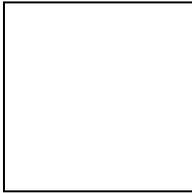


Joint-Venture Project Proposal to ENERQUEST

(30 MW Wind Farm in Western US)



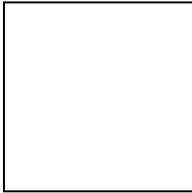
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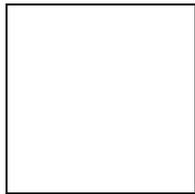
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1. Presentation of the company



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**☎+33 5 61 65 PUIM
+33 5 61 65 78 46**

PUIM Wind Power was founded in 1994, in Toulouse, France.

Our aim is to develop clean and profitable energy generators. The main part of our activity and investments (90%) is concentrated on Wind Farms, the other 10% being our research and development team, working on improving our Wind Turbines and on other clean energy generators such as solar energy generators.

We are considered as the French experts concerning wind turbines and clean energy. We have worked on all the major French achievements concerning wind energy exploitation, including all the Wind Power Farms set in Brittany and in south of France.

About Puim management team

Anthony Pointeau CEO Joint Venture / Financial specialist
0663925705@6sens.com

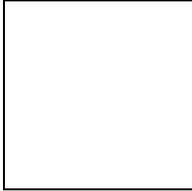
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2. Our experience about wind power farm in Western US

Since 1997, we are also a major actor in Western US, owning and operating 12 Wind Power Farms in Minnesota, each producing 52,000 MW/year, and 6 Wind Power Farms in California (two of them producing 52,000 MW/year and the four others 30,000 MW/year.) Those we have also financed, constructed and equipped, and we are also responsible for the maintenance and selling of the energy. To ensure the success of our past, present and future projects in Western US, we have set a production unit in South California in 1999, which can produce 750 KW and 1.5 MW Wind Turbines.

Our experience in France and in Western US has allowed us to become a leading company in this sector, and one of the most reliable firms concerning wind energy exploitation worldwide. As a proof of our professionalism, we have ISO 9001 and ISO 14001 certifications, as quality and client satisfaction are for us as important as the respect of nature.

3. Our proposal

The Joint Venture proposal that you sent us correspond exactly to our strategy and to a particular project that we planned to develop next year around Las Vegas.

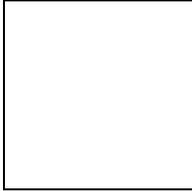
Studying Western US Wind map, we discovered that the area near Las Vegas is a great place to set a Wind Power Farm : perfect wind power, few bird migrations and the desert is wide, the land use is null, and it is not a protected area in terms of aesthetics and won't suffer from the visual impact of a Wind Power Farm.

Knowing this, we had a great idea, which has been supported by several investors. The project we have is to provide a huge hotel, casino in Las Vegas (such as Paris or Luxor) around nature, environment, health and well being with the energy generated by our Wind Power Farm. The name of this complex is : **Green Wind**

We've sold the license of this project to a group of investors, and if it is successful in Las Vegas we could export the project in some other part of the US (Florida).

Our main partners are :

- Green Peace
- WWF
- Evian
- Green Food
- Wilson
- Nike
- Ping



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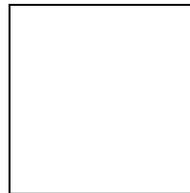
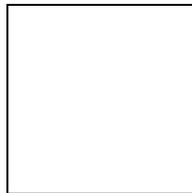
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- NSF International
- Fitness USA
- Basic Nutrition
- Cleveland
- TNT
- Adams
- Bio Life
- Callaway Off
- ...

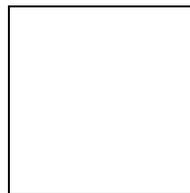
To circulate in the complex, electric mini cars and buses will be provided, using the extra energy generated by our Wind Farm, nevertheless horse-riding and the use of horse-drawn carriages will also be possible.

In the complex, there will be different areas :

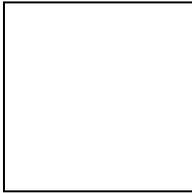
- A huge covered golf, where each hole will be represented by a fake Wind Turbine, the size will be defined later. These fake turbines represent real ones and will be sponsored by famous names of well-being, nature protection and health -see the list above-. Electrical buggies will be used —sponsored by Toyota -.



