SUMMARY

Mean wind speed at the proposed Icebreaker location at an elevation of 90 m is 8.0 m/s (17.9 mph).

Reference: NREL Offshore Wind Maps 2010

This extrapolates to approximately 8.1 m/s at the proposed 100 m hub height

Total annual energy output from the 6 Siemens wind turbines can be expected to be approximately **64,168 MWh,** assuming 90% uptime.

Reference: WindCad performance model from Bergey
Reference: Siemens power curve for SW-3.0-101
Reference: Energy Estimate included in this document

Payback of the initial investment of $127,000,000 (as reported by WKSU) **will never happen**.

Over **$57,000,000** will remain unpaid after 25 years
Assumes $50/MWh value of electricity (annual average wholesale cost)
Assumes inflation of 2.5% on value of electricity
Assumes annual O&M costs of $25/MWh with no inflation applied

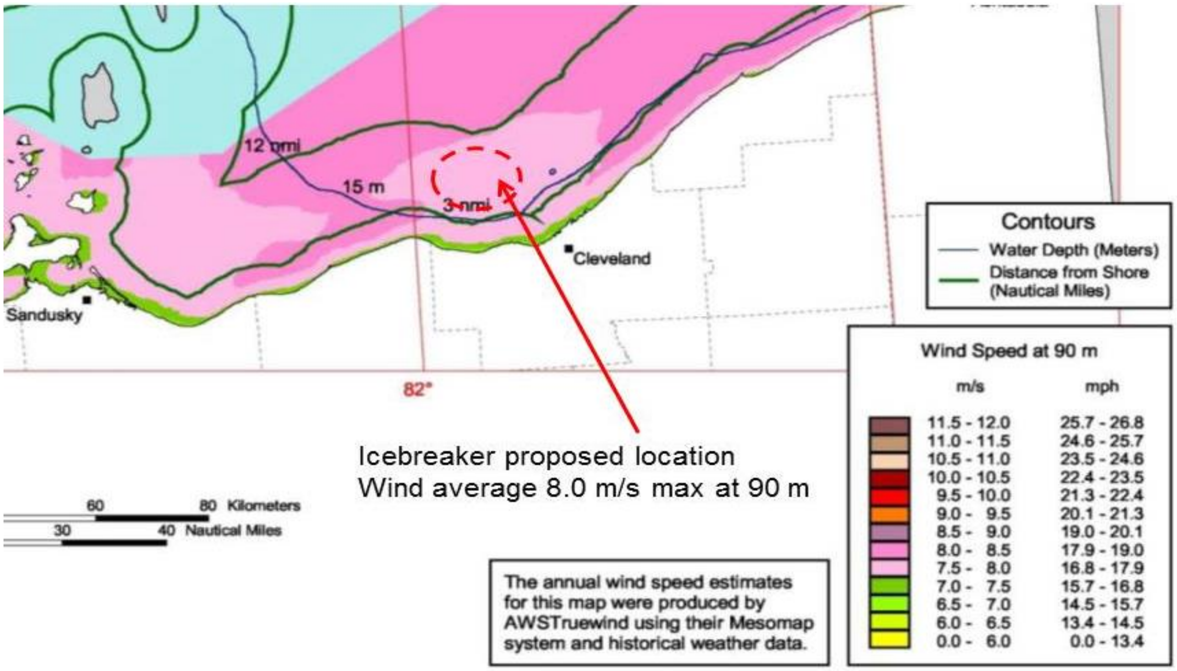
Reference : "The Wind Energy Operations & Maintenance Report" Feb. 2010
P. Asmus - Pathfinder Communications & M. Seitzler - SRE Engineering

