REGISTRATION PURSUANT TO SECTION 7 OF THE ENVIRONMENTAL ASSESSMENT ACT

For the

ST. LAWRENCE WIND DEMONSTRATION PROJECT

Submitted by:

THE NEWIND GROUP

November 16, 2001

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1 NAME OF THE UNDERTAKING AND PROJECT PROPONENT

1.1 Name of the undertaking

St. Lawrence Wind Power Demonstration Project (5 to 25 MW)

1.2 Proponent

i)	Name of Corporate Body:	**The NeWind Group** Joint Venture formed of: CHI Hydroelectric Company, QuadraTec Inc. and fga Consulting Engineers
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For the purpose of developing the Wind Demonstration Project, a joint venture between CHI Hydroelectric Company Inc. (together with its affiliated companies "CHI/ERGA"), QuadraTec and *fga* Consulting Engineers Limited has been formed under the name of the

Newfoundland Wind Group ("NeWind Group"). The objective of the joint venture is to combine the technical and financial expertise of each firm to create synergy aimed at the transfer of wind power technical knowledge to the province of Newfoundland. The NeWind Group is committed to the development of the Wind Demonstration Project and to the development of a wind power expertise in Newfoundland.

1.3 CHI Hydroelectric Company Inc. – Part of the CHI / Erga Group of Companies

CHI Hydroelectric Company inc. is a Newfoundland Corporation active in the development and operation of renewable energy projects. CHI has been active in Newfoundland since 1993 with the development of the Star Lake Hydroelectric Project, in Partnership with Abitibi-Consolidated Inc. CHI is part of the Erga group of companies, the world's largest renewable energy company based in Italy. Erga has a generating capacity of more than 2,300 MW and produces approximately 7.5 billion kWh annually. Erga's geothermal, small hydro, wind and photovoltaic energy generation is sufficient to supply the electricity needs of about 3.5 million homes.

Erga is the wholly owned renewable energy subsidiary of Enel, the main electricity company in Italy and the world's largest traded utility with over 29 million customers and 56,000 MW of installed capacity.

Erga's North American affiliates, represented by the CHI Energy group of companies, owns and manages a portfolio of renewable energy projects across the United States and Canada with a total generating capacity of 284 MW, plus 23 MW under construction and several other projects under development. CHI Energy's projects are located in 15 U.S. states and two Canadian provinces, with concentrations in the northeastern, southeastern and western United States and eastern Canada. CHI Energy's diversified portfolio of renewable energy projects includes hydropower, biomass, landfill gas, wind and other clean energy generation technologies.

As a whole, the Erga group has developed, owns and operates 115 MW of wind power representing more than 150 commercial type wind turbines. Another 270 MW are currently under development. Active since 1984 in the research and development on wind energy, Erga has developed sound research and operational experience in wind turbine operations with two wind testing facilities and five installed wind farm projects.

1.4 QuadraTec Inc.

QuadraTec was incorporated in 1993 and today represents one of Atlantic Canada's leading mechanical and electrical engineering firms. The firm counts on the combined experience of the principals, which represents more than 100 years in the electrical and mechanical engineering fields.

QuadraTec's principals have extensive experience in energy related projects, ranging from energy conservation in the commercial, industrial and institutional building sectors, to involvement in the Cat Arm Hydroelectric project.

In the alternative energy field, QuadraTec's experience includes:

- Solar power
- Energy from waste
- Energy from peat
- Geothermal heat pumps
- Cogeneration.

QuadraTec also has demonstrable experience in several other areas applicable to this project including electrical distribution, protection and control, microwave communications and process control.

1.5 fga Consulting Engineers Ltd.

fga Consulting Engineers Limited is a wholly owned and operated Newfoundland firm established in 1983 and active primarily in the fields of structural/civil/mechanical engineering. The firm provides a diverse array of multidisciplinary engineering consulting services in the areas of:

- structural engineering
- welding engineering
- QA/QC services
- civil, marine, prime consulting
- non-destructive examination/materials engineering

fga Consulting Engineers Limited is based in St. John's; the firm is also working throughout Atlantic Canada with projects in Nova Scotia and New Brunswick.

In 1991, *fga* entered into a Joint Venture with CANSPEC Group Inc. to provide extensive NDT/Inspection capability for a consistent and conscientious service by a team of engineers and inspection specialists in the field of non-destructive examination.

The principals of *fga* have an extensive combined experience in the energy sector, most notably in the fields of hydroelectricity and tower design and inspection. The firm has designed and constructed numerous navigational towers for the Canadian Coast Guard, designed protective structures below communications towers and inspected 200-foot high towers in Labrador.

2 RATIONALE AND NATURE OF THE UNDERTAKING

2.1 Rationale for the Undertaking

2.1.1 A Wind Demonstration Project Initiated by NLH

Wind power is currently the fastest growing form of energy generation in the world. Wind power technological advances in the last decade have resulted in increasing reliability with availability rates exceeding 98 % and in cost reduction in excess of 50 %. Growth of installed capacity has averaged 32 % during the last five years and in 2000, a total of 4,600 MW was installed for a total worldwide installed capacity of close to 18,000 MW. Canada, while presenting an excellent wind resource potential, has been slow to recognise the benefits of wind power, which still takes a back seat to traditional energy generation methods.

Through the call for proposals for a Wind Demonstration Project, Newfoundland & Labrador Hydro’s (NLH) primary objective is to obtain, at reasonable cost, assurance that current wind generation technology can operate successfully at a representative site in the Province. In doing so, NLH has shown an interest and a willingness to explore the development of wind power as part of its energy portfolio. NLH has also recognised the complementary nature of wind power and hydroelectric facilities, as well as the need for reducing greenhouse gases, through a reduction in its dependence on fossil fuels.

The purpose of the demonstration project is essentially to establish the reliability and durability of wind turbines in Newfoundland’s climate while valuing their performance in providing electricity to the grid. The electricity being generated will also provide a minimal but valuable contribution to Newfoundland's current generation system as an alternative green energy source without significant negative environmental effects. Thirdly, the feasibility supporting the project will provide insights into the correlation between the availability of wind energy and the load profile of the utility.

2.1.2 A Flexible Source of Energy Generation

The modular nature of wind energy projects makes it a very flexible generation option. The potential for a progressive installation and operational adaptation makes wind power a flexible alternative to conventional energy sources. Also, an interconnection point at the Laurentian substation could allow for future expansion of the wind power plant without major system upgrades.

The lead-time required for installing wind energy systems is very short in relation to other conventional energy sources. It is reasonable to consider an in-service date of 8 months following the signing of a Power Purchase Agreement (PPA) for the proposed wind power demonstration project to begin operations.

The first wind turbines could be delivered within a 6-month period from the date of order and up to 6 turbines could be delivered per week. The construction time period is also quite short, as the civil works required for wind turbine installations are of standard design and relatively straightforward.

2.1.3 A Renewable Energy Alternative

In addition to providing diversification to NLH's generation mix, the proposed wind farm installation(s) will make a significant contribution to the goal of reducing greenhouse gas and other detrimental emissions.

An initial evaluation shows the electricity supplied would primarily displace fossil fuel generated electricity and in this manner avoid substantial amounts of emissions. At an anticipated average annual production of 80,000 MWh for a 25 MW demonstration project, the annual pollution from the combustion of more than 20,000,000 litres of fuel oil could be avoided. This would represent a substantial reduction in greenhouse gas emissions, equivalent to approximately 60,000 tons of CO_2 annually.

The Kyoto Protocol has resulted in a marked increase in the development of green renewable energy generation both in Europe and North America. Local, provincial and federal governments all realise some form of accountability of greenhouse gas generation within their territory will be required. A few government agencies are leading the way and actively developing programs to promote the reduction of greenhouse gas emissions. In 1996, the Federal Minister of Natural Resources announced the Government of Canada would embark on a green power procurement program in order to work towards complying with Canada's greenhouse gas emission reduction target. This program is especially directed at provinces and utilities with a large percentage of fossil fuel fired generation on the grid. In its 2000 federal budget alone, the Canadian government targeted PEI and Saskatchewan for a total of 15 million dollars earmarked for government procurement of green energy.

2.2 Nature of the Project

2.2.1 The Wind Resource in Newfoundland

According to the long-term Environment Canada weather station data available for the island, Newfoundland has one of Canada's, if not one of the world's, best wind resources. Currently, no other area in Canada capable of being connected easily to a transmission or distribution grid could even be considered as having a wind generating capacity potential similar to Newfoundland's. With net capacity factors for specific sites reaching over 35% and with falling capital costs for an environmentally acceptable energy source, wind power generation should be considered as an efficient and promising form of alternative energy for the province of Newfoundland and Labrador.

2.2.2 The Site Selection Process

A GIS-based screening process was developed and implemented to identify the areas of greater potential for wind power development. However, before this process was initiated, a detailed theoretical wind model was developed for the island of Newfoundland to identify its wind potential. This exercise was validated using Environment Canada weather station data across the island. A wind map of the island was produced and identified the various wind potentials and the areas of interest for a wind demonstration project. Note that this map contains proprietary information and hence is not been included.

To select the potential sites, the following selection criteria were used:

Variable	Description
Land Use	Suitable land use is defined as not including native lands, land with high archaeological potential, parks, fauna/flora reserves, or any other protected or regulated areas.
Wind Regime	Suitable wind regime is defined as having an average wind speed of 7.0 m/s or higher at 50 m above ground level.
Ice Regime	Suitable ice regime is defined as causing energy production losses of 10 % of less.
Grid Proximity	Suitable grid proximity is defined as areas within 20 km of a transmission line.

Candidate sites were screened on a 2-tier level. Once the sites having the above characteristics were identified, they were retained as potential sites for the Wind Demonstration Project. The next step in the screening process consisted of ranking the short-listed sites according to a number of criteria related to the development of a wind power project, and thereby identifying the site offering the highest potential for the Wind Demonstration Project. The criteria used are presented in the table below.

Meteorological Wind regime (average wind speed) Icing severity (production losses) Marine corrosion (distance from sea) **Land Use** Size of developable area (km^2) Land ownership Land cover Compatibility with existing land use **Environmental** Proximity to bird habitat or migration route Deforestation requirements Impacts of road construction	**Social** Tourist potential (proximity to existing point of interest) Visibility to NLH customers (population within 100 km) Noise impact Visual impact **Utility Interconnection** NLH or NP service area Proximity to grid **Ease of Construction and Operation** Road access (seasonal, year round) Construction & shipping access Proximity to services, labour Suitability of topography Suitability of soil type

Based on the results of the pre-selected site screening and rating process, the NeWind Group selected the area northwest of St. Lawrence, in Burin Peninsula, for the project. The location presents a high wind potential, with the Environment Canada data indicating an average wind speed in the 8.5 m/s range at 50 metres above ground leading to a capacity factor greater than 35 %. The energy losses resulting from icing in this area are estimated to be in the 5-10 % range. This site is thus representative of the basic climatic conditions experienced in Newfoundland and shows good wind power potential.

Figure 1. Location of Selected Cities in Newfoundland.

The area is in close proximity to a 69 kV transmission line that loops in the Burin Peninsula. The soil and climatic conditions in the area result in a landscape featuring very little forested areas. Shrubs and grasses are the site's predominating vegetation.

The site also provides clear economic development potentials, being in close proximity to the St-Pierre et Miquelon islands, a popular tourist destination. The towns of Marystown and Burin also provide an industrial and services infrastructure that will benefit the development of the project. Finally, the environmental and regulatory screening has identified no areas of conflict with existing land uses, restrictions or identified parks or reserves.