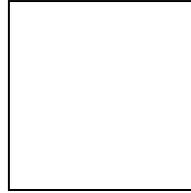
- A great hotel, with several floors sponsored by our partners, a great greenhouse, with a river in it and several swimming pools. The rooms will be on different themes such as Water, Earth, Wind, Fire, Sea, Beach, Forest, Mountains . Half of them will have views towards the Wind Turbines —of course the fake ones on the Golf course -.



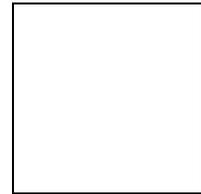
- A big classical Casino, decorated on the topic of Nature and the several themes above.



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- A great shopping center, with reputable shops selling only natural products, hairdressers, beauticians, clothes shops —where Puim logo products will be sold- and around 40 bio or vegetarian restaurants.
- A sea-water therapy area, with swimming pools, natural cares, massages, saunas, fitness courses



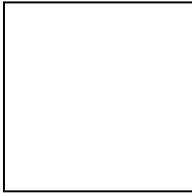
- A well-being area with personalized programs provided by specialists in nutrition, health, weight, beauty all in a natural way.



- A Green Peace Area, in a huge model of the Rainbow Warrior, a kind of educational and interactive museum with all that concerns protecting the environment, from the everyday life acts, to the different achievements of the Green Peace Organization. A special part will be dedicated to clean energy and Wind Power Energy by Puim, and visits of the Wind Farm will be proposed. Specific workshops will be dedicated to make the children sensitive to protecting the environment.



- For the children, a farm and a mini zoo with real animals will be set in partnership with the WWF, with activities to discover the different



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endangered species. Children will also be able to feed, cuddle and play with the farm animals, and to ride ponies.

The complex will use the fact that they use Puim clean wind energy as a marketing strength, and use it in their advertising programs. In counterparts, the complex will promote clean wind energy and familiarize people to this way of generating power. We ve sold the license and we have a special agreement with the future complex management.

We decided to sell our energy to Windy Vegas at a lower price for 20 years so as to promote Wind Energy, prove that our concept can be profitable very fast, to license Windy Vegas in other states of the US. The project allows us to create our own market, and our only concern now is to set the Wind Farm and to bring the energy to the hotel, which will only be a client. The need of the complex (hotel, casino, sea-water therapy, swimming pools, Green Peace area and electrical cars needs) matches the 30MW you require in your RFP, the following parts of this file will explain to you the details of our location and of our technical choices. client.

4. Capital shares in the Joint Venture

Puim shall have 55% of the ownership of the J-V, while the partner shall own 45% of the equity. Financing of the J-V shall be done through 60% of debt and 40% of equity. Please review table.

	Investment	Capital shares
EPDC	40%	45%
Puim	60%	55%

5. Technical aspects

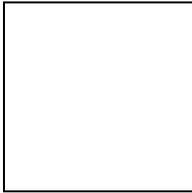
a) Wind resource analysis

In the United States, wind energy contributed about 3.5 billion kilowatt-hours (kWh) of electricity last year.

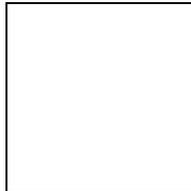
Power of the wind is proportional to the cube of the wind speed. Therefore, the wind speeds is the key point to measure the wind energy resources of locations. The windier the location, the more kilowatt-hours can be produced by the same equipment and the lower the overall cost of energy.

Existing wind power plants exploit very windy locations with average annual wind speeds of at least 16 miles per hour. The United States could supply 20% of its electricity from these very windy locations with existing technology producing 560,000 million kW per year.

The United States has 18,000 square miles of excellent wind locations, the equivalent of 0.6% of the lower 48 states. Less than 5% of this land would be used by the equipment and access roads; most of the existing land use, such as ranching and farming, would not be



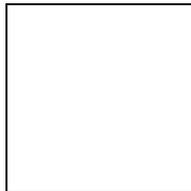
We carried out strategic analysis to locate the best site. In the first time, we studied the wind map of US, then the west American relief map. In this way, we excluded the windy and mountainous states such as Colorado, Wyoming, Idaho..., which would considerably increase the installation cost of wind farms.



Nevada and Nevada seem to be two states more interesting for developing a wind farm where the wind power class is regular during all the seasons.

