest in this size range. The turbines will be virtually inaudible at the nearest residence, several hundred meters away.

Figure 7, from the web site of the Danish Wind Turbine Manufacturers Association (www.windpower.org), compares the noise level from a modern wind turbine with noise emissions from common noise sources.

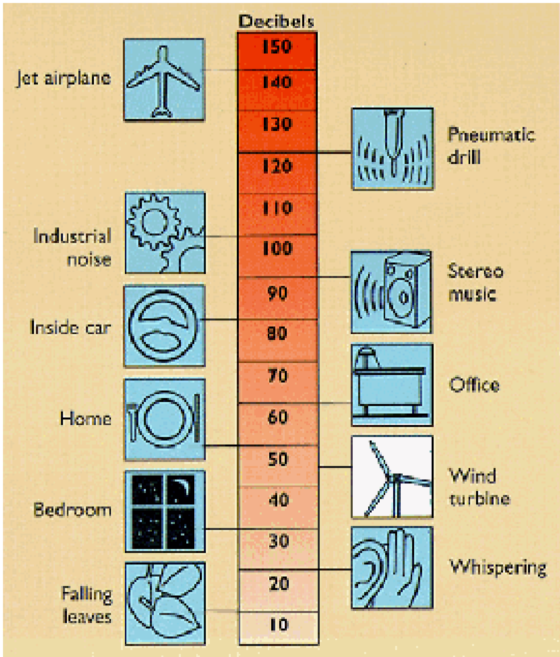


Figure 7

3.2.2.2 Flicker

Flicker is a phenomenon which occurs when the sun light passes through the wind turbine rotor. The rotation of the wind turbine creates a cyclic flashing that can be very disturbing visually. While the problem usually only occurs for a few hours each year, it can be very disconcerting and can create problems for residents. The problem is more prevalent on larger wind turbines when they are located in close proximity to residence.

In this project, the turbines are small enough and placed at a sufficient distance from nearby residences that flicker will not pose a problem at any time.

3.2.2.3 Birds

The interaction between wind turbines and birds is the single most quoted concern related to the installation of wind turbines. Many studies have been conducted to evaluate this issue and to attempt to minimize the impact of interaction between wind turbines and birds. Appendix IV summarizes current thoughts on the interaction between birds and wind turbines with selections from various bird studies.

In summary, it is felt that the proposed project presents minimal risks to the local bird population. As more fully described in Appendix IV, wind turbines kill very few birds compared to other sources of avian mortality, such as cars, electrical wires, buildings and house cats. In those areas where wind turbines have been observed to be a threat to local bird populations, most have been high profile raptors, such as those found in the mountain passes of California. In areas where local birds tend to be shorebirds or passerines, as is the case for Ramea, study after study has confirmed that wind turbines have no impact on the local bird populations.

To provide some context on the impact of wind turbines on birds, the following was excerpted from the National Wind Coordinating Committee (NWCC) Document " Avian Collisions with Wind Turbines" "… the following estimated annual avian collision mortality in the United States:

- Vehicles: 60 million - 80 million
- Buildings and Windows: 98 million - 980 million
- Powerlines: tens of thousands - 174 million
- Communication Towers: 4 million - 50 million
- Wind Generation Facilities: 10,000 - 40,000"[1]

One pertinent Atlantic Canada study has been conducted by the Prince Edward Island Energy Corporation at the North Cape wind plant. North Cape is a marine environment with exposure to the water through 300 degrees and is located at almost the same latitude as Ramea, but five hundred kilometers east of Ramea in the Gulf of Saint Lawrence. Detailed bird mortality studies carried out over two migration seasons on the 5,280 kW North Cape wind plant found only one dead bird that was attributable to the operation of the wind plant. The study also noted that 'avoidance' behavior, where birds appeared to keep their flight paths away from the wind turbine rotors, was observed. This is consistent with studies on offshore wind plants in Europe where sea birds have been observed avoiding the wind turbines.[2]

At the Atlantic Wind Test Site, also located at North Cape, Prince Edward Island, eight wind turbines, similar in size to the turbines proposed for this project are currently operating. Similar numbers of turbines in this size range have been operating over the past fifteen years, in an environment that is very similar to Ramea. There have been no observed fatalities of any birds by the smaller wind turbines in this period.[3]

It has been noted, by local birding enthusiasts, that Ramea Islands are an interesting location for the study and observation of birds. The islands provide nesting habitat for several seabird species, including two colonies of puffins (the provincial bird of Newfoundland and Labrador), each with seventy (70) to one hundred (100) pairs. Other seabird populations include eider ducks, harlequin ducks, storm petrels and cormorants. A local Natural Historian has kept good records of rare bird sightings and has published articles in naturalist magazines. Examples include the Eastern Bluebird (first in the Province), Wood Thrush, Grey Catbird (first nest found in Newfoundland), Tri-Coloured Heron (first in the Province) and the Ross Gull.[4]

The Harlequin duck is designated by, COSEWIC (Committee on the Status of Endangered Wildlife in Canada), as a 'Special Concern' species. However, for this project as it was in the North Cape project, this offshore water bird is unlikely to be impacted by this development.[5] Care will have to be taken to ensure that the area of development does not impact nesting areas of any of the rare species identified. This will be confirmed before finalizing the locations of the wind turbines.

Birds that reside or migrate through Ramea are shorebirds; puffins, gulls and ducks and passerines. These types of birds tend to move at relatively low speeds, are conscious of local hazards and have been observed avoiding wind turbines[6]. It is felt that this wind development will have no significant impact on local bird populations.

Finally, it is expected that the size of the proposed wind plant is simply too small to have an impact on the local population. It has been estimated, Erickson *et al.*,[1] that, outside of California (where birds mortality is higher), wind turbines, on average wind turbines result in approximately 1.83 fatalities per year per turbine. This average is taken over a fleet of wind turbines that are significantly larger (nearly ten times as large) as the turbines proposed for Ramea. It is unlikely this project will kill more than one or two birds per year.

3.2.2.4 Visual

Concerns about aesthetics and the impact of visual intrusion from wind turbines is another point that is occasionally raised in consideration of wind developments. Concerns are higher when relatively large numbers of large wind turbines are placed within the field of view from people's residences or within natural vistas. Objections to the visual impact are often raised by those fundamentally opposed to wind development within their communities, often referred to as the NIMBY (not in my back yard) group and by a very small percentage of people who find wind turbines to be unappealing visually. Most people find wind turbines to be an attractive structure on the skyline and are strongly supportive of wind turbines within their community. The Ramea wind project will be located in an area where few of the turbines will be even visible from most of the residences and should not be in the dominant field of view from any residence.

3.2.2.5 Electromagnetic Devices

Despite occasional concerns being raised about the impact that wind turbines can have on electromagnetic devices such as television receivers or cellular telephones, there is not theoretical reason for this concern and no documented evidence of that such problems occur.

3.2.2.6 Air Traffic

Wind turbines placed on tall towers or in proximity to airport flight approaches, may be denied permission for installation or be required to have standard aircraft warning lights to be installed. Transport Canada's guidelines will be followed for the Ramea project.

3.2.3 Physical Environment

3.2.3.1 Climate

The climate in Ramea is typical of the southern coast of Newfoundland. Average temperatures tend to be typical for the temperate climate with annual average temperatures of 4.2 degrees Celsius. Average monthly temperatures range from -4.9 degrees to +14.8 degrees throughout the year.