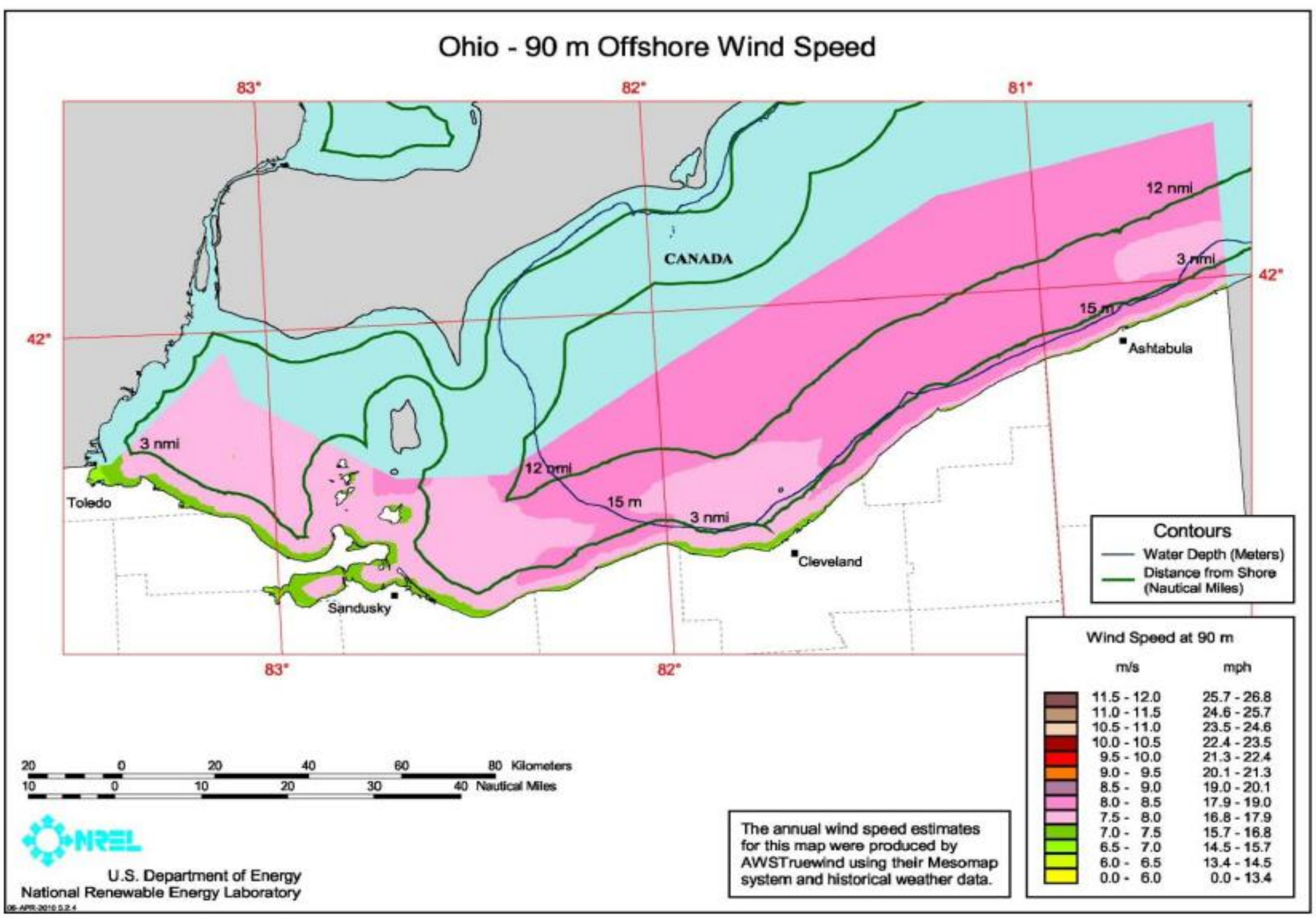
Additional Considerations:

- These economic analyses do not account for the cost that will be incurred to maintain and operate a traditional back-up system for generating power when the wind is not blowing adequately, and for the added cost and inefficiency of cycling this back-up system on and off to balance the supply load against the variability of the wind generated power.
- These analyses are presented for a 25 year period, although it is becoming evident that the useful life of many wind turbines is less than 20 years, and sometimes as little as 10 to 15 years. Siemens estimates the life of the SW-3.0-101 to be 20 years.
- Any supposed reductions in dependency on conventional power generation and any reductions in associated levels of pollution, attributed to use of wind power generation, are highly suspect; because of the need to maintain and operate the back-up systems in an inefficient manner.
- The lowest wind conditions and the lowest power output will occur in the summer, when the electricity demand is highest.
- Despite their supposed presentation as power sources for average everyday power needs, wind turbine projects are often granted special Power Purchasing Agreements (PPAs) which allow prices for their electricity that are many times higher than average wholesale price. It is disconcerting that a large portion of the feasibility studies and the on-going discussion are often devoted to proposals to make the projects appear viable with public spending and it is evident that, to make these projects work, massive government subsidies and large increases in the cost paid for electricity will be required to offset the investment losses and attract investors.