3 DESCRIPTION OF THE ST. LAWRENCE WIND DEMONSTRATION PROJECT

3.1 Wind Demonstration Project Description

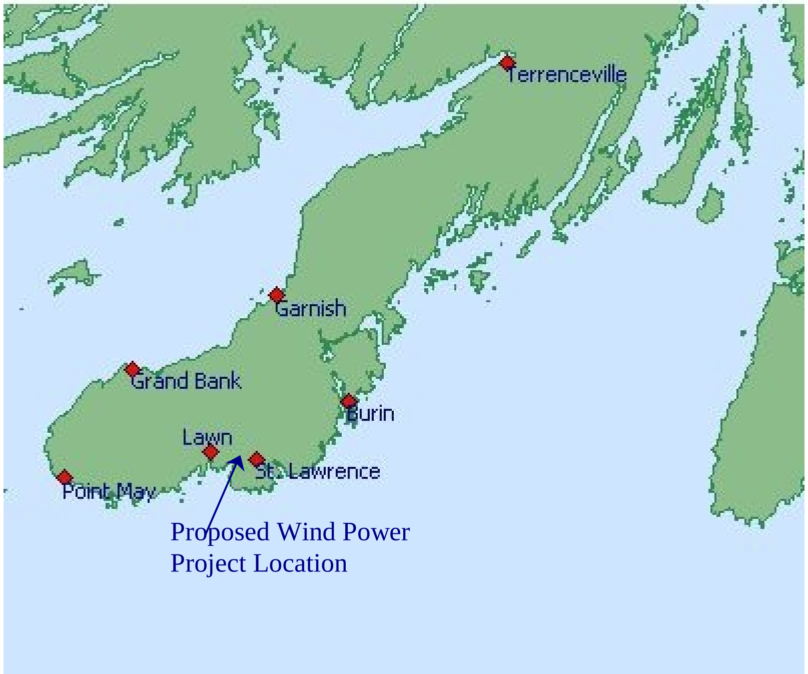
The NeWind Group proposes to implement a 5 to 25 MW wind generation demonstration project consisting of up to 50 wind turbines with an individual rated capacity ranging between 500 kW and 1.8 MW. The wind turbines are horizontal axis, three bladed wind energy converters, with a maximum hub height of 75 metres. Their rotor diameter will be between 40 and 54 metres.

The NeWind Group is currently considering a choice of wind turbine suppliers to provide the equipment most adapted to Newfoundland's climate and with a proven track record for reliability and availability. The final decision on the model selected will be based on a well-proven design and demonstrated operating records. Also, wind-monitoring activities have been undertaken since mid-summer 2001 to collect data in order to establish the particular characteristics of the wind turbine most suited to the prevailing wind and climatic conditions in the St. Lawrence area.

The site chosen for the wind farm is located in the lower elevations of the Burin Peninsula, northwest of the town of St. Lawrence (see Figures 2 and 3 for site location), to the north and south of Route 220. The relatively smooth terrain along with the unobstructed and exposed areas will allow the wind to approach the wind turbines without reduction in intensity and interference by human or natural obstacles.

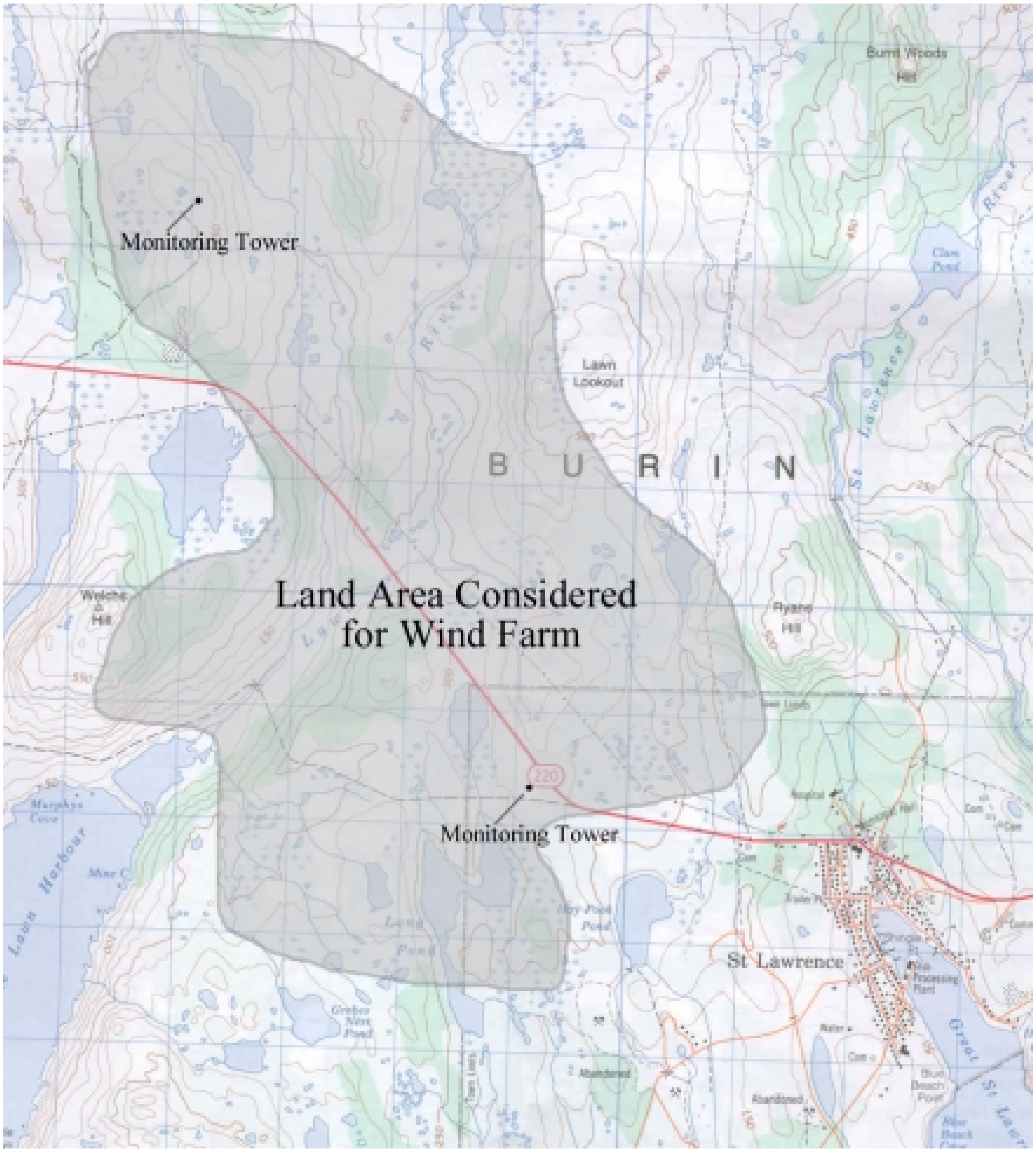
A more precise location for the wind turbine units within the St. Lawrence area will be determined based on wind monitoring data obtained through NeWind wind monitoring stations (installed in July and October 2001). These two stations consist of a 50-metre tall tower with wind measurement instruments at the 10-m, 30-m and 50-m levels. The wind measurements obtained will specify the area's wind characteristics, required for turbine design, turbine siting and energy generation calculations. The data so obtained will be compared to the Environment Canada long-term station in the vicinity for the same time period.

Figure 2. Location of Selected Cities in Burin Peninsula.



Data obtained during the same time period from both the monitoring station and the Environment Canada weather station will be correlated. This will allow an extrapolation of the historical wind data, provide an estimate of the relative long-term wind potential and establish an energy generation curve for the proposed site. The exact location of the wind turbine units will depend on the results of this correlation exercise, as well as on the specific characteristics of the wind turbine model selected and other environmentally dictated location factors (presence of streams or bogs, road access, visibility, etc.). For this reason, the area requested for permitting appears somewhat extended from the area actually required for turbine placement. Once the micro-siting process is completed, the final turbine array layout and site plan will be submitted for information to the Department of Environment. For the time being, a potential layout is included in Figure 4. It is important to note this layout is subject to change once all the required information is gathered and analysed. For instance, the exact number of turbines will depend on the size of the wind turbine model selected and on the size on the power purchase agreement to be negotiated. Typically, the wind turbine foundations and service roads occupy less than 2 % of the land over which the wind farm spreads.

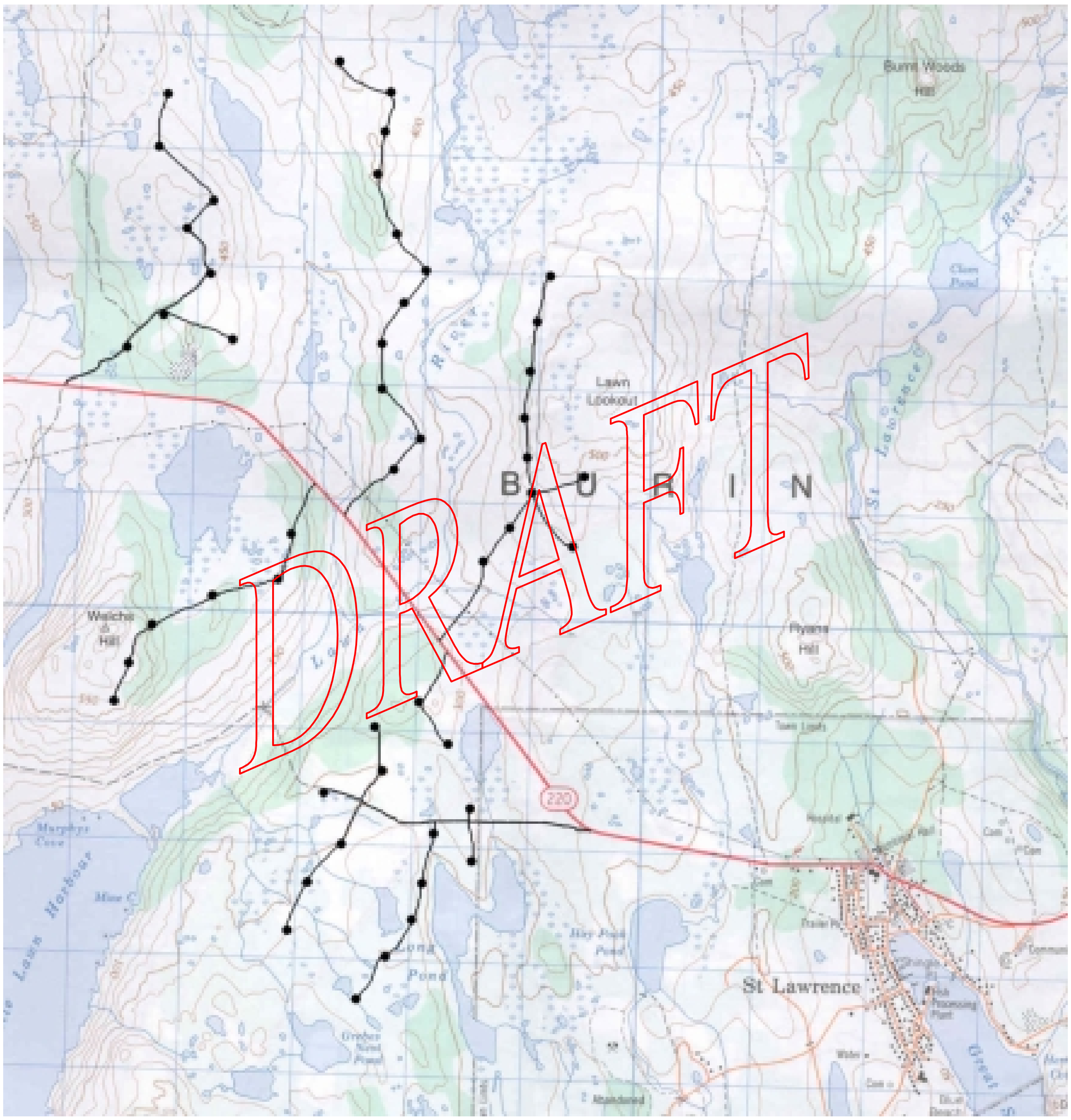
Figure 3. Proposed location of demonstration wind power project.



Interconnection could be accomplished at Newfoundland Power's Laurentian Substation, located within the town of St. Lawrence boundaries, or through a tap on either the 69 kV or 25 kV line adjacent to the project area.

The NeWind Group has initiated discussions with the Department of Government Services Crown Lands Division to secure the land rights and ensure the possibility of installing the wind turbines along with the required access roads and electric transmission lines. Following the establishment of the more precise location for the wind turbines, an application for the required land leases will be submitted to Crown Lands.

Figure 4. Potential Wind Farm Layout of the Proposed Wind Power Demonstration Project.