Rainfall is higher than average at more than 1700 millimeters annually and the occurrence of freezing rain is more frequent than locations further inland. Wind speeds are considerably higher along the southern coast than in most other parts on the province. Snowfall accumulations tend to be more modest as a result of the limited vegetation and high winds.

3.2.3.2 Topography

The topography of Ramea is almost entirely rock. As noted on Ramea's web page "The bedrock that underlies southwestern Newfoundland, from North Branch south to Port aux Basques and then east to Rose Blanche, is not dominated by either one of the 3 fundamental rock types (igneous, metamorphic and sedimentary). Rather the underlying geology draws its character from among them.

The oldest rocks in southwestern Newfoundland are those that make up parts of the highest mountains in the area. These are ophilitic rocks, pieces of the ancient ocean floor, which were pushed up during mountain building processes, and which are roughly 500 million years old (Upper Cambrian). These pieces of ancient ocean floor rock were embedded within the mountains, which for the most part are made of granite and roughly 380 million years old (Late Devonian).

The rocks in the immediate Port aux Basques area are metamorphic rocks such as gneiss (pronounced "nice"), schist and amphibolite. These rocks haven't been dated to tell their age, however they are thought to be older than the rocks which make up the mountains. Minerals such as garnet, staurolite and kyanite are common in these rocks. The rocks between Port aux Basques and Rose Blanche are much like the rocks in the Port aux Basques area, however there are some areas which also have quite a bit of granite. In fact, some of the finest granite in Newfoundland is found at an abandoned quarry near Petites, which is near Rose Blanche.[4]'

3.2.3.3 Soils

There are limited soils in the area of the wind plant. With the exception of some boggy areas, likely peat, which must be avoided for construction purposes, the area on which the wind plant will be located is either solid or fractured exposed granite bedrock.

3.2.4 Biological Environment

3.2.4.1 Vegetation

Ramea lies within 'South Coast Sub-region' of the 'Maritime Barrens Eco-region' of Newfoundland. It is not considered to be within the 'Productive Forest Land Base' of Newfoundland. This is not surprising since there is virtually no tree cover on Ramea except for one of the uninhabited outer islands. The primary vegetation on Ramea is grass and moss like vegetation.

3.2.4.2 Wildlife

The only wildlife on Ramea are birds. No large undomesticated mammals, such as moose, caribou, fox or coyote, live on Ramea.

As noted earlier, Ramea Islands are an interesting location for the study and observation of birds. They provide nesting habitat for several seabird species, including two colonies of puffins (the provincial bird of Newfoundland and Labrador), each with seventy (70) to one hundred (100) pairs. Other seabird populations include eider ducks, harlequin ducks, storm petrels and cormorants.

3.3 CONSTRUCTION

3.3.1 Construction Period

Construction is anticipated to start in September 2003, with the installation of road ways and foundations and conclude in December 2003 with the commissioning of the wind-diesel control system.

3.3.2 Description of Construction

Project construction will consist of seven specific site activities;

1) Construct Roads

Roads will be constructed to provide access from existing roads to the wind plant.

2) Install Foundations

Foundations will be installed for each of the six wind turbines. The type of foundations will depend on the results of geo-technical analysis and detailed engineering review. It is anticipated that either spread footing or rock anchors will be the most optimum design.

3) Install Turbine Distribution and Control Cables

Power and control cables will be buried within the wind plant to connect the individual wind turbines to the wind plant control building.

4) Assembe and Install Turbines

The wind turbines will be delivered to site, assembled and erected on the previously installed foundations and connected. The turbines will be assembled at the base of each tower using a local work crew. It is not anticipated that a local construction building will be required but there will be a local facility for tool storage. Assembly will require slightly less than one week for each turbine and will require equipment marshalling area of approximately 120 square meters per turbine.

5) Wind plant control building

A control building, to house the wind plant control and monitoring equipment, will be installed within the wind plant.

6) Install Utility interconnection equipment

The utility's distribution system will be expanded to enable the wind plant to be interconnected.

7) Diesel Plant modification

The diesel plant controller will be modified to integrate the wind plant with the existing diesel plant. The diesel plant controller will provide master control for the wind-diesel system, supervising the operation of the wind turbines and allocating load set-points for the wind plant. These modifications will take place within existing Newfoundland and Labrador Hydro facilities.

3.3.3 Potential Sources of Pollutants during Construction

There are two potential sources of pollution during construction; noise and the accidental discharge of lubricants.

Noise levels will be slightly higher in the immediate vicinity of the wind plant construction area with the use of electric and, possibly, pneumatic tools. The noise level will not impose a problem on local residents since the distance will allow the noise levels to dissipate.

The use of lubricants, in the wind turbines and in the construction equipment, could inadvertently result in small spills during the construction period. Special precautions will be taken to ensure this will not occur.

3.3.4 Potential Resource Conflicts

There should be limited resource conflicts from this project. Because the construction will occur after the completion of the tourist seasons it is not expected to disrupt tourist traffic. Local residents may have their daily walks re-routed and there may be some temporary disruptions to local traffic during the delivery and construction phase. Construction will not serious impede traffic flow or the routine of the local populace.

The proposed area for the project is currently vacant so there will be no conflicts related to land use.

3.4 OPERATION

3.4.1 Descriptio n of Operation

3.4.1.1 Operation

The wind turbines operate automatically as long as the wind speed is within the turbines operating range and the local utility is available to accept the wind generated electricity.

The turbine aligns itself into the wind as the wind direction changes. The computerized control system continuously monitors all operating variables on the wind turbines to ensure that the wind turbines operate safely at all times. If an event occurs to force the wind turbine outside the normal operating range, the turbine is immediately taken off line and the brake applied to bring the unit to a stop. In the event of a trip, operator intervention is required before the unit can restart.

3.4.1.1.1 Maintenance

Maintenance must be regularly carried out on the wind turbines to ensure they operate safely and reliably. Maintenance may be either planned or forced. Planned maintenance is carried out twice per year, typically in the spring and in the fall, when all of the mechanical and electrical components are inspected, adjusted and lubricated as required. Forced maintenance is required when unexpected electrical or mechanical problems occur on the turbines. This will require the intervention of a maintenance technician. This may be either a locally trained operator, in the event of a routine problem or a technician from the manufacturer's facilities, in the event of a serious problem.

3.4.2 Period Of Operation

The wind plant is expected to be a permanent installation. Wind energy will continue to evolve and it is expected to become more cost effective in the future as fossil fuel prices and the environmental premiums, associated with the use of fossil fuels, continue to increase. When the current wind turbines reach the end of their economic lives, they will probably be replaced with more advanced wind turbine models available at the time.

3.4.3 Potential Sources of Pollutants During Operation

Wind energy is a zero emissions source of electricity. Every kilowatt hour of electricity generated by the wind turbines will displace one kilowatt hour of diesel generated electricity and a corresponding 0.75 kg of CO_2 emissions from the diesel. Emissions of SO_X and NOx are also lowered when diesel generation is reduced. Reducing the consumption of diesel fuel means that less diesel fuel needs to be delivered further reducing the environmental risk associated with transport.