Desert conditions are found in most of southern California and the valleys of southern Nevada. Intense heating often generate strong afternoon winds that persist into evening. However, many wind farm have been set up in the windy area of California like Tehachapi, Santo Rosa Island, Pleasanon, Solano county, San clemente...

The wind power plants in California produce 1.2% of the electricity used by California or 0.1% of the electricity used by the United States enough to supply the needs of both San Francisco and Washington, D.C., for example.



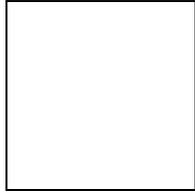
This map shows general wind power classes for the state and indicates that Nevada has excellent wind resources in portions of the state. If all the potential was developed with utility-scale wind turbines, the power produced each year would equal 63,000,000 MW/hours or 279 % of the entire state s electricity consumption.

b) The wind farm site

Therefore, We decided to locate our wind farm in the southern desert of Nevada near Las Vegas.

Green Wind site



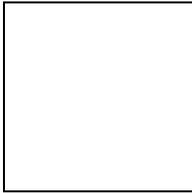


Puim wind farm site



The Puim wind farm is located near Jean, along the road 15 , which leads to Los Angeles.
The Hotel is in Las Vegas, 20 miles from the wind farm.





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c) Technology

Project Capacity: 30 MW

Estimated Annual Generation: 52,000 MW hours per year with an average wind of 8m/s

Number of Wind Turbines: 20 turbines



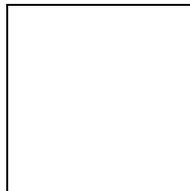
Puim turbine

Manufacturer: Puim

Wind Turbine Type: Puim s 1.5 MW Series wind turbine.

Puim s 1.5 MW Series turbine is the largest wind turbine manufactured in the United States, was the first of its size class to be manufactured for the global wind power market, and has the longest track-record of any MW class turbine. Puim s 1.5 MW wind turbine utilizes a variable speed, constant frequency design and a custom designed airfoil resulting in enhanced reliability and durability due to reduced mechanical loads, higher energy capture and lower noise signature than conventional fixed speed turbines due to improved aerodynamics. Interconnect costs are reduced due to selectable power factor and voltage control compared with conventional turbines with induction generators and fixed capacitors.

Rated Output: 1.5 MW



Wind power curves and annual yaled

Turbine Height (at highest point): approximately 330 feet (about as tall as a 33 story building)

Turbine Hub-height: Approximately 213 feet (65 meters)

Turbine Weight: Approximately 184,000 lbs. (nacelle, hub and blades)

Foundation: Each wind turbine foundation consists of a concrete cylinder 18 ft. to 28 ft. deep by 10 ft. wide (14 outside diameter).

Footprint: 14 ft. diameter — spaced 1,000 to 2,000 feet apart

Concrete: 167 tons per foundation (3,356 tons to complete all 20 foundations, or 186 full concrete truckloads — enough to make a 3 x 3 sidewalk approximately 11.5 miles long).

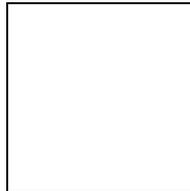
Tower: Tubular Steel

Tower Height: Approximately 207 feet (63 meters)



Blade Length: Approximately 112 feet (34 meters)

Rotor Diameter: 231 feet (70.5 meters) — 10% longer than the wingspan of a jumbo jet (a Boeing 747-400 has a wingspan of 64 meters)



How does it work?

Revolutions per minute: 11-20 (one revolution every 2-3 seconds)

Swept Area: 41,995 sq. feet per turbine or 1.7 times the sail area of a flying clipper ship. The clipper ship Star of India has 24,000 sq. feet of sail area



Green energy

Construction Schedule :

Groundbreaking : January 2002

Completion : February 2002

Schedule :

January 2002 — Grading of roads and substation site, turbine pads and foundation begin. Collection system lines begin to be run from the turbines sites to the on-site substation.

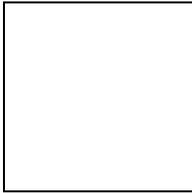
February 2002 — Complete all 20 foundations and step-up transformers. Begin construction of substation.

June 2002 — Complete transmission line, power collection system and interconnect construction.

November 2002 — Turbines and towers begin to arrive — by train- and erection begins. Energization of the system begins.

December 2002 — Project complete.