3.2 Wind Resource Assessment

The NeWind Group has conducted a preliminary assessment of the wind potential throughout Newfoundland based on a review of the topographic features of the island and on available Environment Canada weather station data. This technical pre-feasibility exercise identified a number of locations throughout the island with excellent wind power potential. The coastal regions of Newfoundland appear to provide promising wind power locations as winds are relatively strong, over 9 m/s, relatively constant and have a high wind power output.

St. Lawrence was selected as a choice site based on its above average rating in the above categories. A wind resource consultant completed an initial review of the past years' regional weather data. This analysis has confirmed an excellent projected average wind speed for the area. A site visit earlier this year confirmed the quality of the site for wind power generation. The site visit also confirmed the excellent wind exposure and the close proximity to the existing utility substation, making it a prime candidate for wind power generation. The relatively even and sparsely vegetated landscape minimises ground turbulence.

In early July 2001, the NeWind Group installed a first tower with wind monitoring instruments. The measurements obtained will provide site-specific wind data and will allow a more precise assessment of the site's wind characteristics. The measured wind speeds are expected to demonstrate even better quality winds than the regional weather station data has shown. Since the installation of the first monitoring tower in July 2001, the average wind speed is 7.5 m/s. This is slightly higher than Environment Canada's St. Lawrence station average for the same months. A second tower was installed in October and will provide the additional information required for the micro-siting of the wind turbines within the proposed project area.

A cursory analysis of the wind data indicates a capacity factor of approximately 40% can be expected for this site. Currently, industry standards indicate good potential sites have an average capacity factor ranging between 25 and 35%.

3.3 Geographical Location

The site chosen for the Wind Demonstration Project is located approximately 1 km northwest of the town of St. Lawrence, and follows Route 220. The areas considered are located to the north and to the south of Route 220 (see Figure 3). The maximum elevation of the site is 170 m above sea level.

The location of the individual wind turbines will consider a minimal spacing of 150 metres between each unit, to reduce wake losses, with minimal access roads being required, as access will be mainly by the adjacent route 220. The turbines will be sufficiently distant from the closest residences to minimise or negate any impacts, and will be located almost entirely on barren ground (see Figure 6 for visual simulation). The turbines will also be located at least 200 metres away from Lawn River, a scheduled salmon river, in order to avoid any negative impacts on the river. A large portion of the proposed project is drained by this river, hence the importance of preventing any negative impacts.

The presence of the wind farm should present no conflict with existing land uses and potential farming and forestry land uses. The site of this facility shows very little signs of being extensively used and is noted to be only infrequently used for berry picking, hiking, fishing, and similar pursuits. The presence of well-spaced turbines will not impact these uses. However, the gravel roads required to access the wind turbines, along with the proximity of Route 220 may enhance access to the area for the local residents and tourists.

3.4 Physical Features

3.4.1 Topography and Vegetation

The topography of the area is flat to rolling hills and ridges, with no mountains. On this land, barrens, blanket bogs and tuckamoor dominate (Meades, 1990). A site visit has shown the most common vegetation species are heath moss, empetrum heath, black and pink crowberry, blueberry, bottlebrush and alder. The scrub/tuckamoor forest in the Welch's Hill area, which is located at the western end of the southern portion of the proposed project area, was burned in 1985. The regeneration occurring appears to be barren/heath vegetation. While orchids are said to be found in the wetland areas south of the fluorspar mine, no field investigation of flora was performed, as most plants do not flower in the fall. Such investigation will be conducted prior to construction when plants are in full bloom.

3.4.2 Climate

The area is considered part of the Eastern Hyper-oceanic Barrens (Meades, 1990). The summers are cool, with an average of 12 degrees C, and the winters mild, at –4 degrees C. The area also experiences frequent and persistent fog. Yearly precipitation typically ranges between 1250 to 1450 mm.

3.4.3 Resource and Land Uses

The St. Lawrence River is a protected water supply. Newfoundland Power uses a portion of it for hydropower. Little Lawn Brook is a water supply for Newfoundland Power's hydropower generation located in the town of Lawn. Part of this watershed is also designated as a backup water supply for the town of Lawn (S. Tobin, pers. comm.).

There are also some domestic cattle pasturing in the area. In the past, fences delimited livestock areas. However, these have fallen into disrepair, allowing the cattle to wander freely. The cattle have also been observed at Little Lawn Harbour.

The St. Lawrence Fluorspar Mine (held by Burin Minerals Ltd.) is located to the southeast of the proposed site, although mineral deposits extend north, and possibly into the site.

The main hunting effort in this area is for ptarmigan, using 22 calibre riffles and shotguns. No snaring of ptarmigan is allowed in the area (B. Barnes, pers. comm.). Snares are set for snowshoe hares and moose are hunted back in the country remote from the site (S. Tobin, pers. comm.). No trapping of any sorts is conducted in the area (B. Barnes, pers. comm.).

There is some berry picking activity in the area, although it is not known to be a prime area for this (S. Tobin, pers. comm.).

3.5 Wildlife

3.5.1 Fish

The scheduled salmon rivers in the area are the St. Lawrence River and Lawn River. Atlantic salmon (sea-run) and brook trout (sea trout) enter the Little Lawn Harbour barachois and the lower reaches of Lawn River. Most ponds in the area have resident brook trout populations.

3.5.2 Birds

Local surveys have compiled a checklist of 125 bird species that have been sighted in the St. Lawrence area (including seabirds) from January 1998 to present (N. Wilson pers. comm.). Such species as bald eagles and golden eagles have been observed along the coastline, remaining well outside the area of the proposed project.

The immediate area of the project is mostly open habitat, known to support various avian species including:

- Waterfowl (black ducks and other dabblers, Canada geese);
- Willow ptarmigan;
- Raptors (northern harrier, rough-legged hawk, merlin, sharp-shinned hawk) (N. Wilson pers. comm.);

- Passerine birds typical of open/shrub type habitats as well as generalists including ravens, crows, American robin.
- Double-crested and great cormorants are likely nesting in the region as they are observed flying inland and along the coast (N. Wilson, pers. comm.).
- Greater yellowlegs, semi-palmated sandpipers, spotted sandpipers, sanderlings, and other shorebirds forage along the coast, particularly during migration.

Further from the area, seabird colonies are present along the coast, at a distance of no less than 10 km, as they nest principally on offshore islands to the west and east of the project area (Cairns et al., 1989):

- Columbier Islands (10 km southwest of the proposed project location) support roughly 500 herring gulls, 500 black-legged kittiwakes, and 125 Leach's storm petrels;
- Middle Lawn and Offer Lawn Islands (approximately 15 km southwest of the proposed project location) support approximately 26,500 Leach's storm petrels, 100 herring gulls, and 100 Manx shearwaters (Middle Lawn Island only); and
- Corbin Island (approximately 15 km east of the proposed project location) supports approximately 100,000 nesting Leach's storm petrels and some herring gulls, black-legged kittiwakes, and great black-backed gulls.

3.5.3 Mammals

Red fox and coyotes are seen around the edge of St. Lawrence and are most likely common throughout the area. Fox have also been seen on the cart track to Little Lawn Harbour and at the gravel pit in the northwest end of the project area. Moose are not numerous, but have been found in this habitat. It is normal for densities to be naturally low in this area, considering wintering habitat appears to be mainly restricted to river valleys.

Caribou have not been seen in the area for a number of years. Black bears rarely come down to the proposed site location. Snowshoe hare, red squirrels, as well as other small mammals are present in the area. Arctic hare are also found, in low densities, in the areas of highest elevation.

3.6 Wind Turbine Characteristics

The infrastructure and equipment required for wind farm installation are described below:

3.6.1 Turbine Installation

The installation of wind turbines is a standard procedure and requires minimal site-specific changes. Essentially, the construction activities consist of building access roads, installing the required underground cabling, excavating and installing a 4- to 6-m deep tower base, and installing the turbine tower and equipment.

The selected turbine manufacturer will provide the necessary wind turbine adaptations and engineering changes to withstand the specific climatic conditions experienced in Newfoundland: freezing rain, rime icing and extreme wind gusts. The turbine manufacturer will be certified for St. Lawrence's site-specific wind conditions.

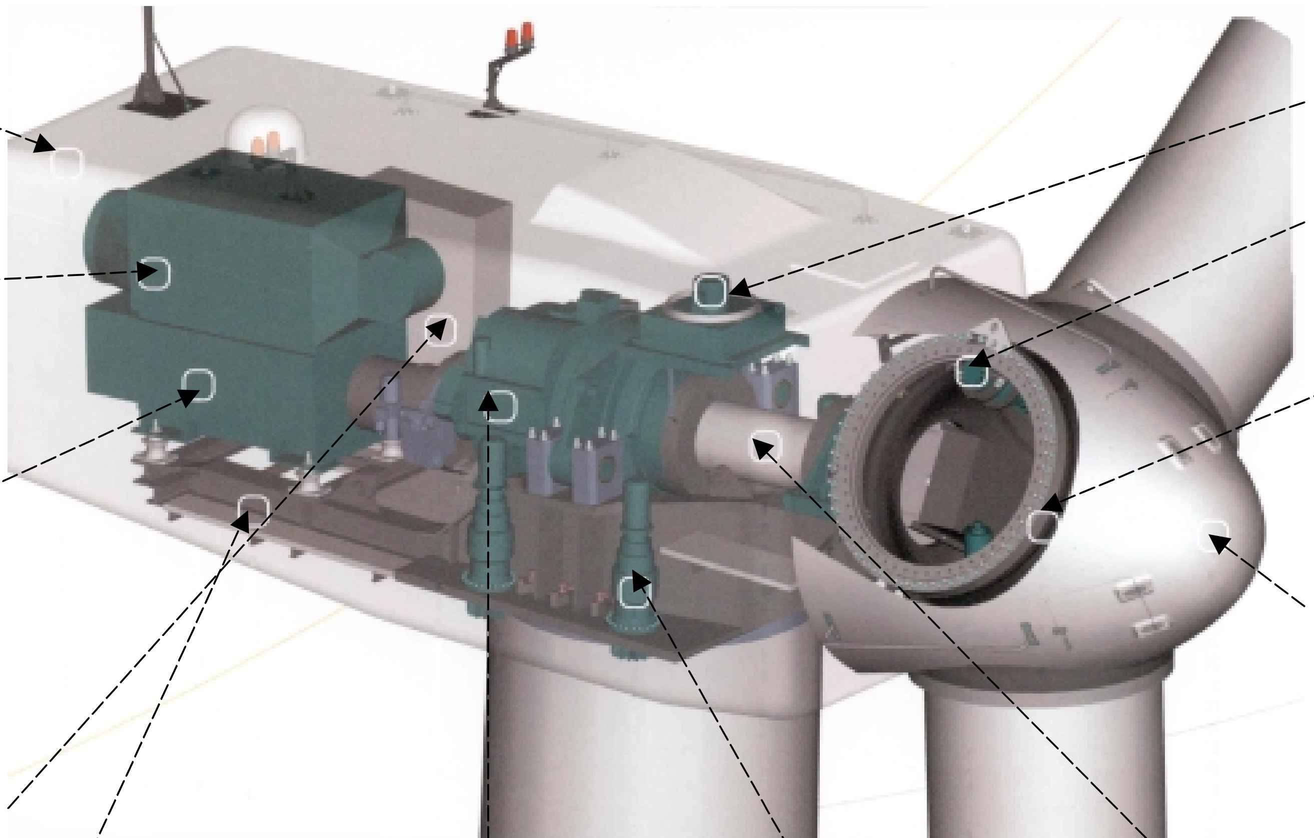
For the installation of the turbines, two cranes are generally required: a small, 80-ton, mobile hydraulic crane and a larger, 150-ton or more, conventional mobile crane. The tower will possibly be manufactured locally in two or three sections, provided a suitable supplier can be identified. It is worth mentioning that some of the towers were procured locally for projects built in Quebec and Alberta. The tower sections are usually installed using both cranes, with one crane lifting the top section while the tailing crane will be securing the bottom section. The turbine nacelle, which houses most of the equipment (main shaft, gearbox, generator, lubrication and cooling systems), will be hoisted by the larger crane and installed on top of the tower. The rotor will be assembled on the ground and will be hoisted in place, helped by the use of both cranes.