The only potential sources of pollutants during operation include noise and the potential leakage of lubricants from the turbine itself. Noise, as described earlier, is not expected to present a problem to nearby residents. Lubricants are used in all of the mechanical components within the turbine. With the exception of the gearbox, only small amounts of lubricants are used. The gearbox contains nearly twenty litres of lubricating oil. However, the seals are reliable and special oil change procedures are implemented to reduce the risk of oil spillage.

3.4.4 Potential Resource Conflicts

3.4.4.1 Noise Impact

The wind turbines will not emit objectionable noise levels at nearby residences. As described earlier, the sound emissions from modern wind turbines are reduced to levels equivalent to those found within residential areas within a short distance from the turbines.

3.4.4.2 Visual Impact

The proposed wind plant will add a new visual dimension to the community since they will among the largest structures on the island. The six turbines will be prominent as visitors approach the island by boat and they will also be visible to some of the houses within the community. However, for most of the residences, the turbines will not be within their field of view and for those who are able to see the turbines they will not dominate the landscape.

The turbines will be at a sufficient distance from residences to prevent flicker problems.

The general result of the visual impact will be positive. Most small communities, where wind turbines are installed, take great pride in watching and discussing the operation of the turbines. The turbines are also likely to attract curious tourists.

3.4.4.3 Impact on Birds

The observed behavior of birds on other wind projects with similar types of bird populations as those found in Ramea (mostly shore birds and passerines) tend to avoid wind turbines. The small size of the wind plant, coupled with the behavior of resident birds, is expected to have no impact on local bird populations.

3.4.4.4 Safety Issues

A number of important issues must be considered to ensure the facility does not pose a risk to the community or to the operators.

Security to the facility will be provided for each structure. Each of the turbines will be fenced with a 1.8 meter chain link fence. The control building will also be secured against unauthorized access.

Electrical safety is a critical issue and the installation of the project will be done in a manner that is fully compliant with local electrical standards and with utility practices.

Mechanical safety will be a critical priority during construction and during operation sin ce much of the maintenance activities are carried out high above ground. All personnel working above ground level will be properly equipment with fall restraint equipment and trained in its use.

Lightning can be a serious issue with wind turbines since wind turbines are usually the highest structure in an area and are prone to be struck before other structures. Special consideration needs to be given to electronic signals to ensure that small transients do not cause problems. A direct strike on a wind turbine, unfortunately, often causes serious damage. This should not cause a personnel risk since people tend not to be near wind turbines during lightning storms.

Icing is also expected to be a frequent event in Ramea. The accumulation of icing on a wind turbine blade causes the aerodynamic lift to be destroyed and the blades usually stop rotating until the icing falls from the blades. As in any eastern Canadian communities, locals are aware that towers and trees laden with ice present a danger if caution is not exercised. It is expected that signage will be sufficient to keep passers by at a safe distance from the turbines during an icing event.

3.4.5 De-commissioning

Wind plants are usually eternal. When the economic life on the turbines is completed they are replaced with more advanced and more cost effective turbines. That is expected to be the case for this wind plant. In worst case scenarios, where total financial failure of the operating company occurs, it has been found that the scrap value of the turbines and ancillary equipment is sufficient to fully decommission the wind plant.

3.4 Occupations

The project will require approximately 8-10 weeks of construction to complete the tasks described. In order to complete this activity a variety of trades people will be required either employed by sub-contractors to the proponent or employed directly by the proponent for term employment.

Occupational trades which will be used in the construction of the facility include: crane and heavy equipment operators, electricians, laborers, electronic and mechanical technicians, engineers, utility line workers and concrete workers.

3.5 Project Related Documents

A proposal to Install and Operate a Wind Generation Plant in Ramea Newfoundland; Submitted to Newfound land and Labrador Hydro, August 19, 2002

Application to Technical Early Action Measures (TEAM), a Climate Change Initiativeof the government of Canada for "Demonstration of a Wind-Diesel Integrated Control System in an Isolated Newfoundland Community", October 16, 2002

Frontier Power Systems Inc. Business Plan; November 2002

Correspondence – Numerous items between Frontier Power Systems and Ramea Town Council; May 2000 - June 2002

APPROVAL OF THE UNDERTAKING

Prior to proceeding with the undertaking the following permits and agreements must be finalized:

Permit	Authority
Application for Crown Land	Municipal Council
Municipal Recommendation Form for Crown Land Application	Municipal Council Department of Government Services and Lands
Building Permit	Municipal Council
Environmental permit	Department of the Environment
Electrical Permit	Government Services Centre
Power Purchase Agreement	Newfoundland and Labrador Hydro
Confirmation of conformance to Technical Requirements and General Terms of Interconnection with Hydro's Isolated Systems	Newfoundland and Labrador Hydro
Approval to proceed under CEAA	Environment Canada

4 SCHEDULE

The schedule for the construction of the project is dependent upon the completion of environmental assessme nt documents and the procurement of required permits. Concurrently there are project design issues which need to be finalized. It is anticipated that these activities can be completed by early September 2003. Project construction will commence immediately and the project installation will be completed prior to December 1, 2003.

5 FUNDING

The proponent has secured funding for the project. Funding assistance for the project has been provided by the Government of Canada. As a result of this an environmental assessment to conform to the requirements of the Canadian Environmental Assessment Act will be carried out prior to commencing the project.

References:

1) Avian Collision with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States: http://www.nationalwind.org/pubs/avian_collisions.pdf

2) Incidence of Bird Mortality From Collisions with Wind Turbines North Cape Wind Farm, Prince Edward Island, Prince Edward Island Energy Corporation December 2002