Annual offsets :



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Based on the average fuel mix, the 20 Puim 1.5 MW wind turbines can be expected to annually offset approximately 157 million pounds (78,000 tons) of carbon dioxide, the leading greenhouse gas associated with global warming, 824,000 pounds (412 tons) of sulfur dioxide (the major cause of acid rain, pollution of waterways, and air-borne particulate pollution), and 505,000 pounds (253 tons) of nitrous oxide. If oil were burned to generate the same amount of electricity, more than 175,000 barrels would be required each year.

Noise :

Concerning the noise, Puim does turbine sound emission measurements, are all in accordance with the MEASNET regulations.

The acoustic sound power level and tonality of a wind turbine are determined according to international established procedures i.e. IEC 61400-11.

The developed measurement methods can also be used in special projects to determine the specific noise production of various components, such as the individual rotor blades on the same turbine. A parabolic antenna can be deployed for this purpose.

The measurement results of the standard determination of the acoustic sound power level and tonality are reported according to the standard IEC 61400-11. The group Experiments and Assessment is certified according to EN 45001 for noise measurements. The results are important for wind turbine manufacturers, certifying bodies, legal authorities, developers.

6. Staffing

a) Human Resources

According to the wind farm designed, skilled and professional local staff is needed for constructing and operating the new site.

i. Construction Period

The construction time for the site will take approximately 12 months. The project will create approximately 40 full-time jobs during this period, working with our engineers.

Typical personnel requirements include:

- Construction Management
- Operators for heavy equipment
- Laborers for assembly
- Electricians
- Safety personnel
- Civil works

ii. Operational Period

Total 8 full-time staff will be employed in the following four functional sectors in the site to ensure its running.

➤ **Site Manager**

- Job description: the person who is in charge of the general operation and HSE (Health Safety, Environment) and quality issues of the site.
- Skills required: have general knowledge of wind energy industrial, good management skill. Site management experience is preferred.

➤ **Production Department**

4 production engineers

- Job description: the person who is taking responsibility for operating the central control and monitoring system, making the performance records and addressing any system alarms.
- Skills required: familiar with computer literary, inventory management, job and equipment scheduling and performance record keeping.

➤ **Maintenance Department**

3 maintenance engineers working for 3 parts: mechanics, electricity and electronics

- Job description: the person who is taking responsibility for keeping the equipment running in a good condition, do the regular inspection and solve the trouble promptly.
- Skills required: have 4 years working experience in mechanics, electricity or electronics.

b) Training Program

Since the wind power plant operates automatically, our training program focuses mainly on developing and promoting the technical skills of our engineers. The entire training package will be organized and conducted by PUIM at one of its wind farm.

The training package is as follows:

Section	Site Management	Production Engineer	Maintenance Engineer
I	General introduction of wind energy industrial including the area of social, environmental, economic, and the new technology and scientific		
II	Site tour to study a successful wind power plant, realize the design, the main equipment		
III	HSE procedure and Quality Standard of PUIM for its wind farm	1. The operation procedure of the central control and monitoring system 2. Statistical trend analysis	The detailed design and construction of wind tube
IV		Workshop for trouble-shooting	Workshop for repair the equipment
V		Practice and getting the PUIM operating certificate	Getting the PUIM operating certificate

c) Engineering support from PUIM

In additional, the experts from PUIM will give following supports to the JV:

- a free exchange technical support to site regarding computer system, software support and data analysis.
- Annually HSE & Quality audit will be conducted by PUIM to help the site improve its performance and internal control.
- The experts from PUIM take responsible for keeping good relationship and communication with local Environment Department, legal Department, community and customers.
- New technical developing projects are also strongly supported by the experts from PUIM.

7. Incentives and policies

As one of the renewable energies, wind power benefits Nevada’s quality of life. In order to improve the development of this industry, following financial incentives and legislative policies have been adopted in Nevada:

a) Property Tax Exemption

Applicable sectors: Commercial, Industrial, Residential

Amount: 100%

Max. Limit: none

Terms: N/A

Legislative Code: NRS 361.079

Summary:

This statute states that any value added by a qualified renewable energy source shall be subtracted from the assessed value of any residential, commercial or industrial building for property tax purposes. Qualified equipment includes solar, wind, geothermal, solid waste converters and hydropower systems. This exemption applies for all years following installation.

b) Generation Disclosure

Applicable Sectors: Utilities

Fuel Mix: Yes

Emissions: Yes

Std Format: Yes

Date Enacted: 6/5/01

Expiration Date: none

Legislative Code: NRS Chapter 704, as amended by AB 197 (2001)