- **IF WE ARE CONCERNED ABOUT CO2 EMMSIONS: $127,000,000 could be used to procure approximately 115 MW of combined cycle gas turbine (CCGT) natural gas generation capacity. This would be capable of producing more than 856,920 MWh of reliable and dispatchable electricity every year. This is more than 13 times the electricity that the wind turbines will be able to produce and, by directly displacing coal generation, would have the ability to eliminate more than 6 times more CO2 than the wind turbines can eliminate.**

WIND SPEED MAP FROM NREL OFFSHORE MAPS 2010





http://www.nrel.gov/docs/fy10osti/45889.pdf

WindCad Wind Profile Model

As Provided by Bergey Windpower

Prepared For:	**LEEDCO Icebreaker Project**
Site Location:	**Lake Erie**
Data Source:	**AWEA Standard per Bergey**
Date:	**9/29/2013**

Inputs:

Ave. Wind (m/s) =	8
Weibull K =	3
Site Altitude (m) =	0
Wind Shear Exp. =	0.110
Anem. Height (m) =	90
Tower Height (m) =	100
Turbulence Factor =	-10.0%

Output:

Hub Average Wind Speed (m/s) =	8.1

Weibull Performance Calculations

Wind Speed (m/s)	Wind Probability (f)	Hours
1	0.40%	34.9
2	1.58%	138.3
3	3.46%	303.4
4	5.86%	513.5
5	8.45%	739.9
6	10.78%	944.0
7	12.39%	1085.2
8	12.92%	1132.1
9	12.26%	1073.7
10	10.55%	924.4
11	8.22%	720.3
12	5.77%	505.6
13	3.63%	318.0
14	2.03%	178.2
15	1.01%	88.4
16	0.44%	38.6
17	0.17%	14.7
18	0.06%	4.8
19	0.02%	1.4
20	0.00%	0.3
21	0.00%	0.1
22	0.00%	0.0
23	0.00%	0.0
24	0.00%	0.0
25	0.00%	0.0
Totals:	100.00%	8760.0

Weibull Calculations:
Wind speed probability is calculated as a Weibull curve defined by the average wind speed and a shape factor, K. To facilitate piece-wise integration, the wind speed range is broken down into "bins" of 1 m/s in width (Column 1)

Best results are achieved using annual or monthly average wind speeds. Use of daily or hourly average speeds is not recommended.

Instructions:

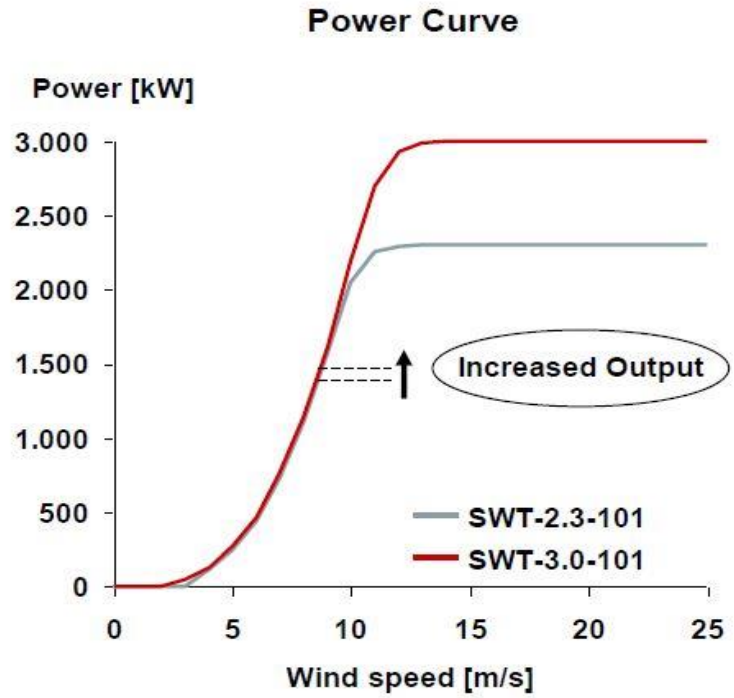
Inputs: Use annual or monthly **Average Wind** speeds. If **Weibull K** is not known, use K = 2 for inland sites, use 3 for coastal sites, and use 4 for island sites and trade wind regimes. **Site Altitude** is meters above sea level. **Wind Shear Exponent** is best assumed as 0.18. For rough terrain or high turbulence use 0.22. For very smooth terrain or open water use 0.11. **Anemometer Height** is for the data used for the **Average Wind** speed. If unknown, use 10 meters. **Tower Height** is the nominal height of the tower, eg.: 24 meters. **Turbulence Factor** is a derating for turbulence, site variability, and other performance influencing factors -- typical turbulence has already been incorporated into the model. Use 0.00 (0%) for level sites with limited obstructions. Use -0.10 (negative 10%) for flat, clear sites on open water. Use 0.05 to 0.15 (5% to 15%) for rolling hills or mountainous terrain.