3 Personal Correspondence – Atlantic Wind Test Site

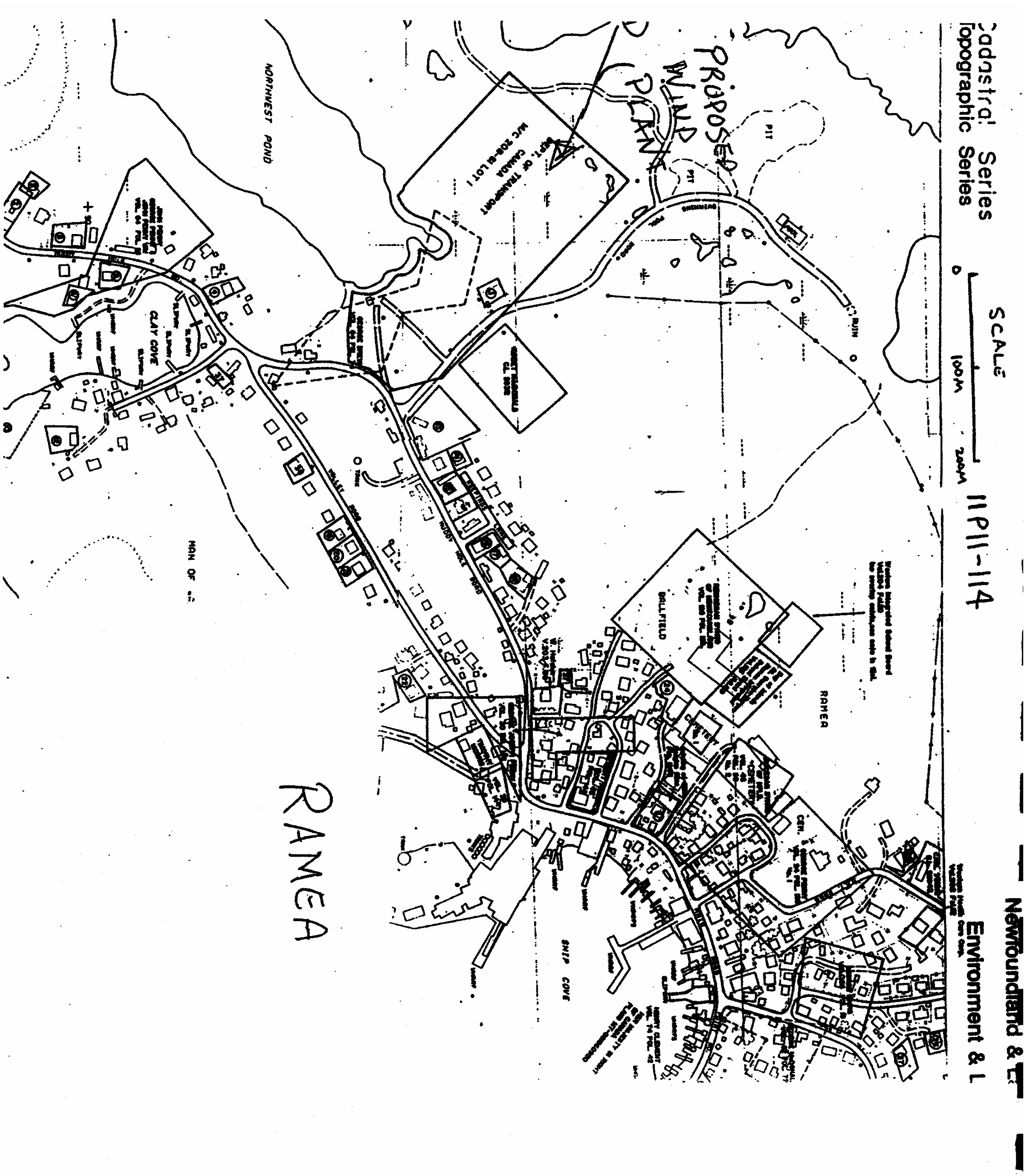
4 Ramea on theWWW (www.wordplay.com/tourism/communities/ramea1.html)

5 Avian Potential Impacts of Wind Turbines on Birds at North Cape, Prince Edward Island A report for the Prince Edward Island Energy Corporation Andrea Kingsley* & Becky Whittam Bird Studies Canada, Atlantic Region, 13 December 2001

6 Impacts at Wind Power Facilities in Europe - An annotated summary of studies as of February 2001. Report prepared for CHI Energy by Paul Kerlinger

APPENDIX I

COMMUNITY MAP


Cadastral Series
Topographic Series
SCALE
11P11-114
Newfoundland &
Environment &
PROPOSED WIND PLANT
NORTHWEST POND
CLAY COVE
SHIP COVE
RAMEA

APPENDIX II

Wind-Diesel Systems - Description & Operation-

Introduction

Wind-diesel is the generic term given to energy supply systems that combine diesel powered electrical generators, which provide prime power, with wind turbines, which operate when wind power is available to reduce the load on the diesels and displace diesel fuel. Most wind-diesel applications are for remote communities, such as those in northern Canada and on many small island grids around the world.

The "penetration" of wind-diesel systems can vary from low to high level. At low penetration levels, the wind plant provides relatively small amounts of power and energy relative to total system requirements. At high penetration levels, the wind plant can provide as much as several times the total plant power capacity. For example, in a plant with total installed diesel capacity of 500 kW system and an average load of 300 kW, a low penetration wind-diesel system might have 50 kW of wind turbines, while a high penetration system might have 1000 kW of wind turbines. In high penetration systems the wind power capacity is greater than the maximum load demand of the community.

For low levels of penetration, there is literally no impact on the diesel plant operation. As wind energy is supplied into the grid the energyrequired from the diesel plant is reduced as is fuel consumption. However, because the size of wind plant is small, the total fuel saved is limited.

At high penetration levels, there is a significant impact on the operation of the diesel plant. When the available wind power exceeds the community requirements the system can operate autonomously, with the diesels turned off and the wind plant providing all the load requirements. This maximizes fuel savings. For autonomous wind operation some method of regulating the system voltage and frequency, parameters usually controlled by the diesel, is required. Even at intermediate wind power levels, where the diesels are required to operate to provide a small share of the load, the operation of the plant is affected, since the optimum diesel size for the new operating condition is different than it would be for the diesel only system.

Wind-Diesel Configurations (typical)

Penetration Level	**Low**	**Medium**	**High**
Diesel plant	500 kW	500 kW	500 kW
Wind plant	50 kW	250 kW	1000 kW
Impact on diesel plant	None	Reject wind when diesel load low	Reject wind when diesel load low Turn off diesels in high winds
Special Control Equipment	Communication	Communication Dump load& regulator	High speed communication Dump load& regulator Synchronous condenser
Revenue sources	Displaced fuel	Displaced fuel Thermal energy	Displaced fuel Thermal energy Diesel life extension
Fuel saved	5% - 10%	15% -20%	30% -50%

Table 1

A schematic of a WDICS high penetration wind-diesel system is shown attached. The system configuration will vary widely from application to application, depending on the wind resource and load requirements and on whether the wind turbines are added as a retrofit to an existing diesel plant or installed as part of the initial power plant.

The wind-diesel system generally has six components; wind plant, diesel plant, synchronous condenser, dump load, community load and system controller. Some components are readily available products, others are modified slightly or specifically designed for the application.

Description of Components

l) Wind plant consists of 1 - 10 wind turbines that are connected to the community grid. These wind turbines usually are installed in multiple units for economic (there are usually limited logistics within the small communities to install large turbines) and for power quality reasons (larger number of turbines tend to filter the short term power fluctuations from each wind turbine). Wind turbines are usually equipped with induction generators. These turbines are usually equipped with power factor correction capacitors (PFC's) that provide most of the reactive current required by the induction generator but the diesel genset's voltage regulators are required to provide accurate voltage regulation to the system.

Each wind turbine is equipped with a PLC based control system to monitor key turbine variables and to ensure the unit is removed from service if a problem is detected with the turbine or the grid. Each PLC is connected to provide some information to the main system controller.

2) Diesel plants usually use multiple diesels installed in increasing sizes to enable each unit to operate at peak efficiency at different times and to provide redundancy in the event of diesel failure. Each diesel requires a synchronizer, load controller and voltage regulator. Isochronous control is most common but, in lower cost systems, droop mode control is still used. The operating characteristics of the plan may vary and the diesels may be operated individually or in parallel with load sharing or one diesel may be designated prime and operate at fixed load.

3) Synchronous condensers are required to enable the wind turbines to operate if the diesels are turned off. These synchronous condensers are simply synchronous generators that operate with no active load. Their sole function is to provide voltage regulation to the system with the diesels not connected. Voltage regulators are usually similar to the regulators used on the diesel gensets.

An alternative to synchronous condensers is the use of clutches between the diesels and generators. These clutches (several types may be used) enable the generators to continue to rotate when the diesels are switched off, providing voltage regulation.

