

Case Study

Satara - Maharashtra (India)

Windfarm

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Agenda

- Background of the project
- Planning Phase: Estimated timeline, budget
- Wind Resource Assessment
- Selection of Turbine
- Financial Model
- Development, Construction, Commissioning and Operation phases
- Financial Result

1a. Background of Project

○ Reasons for choosing to invest in wind project

- **Attractive Government policies:**
 - Accelerated Depreciation
 - Deferred sales tax
- **Captive power consumption**
- Management had the idea of investing in wind power project
- The project implemented in phases from 1998 to 2001
 - 2.07Mw (9 X 230Kw) – June 1998
 - 6.9Mw (30 X 230Kw) – March 2000
 - 2.76Mw (12 X 230Kw) – Dec' 2000
 - 6.6Mw (11 X 600Kw) – Sept' 2001
 - 4.2Mw (7 X 600Kw) – Dec' 2001
- The Project Located at Satara, Maharashtra, India

1b. Planning Phases

- Project Size: 22.53Mw
- Loc: Satara, Maharashtra, India
- Land: Private Land acquired @ 350 Acres by OEM
- Project executed between 1998 - 2001
- Earlier the plan was for 50Mw
- **OEM did all the Wind Resource study no consultant involved**
- **Site chosen based on the near by mast (Govt – CWET) data**
- **Infrastructure in the region:**
 - Transmission none (built 33KV line of @ 35Km)
 - The project is at a hill top, there were no proper road at the time of execution

2. Wind Resource Assessment

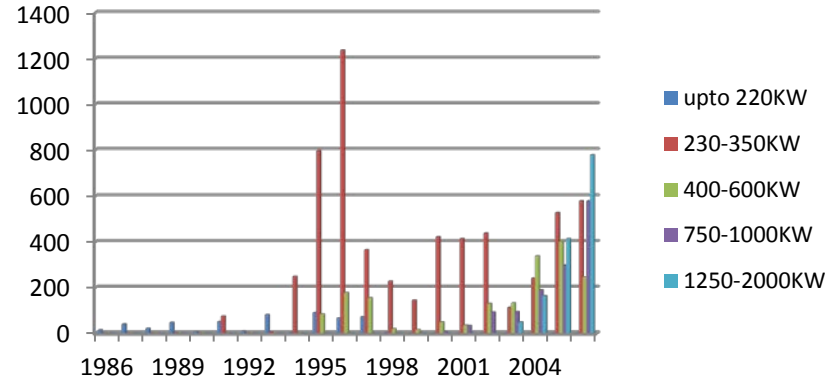
- Wind measurement phase:
 - Data of near by mast (Govt - CWET's RS) used
 - Mast Height 20m
 - Avg. Wind speed at Mast Height is 6.03
 - Avg. Annual Energy Production is about 1.84Million Kwh / Mw (21% PLF)
 - Variation during day and by month Yes, even by year
- Who performed detailed wind resource assessment
 - The WRA done by OEM
- Factors contributing to high uncertainty:
 - Factored by OEM not known
- Extreme weather event prediction and modeling
 - None of those methods were used

3a. Turbine

- Enercon 230Kw turbine:
 - E30, 230Kw WEC of Enercon
 - Capacity 230Kw
 - Rotor Diameter – 30m
 - Hub Height – 50m
 - Direct drive
 - Independent Electrical Pitching
- Enercon 600Kw turbine:
 - E44, 600Kw WEC of Enercon
 - Capacity 600Kw
 - Rotor Diameter – 44m
 - Hub Height – 56m
 - Direct drive
 - Independent Electrical Pitching
 - Cut off wind speed 25-34m/s with storm control

3b. Turbine

- Why Enercon 230 & 600Kw WEC:
 - Market available turbine capacity is between 200 – 600Kw
 - Direct drive turbine
 - Performance was good compared to others in the market
 - Independent Blade Pitch control
 - Storm control



- Warranty for 2 years
- Comprehensive maintenance contract for 20 years with 10 year agreed fee and with escalation but renew the price after 10 years and also carrying out stipulated overhaul and major maintenance at investor's cost