Summary:

Beginning October 1, 2001, each electric utility must disclose certain information to its customers. The disclosure must be in a standard format, provided in bill inserts twice a year, and be available on the utility's website. The disclosure must include the average mix of fuel sources used to create the electricity, the average emissions, customer service information, and information on low-income energy programs. The Nevada Public Service Commission will establish the specific regulations for disclosure.

c) Renewable Portfolio Standard

Applicable Sectors: Utilities,
Initial Minimum: 5%
Effective: 1/1/03
Date Enacted: 6/8/01
Legislative Code: NRS 704, as amended by SB 372

Summary:

As part of its 1997 restructuring legislation, the Nevada legislature established a renewable portfolio standard. Under the standard, the Utilities must derive a minimum percentage of the total electricity they sell from renewable energy resources. In 2001, the legislature revised the minimum amounts to increase by 2% every years, starting with a 5% renewable energy requirement in 2003 and achieving a 15% requirement by 2013 and each year thereafter. Not less than 5% of the renewable energy must be generated from solar renewable energy systems.

% Renewables	Date
5%	01/01/2003
7%	01/01/2005
9%	01/01/2007

8. Financial aspects

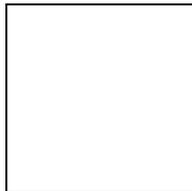
This chart represents the details of the costs of the project.

Investments Costs	Item	Quantity	Cost / Item	Amount
FEASIBILITY STUDY	°	°	°	°
Site inspection	day/person	4	\$500,00	\$2 000,00
Wind potential estimation	met tools	1	\$15 000,00	\$15 000,00
Environmental estimation	day/person	6	\$500,00	\$3 000,00
First conception	day/person	10	\$400,00	\$4 000,00
Detailed cost estimation	day/person	10	\$400,00	\$4 000,00
Report preparation	day/person	10	\$500,00	\$5 000,00
Project management	day/person	6	\$600,00	\$3 600,00
Travel and accommodation	trip/person	5	\$3 000,00	\$15 000,00
Other costs (radar,...)	-	1	\$10 000,00	\$10 000,00
ENGINEERING	°	°	°	°
Wind power tower location	day/person	35	\$500,00	\$17 500,00
Mechanical conception	day/person	30	\$400,00	\$12 000,00
Electrical conception	day/person	35	\$550,00	\$19 250,00
Civil engineering	day/person	15	\$600,00	\$9 000,00
Work supervision	year/person	0,8	\$150 000,00	\$120 000,00
ENERGETIC EQUIPMENTS	°	°	°	°
Wind power tower	wind power tower	20	\$1 150 000,00	\$23 000 000,00

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Spare parts	%	5%	\$23 000 000,00	\$1 150 000,00
Transport	wind power tower	20	\$2 000,00	\$40 000,00
ALLIED INFRASTRUCTURES				
Wind power tower foundation	wind power tower	20	\$30 000,00	\$600 000,00
Wind power tower erection	wind power tower	20	\$17 500,00	\$350 000,00
Approaches	miles	40	\$45 000,00	\$1 800 000,00
Network and transformer	project	1	\$650 000,00	\$650 000,00
Maintenance building	building	1	\$40 000,00	\$40 000,00
Transport	project	1	\$100 000,00	\$100 000,00
OTHER COSTS				
Training	day/person	25	\$700,00	\$17 500,00
Interest	%	6%	\$27 986 850,00	\$1 679 211,00
Unexpected costs	%	6%	\$29 666 061,00	\$1 779 963,66

\$31 446 024,66



So the total amount of money we need is \$31 446 000. The loan of the bank is \$29 666 061,00.

However, as we have a partnership with 20 companies concerning the financing of the Wind Power Towers, we can decline the cost of the project. As a matter of fact, these companies are financing \$250 000 for each tower (1 company = 1 tower = \$250 000).

$$\$250\,000 \times 20 = \$5\,000\,000$$

Total amount of the project : **\$26 446 000** to finance
\$250 000 represents :

- A big banner on each tower with the name of the company (on both the wind farm and the fake towers on the golf green).
- A hole on the Golf course having the name of companies
- A floor on the Hotel having the name of the partner
- Their name on the advertising products

This is possible thanks to the partnership with the Hotel. We will charge the Hotel 2,5 cents per kW for the electricity (26 000 000 X \$0,025 = \$650 000) and of course offer them a wonderful concept : The cleanest Hotel of Las Vegas . This concept is of course included in this price. In



exchange, they will provide us with the parcel of land where the towers will be placed (they still own it). They will also sell products representing our Towers (T-Shirts, Toys....). They will also organize visits of the Wind Farm in the Desert. We can be benefited **\$800 000 per year** from this program.