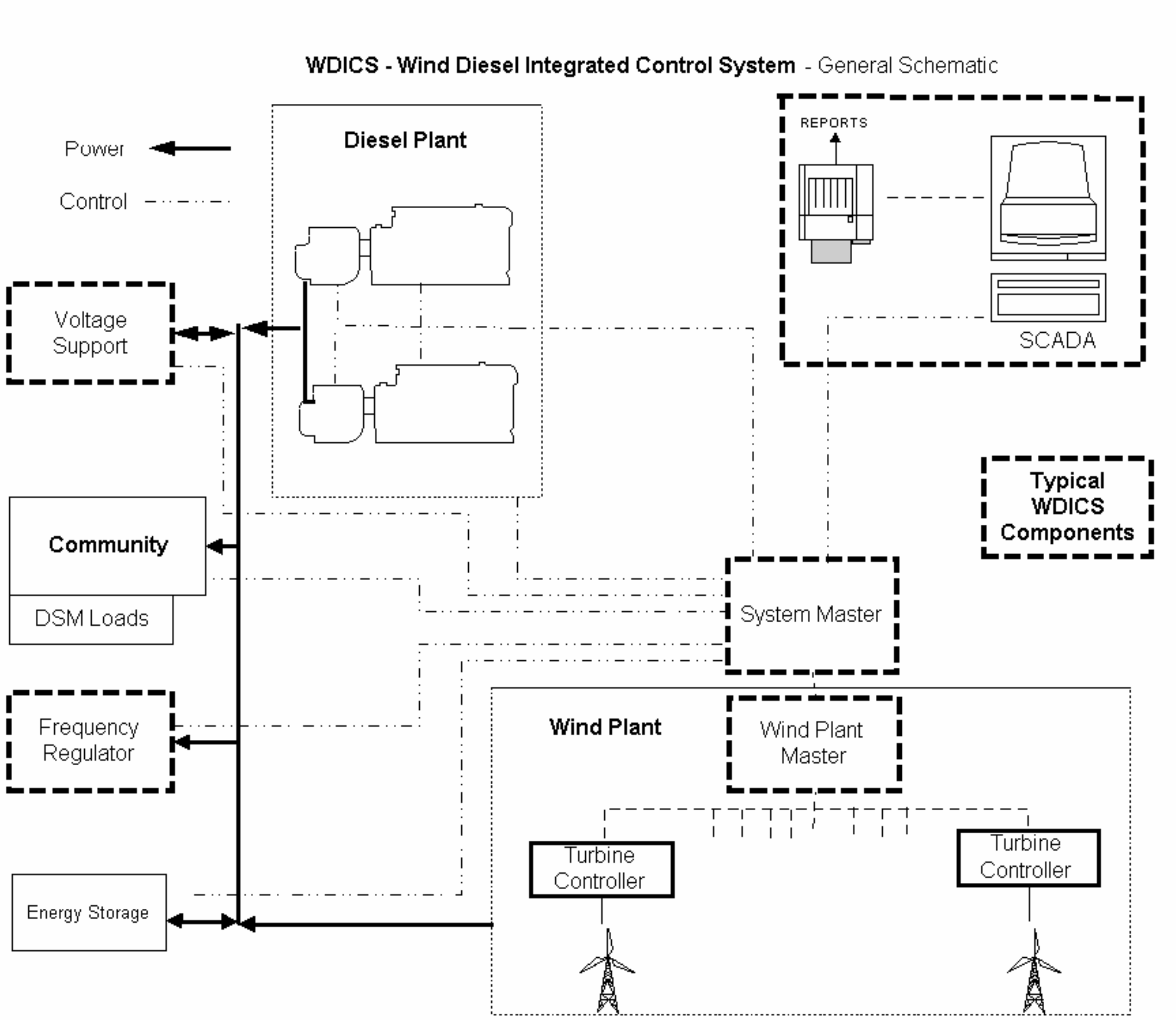
4) Dump load is used to provide frequency regulation when the wind plant is operating with the diesel shut down. The dump load may be a simple load bank that dissipates the electrical energy or it may be used as dispatchable loads, such as building heat, ice making or desalination. Dump load is regulated by a commercial PID controller, but it may be similar or identical to the diesel load controllers if it is cost effective.

5) Community load is the independent variable for which the wind-diesel system is designed to provide reliable and economical electrical power.

6) System controller is the master controller that supervises the complete system operation. For a single diesel the control is very simple and carried out by the diesel controller. As diesels are added and dispatched in an optimized manner, the control becomes more difficult. Adding multiple wind turbines to the system, cycling the diesels off and on, in conjunction with a separate voltage and frequency regulators, makes the system control quite complex.
The system controller will probably be either a mid -range PLC or an industrial hardened computer. It must start and stop the diesels to maintain peak system efficiency, authorize each wind turbine to start, enable the dump load and synchronous condensers (if used) and control the autonomous operation of the system so that reliable power is provided with maximum fuel savings.

Typical System Operation

The system must operate autonomously with the system controller supervising the start of the appropriate diesel and, perhaps, the synchronizing and load sharing as well. Community feeders are connected automatically or manually once the system power is available. As the wind speed increases and the turbines are available for service, the controller authorizes the start of each turbine and regularly monitors the turbine status. The controller provides continuous monitoring of the various system power flows and initiates the starting and stopping of the synchronous condensers, dump load, diesels and wind turbines as required. In more sophisticated systems the controller will predict the energy flow (based on a number of algorithms under development) and perhaps control short term energy storage devices as well.


WDICS - Wind Diesel Integrated Control System - General Schematic
Power
Control
Diesel Plant
REPORTS
SCADA
Voltage Support
Community
DSM Loads
Typical WDICS Components
System Master
Frequency Regulator
Wind Plant
Wind Plant Master
Turbine Controller
Turbine Controller
Energy Storage

APPENDIX III

Atlantic Wind Test Site
North Cape, Prince Edward Island

WDICS - Wind-Diesel Integrated Control System

ADVANCED WIND-DIESEL TECHNOLOGY

1.0 INTRODUCTION

As Canada's national wind energy testing and development laboratory, the Atlantic Wind Test Site, at North Cape, Prince Edward Island has been involved in the research and development of wind-diesel systems for more than ten years. In addition to operating one of the most advanced wind-diesel development test beds in the world, AWTS has been involved in the development of computer models and several operating strategies in that time. Since achieving autonomous operation with the first system in 1987, AWTS has continued to build on that understanding of the technology and has undertaken a number of projects to study the energy requirements in remote communities, to develop control systems appropriate for wind turbines on small grids and to collaborate with industry and other research organizations to further wind-diesel technology.

AWTS has recently developed WDICS, "Wind-Diesel Integrated Control System". WDICS is an advanced wind-diesel control system that will enable wind power systems to be optimally integrated into diesel powered generating systems. It uses a computer based control system to fully integrate the operation of the wind powered generators with the diesel powered generators system into a single system. WDICS offers a complete control package that can be quickly deployed, over a range of penetration levels, into areas where wind-diesel systems are economically viable. The control system can also provide considerable improvements in the control and operation of diesel only generating systems.

With this integrated approach, WDICS provides complete control for a community electrical power supply system, which optimizes the utilization of renewable energy while enabling efficient dispatch of the diesel plant.