3.6.2 Turbine Description

All turbines have the same basic components. Their differences come from special features added by the manufacturer. A typical turbine's components are listed below and presented in Figure 5:

- tower
- nacelle
- gearbox (except for the Enercon turbine, which is gearless)
- rotor
- generator
- braking system
- yaw system
- control system
- anemometer and wind vane

Figure 5: Typical Wind Turbine Major Components



Towers carry the nacelle and rotors. Most modern towers are solid and tubular steel constructions. Although these are more expensive than lattice towers, their benefits generally outweigh their cost. Solid structures prevent birds and raptors from perching, thus reducing the risk of bird fatalities. Furthermore, solid, tubular towers provide an all weather access to the nacelle for the maintenance crews and are more aesthetic. In terms of efficiency, it is beneficial to have tall towers, because wind speeds increase with increasing height above ground. Turbulence is also lower at higher levels.

The nacelle houses all the turbine's gear: gearbox, generator, converter, braking system, yaw system, control system, and rotor hub. In solid, tubular towers, the nacelle is accessible through a ladder, located inside the tower.

The gearbox is used to convert from the slowly rotating, high torque of the rotor to the high speed and low torque used by the generator.

The rotor interacts with the wind, transforming the flowing energy of air into rotary mechanical energy for transfer to the generating system. The rotor is comprised of a rotor hub and blades. The rotor is located on the outside of the nacelle, on the upwind side of the tower. Most modern turbines have 3 blades, although some turbines have 1 or 2 rotor blades.

The generator converts the mechanical energy obtained from the wind into electrical energy. Because generators produce heat, they need to be cooled. Although air-cooled systems are more common, water-cooled designs exist. Both arrangements are fitted with an air vent and a fan. Water-cooled systems allow a more compact and electrically efficient set up. However, this system also requires a radiator to dissipate the heat emitted by the water-cooling system.

Several types of braking systems are currently available on the market: disk brakes on the rotor and/or generator shaft, aerodynamic braking systems, electromechanical brakes, etc. A braking system is required to stop the turbine in the occurrence of high wind velocities in excess of the design criteria (the brakes are applied when winds reach the cut-out wind speed). Sustained wind speeds greater than 25 to 30 m/s, depending on the turbine model, will either cause over-speeding of the rotor or overproduction from the generator. Both situations risk damage to the equipment. Brakes are also required for emergency situations such as mechanical or electrical component failure, and for periods of ice accumulation (which are dangerous for ice throw). Turbines are also equipped with a parking brake, which is locked on during maintenance.

The yaw system is required to turn the rotors in and out of the prevailing wind direction. The turbine's wind vane informs the yaw mechanism about changing wind directions.

The control system houses a computer, which monitors the condition of the turbine and controls the yaw and pitch mechanisms, among others. Should a component failure occur, the control system stops the turbine and contacts the turbine operator via telephone modem. The control system also compiles statistics on the turbine operating parameters.

The anemometer and wind vane measure wind speed and wind direction, respectively. The anemometer sends signals to the controller to start the rotors when the wind speed approaches the turbine design cut-in speed. When sustained winds reach the design cut-out speed, the control system gives the order to shut down the turbine for safety reasons. The wind vane is used to send signals to the control system regarding which direction the rotor should face. The rotor is then steered by the yaw system. In regions such as St. Lawrence, it is important to use heated anemometers and wind vanes, to ensure correct functioning during the wintertime. A faulty or frozen anemometer may stop the rotors when wind speeds are actuality sufficient to produce energy.

3.6.3 Turbine Comparison

The following is a comparative table of the 6 turbine manufacturers considered for this project.

Supplier	Model Available	Hub Height (m)	Total Height (m)	Cut-in Speed m/s	Cut-out Speed m/s	Power Regulation	Particular Feature	Cold-Weather Package
Enercon	850 kW	70	99	2.5	N/A	Pitch	Gearless	N/A
	1.5 MW			2.5	N/A	Pitch	Gearless	
Enron	600 kW			N/A	N/A	N/A	N/A	Yes
	750 kW	46-50	83	3.0	29.0	Pitch	Dynamic VAR Control	
	900 kW			3.0	25.0	Pitch	Dynamic VAR Control	
	1.5 MW			3.0 or 4.0	20.0 or 25.0	Pitch	Dynamic VAR Control	
Mitsubishi	600 /180kW	38	60.5	3.0	N/A	Pitch		Yes
	1000/250 kW			3.0	N/A	Pitch		
NEG Micon	600 kW			3.0	20.0 to 25.0			Yes
	750 kW			4.0	25.0	Stall		
	900 kW			3.5	25.0	Stall		
	1000 kW			3.0 to 4.0	20.0	Stall		
	1500 kW			4.0	18.0 to 25.0	Stall		
Nordex	600 kW			3.0	25.0	Stall	Combined, 3 stage gearbox	Yes
	800 kW			4.0	25.0	Stall	Combined, 3 stage gearbox	
	1000 kW			4.0	25.0	Stall	Combined, 3 stage gearbox	
	1300 kW			4.0	25.0	Stall	Combined, 3 stage gearbox	
Vestas	660 kW	40-55	78.5	4	25.0	Pitch	OptiSlip, OptiTip	Yes
	660/200 kW	40-65	88.5	3.5	25.0	Pitch	OptiSlip, OptiTip	
	850 kW			4	25.0	Pitch	OptiSlip, OptiTip	

3.6.4 Access Roads

Each turbine will be accessed through a 4.5-metre wide gravel access road. Access roads and turbines are expected to occupy less than 2 % of the demonstration project land area, thus presenting a minimal impact on the land. The side of the roads will be planted with native grass in order to avoid long-term erosion.

3.6.5 Transmission Lines

Generation voltage from each turbine is expected to be at 400 to 600 volts, depending on the model selected. The generation will then be transformed by each individual turbine transformer, located at or near the base of the wind turbine, to the feeder voltage required to feed the substation, either 25 kV or 69 kV. Electrical services for each individual turbine will be installed close by at the relevant feeder voltage. All the turbines will be linked through underground cabling. Generation will be fed through the turbine intertie point, which will then be connected through an overhead feeder to the interconnection point substation. The short overhead pole line will result in minimal visual impact. Aerial lines will be sighted to minimise visual impact by travelling along existing infrastructure such as roads and other utility lines, to the greatest extent possible.

3.7 Project Construction

3.7.1 Construction Period

From the time of signing a PPA, a period of six to nine months is expected to be needed to secure all the required authorizations and permits, undertake the civil construction work, erect the wind turbines and begin actual power generation. However, erection of a 50- or 70-metre tall wind turbine can be difficult in the winter period when snow, frozen ground and higher wind conditions prevail. It is therefore preferable to plan for site construction between the months of April and October.

3.7.2 Proposed Date of First Activities

The date of beginning of construction will be dependent on the time at which a PPA will be executed with the purchasing utility. Based on the milestones set in the utility request for proposals, a PPA could be signed by the fall of 2002, while all permits and authorizations would be obtained during the following semester for a start of construction in early 2003 and a projected in-service date in late 2003.

3.7.3 Potential Sources of Pollution

No harmful waste or pollutant will be discharged into the environment during the construction time period. All normal precautionary measures and standard construction practices will be implemented to minimise disturbance to the site, control runoff and sedimentation, noise levels, dust emissions, to avoid oil or fuel spills, and to collect waste. As a precautionary measure, the project proponent will allow only construction and craning equipment in good repair on site. Furthermore, emergency response spill kits will be maintained on site in the event of the loss of containment of hazardous fluids.

Noise levels are expected to increase during the construction period. Road graders, construction equipment, cranes and increased traffic will be the major sources of noise, which will result in minor inconveniences for local residents as all construction work is expected to be more than 350 metres from the closest residences.

3.7.4 Potential Cause of Resource Conflicts

Recreational land use around the construction site is expected to be temporarily affected. Since the wind turbines will be installed systematically, only a small amount of the total land area is expected to be unavailable for recreational use at the time of construction.

Discussions with the Department of Mines and Energy have revealed that the southern portion of the project area may hold fluorspar veins, which may eventually represent a mining potential. The characteristics of the mining activities for fluorspar extraction consist mainly of underground mining and blasting. Due to the solid nature of the surrounding bedrock, blasting at distances of 50 m from the wind turbines would have no impact on the tower structures, the foundations or their overall stability. As such, no resource use conflict is expected between the wind power project and potential future fluorspar mining activities.

Other land uses in the area are limited and no particular resource conflict is expected with the implementation and operation of wind turbines.

- Route 220 crosses the proposed project area in an east-west manner.
- Freshwater Pond Provincial Park is located approximately 15 km to the northeast of the proposed project area and Frenchman's Cove Provincial Park lies 23 km north of the proposed wind farm – no interaction is predicted.
- Silvicultural areas are located 14 km to the north of the proposed project area – no interaction is predicted.
- A protected watershed area lies 500 m to the east of the project. However, the turbines will be sited so there is no negative impact on the water supply.

- Lawn River crosses through the proposed wind farm location. Because this is a scheduled salmon river, turbines will not be sited any closer than 200 m from the river to reduce or eliminate impacts.
- A transmission line runs along Route 220, just south of the northern portion of the proposed project area.
- The southeastern boundary of the proposed project area lies within the municipal boundaries of St. Lawrence, although no residences are located there. This area is zoned rural, as the rest of the site, and will not required a change in zoning, should any turbines be located there.
- There is ptarmigan hunting in the area. The turbines are not expected to disrupt this activity.
- Berry picking also occurs in the area, although this area is not known as a prime berry-picking area. This activity can be held concurrently with the demonstration project.

3.8 Construction Period Mitigation Measures

In order to minimise the amount of environmental impacts the project could generate, certain mitigation measures will be implemented.

- Prevention of non-native vegetation species from colonising the area (dispersed by machinery and workers) by ensuring the machinery is clean.
- Timing of construction: undertaken to minimise impact on the soils and vegetation.
- Use existing roads as much as possible.
- Avoid ecologically sensitive areas.
- Should any objects of archaeological value be found during construction, work should stop temporarily to allow a qualified archaeologist to assess the importance of the finding and devise a suitable mitigation plan, including buffers to protect the site.
- Minimise the amount of vegetation removed from the site.
- Avoid avian nesting seasons.
- Avoid fording of watercourses.
- Silt controls to monitor the amount of silt created by the access roads. Native grass will also be planted on the access ways to minimize silt.

These measures will be included in a detailed environmental protection plan (EPP) that will be developed and submitted to the Department of Environment prior to the onset of the project construction activities.

3.9 Project Operation

3.9.1 Operation Description

Wind turbines are relatively simple systems that generate electricity when wind conditions are between 3 and 4 m/s, the speed at which the turbine blades experience sufficient lift to begin rotating, and 25 to 30 m/s, depending on the model, when the control system stops the units as wind conditions are too strong and can cause mechanical damages due to over-speed and/or over-production.

Each wind turbine can be considered a fully self-controlled power unit. A wind turbine consists of the rotating blades fixed around the hub, a main drive shaft, a gearbox assembly, a generator, the control cabinet located inside the base of the tower, the tower, the concrete foundation and a transformer located either at the base of the turbine or pad-mounted adjacent to the tower base.

The control of all production and ancillary equipment will be through multiple programmable logic controllers (PLC), which interface with computers at each turbine. Wind turbines are designed to be operated in the automatic mode; however, turbines may also be manually controlled for specific situations, such as resets following turbine trips.

All individual wind turbines will be controlled through a remote control centre. This centre could be located in an available office or storage space in the town of St. Lawrence. Should such a space be unavailable, NeWind would consider either building a suitable facility in St. Lawrence or finding an appropriate space in Lawn. During fault conditions, automatic notification will be provided to the control centre via modem. Full diagnostics can be run from the remote control centre from which the turbine(s) can also be started and stopped.

Wind project operators will make daily trips to the site in order to ensure the turbines are in operating conditions at all times, for regular unit maintenance and for overall project surveillance. The wind turbines will undergo semi-annual scheduled maintenance, which can require from one to two days per turbine. The O&M system will be implemented so only one turbine will be required to go off-line at a time for scheduled maintenance. In this manner, maintenance will result in minimal effects on the overall wind farm availability and energy generation. The scheduled maintenance will not require the use of cranes, as the crew can access the equipment from the ladder located in the tower, and can easily be handled by a two-man crew.