Note: The total amount of the project is \$26 446 000 but we borrow \$29 666 061.

$$\mathbf{\$29\ 666\ 061 - \$26\ 446\ 000 = \$3\ 220\ 061}$$

We have an extra money that we will use during operation period for :

- Training
- Employment
- Unexpected costs

As we produce 52 000MW, we will sell 26 000MW to the Hotel (as decided with the Hotel, thanks to the study they made), and we will sell the other 26 000MW to the city at 4 cents per kW.

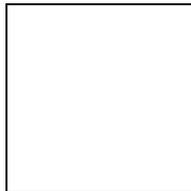
$$\mathbf{26\ 000\ 000 \times \$0.04 = \$1\ 040\ 000}$$

So, the total amount of revenue we will have per year is :

$$\mathbf{\$800\ 000 + \$1\ 040\ 000 = \$1\ 840\ 000}$$
$$\mathbf{\text{Advertising} + \text{Electricity} = \$1\ 840\ 000}$$

That s why this project will be auto-financed in :

$$\mathbf{\$26\ 446\ 000 / \$1\ 840\ 000 = 14,37\ \text{year that is to say } \mathbf{15\ \text{YEARS.}}$$



* with ads means that the contract is renewed every 5 years

Note :

This partnership with the Hotel will last 15 years. After this period of time, we will sell them the electricity @ \$0,03 per kW for 5 years. After these 20 years, a new contract will be signed.

Concerning the advertisers, they will be charged \$250 000 for 5 years. After that, new contracts will be signed engaging them for a new 5 years period. With \$5,000,000 every 5 years, we can auto-financed faster the project. If they disagree, the auto-financing will remain the same.

9. Environmental effects

Although wind power plants have relatively little impact on the environment compared to other conventional power plants, there is some concern over the noise produced by the rotor blades, aesthetic (visual) impacts, and sometimes birds have been killed by flying into the rotors. Most of these problems have been resolved or greatly reduced through technological development or by properly locating the wind plants. Avian mortality remains an issue to be better understood and resolved.

a) Protocols for Evaluation of Existing Wind Developments and Determination of Bird Mortality

i. Project Protocol I: Evaluation of Existing Wind Developments

The protocol will determine the relative abundance and utilization rates of birds in an area, sample for bird mortality, and then determine the bird risk and attributable risk due to the WRA.

This approach should allow researchers to focus quickly on key areas for further inquiry and uncover potential relationships that could be verified through follow-up studies, as warranted.

The general goals of the protocol are :

1. Establish a methodology for conducting avian mortality monitoring studies that will set standards for other such studies.
2. Determine if differing risk levels of avian mortality are attributable to the WRA, and if so, determine if they represent potentially significant problems for a population.

Develop research methods and conduct field research on increasingly focused problem areas, and develop recommendations that provide resolution of the problem(s) in order to facilitate locating of future developments.

ii. Project Protocol II: Determination of Bird Mortality

The goal of this protocol was to determine the best possible study design and testable hypotheses concerning the effect of treatments on bird mortality and/or use in wind farms or around individual turbines.

b) Practices for Monitoring Bird Populations, Movements and Mortality in Wind Resource Areas

It is important to use a technique for monitoring bird populations that will provide sufficient information for assessing the impact of the wind development on the avian resource. A monitoring program should provide information on :

- estimated population sizes and trends for various species of birds,
- estimated demographic parameters for at least some of the populations,

- habitat data to link population size and demographic parameters to habitat characteristics.