Results: Hub Average Wind Speed is corrected for wind shear and used to calculate the Weibull wind speed probability.

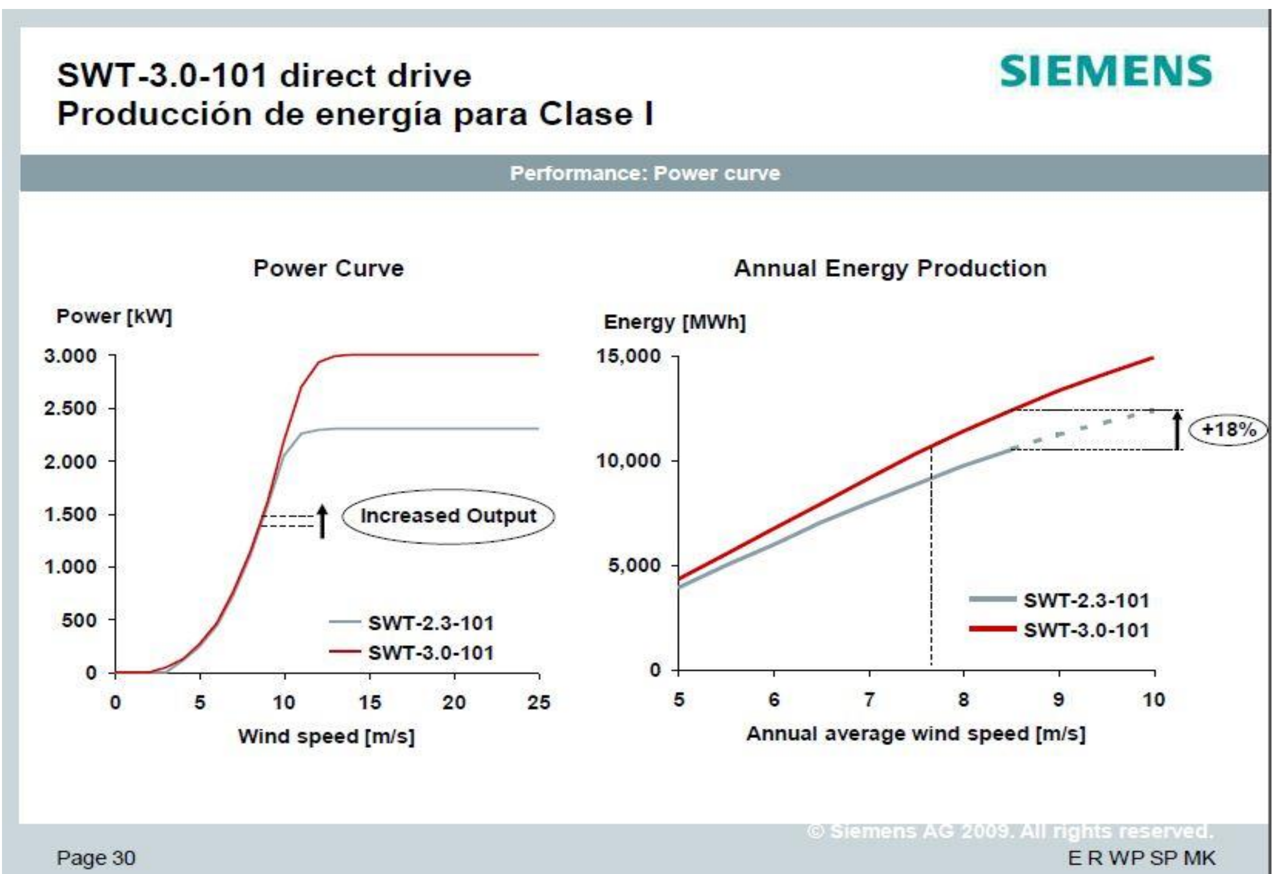
Limitations: This model uses a mathmatical idealization of the wind speed probability. The validity of this assumption is reduced as the time period under consideration (ie, the wind speed averaging period) is reduced. This model is best used with annual or monthly average wind speeds. Use of this model with daily or hourly average wind speed data is not recommended because the wind will not follow a Weibull distribution over short periods.