The project will not require fencing, as most of the equipment will be installed within the towers, which will be large tubular structures, safely secured and impossible to scale. The individual transformers will be the only piece of equipment accessible and these are well secured and safe for the general public.

3.9.2 Estimated Period of Operation

A typical wind power project can be expected to be operational for a minimum of 20 years. The first wind projects installed, in the late seventies and early eighties, have just recently reached this life-span and have shown the wind turbines can, with some equipment upgrades, continue to generate efficiently. Also, a new upgraded and more productive unit with minor civil works requirements can easily replace an older wind turbine.

3.9.3 Potential Sources of Pollutants

Wind energy is an extremely clean electricity source. No airborne or other pollutants are emitted during the operation of the wind turbines.

Wind turbines do require the use of hydraulic and/or gearbox oil while individual transformers are oil-cooled. Any potential oil leak would be contained inside the turbine tower or transformer pedestal and would be prevented from reaching the surrounding environment by enclosed basins capable of retaining 110% of the oil holding capacity. Also, the transformer will be installed on an impermeable concrete slab, with a lip designed to contain any oil spill.

3.10 Potential Impacts During Operation

3.10.1 Noise Impact

The modern turbines to be installed have low noise levels and even in larger turbine clusters do not negatively affect adjacent communities. A typical 600 kW wind turbine will emit noise levels of 55 dB (A) at a 50-metre distance, which is reduced to 44 dB (A) at a 250-metre distance. The following table provides a comparison of noise levels for commonly known noise sources:

Elevated Train	100 dB (A)
Noisy Factory	90 dB (A)
Average Street	70 dB (A)
Average Factory	60 dB (A)
Average Office	50 dB (A)
Quiet Conversation	30 dB (A)

Within a wind farm, a normal conversation can be held without raising one's voice. The potential turbine locations are located more than 350 metres from the nearest residences; therefore the noise levels experienced would be audible, although they should represent a minor perceived negative impact, if any. Also, it is worth noting that in windy conditions, the background noise level associated with the wind is expected to be greater than the turbine-generated noise level.

3.10.2 Visual Impact

The implementation of numerous 50 to 75-metre tall wind turbines in an undeveloped and mostly barren location will certainly be visible. However, the tubular towers and the aerodynamic blades have been designed with smooth lines of greater aesthetic value. They can be considered attractive industrial structure devices. Also, the rotation of wind turbine blades during periods with low sun angles and bright sun, such as early morning and late evening, may result in a flickering, or shadow, effect. These effects may be disturbing for local residents. However, by placing the individual wind turbines at a minimal distance of 350 metres from residences, this effect should result in a negligible impact (see Figure 6).

Figure 6. Visual simulation of wind farm, looking towards Lawn Lookout from Route 220.

3.10.3 Economic Development Impact

The development and implementation of a wind power project in Newfoundland and Labrador will represent a novelty and, as has been witnessed in other parts of North America and Europe, could represent an important tourist attraction. The implementation of such a demonstration wind power project in close proximity of Route 220 and close to the town of St. Lawrence could represent an important tourist attraction. The possibility for such a project becoming a central element in a concerted economic activity aimed at the tourist industry would result in a positive impact.

3.10.4 Bird Collisions

There has been no identification of medium or large numbers of raptors in this area. This further reduces the risk of any potential collisions. Also, St. Lawrence is not located in close proximity to known migratory routes. Most of the birds found in the area travel closer to the coastline.

In the past, bird collisions have often been mentioned when discussing wind turbines as a major source of environmental impact. However, these problems have primarily been an issue near mountain passes where large raptors have been carried by the updrafts along the mountainside into the turbine rows. Also, earlier turbine tower designs used latticed towers, which were frequently used by raptors as perching locations allowing for a clear view of open land (Kerlinger, 2001a).

Studies have shown a predominance of bird strikes during take-off, as the birds were carried by the draft into the rotor of downwind-operated turbines. Today's wind turbines are essentially upwind machines (i.e. the rotor is upwind from the tower), commonly mounted on tubular towers, where raptors have no opportunity to perch. Furthermore, large turbines have reduced rotational speeds (26 to 36 rpm), which lowers chances of bird collisions.

Also, recent reviews of avian impact studies conducted at wind power facilities in Europe and in the United States reveal that bird turbine interactions resulting in bird fatalities represent extremely minor occurrences. Nowhere in Europe (even in Tarifa, Spain and in the coastal Netherlands) and in all but one location in the United States (Altamont Pass in California) have these impacts been judged to be significant or to cause avian population problems or impact rare or threatened species (Kerlinger, 2001b). Finally, the numbers of fatalities reported at wind plants has been extremely small, especially when compared to other sources of human induced mortality as shown in the following table (Kerlinger, 2001a).

Source of Mortality in USA	Numbers Estimated (BPY)	Attribution/Reference
Glass Windows	100 million to 1 billion	D. Klem, Muhlenberg College
House and Feral Cats	100-200+ million	National Audubon Society
Hunting	120 million	U. S. Fish and Wildlife, Gill 1995
Pesticides	67 million	Smithsonian Migratory Bird Centre
Automobiles and Trucks	60+ million	U. S. Fish and Wildlife
Mowing of Hay	millions	Suspected–smaller numbers known
Communication Towers	4-5+ million	U. S. Fish and Wildlife
Oil & Gas Extraction	1-2 million	U. S. Fish and Wildlife
Stock Tank Drowning	1 million?	Suspected – smaller numbers known
Commercial Fishing	1 million?	Suspected – smaller numbers known
Coal Strip Mining	millions	Documented habitat elimination
Wind Turbines	low thousands	Curry & Kerlinger estimates*

Note : Summary of human sources of direct avian mortality in the United States. The numbers provided are generally accepted by the environmental community (conservation organizations and government wildlife agencies). BPY = birds per year killed by the source indicated. The number of fatalities does not include habitat impacted or expected impacts as a result of these activities. For example, there are no impacts calculated as a result of climate change resulting from the burning of fossil fuel or habitat change resulting from acid precipitation. The American Bird Conservancy, National Audubon, and US EPA have provided models that predict habitat change and subsequent population impacts on birds in North America.

*Estimates made through calculation using known number of fatalities from wind plants studied, the number of turbines known to be operating (about 11,000 currently), and several other factors.

3.11 Operation Period Mitigation and Monitoring Measures

3.11.1 Mitigation Measures

During the operation period of the wind farm, mitigation measures will be undertaken to ensure minimal environmental impact.

- Tubular towers will be selected to reduce the possibility of birds perching on the towers. They also improve the aesthetics of the wind farm.
- The obstruction lighting system for air traffic will be limited to the requirements agreed to with Transport Canada. NeWind will propose a lighting strategy similar to the one used by the 100 MW Le Nordais wind farm in Quebec, which consists of lighting only the extremities of the wind farm. In this manner, attraction lighting for night flying will be limited. Finally, the type of lighting will be selected on the basis of the least attraction potential in relation to the bird species' specific behaviour.
- The power collection lines, linking the wind turbines to one another, will be underground. Again, this prevents avian collisions and improves aesthetics.
- Any equipment brought to the site during the operational period will be in good repair, to prevent spills.
- The layout of the wind farm will be harmonized with the local features of the land through visualization and with the help of landscape architects to minimise the visual impacts.
- The turbines will be placed at a distance of at least 350 metres from residences in order to minimise noise and visual impacts.
- Grass will be planted on disturbed areas, in order to prevent silt formation.

3.11.2 Bird Monitoring Measures

NeWind is committed to developing and implementing a focussed follow-up study on the effects of the Project on migrating birds in the Project area. The highest probability of bird strikes will be during the spring and fall bird migration periods.

A baseline study of bird migration patterns will be implemented at the St. Lawrence site prior to project construction to identify key periods to conduct the follow-up study. Critical migration periods (spring and fall) will be identified and these periods will be the focus of monitoring mortality associated with the operations phase. This program will determine the level of wind turbine bird mortality during migration. In developing the study, the Proponent will ensure there are clear and achievable objectives and hypotheses, temporal and spatial controls, and practical methodologies. The Proponent will consult with regulatory authorities and stakeholders to discuss aspects of this study prior its implementation. The study's results will help quantify bird mortality during migration periods. Results of the study will be used to design, implement and eventually evaluate mitigation strategies that may be required to address the bird mortality issue. Such adjustments to the program would be made after consultation and in consideration of recommendations from the Department of Environment.

1) Due to the demonstration nature of the project, the monitoring data will be collected and reported to the Department of Environment for information purposes on a regular basis. This study should be done for the 3 years following the in-service date.

3.12 Project Decommissioning

One advantage of using wind farms for electricity generation is the relative ease of decommissioning of these farms. Most of the materials brought to the site can be removed with the help of cranes and trucks. Therefore, the only impacts remaining on the site once the towers are removed are the tower foundations and access roads. Theoretically, the foundations could also be removed, but this would cause considerable disturbance to the site given the bulk on the foundation is underground, and the advantages of doing so would have to be weighed against the disadvantages in order to determine the best course of action.

3.13 Occupations

The construction period will require between 20 to 25 people to build access roads, install pole lines and underground services, build the foundations and erect the wind turbines.

An assortment of occupational trades will be required for the construction of the project:

Iron Workers	Electricians	Line Workers	Crane Operators
Engineers	Labourers	Operators	Control Technicians
Concrete Workers	Millwrights	Heavy Equipment	

It is the NeWind Group's intention to have the towers for the wind turbines manufactured in Newfoundland, as some potential manufacturers capable of fabricating these structures have been identified. However, these manufacturers will have to provide an economical and competitive package. A variety of trades are required for tower manufacturing: Welders, Fitters, Draftsmen, Engineers, Painters.

The project is expected to generate 2 to 3 full time jobs associated with the operation and maintenance of the wind power project. The creation of 2 part-time jobs is expected, in order to assist the regular personnel with various maintenance activities. There will also be an impact on the supply and service sectors as equipment and materials will be procured and a number of contract services will be issued during ongoing operations.

4 PROJECT RELATED DOCUMENTS

Kerlinger, Paul. (2001a). Avian Fatalities at Wind Power Facilities in the United States: An annotated summary of studies as of February 2001.

Kerlinger, Paul. (2001b). Avian Impacts at Wind Power facilities in Europe: An annotated summary of studies.

