

# WIND BASED POWER GENERATION BY PANAMA WIND ENERGY GODAWARI PRIVATE LIMITED, PUNE IN THE STATE OF MAHARASHTRA, INDIA



Document Prepared By EKI Energy Services Limited

|                          |                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Title</b>     | Wind Based Power Generation by Panama Wind Energy Godawari Private Limited, Pune in the State of Maharashtra, India                                                                                                                                                                                                                                              |
| <b>Version</b>           | 02                                                                                                                                                                                                                                                                                                                                                               |
| <b>Report ID</b>         | 1523                                                                                                                                                                                                                                                                                                                                                             |
| <b>Date of Issue</b>     | 18/02/2017                                                                                                                                                                                                                                                                                                                                                       |
| <b>Project ID</b>        | 1523                                                                                                                                                                                                                                                                                                                                                             |
| <b>Monitoring Period</b> | 02-March-2016 to 01-February-2017                                                                                                                                                                                                                                                                                                                                |
| <b>Prepared By</b>       | Mr. Prakash Kr. Sahu                                                                                                                                                                                                                                                                                                                                             |
| <b>Contact</b>           | Assistant Manager Operations – GHG Services<br>EKI Energy Services Limited<br>Email ID : prakash@enkingint.org<br>T +91 731 42 89 086, M +91 9589 899649<br>Address: Office no. 201, Plot 48, Scheme 78 part 2<br>Vijay Nagar, Near Brilliant Convention Centre<br>Indore - 452010 (M.P, India) Website <a href="http://www.enkingint.org">www.enkingint.org</a> |

## Table of Contents

|       |                                                                       |    |
|-------|-----------------------------------------------------------------------|----|
| 1     | Project Details .....                                                 | 3  |
| 1.1   | Summary Description of the Implementation Status of the Project ..... | 3  |
| 1.2   | Sectoral Scope and Project Type.....                                  | 3  |
| 1.3   | Project Proponent .....                                               | 3  |
| 1.4   | Other Entities Involved in the Project.....                           | 4  |
| 1.5   | Project Start Date .....                                              | 4  |
| 1.6   | Project Crediting Period .....                                        | 5  |
| 1.7   | Project Location .....                                                | 5  |
| 1.8   | Title and Reference of Methodology .....                              | 7  |
| 1.9   | Other Programs.....                                                   | 7  |
| 1.10  | Sustainable Development .....                                         | 8  |
| 2     | Implementation Status.....                                            | 8  |
| 2.1   | Implementation Status of the Project Activity.....                    | 8  |
| 2.2   | Deviations.....                                                       | 9  |
| 2.2.1 | Methodology Deviations .....                                          | 9  |
| 2.2.2 | Project Description Deviations .....                                  | 9  |
| 2.3   | Grouped Project .....                                                 | 10 |
| 2.4   | Safeguards.....                                                       | 10 |
| 2.4.1 | No Net Harm .....                                                     | 10 |
| 2.4.2 | Local Stakeholder Consultation .....                                  | 10 |
| 3     | Data and Parameters .....                                             | 10 |
| 3.1   | Data and Parameters Available at Validation .....                     | 10 |
| 3.2   | Data and Parameters Monitored .....                                   | 11 |
| 3.3   | Monitoring Plan .....                                                 | 12 |
| 4     | Quantification of GHG Emission Reductions and Removals .....          | 15 |
| 4.1   | Baseline Emissions .....                                              | 15 |
| 4.2   | Project Emissions.....                                                | 15 |
| 4.3   | Leakage.....                                                          | 15 |
| 4.4   | Net GHG Emission Reductions and Removals.....                         | 15 |
|       | APPENDIX 1: Feeder and Calibration Details .....                      | 17 |
|       | APPENDIX 2: Major Breakdown Details .....                             | 18 |

## 1 PROJECT DETAILS

### 1.1 Summary Description of the Implementation Status of the Project

The purpose of the project activity is to generate power using renewable energy source (wind) and sell the power generated to the state grid. The project activity generates electricity using wind potential and converts it into kinetic energy using Wind turbines, which drives the alternators to generate energy. The generated electricity is exported to the regional grid system which is under the purview of the NEWNE grid of India.