SWT-3.0-101 Power Curve
per Siemens data

Wind Speed (m/s)	Power** (kW)
1	0
2	0
3	49
4	140
5	250
6	425
7	675
8	1200
9	1650
10	2250
11	2650
12	2850
13	2950
14	3000
15	3000
16	3000
17	3000
18	3000
19	3000
20	3000
21	3000
22	3000
23	3000
24	3000
25	3000



** Power levels scaled from Seimens power curve



Use of Siemens SWT-3.0-101 model wind turbines assume from LEEDCO project proposals
Power curve information taken directly from Siemens technical product presentation for SW-3.0-101.
http://windar.com.ar/programas/2011/3_Felipe%20Ferres.pdf

LEEDCO ICEBREAKER

* Wind profile per Bergey WindCad Model
** Power based on power curve for Siemens SWT-3.0-101

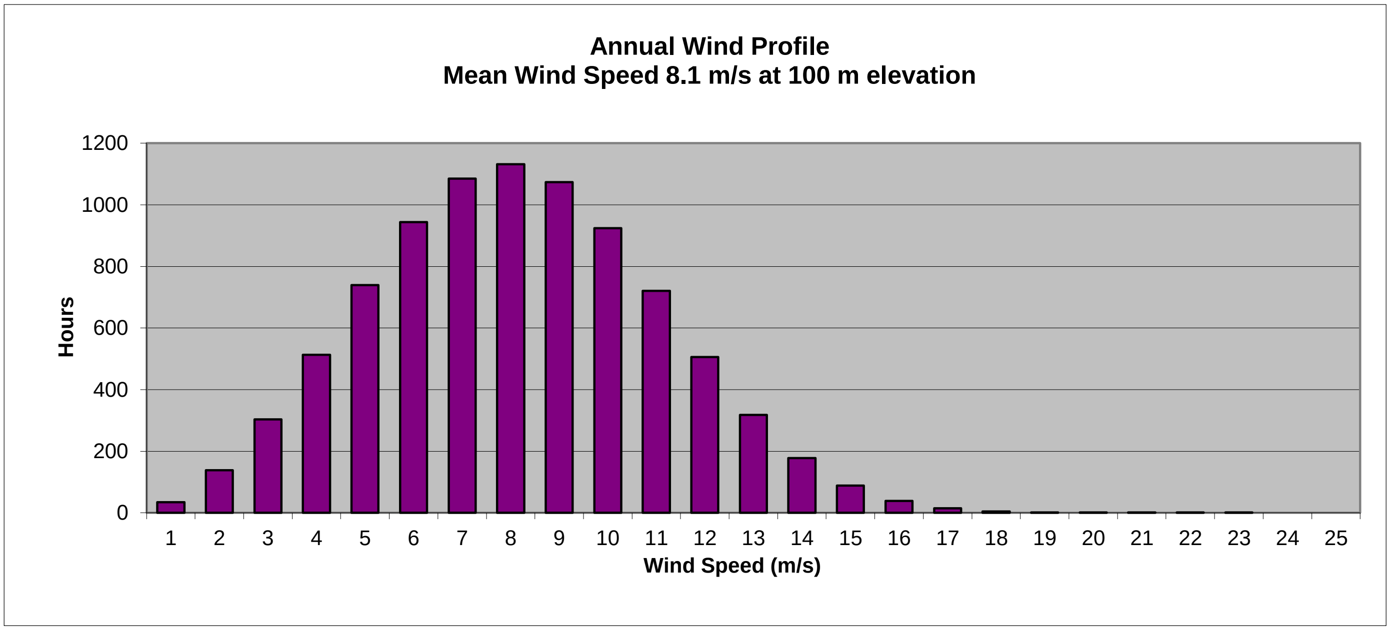
Published Power Capacity (kW)	3000

CONVERT FREQUENCY TO HOURS PER YEAR (1 YEAR = 8760 HOURS)