4a. Financial Model of Wind Project

Revenue

- Tariff:
 - Captive Consumption for the Group offsetting paying for MSEB (@ Rs. 3.25/Kwh)
- Incentives:
 - Sales tax deferred payment for partial Mw Project and not for all
- CDM, Carbon credits and others:
 - Yes the project got qualified
 - Estimated Avg. CER was 30804
- Tax incentives:
 - 80% Accelerated depreciation
 - Sales tax incentive

1Rs = 0.023\$ (15th June 1999)

1Rs = 0.017\$ (29th May 2012)

- Total Installed Cost per MW
 - 60 Million Rs / MW
 - Which includes Foundation, erection and civil works
 - Unit transformer & associated switch gears.
 - Land and Transmission line etc
- Operating cost
 - Administrative costs
 - Scheduled maintenance cost
 - Unscheduled maintenance cost
 - Insurance cost
 - Others:
 - Overall cost: Rs. 0.46/Kwh

4a. Financial Model of Wind Project

Table 4
Tariff Schedule

Rates (Rs. Per kWh) applicable for Wind Power Projects in the State of Maharashtra

Sr.	Financial Year	Group I (Projects Commissioned before 27 th December, 1999)		Group II (Projects Commissioned after 27 th December, 1999 but On or before 31 March, 2003)						Group III (Projects Commissioned From 1 April, 2003)			
		Year	Before 27 th Dec 1999	Year	1999-00	Year	2000-01	Year	2001-02	Year	2002-03	Year	2003-04
1	1994 - 1995	1	2.25										
2	1995 - 1996	2	2.36										
3	1996 - 1997	3	2.47										
4	1997 - 1998	4	2.58										
5	1998 - 1999	5	2.69										
6	1999 - 2000	6	2.80	1	2.80								
7	2000 - 2001	7	2.91	2	2.91	1	2.91						
8	2001 - 2002	8	3.02	3	3.02	2	3.02	1	3.02				
9	2002 - 2003	9	3.13	4	3.13	3	3.13	2	3.13	1	3.13		
10	2003 - 2004	10	3.24	5	3.24	4	3.24	3	3.24	2	3.24	1	3.50
11	2004 - 2005	11	3.24	6	3.35	5	3.35	4	3.35	3	3.35	2	3.65
12	2005 - 2006	12	3.24	7	3.46	6	3.46	5	3.46	4	3.46	3	3.80
13	2006 - 2007	13	3.24	8	3.57	7	3.57	6	3.57	5	3.57	4	3.95
14	2007 - 2008	14	3.35			8	3.68	7	3.68	6	3.68	5	4.10
15	2008 - 2009	15	3.46					8	3.79	7	3.79	6	4.25
16	2009 - 2010	16	3.57							8	3.90	7	4.40
17	2010 - 2011	17	3.68									8	4.55
18	2011 - 2012	18	3.79									9	4.70
19	2012 - 2013	19	3.90									10	4.85
20	2013 - 2014	20	4.01									11	5.00
21	2014 - 2015											12	5.15
22	2015 - 2016											13	5.30

Note :

Group I Start with Rs. 2.25 at 04-05 and escalate at the rate of 5% (i.e. 11 paise every year) till 10th year, then remaining constant for next 3 years, then again escalate 14th year onwards till 20th year at the same rate.

Group II Start with Rs 2.25 at the year 1994-05 with 5% simple escalation (i.e. 11 paise every year) for 8 years.

Group III Start with Rs 3.50 in the year 2003-04 and increase at the rate of 15 paise per year for 13 years. The starting rate will be applicable from the year of Commissioning of the Wind Project.

- Wheeling charges:
 - 2% of Energy wheeled
- T & D Losses:
 - 5%
- Banking Charges:
 - Nil

4b. Financial Model of Wind Project

Structure of project

- 70% Debt
- 13% Interest
- IREDA
- 30% Equity

• Metrics of project

- 18% Equity IRR
- 10 years Payback period
- Debt service coverage ratio 1.8

5a. Project Siting Issues and Contracts

- Land Acquisition Issues:
 - Issues All taken care by Manufacturer/ supplier of turbines
- Birds/Bats/Wild life
 - None Issues
- Noise
 - Not critical
- Airspace obstruction
 - Did Not apply
- Telecommunications interference
 - Nil
- Visual Effect
 - Nil
- Managing neighbors
 - The site is in remote area
- Others:
 - No Issues at site except during running of the farm, opposition for bad rainfall to attribute that the turbine drive the clouds away, some ripple effect for few days but rains came and all stopped?

