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Feasibility study report for the 100 MW wind power project- Executive Summary

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Contents

Page No.

List of tables

Page No.

Executive summary

Introduction

The Oil and Natural Gas Corporation (ONGC) Limited is looking for the investment in 100 MW wind power project (50 MW each in any two states) among the states of Gujarat, Maharashtra, Rajasthan and Andhra Pradesh. ONGC appointed The Energy Resources Institute (TERI) for providing consultancy for the wind power feasibility and tendering. The activity is to be completed in two phases as per the following brief scope of work

Phase1: Preparation of feasibility study report for 100 MW wind power project (50 MW each in two states). This feasibility study includes the review of central government and state governments policies on wind power, assessment of wind farmable sites of the selected states, assessment of the Centre for Wind Energy Technology (C-WET) approved wind turbines available for installation in India, cost estimates of the wind power project, financial assessment including determination of IRR and payback period for the selected sites in all the four states and the selected wind turbines, sensitivity analysis and the recommendation on the selection of wind turbine, wind power sites and the states for the investment in wind power projects. This also involve s the feasibility study of developing the SPV power plant in the land between the wind turbines of its existing wind farm of 51 MW in Gujarat.

Phase 2. This phase involves:

- preparation of bid document for inviting tender from wind farm developers;
- technical evaluation of bids;
- financial evaluation of bids;
- recommendation on final selection of the bidder;
- preparation of draft agreement between ONGC and the selected wind farm developer.

Feasibility study for the wind power project

In the first stage, ONGC awarded the work to TERI for phase 1 with a condition that the 2nd phase work will depend on ONGC's decision for the investment in wind power project.

TERI then prepared the detailed feasibility study for the 100 MW wind power project (50 MW each in any two states) in the selected states of Gujarat, Maharashtra, Andhra Pradesh and Rajasthan. Detailed comparative study of the central and state governments wind power policies were presented in the report

along with the description of wind power technology, selection of wind turbine and wind farmable sites. Three sites from each state were selected based on the wind power density of the sites, the details on the proposed sites being offered by the wind farm developers active in these states, and the availability of infrastructures like power evacuation facility and approach roads. Three wind turbines were selected based on their ratings, performance power curves, and other characteristics. The list of sites and wind turbines selected are given in Table 1 and Table 2.

Table 1 Details of sites selected for the study

State	Site	Latitude	Longitude	Altitude (m)	Mast height (m)	Annual average Air density (kg/m^3)	Annual Average Power Low Index	Annual Average wind speed at 20/25 m (m/s)
	Dhank	21°48'	70°07'	208	20	1.149	0.04	6.97
	Jamanvada	23°25'	68°36'	60	20	1.169	0.26	5.17
Gujarat	Surajbari Gude	23°13	70°42	10	20	1.163	0.39	5.42
	Panchgani	17°07	73°59	903	20	1.072	0.18	5.5
	Vankushawade	17°27	73°50	1100	25	1.052	0.12	5.89
Maharashtra	Matrewadi	17°11	73°56	898	25	1.086	0.07	5.78
	Devgarh	24°03	74°39	520	25	1.11	0.3	5.52
	Jaisalmer-1	26°56	70°54	231	20	1.14	0.22	4.94
Rajasthan	Phalodi	27°06	72°19	250	20	1.14	0.27	4.83
Andhra Pradesh	Kakula Konda	13°43	79°21	981	20	1.061	0.21	6.42
	Ramagiri- 1	14°16	77°31	580	20	1.091	0.13	5.42
	Kondamithipalli	15°03	78°03	449	25	1.114	0.23	5.89

Table 2 Rating of selected wind turbines

Turbine manufacturer	Suzlon Energy Limited	Vestas wind Technologies India Pvt. Ltd	Regen Powertech
Model Name	S82-1500	V82-1650	Regen 77-1500
Capacity (kW)	1500	1650	1500
Score	10.18	10.195	10.32

The energy generation estimation for these sites and turbines were carried out using the RETScreen software, site conditions and wind turbine characteristics. Based on the estimated energy generation and cost of wind power project, the financial analysis

has been carried out considering the CDM benefit as well as without CDM benefit. The results of IRR and payback period for the case of sale to utility for both the cases are given in Table 3 and Table 4.