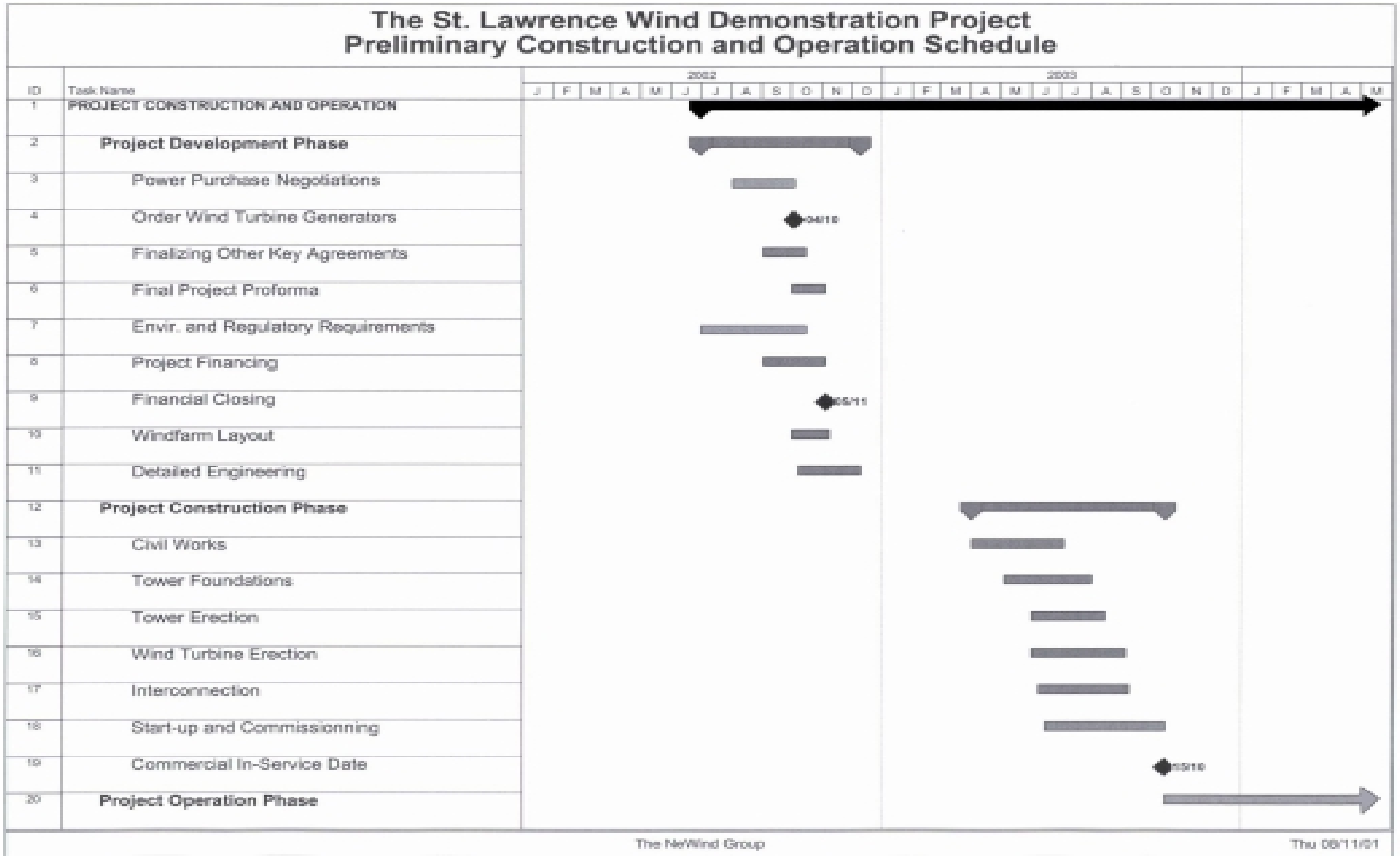
5 APPROVAL OF THE UNDERTAKING

The following is a list of permits, approvals and authorizations, which may be required for the proposed undertaking. This list is not exhaustive.

Permit - Approval – Authorization	**Issuing Agency**
Building Accessibility - Exemption Registration	Engineering services/Operations Division
Permit to occupy Crown Land	Department of Government Services and Lands Offices
Electrical permit **-** Application for permit to install or repair electrical equipment or inspection of work	Customer Services/Operations
Crown lands – Applications/Licences	Applications/Licences
Crown lands - Application for consent and notice of Assignment of Lease/Licence	Customer Services
Crown Lands - Application for grant pursuant to lease/permit to occupy crown land	Customer Services
Develop land - Protected road zoning and development control regulations – Preliminary application to develop land	Customer Services
Develop land - Protected road zoning and development control regulations – Building specifications are required for a permit to develop	Customer Services
Develop land - Application to construct extension or accessory buildings alongside all protected roads or development control areas in the province	Customer Services
Archaeological Research Permit - Archaeological Investigations on land or under water	Tourism, Culture and Recreation
Construction (Site Drainage) - certificate of approval	Environment, Water Resources Division
Water Resources - Water course alterations certificate of environmental approval to alter a body of water	Environment, Water Resources Division
Water Resources - Water course crossings, certificate of environmental approval	Environment, Water Resources Division
Highway Access Permit	Dept. of Works, Services and Transportation
Fish Habitant - Authorization for works or undertakings affecting fish habitant	DFO Canada
Tall structures obstruction clearance	Transport Canada

6 SCHEDULE

The schedule for the construction of the project is dependent on the signing of a PPA with the utility. However, from the date of signature of the PPA, a six to nine month period will be required for the engineering, procurement, construction and commissioning of the wind power project. Once commissioned, the project is expected to be operated in perpetuity.


The St. Lawrence Wind Demonstration Project
Preliminary Construction and Operation Schedule
ID
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2002
2003
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M
1 PROJECT CONSTRUCTION AND OPERATION
2 Project Development Phase
3 Power Purchase Negotiations
4 Order Wind Turbine Generators
5 Finalizing Other Key Agreements
6 Final Project Proforma
7 Envir. and Regulatory Requirements
8 Project Financing
9 Financial Closing
10 Windfarm Layout
11 Detailed Engineering
12 Project Construction Phase
13 Civil Works
14 Tower Foundations
15 Tower Erection
16 Wind Turbine Erection
17 Interconnection
18 Start-up and Commissionning
19 Commercial In-Service Date
20 Project Operation Phase
The NeWind Group
Thu 08/11/01

6.1.1 Funding

The NeWind Group will be responsible for setting up the required funding for the project. It is currently anticipated that the project construction will be mostly funded internally, although potential external funding from federal programs will be investigated. The total cost of a 25 MW project is estimated at $40 million.

The following programs are currently being considered as possible funding sources for the project:

Program	Applicability	Total Size	Main Elements	Other Issues
Green Municipal Investment Fund (GMIF)	High	$100M	Loans for implementation, up to 15-25% of eligible costs. Also grants for pilot projects, $200,000 max.	Municipality / community should be main proponent. Private may apply with a municipal partner
ACOA's Atlantic Innovation Fund (AIF)	High	$300M/5yrs	Soft loans for up to 75% of eligible costs.	First round RFP closes 28 Sept. 2001.
ACOA's Strategic Community Investment Fund	Unknown	$135M/5yrs	New funds for community economic development.	Currently seeking more details.

References:

Cairns, D.K., Montevecchi, W.A., and W. Threlfall. (1989). Researcher's guide to Newfoundland Seabird Colonies. Second Edition. Memorial University of Newfoundland Occasional Papers in Biology, No. 14.

Kerlinger, P. (2001a). Avian Fatalities at Wind Power Facilities in the United States: An annotated summary of studies as of February 2001. Cape May Point, NJ.

Kerlinger, P. (2001b). Avian Impacts at Wind Power Facilities in Europe: An annotated summary of studies. Cape May Point, NJ.

Meades, S.J. (1990). Natural Regions of Newfoundland and Labrador. Report prepared for the Protected Areas Association. St. John's, NF.

Personal Communications:

Barnes, B. Conservation Office, Department of Forest Resources and Agrifoods. Marystown, NF. Contacted in September 2001.

Tobin, S. Town Councillor. St. Lawrence, NF. Contacted in September 2001.

Wilson, N. Local Birder. St. Lawrence, NF. Contacted in September 2001.

APPENDIX I: PROJECT RELATED DOCUMENTS

AVIAN FATALITIES AT WIND POWER FACILITIES IN THE UNITED STATES:

An annotated summary of studies as of February 2001

Report Prepared for CHI Energy

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This report provides an annotated list of avian fatality studies conducted at wind power facilities in the United States. The fatalities summarized have resulted from collisions with the rotors of wind turbines. In some instances, the fatalities have resulted from collisions with the guy wires of meteorology towers. An effort was made to provide as much information as possible regarding the numbers of turbines studied, the duration of the studies, the general types of turbines studied, the habitat and topography of the wind plant, the number of fatalities found, the types of birds involved, and information regarding who did the study and for whom the study was conducted. The numbers presented, in almost all cases, are the results of systematic and rigorous searches beneath turbines. Finds reported by field personnel will probably undercount the numbers of smaller species, but will reflect accurately the numbers of large birds that collide with wind turbines. In addition to the summaries, text is included to provide an overview of the impacts of turbines on birds and the factors that are known to contribute to such impacts.

Review of Avian Fatality Studies at Wind Power Plants in the United States

Eastern United States

- **Vermont –** Green Mountain Power Corp., Searsburg (near Green Mountain National Forest)
    - 11 modern turbines - Zond/Enron Z-40 – 500 kilowatt
    - Forested (deciduous and coniferous) hill/mountain top(s)
    - June-October, 1996 (nesting and migration seasons) – 6+ rounds of surveys
    - Zero fatalities recorded
    - Kerlinger, 2000, National Wind Coordinating Committee Volume III (San Diego Meeting, May 1998)

- **New York** - Copenhagen (30 miles inland from Lake Ontario on the Tug Hill Plateau) – Niagara Mohawk Power Corporation
    - 2 modern turbines - Kenetech 33mvs – 500 kilowatt
    - Farmland site on gently sloped plateau
    - Spring and Autumn migration seasons, 1994 – daily surveys
    - Zero avian fatalities
    - Cooper and Johnson, 1995, Proc. American Wind Energy Association Conference 1996 and report to Niagara Mohawk Power Corporation)

- **Pennsylvania –** Green Mountain Wind Farm, Garrett (Somerset County)
    - 8 modern turbines - Nordex 1.3 megawatt
    - Farm fields (corn, hay, field peas) on gentle slopes
    - June 2000 through February 2001- 10 surveys (will continue until May 2001)
    - Zero fatalities
    - Curry & Kerlinger, LLC, in progress – final report to National Windpower and Green Mountain Energy will be published 2001

- **Massachusetts** - Princeton Windfarm (Watchusett Mountain State Forest and Hawkwatch) – Town of Princeton
    - 8 older turbines - type unknown
    - Forest (hardwood) and brush
    - Autumn & winter, 1993
    - Zero avian fatalities recorded
    - Jacobs, 1995, Presented at Windpower '94, Minneapolis, MN

<u>Midwestern United States</u>

- **Minnesota** – Buffalo Ridge (near Lake Benton) – ExelEnergy (Northern States Power), SeaWest, Enron/Zond.
    - 100s of modern turbines in wind plant– Various types (Zond/Enron, Kenetech, …)
    - Farmland – grassland, corn, soybeans (wetlands nearby) on relatively level terrain
    - Several studies – see below –
    - Osborn et al. 2000 – 50 turbines, 1-year (1995)
    - Johnson et al. 2000 – 21 turbines, 3+ years (1996-1999)
    - Johnson et al. 2000 – 40 turbines, 1.5 years (1998-1999)
    - Johnson et al. 2000 – 30 turbines, 9 months (1999)
    - Total fatalities for all studies – 53 (diverse array: mostly songbirds and 1 hawk)
    - Reports by WEST Inc. and others to Northern States Power/some available on Sustainable Minnesota website; American Midland Naturalist (Osborn et al.)

- **Kansas** – St. Mary's – Western Resources and Kansas Electric Utilities Research Program
    - 2 modern turbines (750 kilowatt, Enron)
    - Grassland Prairie (mid- and tall grass)
    - Spring and autumn migration seasons; 33 surveys
    - Zero fatalities
    - Gene Young, Cowley College, KS, report to Western Resources and KEURP

- **Wisconsin** – Kewaunee County Peninsula – Madison Gas & Electric, Wisconsin Public Service
    - 31 modern turbines (Vestas, V-47, 750 kilowatt)
    - Farmland site with woodlands nearby
    - One+ year (1999-2000),
    - 18 fatalities recorded (3 waterfowl, 14 songbirds, some night migrants)
    - Report to Wisconsin Dept. of Natural Resources, Madison Gas & Electric, and Wisconsin Dept. of Public Service and unpublished data

- **Wisconsin** – Shirley – Wisconsin Electric
    - 2 modern turbines (Vestas, V-47)
    - Farmland site in flat to slightly sloping terrain
    - Spring and autumn migration (54 surveys)
    - 1 Night migrating songbird
    - Report to Wisconsin Department of Natural Resources Bureau of Ingrated Science Services and Richter Museum of Natural History Special Report

- **Iowa** – Algona – IDWGP Wind Farm
    - 3 modern turbines (Zond/Enron 50 – 750 kilowatt)
    - Farmland site on relatively level terrain
    - Autumn, Winter, Spring-Nesting, 1998-1999

- 0 fatalities
- Demastes & Trainer (2000, report from the Univ. of N. Iowa)

Western United States

- **Colorado** - Ponnequin (south of Cheyenne on Wyoming border) – ExelEnergy (PSCO)
  - 29 modern turbines (Micon 750s)
  - Rangeland site (cattle and bison).
  - 2 Years - 1999-2000 (32+ complete searches – weekly during migration)
  - 8 songbird and 1 duck fatality recorded
  - Curry & Kerlinger Report to ExelEnergy and Technical Review Committee (National Audubon Society, U.S. Fish & Wildlife Service, Colorado Division of Wildlife)