Wind Speed (m/s)	Freq * (%)	Hours	Power** (KW)	Energy (KWh)
1	0.40%	35	0	0
2	1.58%	138	0	0
3	3.46%	303	49	14,869
4	5.86%	514	140	71,897
5	8.45%	740	250	184,975
6	10.78%	944	425	401,206
7	12.39%	1085	675	732,534
8	12.92%	1132	1200	1,358,578
9	12.26%	1074	1650	1,771,599
10	10.55%	924	2250	2,080,007
11	8.22%	720	2650	1,908,740
12	5.77%	506	2850	1,440,915
13	3.63%	318	2950	938,149
14	2.03%	178	3000	534,595
15	1.01%	88	3000	265,168
16	0.44%	39	3000	115,657
17	0.17%	15	3000	44,053
18	0.06%	5	3000	14,550
19	0.02%	1	3000	4,137
20	0.00%	0	3000	1,005
21	0.00%	0	3000	207
22	0.00%	0	3000	36
23	0.00%	0	3000	5
24	0.00%	0	3000	1
25	0.00%	0	3000	0
TOTALS	100.00%	8760		11,882,883

Capacity Factor **40.7%**

Uptime	Actual Energy (KWh)	Actual Energy (MWh)	Total Energy x6 Turbines (MWh)
85%	10,100,451	10,100	60,603
90%	10,694,595	10,695	64,168
95%	11,288,739	11,289	67,732
100%	11,882,883	11,883	71,297



LEEDCO Icebreaker - Total Investment of $127,000,000
6 Siemens SWT-3.0-101 Turbines
Annual Energy Production per Wind Profile Analysis - 90% uptime

Annual Energy Production	*input*	64,168	MWh
Value of Electricity	*input*	$50	per MWh
Annual Inflation Rate	*input*	2.5%	
1st Year Revenue		$3,208,400	
Maint. Cost per MWh	*input*	$25	
1st year Maint. Cost		($1,604,200)	no inflation applied

Year	Inflation Factor	Revenue	Maint & Ops	Cash Flow
0				($127,000,000)
1		$3,208,400	($1,604,200)	($125,395,800)
2	1.025	$3,288,610	($1,604,200)	($123,711,390)
3	1.025	$3,370,825	($1,604,200)	($121,944,765)
4	1.025	$3,455,096	($1,604,200)	($120,093,869)
5	1.025	$3,541,473	($1,604,200)	($118,156,596)
6	1.025	$3,630,010	($1,604,200)	($116,130,785)
7	1.025	$3,720,760	($1,604,200)	($114,014,225)
8	1.025	$3,813,779	($1,604,200)	($111,804,646)
9	1.025	$3,909,124	($1,604,200)	($109,499,722)
10	1.025	$4,006,852	($1,604,200)	($107,097,070)
11	1.025	$4,107,023	($1,604,200)	($104,594,247)
12	1.025	$4,209,699	($1,604,200)	($101,988,748)
13	1.025	$4,314,941	($1,604,200)	($99,278,007)
14	1.025	$4,422,815	($1,604,200)	($96,459,392)
15	1.025	$4,533,385	($1,604,200)	($93,530,207)
16	1.025	$4,646,720	($1,604,200)	($90,487,687)
17	1.025	$4,762,888	($1,604,200)	($87,328,999)
18	1.025	$4,881,960	($1,604,200)	($84,051,239)
19	1.025	$5,004,009	($1,604,200)	($80,651,430)
20	1.025	$5,129,109	($1,604,200)	($77,126,521)
21	1.025	$5,257,337	($1,604,200)	($73,473,384)
22	1.025	$5,388,770	($1,604,200)	($69,688,813)
23	1.025	$5,523,490	($1,604,200)	($65,769,523)
24	1.025	$5,661,577	($1,604,200)	($61,712,147)
25	1.025	$5,803,116	($1,604,200)	($57,513,230)

Investment of $127,000,000 taken from report regrding Icebreaker project on WKSU
http://www.wksu.org/news/story/36917

Operating and Maintenance cost assumptions supported by information from
The Wind Energy Operations & Maintenance Report Feb 2010
P. Asmus - Pathfinder Communications & M. Seitzler - SRE Engineering