Because of the lack of information on the species at risk at wind farm developments, all species should be monitored. However, emphasis may have to be placed on particular species (e.g., endangered or threatened species) or groups of special concern (e.g., raptors).

c) Use of Radar for Wind Power-Related Avian Research

i. Common Types of Radar Used for Bird Studies

Large weather radars (e.g., WSR-57, NEXRAD or WSR-88D) and air surveillance radars are excellent tools for studying patterns of bird migration over extensive areas (Eastwood 1967; Gauthreaux 1975; Richardson 1979; Able 1985; Buurma and Bruderer 1990; Buurma 1995). These types of radars could be useful for broadarea preliminary site selection surveys. However, they are not useful for collecting high-resolution data over small areas such as wind sites. Further, they are usually stationary and may not always be available near a particular wind site. Finally, some of these radars are equipped with devices that filter out and remove echoes of some birds (Richardson 1972). For these reasons, the following discussion will focus on smaller, mobile types of radar that could provide high-resolution data from a desired location.

Marine radar, which typically is used on boats for navigational purposes, is an excellent tool for many types of wind power-related avian research. The advantages of marine radar systems are that they are inexpensive, are available off-the-shelf, require little modification or maintenance, are dependable, have repair personnel readily available worldwide, are easy to operate, have very high resolution, and can be modified to collect altitude information (Williams et al. 1972; Korschgen et al. 1984; Williams 1984; Gauthreaux 1985a,b; Cooper et al. 1991).

ii. Limitations of a Marine Radar System

Number of Birds

A flock of birds usually appears as one echo on the radar screen. That is why most radar studies report movement rates as targets/h rather than as birds/h. For many types of research, this index of movement can be used without problems, but there are occasions when one wants information on actual numbers of birds crossing a site.

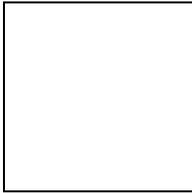
Effects of Weather

Rainy or snowy conditions make radar observations of birds difficult to impossible, because the attenuation required to remove the echoes of the precipitation also removes most or all bird echoes.

iii. Standards for Equipment, Settings, and Methods

Equipment

A marine radar system used to monitor birds should be X-band (3-cm wave-length), transmit with 10 to 25 kW of peak power, and have plotting and alarm functions. A color display monitor is an excellent feature to reduce observer fatigue (especially on surveillance radar), but monochrome displays are easier to videotape and are less expensive than are color



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monitors. The cost of one of these radars, including the modifications for the vertical or surveillance radars, would range from ~\$8000 to ~\$15,000 (US), excluding installation.

Radar Placement

One of the most important and difficult-to-learn aspects of using surveillance radar is selection of sampling location. The site one chooses has important implications for data quality and comparability among sites. Basically, one needs to choose a site where ground clutter and shadow zones (e.g., areas behind hills or other objects that shield bird targets from radar) do not obscure or exclude important portions of the study area. Within a particular area, it usually is possible to find a particular site from which observations can be made, especially if "radar fences" are used. One additional technique that could allow greater flexibility with location would be to mount the radar on a small crane that could be elevated to a desired height. This technique would be particularly useful in flat, heavily wooded areas.

Methods for Data Collection

One of the most important aspects of data collection, however, is to collect data in discrete sampling periods no longer than 30 min in length, at a standard range. By collecting data this way, one can standardize movement rates to targets/h/km, which allows comparison among studies. Further, time and weather data should always be collected, as these variables can be strongly correlated with movement rates and flight behavior. A sampling design for a visual and radar study to quantify bird movements and flight altitudes at proposed or existing wind-farms can be found in Cooper *et al.*

iv. Applications of Radar for Wind Power-Related Avian Research

Pre-construction Studies

- Siting : Locating wind farms in areas with few low-flying birds probably is the best solution for minimizing bird fatalities. Within an area of interest, radar and visual sampling should occur at a number of sites; the resulting data will provide a comprehensive, around-the-clock look at where "windows of movement" exist and will identify areas with heavy concentrations of low-flying birds.
- Identifying Periods of Risk : It may happen that an area is devoid of significant numbers of low-flying birds most of the time, but that there are certain seasons and/or weather conditions when significant numbers of birds do fly low enough to be at risk

Post-construction Studies

- Monitoring impacts : Radar and visual studies can be used to assess post-construction changes in avian use or behavior over an area (day or night).
- Assessing effectiveness of collision reduction techniques : To assess the success of collision reduction techniques properly, it is necessary to know the number and altitude of birds flying over the area, in addition to number of collision victims.
- Real-time warning system to reduce bird collisions : Visual and radar monitoring could provide information so that schedules for wind power generation could be adjusted to adapt to periods when large numbers of low-flying birds are passing through a wind farm, either during the day or at night.