Table 3 IRR values and payback periods calculated based on the estimated CUF for all the sites and S1500 wind turbines when all the generation is sold to the grid and with CDM benefit

			Sale to grid With CDM
State	Site	IRR%	Payback period (years)
Gujarat	Dhank	12.84	5.91
	Jamanvada	10.23	6.99
	Surajbari	13.97	5.52
Maharashtra	Gude Panchgani	15.39	5.69
	Vankushwade	12.81	6.56
	Matrewadi	11.93	6.91
Rajasthan	Devgarh	15.53	5.12
	Jaisalmer	11.63	6.45
	Phalodi	14.00	5.59
Andhra Pradesh	Kakula Konda	13.93	5.61
	Ramagiri	9.62	7.36
	Kondamithipalli	10.18	7.09

Table 4 IRR values and payback periods calculated based on the estimated CUF for all the sites and S1500 wind turbines when all the generation is sold to the grid

			Sale to grid Without CDM
State	Site	IRR%	Payback period (years)
Gujarat	Dhank	11.12	6.67
	Jamanvada	8.80	7.86
	Surajbari	12.19	6.23
Maharashtra	Gude Panchgani	13.33	6.43
	Vankushwade	11.05	7.42
	Matrewadi	10.22	7.83
Rajasthan	Devgarh	13.80	5.66
	Jaisalmer	10.06	7.14
	Phalodi	12.34	6.18
Andhra Pradesh	Kakula Konda	11.56	6.48
	Ramagiri	7.64	8.54
	Kondamithipalli	8.16	8.22

Also, the analysis was carried out for the captive consumption by ONGC or its subsidiary, the generation-based incentive, sensitivity analysis for the variation in power generation or the cost variation and so on. Based on the analysis, the following recommendations were given to ONGC limited for the final decision in the investment in wind power projects

Recommendation for the wind power project capacity

The captive consumption of ONGC is higher in the states of Gujarat and Maharashtra. But it has been informed that the C2-C3 plant in Gujarat for which the captive consumption was being considered will not be feasible, so only Maharashtra remains for the captive consumption only with a captive wind power project capacity of 15 MW and the rest of the capacity for higher capacity wind power project will be considered for sale to the state utility.

Based on the detailed study, it was observed that for captive consumption of power from the wind farm, the state of Maharashtra gives better return among all the four states where 15 MW project is considered for captive power use and the rest 36 MW is considered for the sale to grid. But again, this 15 MW captive capacity is less compared to the 36 MW capacity for sale of power to utility so the investment in wind power project for the purpose of the sale to the state electricity utility may be considered. Also, the risk of public agitation in land acquisition being faced by all the wind farm developers in Maharashtra is a constraint.

In the case of sale of power to the utility, the states of Rajasthan and Maharashtra produced almost equal returns, followed by the Gujarat. But for Maharashtra, the tariff is applicable for 13 years from commissioning, which can be lower after the 13th year if the discoms do not agree to pay the tariff at the same rate, whereas in Rajasthan it is for 20 year, so Rajasthan would be the best state for investment in wind power project or the purpose of sale to utility. Again, the available project capacity with the wind farm developers in these states is different. It is up to 150 MW for Rajasthan, up to 100 MW for Gujarat and up to 50 MW each for Maharashtra and Andhra Pradesh.

Considering the above, the investment in wind power project is feasible and recommended to ONGC and based on the financial returns achievable, the recommendation for the wind project capacity is as follows:

- 50 to 100 MW capacity in Rajasthan for the purpose of sale of electricity to the state grid;
- up to 50 MW capacity in the Maharashtra state (But the risk of delay in the project due lo land acquisition problem by the developers);
- 50 MW captive / sale to grid-based wind power plant in Gujarat.

Feasibility study for solar PV power plant

A detailed study on the feasibility of developing the SPV power plant in the land between the wind turbines of ONGC's existing

wind farm of 51 MW in Gujarat was conducted. A site visit was carried out to assess the topography of the land and it was found that the land is suitable for solar PV installations. A detailed analysis has been carried out using ECOTEC and AutoCAD software to analyse the size of shadow free land that will be suitable for the solar PV installation between the wind turbines installed in the wind farm. Radiation analysis has been carried out to estimate the solar power potential of the site and RETScreen software was used for estimation of the possible SPV power plant capacity in the existing land. It was found that 928 acres of land area is available at the wind farm, which can effectively be used for installation of solar PV-based power plants. Taking into account the area required for setting up a mono-crystalline solar cell SPV based power plant (5 acres/MW), it was determined that there is a potential of setting up solar PV-based project(s) of 186 MW.

A summary of the solar radiation and the estimated power potential is given in Table 5.

Table 5 Technical Feasibility of solar PV power plants at ONGC wind farm at Jakhau

Annual Average Solar Radiation	2033 kWh/m^2
Annual average solar radiation (latitude)	2166 kWh/m^2
Annual Average Ambient Temperature	26.64^{o}C
Annual Average Relative Humidity	56.2 %
Potential of SPV power plants at Site (5 acres/MW)	186 MW
Annual Electrical Output (mono-crystalline)	3,00,000 MWh
Approximate cost (per MW)	15-17 crore/MW