5b. Project Siting Issues and Contracts

○ EPC contractor selection

- None of these apply as project is handled totally by Supplier's own employees , some sundry and civil works are only subcontracted?

○ Contract with utility:

- Adjustment of Power (Energy wheeling agreement)

○ What was in scope of OEM:

- Turnkey

○ Logistics: Port, roads, bridges for both turbine and construction equipment

- None were there, managed

○ Interconnection issues

- Separate Double circuit 33 Kv line was to be laid to EB substation , much before the planned Grid connectivity issues are addressed by the Utility company

6. Financial Results of Wind Project

- Metrics of project (plan versus actual):
 - IRR
 - 18% Vs 17.41%
 - Payback period
 - 10 Years Vs 10 Years
 - Generation Estimated Vs Actual
 - 21% PLF Vs 25% PLF

6c. What was fun and rewarding?

- Exploring all hidden avenues to improve the performance,
 - Failure on other Transmission line causing entire wind farm to go down
 - Power regulations due to temp.
- To learn that the challenge is not just to go for the best technology turbine but need to look at many other associated issues of the Project?
 - Evacuation arrangements
 - Equipment selection for the evacuation and the positioning
- Rewarding is to get continuously the recognition as the best performance (including Generation) for this region.

6d. What was frustrating?

- To get the conviction of our solutions for improvement through both Local and International Partners of Turbine Manufacturer?
 - Changes in the positioning of the components in the grid connectivity to avoid the group shut downs for the replacement
 - Failures due to turbulence, needed change in the turbine components

Good Wind Farm.... Infra & wind resource

- Project had
 - Full area- ownership basis
 - better control for Siting.
 - Site close to a district Headquarter
 - manpower available and can be trained;
 - Good approach road Government built-over a period
 - Once the basic roads established all around the site, execution of project was smooth and ease of speed.
- Wind Resource
 - Seen good winds, better than Data available?
 - but the turbulence gave challenging tasks
 - to make and redesign the product elements;
 - became a test site for Manufacturer understanding of application of its turbines for other India wind farms?

Good Wind Farm.... Project Construction

- Reasonably good,
- Manufacturer - International partners' intervention
 - Establishing the Construction process to suit local conditions,
 - Brought the first lot of Quality tools and tackles for ease of handling, Training of its people for excellent execution
- Customer not satisfied
 - with Micrositing 2nd Phase onwards even when the first lot performed
 - with the proposed evacuation arrangement
- Customer had to force major changes to get the optimum solutions

Good Wind Farm.... Operation and Maintenance

- Includes Spare parts support, Coordination and Revenue collection
 - Systems were slowly evolved by joint cooperation and skills
 - Continuous study for optimum performance.
 - Not only Grid side but also Turbine (Technical)side
 - questioning at all fronts and arrived at the right trouble shooting methods.
- Continuous improvement attitude and commitment from Mfr and Customer
- Manufacturer team came to agreement with the Investor's demands and suggestions,
 - Saw positive results
 - Continued to look for meeting of minds,
- Results poured with delight to all!

Good Wind Farm.... Operation and Maintenance

- Required PR for managing local environment and for upkeep of comforts of site people.
 - The O & M team had good staff to manage this,
 - continuously monitor & anticipate troubles,
 - come up with timely responses,
- Became Joyful site & much sought after work site for all company employees.
- SEEN AS MOST KNOWLEDGABLE TEAM AND TRAINING GROUND FOR OTHER SITES

Good Wind Farm.... Performance examination for

- Optimization of designed features and safe operation.
- The generation/ output for the set Micro Siting were optimum.
- Continuous interaction and Customer's pursuance & close supervision/ surveillance
- Carried out some R&D objective checks
- Yielded jump generation

6e. Wish List to Accelerate Wind Development

- What Government can do to?
 - Address at macro level, (take out of State Government subject) Power Evacuation and allocation of available , fertile & unusable for any other purpose Government owned Lands (including Forest declared) in a quick pace, for Projects
- What the industry & others can do?
 - Importance to the quality , in Project execution, Turbine and Generation as the main focus.



Thanks

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