2.0 BACKGROUND

Wind-diesel markets are emerging because the technical developments over the last decade are now recognized by the market. Still, economic hurdles remain because wind-diesel installations are usually small and remote and, lacking economies of scale, the costs have been relatively high. These economies of scale can be improved by increasing the numbers of wind turbines installed and significant amounts of diesel fuel can be displaced. This can cause system stability problems, however, at high penetration levels, where the fluctuating wind power levels can affect system frequency and voltage. The key to successful deployment of the technology lies in the control system, which must be capable of maximizing the generation of wind power while maintaining system stability under all conditions.

3.0 WIND-DIESEL SYSTEMS

Synchronous generators driven by diesel engines have been the primary means of generating electricity for small systems for more than fifty years. It is estimated that more than one million diesel gen-sets are presently used around the world to provide electricity for a range of applications. Diesel gen-sets vary in size from a few kilowatts to several thousand kilowatts. For village and remote community power applications, the majority of installations range in size from 100 kW - 1000 kW.

Wind-diesel is the generic term given to energy supply systems that combine diesel powered electrical generators, which provide prime power, with wind turbines, which operate when wind power is available to reduce the load on the diesels and displace diesel fuel. Most wind-diesel applications are for remote communities, such as those in northern Canada and on many small island grids around the world.

The "penetration" of wind-diesel systems can vary from low to high level. In low level penetration, the wind plant provides small amounts of power and energy relative to the total system requirements. At high penetration levels, the wind plant can provide as much as several times the total plant power capacity. For example, in a plant with total installed diesel capacity of 500 kW system and an average load of 300 kW, a low penetration wind-diesel system might have 50 kW of wind turbines, while a high penetration system might have 1000 kW of wind turbines.

For low levels of penetration, there is literally no impact on the diesel plant operation. As wind energy is supplied into the grid the energy, as well as the fuel required from the diesel plant, is reduced. However, because the size of wind plant is small, the total fuel saved is limited.

At high penetration levels, there is a significant impact on the operation of the diesel plant. When the available wind power exceeds the community requirements the system can operate autonomously, with the diesels turned off and the wind plant providing all the load requirements. This maximizes fuel savings. For autonomous wind operation some method of regulating the system voltage and frequency, parameters usually controlled by the diesel, is required. Even at intermediate wind power levels, where the diesels are required to operate to provide a small share of the load, the operation of the plant is affected, since the optimum diesel size for the new operating condition is different than it would be for the diesel only system.

4.0 WIND-DIESEL INTEGRATED CONTROL SYSTEM (WDICS)

Wind-diesel technology has been based on the combination of a number of discrete components that were operated together in a way that the operation of the wind plant did not seriously disrupt the operation of the diesel plant. However, the recent convergence of several key technologies is changing the situation. Wind turbines are becoming increasingly more cost effective, computerized control systems are rapidly becoming more sophisticated and the recent introduction to the market of computerized "Gen-Set Controllers" means that all components of the wind-diesel system can be fully integrated into a single package. WDICS does this and, as a result, the economy of wind-diesel power plants can be improved everywhere.

Figure 1 illustrates the various components of the WDICS system. The primary components are the diesel plant "Gen-set Controllers" (GSC), the Wind Turbine Controllers (WTC), the Wind Plant Master (WPM), the System Master (SM) and the SCADA system.

4.1 Gen-Set Controllers (GSC)

Control systems for diesel generating plants have been traditionally based on analog control technology which has been developed over the last several decades. This technology requires discrete control equipment to monitor and control each variable of the plant operation. Future control systems will rely more on digital control technology that is presently emerging. Several of these "gen-set controllers" (GSC) have already been introduced into the market place and they offer a number of advantages over conventional systems, most notably a reduction in the number of components and reduced cost. A single computerized GSC will perform synchronizing and load sharing functions as well as provide all protective functions (over voltage, phase imbalance, etc.) and continuously monitor all parameters on the system. The GSC's ability to communicate with other segments of the control system provides rapid update on the status of the system and also enables much more comprehensive diagnostics to be carried out and more detailed reports to be automatically prepared. Since the components are low voltage devices, fabricated in high volumes, the costs of these components will be decreased as well.

4.2 Wind Turbine Controller (WTC)

Each wind turbine in the wind plant is supervised by their Wind Turbine Controller (WTC), an autonomous controller that has the intelligence to monitor a number of subsystems and to safely start and stop the wind turbine as required. To be effective in a wind-diesel system, the WTC must be utilized in a manner that optimizes system operation. To do this, it has the ability to communicate with the system controller so that it can be regulated as the system requires and so that it can keep the system operator fully advised of the operating status of the turbine.

4.3 Wind Plant Master (WPM)

The wind plant consists of a number of wind turbines and, because it is often some distance from the diesel plant, a "Wind Plant Master" (WPM) is used to consolidate the information from the wind turbine controllers and to provide supervisory control on the wind plant. The WPM is in continuous communication with each WTC and continuously monitors the overall operation of the wind power plant. It is also in regular communication with the "System Master" reporting on the status of wind plant and receiving instructions for the supervision of the wind plant.

4.4 System Master (SM)

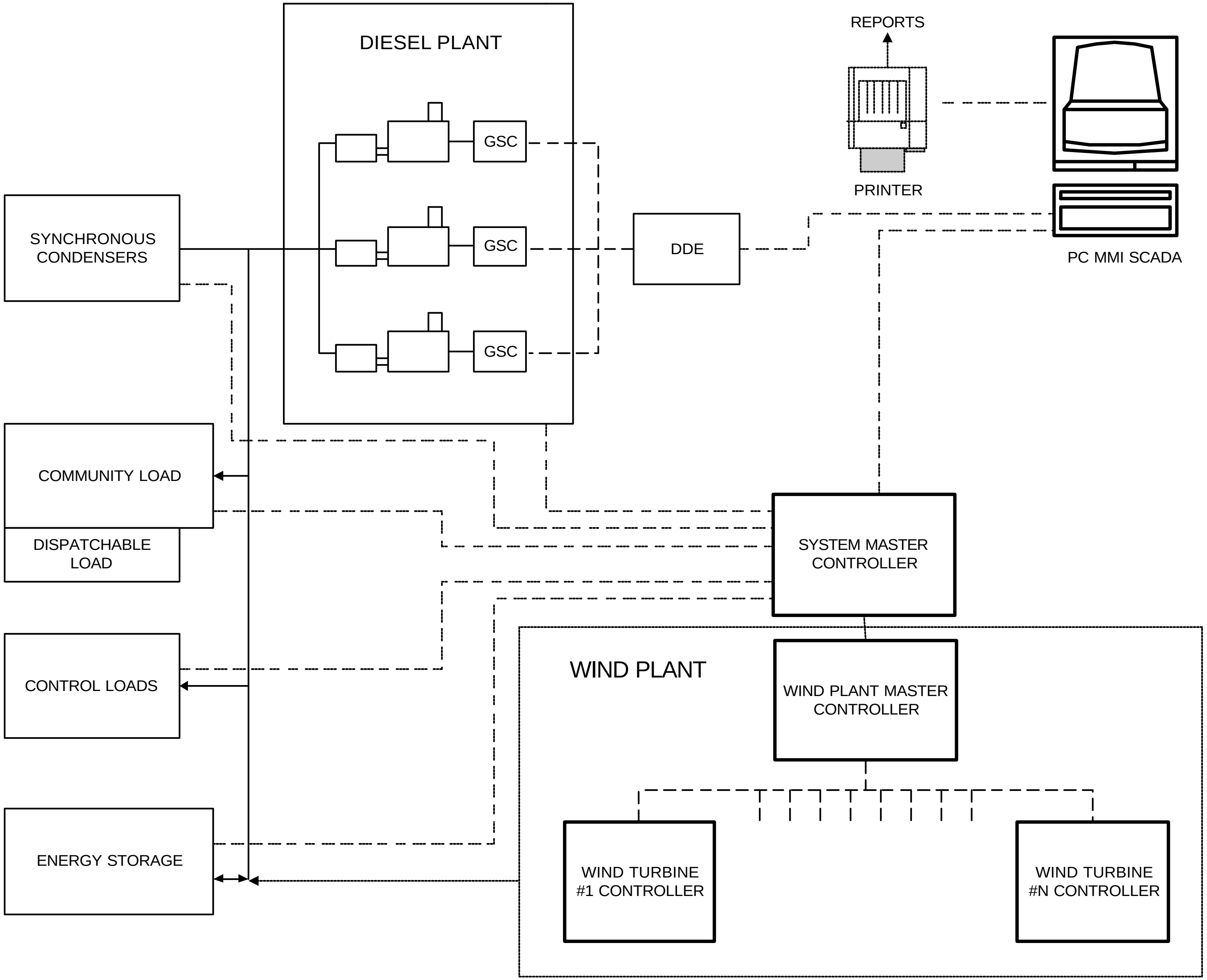
The "System Master" is responsible for the overall control of the power plant. It controls the dispatch sequence of the diesel plant, permits the operation of the wind plant and regulates any of the control loads that are required. The system operator has the ability to modify the system control parameters by interfacing with the SM through the SCADA system.