- **Wyoming** – Foote Creek Rim near Arlington – PacificCorp, SeaWest
  - 69 modern turbines - Mitsubishi 600 kilowatt
  - Rangeland site on a level, high plateau adjacent to steep slopes
  - Two years of surveys - 1998-2000
  - 55 fatalities - mostly songbirds (one-half were night migrants migrating) and 3 raptors
  - Report from WEST Inc to U.S. Bureau of Land Management and SeaWest Energy Corporation

- **Oregon** – Vanscycle overlooking the Columbia River – FPL Energy, Portland General
  - 38 modern turbines – Vestas V-47, 750 kilowatt
  - Farmland site (grazing and grain)
  - One year of surveys- 1999 and ongoing windsmith reports
  - 7 songbirds (~ 4 night migrants), 4 gamebirds (3 were alien species [Chukar])
  - Report by WEST Inc.to Umatilla County, FPL Energy, and government agencies

- **California** - Altamont Wind Resource Area – various companies, Pacific Gas & Electric
  - 5,400 older turbines (Kenetech 56-100, Bonus, Enron/Zond, WindMaster, etc. mostly on short, lattice towers)
  - Grazing lands and small grain agriculture on steep hillsides and through canyons
  - Several studies conducted:
  - Howell and DiDonato – 1991; Howell 1997; 359 and 159 Kenetech 56-100 and Kenetech 33 turbines; 2 years of surveys – Report to Kenetech Windpower
  - Orloff and Flannery 1992, 1996; 1169 turbines – various models; two years of surveys – Reports to California Energy Commission
  - Kerlinger and Curry 1997, 1999; 3,400 Kenetech model turbines, 11 years – Reports to US Fish and Wildlife and Altamont Infrastructure Company – final report to be published in 2001

- Thelander and Rugge 2000; 500+ various turbines; 1+ year of surveys – Reports to National Renewable Energy Lab and report in the National Wind Coordinating Committee San Diego Volume and unpublished
- Above studies combined (except Curry & Kerlinger) total of 400+ birds of more than 50 species found at studies done at more than 1,000 turbines
- In all studies raptor (hawks and eagles) mortality was high in all studies (hundreds involved over a 10+ year period) small numbers of some other species involved
- Development surrounding Altamont has eliminated thousands of acres of prime raptor foraging and nesting habitat leaving the wind resource area as some of the only open space nearby

➢ **California** – Montezuma Hills, Solano County near Sacramento River – Sacramento Municipal Utility District

- Farm fields – wheat, canola, grazing on gentle hills – adjacent to Suisun Marsh and wetlands complex along Sacramento River- massive waterfowl and other bird concentrations during autumn and winter
- Howell and Noone 1992 – 2 years of surveys at 237 older turbines (Kenetech 56-100) – 22 fatalities (10 raptors, 2 songbirds, 1 duck); Report to Solano County Dept. of Environmental Management and Kenetech Windpower
- Howell 1997 (report to Kenetech Windpower and Western Section of the Wildlife Society) compared about 11 Kenetech 33 turbines with smaller Kenetech 56 turbines – about 50 turbines and about a dozen fatalities of various species
- Larger, modern turbines were not more dangerous than smaller, older turbines

➢ **California** - San Gorgonio Pass Wind Resource Area (Palm Springs area) – various companies, Southern California Edison

- 120 old and modern turbines (Zond, etc.)
- Desert site – relatively flat to rolling hills
- 2 year study
- 30 fatalities (9 waterfowl, 2 raptors, 4 songbirds, etc.)
- Anderson et al., National Wind Coordinating Committee Avian Planning Meeting Volume III – San Diego 1998 Meeting)

➢ **California** - Tehachapi Pass Wind Resource Area – various companies, Southern California Edison

- High Mojave Desert, mountains and steep ridges, grazing grassland and scrub
- Mitchell et al. 1991 –50 older turbines, 2 years of surveys – 0 fatalities, company report
- Orloff 1992 – one time search of 156 older turbines – 0 fatalities, Report to California Energy Commission
- Anderson et al. 2000 - 180 modern and older turbines in rangeland/arid grassland, 2 years of surveys, 84 fatalities (wide variety of species, small numbers of raptors),

reports to California Energy Commission and National Wind Coordinating Committee Avian Planning Volume III, San Diego Meeting)

<u>Other States</u>

- **Texas** - no reports available at the present time, but large numbers of fatalities have yet to be reported – more than 100 turbines are now operating and have been operating for more than 2 years. FPL Energy windsmiths are instructed to report fatalities but few to no fatalities have been detected.

- **Iowa** - no reports available at the present time from wind plants other than the small facility at Algona. More than 200 turbines now online in IA. Conversations with FPL Energy representatives revealed no indication that large numbers of fatalities are occurring. FPL Energy windsmiths are instructed to report fatalities but few to no fatalities have been detected.

Types of Birds Impacted

Birds reported to collide with wind turbines represent a diverse taxonomic array of species. At most facilities where fatalities have been studied the species composition has been relatively evenly distributed among species. Songbirds are generally most numerous, although at a few sites, other species are more numerous. For example, in the Altamont of California, raptors (Red-tailed Hawks, Golden Eagles, and American Kestrels) are disproportionately represented. At most sites, however, few, if any of raptors are killed. In general, the numbers of any given species is usually small, with very few exceptions.

Estimating Overall Numbers of Fatalities and Impacts on Populations

<u>Total Number of Avian Fatalities</u>:

Recent estimates have ranged from fewer than one bird fatality per turbine per year to slightly greater than two bird fatalities per turbine per year. These estimates are based on studies of observer efficiency and scavenging at about a dozen sites across the United States. Small birds are found to disappear more quickly than larger birds and are not be as visible to searchers. Larger birds, the size of Red-tailed Hawks and eagles, are almost never missed during searches and tend to remain on the ground for several weeks or months. In the case of eagles and other large birds, carcasses are detectable for many months and in some cases for more than a year. Thus, the counts of fatalities of large birds are very accurate and are likely to reflect the actual numbers of birds killed.

Comparing the numbers of birds killed by wind turbines with other sources of mortality is of interest. As can be seen in Appendix I, the numbers of fatalities for wind turbines is orders of magnitude smaller than for other human mortality sources.

Population Impacts:

To date, there has been no suggestion that wind turbines impact populations of any species, with one possible exception. The numbers of fatalities reported at wind plants has been small, especially when compared to other sources of human induced mortality (summarized in Appendix I).

The fact that fatalities of birds reported from wind plants come from a taxonomically diverse array of species is an important factor in determining whether turbines impact populations. At least 50 species have been involved in collisions with turbines. At most wind plants, except the Altamont Wind Resource Area of California, fatality numbers for any given species are extremely small. For example, at the Ponnequin wind energy site, the largest number of fatalities for a species is four individuals (Horned Larks).

An exception may the Golden Eagle population in the Altamont Pass Wind Resource Area of California, where the fatality rate of eagles is high. At this site, about 5,400 wind turbines are now operating. Still, there has not been a demonstrated reduction in the number of eagles nesting in the general area. Part of the reason for this lack of a decline is that many of the fatalities come from well away from the wind plant such that the source area for the fatalities is a large geographic area. Thus, the local population is not sustaining all known fatalities. [It should be noted that several factors confound the fatalities of raptors in the Altamont of California, with habitat destruction being the most important factor from a population perspective. Human developments, including industrial parks, a 6,000 acre reservoir, landfills, and a housing development have encroached dramatically on the Golden Eagle nesting areas and may soon cause a decline in nesting numbers of this species. These developments may also have contributed to greater eagle mortality in the wind plant because they have nowhere else to go.]

Unlike communication towers, wind turbines have not been found to impact large numbers of night migrating song and other birds. With communication towers, studies have shown that a large majority of night migrating birds are killed at towers in excess of 400-500 feet (152 m; Trapp – report to the US Fish and Wildlife Service; Kerlinger – report to US Fish and Wildlife Service – reports available on the Service's Office of Migratory Bird Management web page – http//www.fws.gov/r9mbmo). No mass mortality events of night migrating or other birds have been found at communication towers less than 400-500 feet in height or at wind turbines. These towers do not seem to project high enough into the night sky to impact anything other than very small numbers of migrants.

Appendix I. Summary of human sources of direct avian mortality in the United States. The numbers provided are generally accepted by the environmental community (conservation organizations and government wildlife agencies). BPY = birds per year killed by the source indicated. The number of fatalities does not include habitat impacted or expected impacts as a result of these activities. For example, there are no impacts calculated as a result of climate change resulting from the burning of fossil fuel or habitat change resulting from acid precipitation. The American Bird Conservancy, National Audubon, and US EPA have provided models that predict habitat change and subsequent population impacts on birds in North America.

Source of Mortality	Numbers Estimated (BPY)	Attribution/Reference
Glass Windows	100 million to 1 billion	D. Klem, Muhlenberg College
House and Feral Cats	100-200+ million	National Audubon Society
Hunting	120 million	U.S. Fish and Wildlife, Gill 1995
Pesticides	67 million	Smithsonian Migratory Bird Centre
Automobiles and Trucks	60+ million	U.S. Fish and Wildlife
Mowing of Hay	millions	Suspected – smaller numbers known
Communication Towers	4-5+ million	U.S. Fish and Wildlife
Oil & Gas Extraction	1-2 million	U.S. Fish and Wildlife
Stock Tank Drowning	1 million?	Suspected – smaller numbers known
Commercial Fishing	1 million?	Suspected – smaller numbers known
Coal Strip Mining	millions	Documented habitat elimination
Wind Turbines	low thousands	Curry & Kerlinger estimates*

*Estimates made through calculation using known number of fatalities from wind plants studied, the number of turbines known to be operating (about 11,000 currently), and several other factors.

AVIAN IMPACTS AT WIND POWER FACILITIES IN EUROPE:

An annotated summary of studies

April 10, 2001

Report Prepared for CHI Energy

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This report provides an annotated list of avian impact studies conducted at wind power facilities in Europe. To the author's knowledge, the European wind power literature has never been summarized or reviewed. This report summarizes fatalities resulting from collisions with the rotors of wind turbines and studies of bird behaviour in wind parks. The latter is a means of determining disturbance to birds in the vicinity of wind turbines. The list of wind parks in Europe included in this report is not complete and represents a work in progress. The reason for this is that results from European studies are published in an array of publications and languages, which makes them difficult to locate and, in some cases, translate.

An effort was made to provide as much information as possible regarding the numbers of turbines studied, the duration of the studies, the general types of turbines studied, the habitat and topography of the wind plant, the number of fatalities found, the types of birds involved, and information regarding who did the study and for whom the study was conducted.

European studies differ greatly from those in the United States. Many lack fatality information, presumably because few carcasses are found or are obvious to researchers. Because of the strong environmental restrictions of the EU, impacting birds and bird populations is a serious issue in Europe. However, the paucity of studies that can be found suggests that fatalities at turbines in Europe are rare and infrequent at most wind power facilities.

Review of Avian Fatality Studies at Wind Power Plants in Europe

United Kingdom

As of early 2001, the British Wind Energy Association listed more than 40 commercial wind power facilities having more than 1 turbine and supplying more than 1 megawatt of electricity. In addition, there are at least 5 individual sites where there was only one commercial sized turbine. A total of about 750 turbines were operating at the end of 2000 in the UK providing more than 350 megawatts of power. At none of these facilities has there been a report of significant mortality.

The Royal Society for the Protection of Birds (RSPB), the largest bird protection organization in the world, stated that wind power can reduce the overall impact of the energy sector on birds. "The use of renewable forms of energy, such as wind power, can help make a significant reduction in such impacts (referring to the energy sector). However, the local effects of wind power can be such that they could outweigh the benefits." The local effects referred to by RSPB include loss of habitat and direct mortality through collisions with turbine rotors.

Llandinam, Wales – Behavioural and fatality studies were done at this inland site where there are 103 turbines (30.9 megawatts) revealed minimal impact.

Mynydd Cemmaes, Wales – Same types of studies as above at this inland site consisting of 24 turbines. Only 2 dead birds were found at this and the above facility: 1 snipe and 1 Black-headed Gull.