4.5 SCADA

The Supervisory Control and Data Acquisition (SCADA) system is the point of Man-Machine Interface (MMI). From the computerized SCADA system, the operator can access all areas of the system to check system status, to prepare reports or to modify the operational characteristics of the system. The MMI to be operated from a computer, which may be located within the power plant or remotely, either in the community or across the country. This greatly increases the ability of the system operator to monitor and optimize the operation of the generating plant.

On the SCADA primary screen, the operator can check the status of the system, including the wind plant, the diesel plant and the community feeders. By clicking on a particular wind turbine a more detailed, 'Wind Turbine Detail Screen" pops up and displays the operating details on each turbine as requested. Similar detailed screens are available for other sub-systems. The operator may also request a number of reports, to summarize the operation of the system. An authorized operator may access a configuration screen to define the operating characteristics of the system (modify the dispatch sequence of diesels, shut down wind turbines, etc.). The capability of the SCADA system is continuously evolving as technology improves.

WDICS - WIND DIESEL INTEGRATED CONTROL SYSTEM



Atlantic Wind Test Site Inc.
North Cape, PEI
C0B 2B0 Canada
WDICS 1/3

Appendix IV

An Annotated Summary of Bird Studies
Prepared by Carl Brothers, July 7, 2003

Potential Impacts of Wind Turbines on Birds at North Cape,
Prince Edward Island
A report for the Prince Edward Island Energy Corporation
13 December 2001
Andrea Kingsley* & Becky Whittam
Bird Studies Canada, Atlantic Region

Note: This report describes the likely impact of a wind plant on birds in the North Cape Area of PEI. This report is significant because Ramea and North Cape are similar environments in many ways. Both are highly exposed to the marine environment with a large presence of sea birds. Both are at identical latitudes. And they are both offer harsh environments that are not conducive to wide spread bird nesting. The complete report can be downloaded from: www.bsc-eoc.org *Some excerpts from the report follow:*

" The breeding bird fauna of North Cape is poor relative to areas elsewhere on Prince Edward Island. According to Erskine (1992), only 27 bird species were believed to breed at this site from 1985-1990 (Table 1), compared to 133 known breeding species for the Island as a whole (Hogan 1991). Of the species known to breed in the North Cape area, five are considered provincially rare (S1-S3; Atlantic Canada Conservation Data Centre 2001). These are discussed in Section 2.3. No colonial nesting species are known to breed at North Cape. It is likely, in the absence of recent survey data, that breeding bird populations at North Cape are low in both species diversity and abundance."

" North Cape is not considered by the Canadian Wildlife Service to be a major staging area for migrating birds (PEI Energy Corp. 2000). However, being a point of land, many species may use it as a navigational point, passing through the area during spring and fall migration."

" Seabirds spend much of their lives in marine environments, generally coming no further inland than the shore. With the exception of gulls, this is true for all seabirds likely to pass by or breed at North Cape. Indeed, only two seabird species have been known to breed at North Cape (Table 1), neither of which is colonial. These are Great Cormorant Phalacrocorax carbo and Black Guillemot Cepphus grille. Seabirds seen at North Cape are most likely to be flying or swimming offshore, and most are unlikely to be affected by the wind facility."

"Numerous studies have shown that most migrating and wintering bird species alter their flight paths to avoid turbines"

" Wind turbines will have little impact on cormorants, waterfowl and shorebirds. These birds appear to exhibit avoidance behaviour to such an extent that there has been essentially no mortality recorded, including areas with high use by, and density of, these species (Rogers et al. 1977, Howell & Noone 1992, Still et al. 1994, Colson & Associates 1995, Mossop 1998). Additionally, these species generally restrict their movements to areas offshore and along the shoreline. Turbines placed even slightly inland, as are most of the turbines at North Cape, should not pose a threat (Howell & Noone 1992)."

" Songbird mortality is greatest for low-flying birds on migration and generally occurs during poor weather conditions when birds are attracted to aircraft warning lights, become disoriented, and fly into the tower or nearby wires (Moorehead & Epstein 1985). The chance of collision with turbines is significantly increased if the blade height is above 150 m (Rogers et al. 1977). The turbines at North Cape are about 73 m from rotor tip to the ground, well below the critical height of most migrating songbirds."

" The chance of endangered or threatened species being killed by the turbines at North Cape is low, given their relatively low regional population sizes and overall scarcity at this site. As mentioned in Section 2.3, there are several species of special conservation concern in this area, four considered nationally rare and three considered provincially rare. They are discussed below. One species not mentioned is the Barrow's Goldeneye (Bucephala islandica), which may, on rare occasions, fly past North Cape but, like the Harlequin Duck, is probably not in any danger of collisions with the wind towers unless it strays inland."

" 4.3.2 Harlequin Duck (COSEWIC - Special Concern)
The Harlequin Duck should not be affected by wind turbine operations. This species is occasionally found at North Cape during the winter months along the shoreline and in offshore waters (D. Busby, G. Martin, pers. comm.). Generally, the species is not expected to come inland and even if it did, it would probably show avoidance behaviour like other species of waterfowl (Rogers et al. 1977, Howell & Noone 1992, Still et al. 1994, Mossop 1998). However, disturbance may be a concern if wind turbines closest to the shore disrupt roosting behaviour. This possibility should not be overlooked."

" 7.0 Summary
With the exception of Altamont in California, most research has shown that bird mortalities at wind energy facilities are not biologically significant at the local or regional level, or with respect to migratory populations. The chance of bird collisions occurring on days with good visibility is low (Crockford 1992). The probability of significant casualties at wind power operations appears to be site- and species-specific. As Colson and Associates (1995) state, "the most important step that can be taken to avoid future adverse bird interactions is to locate facilities based on careful siting studies and away from critical habitat." Most studies seem to reach the same conclusion: impacts are not likely to be significant if wind turbines are located in areas of poor habitat, low bird densities and without significant populations of susceptible species of high conservation importance (Crockford 1992)."