Blyth Harbour, Northumberland – Nine modern turbines were constructed on a seawall in 1992 adjacent to the sea. There were no apparent impacts on Purple Sandpipers that feed on the jetty - sea and water birds (eiders, gulls, cormorants) as well as shorebirds (purple sandpipers, sanderlings). Weekly searches revealed 20 carcasses in about a one year period (34 in 2.5 years); 12 eiders killed in first 2.5 years of study then numbers declined and no fatalities were found in 1996-1997 despite increases in eider population. No significant impacts – fatality and behaviour – were recorded.

Blyth Offshore, Northumberland – 2 modern wind turbines, 4 megawatts, about 1.5 km offshore – erected in 2000, no studies yet available. Mention of this facility in the report was made to show that offshore wind power development is proceeding in Europe.

Bryn Titli, Wales – 22 relatively modern wind turbines, 9.5 megawatts, sheep-grazing and heather moorlands, focus on wintering raptors (Red Kite, Peregrine Falcon, Kestrel, and Common Buzzard) and ravens; behavioural impact on Red Kite and ravens – both used wind power site less than adjacent areas. This effect was apparently compounded by the presence of an ecotourism feeding area for Red Kites some kilometres away that attracted birds for many miles (similar to the attraction of land fills to this species). No fatalities were reported.

Overall, wind turbines have posed little damage or disturbance to birds in the UK.

Spain

A total of 2,500 megawatts from about 4,000 turbines was projected for Spain by the end of 2,000. There are several important areas of wind power development in Spain. In the north, wind plants have been erected in Galicia, Navarre, and elsewhere, mostly after 1998. These areas are wide-open pastures, hayfields, and some other habitats. This author examined several areas in Galicia in 1996 and found bird use to be low at these sites. There do not seem to be any post-construction studies from most sites in Spain because the facilities are so new, but studies are likely to be forthcoming. The other major wind area in Spain is at Tarifa, overlooking the Straights of Gibraltar, where there are more than 1,000 old and modern turbines. This is the only wind farm area in Spain where mortalities have been reported.

Tarifa, Analucia - about 1,000 turbines ranging from older commercial grade turbines to modern turbines, lattice and tubular towers on steep hillside grazing land. Morocco is visible in the distance and the wind park is situated at one of the world's largest migratory concentration points of raptors (more than 100,000 pass per autumn), storks and cranes (more than 50,000 pass per autumn), song, and other birds. Several studies have been conducted. The numbers of migrating birds found has been minimal. It should be noted that Griffon Vultures (2+ m wingspan) have been impacted as have Kestrels.

In one study where rigorous searches were made at 87 turbines, an estimated 30 vultures and 49 Kestrels were killed. The vultures are permanent residents with a population of about 400+ pairs that frequent the general area of the wind plant. Kestrels are resident nesters, wintering birds, and migrants. The behaviour of the vultures (constant soaring at low altitudes looking for dead livestock) and the steep terrain on which the turbines are situated combine to make the wind park risky to this species. This is analogous to Golden Eagle and Red-tailed Hawk mortality in the Altamont where birds hunt at low altitudes amidst a large number of turbines that are on steep hills.

In a second study, only 1 Griffon Vulture and 1 Short-toed Eagle were found dead during 14 months of study. Fatality rate per turbine was estimated to be 0.03 birds per turbine per year. More than 45,000 vultures and 2,500 Short-toed Eagles flew over the site during the study period. Very few migrants were impacted. Researchers feel that migrants fly well above the wind turbines and that it is residents that have greater potential for impact. Tarifa seems to be the only place in Europe where raptor fatalities may be high, but study results have been inconsistent and vary dramatically. It is unlikely that raptor populations are or have been impacted by the turbines at Tarifa.

[Observations of migrating raptors made by this author during spring 1996 at Tarifa and radar observations made by researchers during the same spring confirm that migrating raptors, storks, cranes and other birds fly around or above the turbines. Black Kites, a numerous species, simply flew around the ends of turbine rows, before continuing their northward migration. They did not fly within 50 m of the turbines, except on rare occasions. It was obvious that these birds deviated so as to avoid the turbines.]

There appear to be no records of fatalities of birds at wind turbines in Spain, other than from Tarifa.

Netherlands

Approximately 336 megawatts of wind power are being produced annually in the Netherlands. Most wind energy in the Netherlands is located along the coast of the North Sea in low-lying regions. Some of these low-lying situations are in the polders and are surrounded by wetlands. Fatality information was gathered at several of these facilities, as was behavioural data.

Oosterbierum Wind Park – 18 mid-sized wind turbines (300 kilowatts per turbine) situated in farmland adjacent to the Wadden Sea were studied to determine mortality and behaviour of birds near turbines. Birds were observed to change flight paths at, at least, 100 m when approaching turbines. Birds examined were waders and songbirds. Disturbance distance was also studied among waterfowl and other birds and disturbance was found to be minimal.

Urk Wind Park, Lake Ijsselmeer – 25 mid-sized wind turbines (300 kilowatts per turbine) situated along a 3-kilometre dike along the edge of Lake Ijsselmeer were studied to determine mortality and behaviour of birds (mostly wintering sea ducks) near the turbines. Disturbance occurred within 300 m of the turbines such that diving ducks avoided these areas. Waterfowl and other bird mortality was greater than at most other facilities. Fewer than 63 fatalities were documented during autumn and winter, mostly diving ducks and a few dabblers, when wintering waterfowl were present in peak numbers.

Lake Ijsselmeer – a “lake” inland a short distance from the sea. Study of wintering diving duck (hundreds on the lake) behaviour on lake near a string of 4 wind turbines (200 m between turbines). Some risk perceived, but none documented. The researchers concluded that risk to diving ducks is likely to be low. Study showed that at night ducks “can cope rather well with wind turbines in semi-offshore situations.” On moonless nights, ducks turned away at closer distances than on brighter nights. It is possible that long strings of turbines create barrier effects because ducks were reluctant to fly between turbines spaced by   No fatalities were reported and no fatality data were included. (In 1996-1997, 28 600 kilowatt turbines were installed in Lake Ijsselmeer. Studies of that site were not found.

Oosterschelde – No turbines were at this location so there is no – in an area with large numbers of waders (shorebirds) and some waterfowl. Results for waders studied at this coastal site were similar. Birds avoided turbines, but No fatalities were reported and no fatality data were included.

Other Wind Plant Studies in Netherlands

- Early-mid 1980s – 7 small wind turbines at a coastal site – no collisions or fatalities documented
- 1987 - 75 small wind turbines at several sites were studied – 21 fatalities reported

The fatalities at the wind plant at Oosterbierum adjacent to the Wadden Sea were more numerous than at most wind plants in the world. In general, the wind power facilities located in coastal marsh and lowland areas of the Netherlands appear to pose a higher risk to birds than inland sites. The numbers of migrants in these areas is very high and turbines are located among migration stopover and resting sites, which together may account for the risk.

[Summary of 108 European wind power study sites by Winkelman in 1994 revealed 303 fatalities, of which 124 were proven to collide with turbines. It is likely that the actual number was larger. No rare or threatened species were involved.

Denmark

Denmark is the leading country in the world with respect to per capita generation of electricity via wind power. At the end of 2000, about 6,000 wind turbines were producing about 2,000 megawatts of power in this small country, thereby providing more than 10% of the population with emission free electricity. Studies of avian impacts have been conducted at several sites. Fatality information is lacking and it does not seem that this is a major focus of research.

Tuno Knob, Kaategat – A behavioural study was conducted at 10 modern, 500 kilowatt turbines located several kilometres off the Danish coast in the sheltered waters of the Kaategat. The turbines were erected in 1995 and intensively studied via radar and direct visual methods. The area is a prime feeding area for thousands of wintering eiders and some scoters (also gulls and some other waterbirds present). The study showed that birds did fly in the height range of the rotors, but demonstrated avoidance. There was little in the way of significant disturbance effects, although eiders were reluctant to feed with in about 100 m of the turbines. No fatalities were reported, although the study was not designed to assess mortality.

Rodsand Offshore Wind Farm – This large windplant (about 90 turbines, ~200 megawatts) is planned for an area 10 km southwest of Gedser on the west coast of Denmark. Bird studies are now being conducted to examine potential impacts. Several hundred thousand waterfowl, 15,000 raptors, and 200,000 songbirds move through the area. Results of a preliminary study are available.

Esbjerb – Reference to this study was found, but the original was not. Five turbines of varying sizes were examined. Reduction in breeding birds beneath the turbines was documented and 7 fatalities were located.

To date, significant impacts to birds from wind turbines have not been reported from Denmark, despite the proliferation of wind power in this country.

Germany

Although there are more wind turbines (about 8,000 commercial units as of 2000) and more wind power generation capacity (4,500+ megawatts) in Germany than any other country in the world, there is little information about birds and turbines in that country that is readily available. Most wind plants are located inland from the coast, although significant efforts to develop Helgoland, where there is currently a single, 2 megawatt turbine now operating. This island is located off the north coast of Germany and is known to be an important migration concentration point in the Baltic Sea.

Drochtersen Wind Plant, Saxony – 7 older turbines in a grassland/meadow site were investigated to determine the impact of turbines on these songbirds and waders. Although lapwings "avoid close proximity to the wind power generators" other birds did not seem to be impacted by the turbines and were distributed evenly in the area.

Summary of Studies at 13 wind parks in Lower Saxony – Study in 1997 suggested that birds are less sensitive to the presence of wind turbines than previously thought. (Habituation was not investigated or suggested, but it is likely that after wind turbines are on the land for several years, they do not deter birds to the degree as when they were first constructed.)

Jade Wind Park and Dewi Test Field, Wilhelmshaven – Several species of shorebirds (golden plover, lapwing) and songbirds (skylark, Meadow Pipit) were examined in these German wind parks. They did not seem to be as sensitive as was suggested earlier and did not maintain large distances from the wind turbines.

Cuxhaven Wind Farm, Nordholz – Several small wind turbines in open, grassy fields and farmland. Twelve species of breeding and resting birds including shorebirds and songbirds were examined in relation to wind turbine locations. A slight, but insignificant reduction in numbers of birds occurred after the wind turbines were constructed. Some birds, like Syklarks, reached their highest densities within 250 m of turbines.

North-western German Wind Plants -Lower Saxony – Six wind power facilities were examined to determine the presence of wind turbines on nesting birds. Studies resulted in similar findings with respect to nesting and resting grassland birds in northwest German wind plants.

The above information was assembled from abstracts. The original papers are being sought to provide greater detail.

Sweden

There are currently somewhat less than 500 commercial wind turbines operating in Sweden that generate slightly less than 200 megawatts. More wind power is planned for the future. There were no studies of avian impacts readily available and there have been no reports of large-scale fatalities or impacts from wind plants which are mostly located in Gotland, Oland, and along the west coast.

Summary and Conclusions

Two types of impacts to birds have been studied and demonstrated at wind power facilities in Europe during about a decade of study. There are currently somewhat fewer than about 20,000 commercial turbines at wind plants in the United Kingdom, Spain, Netherlands, Germany, Denmark, and Sweden. Smaller numbers are now operating in Greece, Italy, and elsewhere in Europe. Disturbance via the presence of turbines has been demonstrated at a few sites such that birds are reluctant to forage or nest in the immediate vicinity or beneath turbines. In as many studies, this type of disturbance has not been demonstrated or has been shown to be minimal. Birds are not excluded from large areas by turbines, although localized effects are evident. In at least one or two cases, birds seem to have habituated to turbines so that this impact is minimal.

Fatalities resulting from collisions with turbines have been studied at a limited number of sites in several countries. The number of collisions is usually small, usually involving several species. In two locations, a moderate level of fatality has been documented. In Spain, dozens of resident vultures have been collided with turbines at a large wind plant in Tarifa. In the Netherlands, shorebirds, waterfowl, and songbirds collide with wind turbines in small numbers in low-lying areas along the sea where use by these species is great.

Small numbers of fatalities are likely to occur at all turbine installations, although nowhere in Europe (even in Tarifa, Spain and in the coastal Netherlands) have these impacts been judged to be significant or to cause population problems or impact rare or threatened species. A comprehensive assessment of the impact of turbines on birds in Europe should compare wind turbine mortality to other sources of energy generation and other sources of bird mortality.