Incidence of Bird Mortality From Collisions with Wind Turbines
North Cape Wind Farm, Prince Edward Island,
PEI Energy Corporation December 2002

Note - This report is significant because it summarizes the findings at the North Cape Wind Plant after two migrating seasons. The results are that only one birds was found to be killed during the two migrating seasons by the 5,280 kW wind plant. The report is currently in draft form only and may be available by special request to the PEI Energy Corporation. Some excerpts follow.

"The PEIEC contracted Bird Studies Canada through their Sackville, New Brunswick office to prepare a report that investigated potential impacts of the facility on birds at North Cape. In their report, **Potential Impacts of Wind Turbines on Birds at North Cape, Prince Edward Island**, Kingsley and Whittam (2001) concluded that the establishment of the wind turbines would cause minimal disturbance to the bird populations in the area if forest clearing was minimal and human activity was limited to maintenance activity. It was further stated that offshore waterbirds, that include the Harlequin Duck (COSEWIC - Special Concern), would not be impacted.

However, to confirm the conclusions of their report, the contractor was also instructed to design a protocol that would be used to document bird mortality from the wind farm's turbines. The Canadian Wildlife Service provided input to the design of this mortality sampling program. Description of the protocol that has been implemented for monitoring turbine-induced, avian mortality and the results for the first year of the study has been provided in this report."

"With the eight turbine locations and four control points, a total of twelve survey points were sampled on a twice weekly basis, starting on May 14, 2002 and continuing through to June 13, 2002 to coincide with the Spring migration. Outside this time frame, through to the end of November 2002, only bi-monthly sampling was performed as this was considered the maximum time to provide a reasonable assessment of mortality through a carcass search. As noted by Morrison (1998), 80% of mortalities are scavenged within a two-week period.

Surveys were conducted at dawn so that any mortality could be observed prior to being removed by scavengers. Turbines were visited on a random basis, although each turbine point and its corresponding control point were sampled successively."

"During the course of the North Cape avian study, two mortalities were recorded. Only one of these deaths was characterized as a probable turbine-induced mortality as the other dead individual was found in a control area. The results are consistent with the report, ***Potential Impacts of Wind Turbines on Birds at North Cape, Prince Edward Island***, in which no significant level of mortality was expected. The results also concur with anecdotal accounts from staff of the Atlantic Wind Test Site, an adjacent operation that has been testing various wind machines since 1981, who have yet to witness an avian collision with their turbines."

National Wind Coordinating Committee Reports

" The National Wind Coordinating Committee is an American consensus-based collaborative formed in 1994, the National Wind Coordinating Committee (NWCC) identifies issues that affect the use of wind power, establishes dialogue among key stakeholders, and catalyzes activities to support the development of an environmentally, economically, and politically sustainable commercial market for wind power."

Note: The NWCC has a number of documents related to wind turbine / bird interactions and has taken a leadership role in challenging the wind industry to make the necessary changes to the technology deployment to resolve outstanding concerns related to the technology. A number of their excellent publications can be downloaded from their web site at http://www.nationalwind.org/pubs/ *A few points from their documents follow:*

From: **AVIAN/WIND TURBINE INTERACTION: A SHORT SUMMARY OF RESEARCH RESULTS AND REMAINING QUESTIONS**

Birds and bats sometimes die in wind farms as a result of collisions with wind turbines and meteorological towers (and their supporting guy wires).

- Studies have demonstrated that wind farms with low avian usage have few avian fatalities.
- At those wind resource areas where studies have been conducted, an average of one to two bird kills per turbine per year is at the high end of the range of fatalities recorded during studies of operating wind farms. For some wind farms studied, no bird fatalities have been recorded. The frequency of raptor deaths at Altamont Pass, a large wind development area in northern California, has focused public attention on wind energy's impact on birds. Altamont is the only wind farm location with high, year-round use by raptors, a substantial prey base, and thousands of densely packed, early-generation turbines. The frequency of raptor deaths there is much higher than at other wind farm sites where monitoring of fatalities has been conducted.
- An initial avian site evaluation conducted in tandem with the assessment of the wind resource of a potential wind plant can identify whether wind power development at a particular site is likely to cause a significant number of bird fatalities.

WHAT CURRENT STUDIES IMPLY

- Although the fact that birds are present at a site does not necessarily mean that wind power development there would put them at risk, the weight of evidence to date indicates that locations with high bird use, especially by raptors or protected species, are not suitable for wind farm development.
- Compared with other avian species, raptors appear to be disproportionately vulnerable to collisions with wind turbines. The reasons for this are not fully understood. However, in the Altamont Pass, the specific location of individual turbines in relation to terrain features (for example, the positioning of turbines on the edge of hills, or at points within wind farms that intersect common bird flight

paths) and the existence of a large prey base within the wind farm appear to be factors.

? To date, the only known U.S. wind-development location that has experienced significant avian mortality is California's Altamont Pass.

? Evidence to date indicates that wind turbines are unlikely to present a local or regional population threat to migrating birds. Most migratory flights are conducted at levels above today's typical turbine heights, except during inclement weather conditions with poor or zero visibility. However, as turbine heights increase and aviation lighting requirements evolve, migratory-bird impacts need to be carefully monitored.

From: **Avian Collisions with Wind Turbines:**
" It has been estimated that from 100 million to well over 1 billion birds are killed annually in the United States due to collisions with human-made structures, including vehicles, buildings and windows, powerlines, communication towers, and wind turbines. Although wind energy is generally considered environmentally friendly (because it generates electricity without emitting air pollutants or greenhouse gases), the potential for avian fatalities has delayed and even significantly contributed to blocking the development of some windplants in the U.S. Given the importance of developing a viable renewable source of energy, the objective of this paper is to put the issue of avian mortality associated with windpower into perspective with other sources of avian collision mortality across the U.S.

We have reviewed reports indicating the following estimated annual avian collision mortality in the United States:

- Vehicles: 60 million - 80 million
- Buildings and Windows: 98 million - 980 million
- Powerlines: tens of thousands - 174 million
- Communication Towers: 4 million - 50 million
- Wind Generation Facilities: 10,000 - 40,000

The large differences in total mortality from these sources are strongly related to the differences in the number (or miles) of structures in each category. There are approximately 4 million miles of road, 4.5 million commercial buildings and 93.5 million houses, 500,000 miles of bulk transmission lines (and an unknown number of miles of distribution lines), 80,000 communication towers and 15,000 commercial wind turbines (by end of 2001) in the U.S.
However, even if windplants were quite numerous (e.g., 1 million turbines), they would likely cause no more than a few percent of all collision deaths related to human structures."

"Data collected outside California indicate an average of 1.83 avian fatalities per turbine per year, and 0.006 raptor fatalities per turbine per year. Based on current projections of 3,500 operational wind turbines in the U.S. by the end of 2001, excluding California, the total annual mortality was estimated at approximately 6,400 bird fatalities per year for all species combined. This estimate includes 400 house sparrows, European starlings, and rock doves, and 20 raptor fatalities per year."