The proposed project activity involves the installation of Wind Power Projects. The total installed capacity of the project is 80 MW; which involves operation of 40 Wind Turbine Generators (WTGs) with capacity of 2 MW each located at Maharashtra state in India. The project is promoted by **Panama Wind Energy Godawari Private Limited**.

The power produced displaces an equivalent amount of power from the grid, which is fed mainly by fossil fuel fired power plants. Hence, it results in reduction of GHG emissions. GHG emission reductions from the project activity will be 136,936 tonnes of CO<sub>2</sub> and total GHG emission reductions for the chosen 10 year crediting period will be 1,369,360 tonnes of CO<sub>2</sub>.

The Project activity is a new facility (Greenfield) and the purpose of the project activity is to generate energy electricity by the utilization of wind velocity power and further selling the generated energy to the NEWNE Grid. In this process there is no consumption of any fossil fuel and hence the project does not lead to any greenhouse gas emissions. Thus, electricity would be generated through sustainable means without causing any negative impact on the environment.

In the Pre- project scenario the entire electricity, delivered to the grid by the project activity, would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

### 1.2 Sectoral Scope and Project Type

The project activity falls under the following Sectoral scope and Project Type:

**Sectoral Scope:** 01 - Energy industries (renewable / non-renewable sources)

**Project Type:** I - Renewable Energy Projects

**Methodology:** ACM0002: Grid-connected electricity generation from renewable sources - Version 16.0<sup>1</sup>

The project is not a grouped project activity.

### 1.3 Project Proponent

|                   |                                                    |
|-------------------|----------------------------------------------------|
| Organization name | <b>Panama Wind Energy Godawari Private Limited</b> |
| Contact person    | Mr. Dinesh Jagdale                                 |

<sup>1</sup> <http://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83>

|           |                                                                          |
|-----------|--------------------------------------------------------------------------|
| Title     | Director & Chief Operating Officer                                       |
| Address   | Viman Nagar 1st Floor, Lunkad Towers,Pune Maharashtra 411 014            |
| Telephone | +91 20 26125060                                                          |
| Email     | <a href="mailto:djagdale@panama-group.com">djagdale@panama-group.com</a> |

#### 1.4 Other Entities Involved in the Project

|                   |                                                                                                                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Organization name | <b>EKI Energy Services Limited</b>                                                                                                                                                      |
| Contact person    | Mr. Prakash Kr. Sahu                                                                                                                                                                    |
| Title             | Project Consultant                                                                                                                                                                      |
| Address           | Office no. 201, Plot 48, Scheme 78 part 2, Vijay Nagar, Near Brilliant Convention Centre, Indore - 452010 (M.P, India) Website <a href="http://www.enkingint.org">www.enkingint.org</a> |
| Telephone         | +91 95 89 899649                                                                                                                                                                        |
| Email             | <a href="mailto:prakash@enkingint.org">prakash@enkingint.org</a>                                                                                                                        |

#### 1.5 Project Start Date

Project Start Date: 31-March-2014.

The project start date is the date on which first WTG was commissioned under the Project activity.

| S. No. | Machine ID | DOC <sup>2</sup> | Village   | Taluka | District | State       |
|--------|------------|------------------|-----------|--------|----------|-------------|
| 1      | G 1        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 2      | G 2        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 3      | G 3        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 4      | G 4        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 5      | G 5        | 6-Sep-14         | Khopti    | Georai | Beed     | Maharashtra |
| 6      | G 6        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 7      | G 7        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 8      | G 8        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 9      | G 9        | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 10     | G 10       | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 11     | G 11       | 7-Oct-14         | Mulukwadi | Georai | Beed     | Maharashtra |
| 12     | G 12       | 7-Oct-14         | Manmodi   | Georai | Beed     | Maharashtra |
| 13     | G 13       | 7-Oct-14         | Manmodi   | Georai | Beed     | Maharashtra |
| 14     | G 14       | 6-Sep-14         | Manmodi   | Georai | Beed     | Maharashtra |
| 15     | G 15       | 6-Sep-14         | Manmodi   | Georai | Beed     | Maharashtra |

<sup>2</sup> Date Of commissioning

|    |      |           |                |        |      |             |
|----|------|-----------|----------------|--------|------|-------------|
| 16 | G 16 | 7-Oct-14  | Manmodi        | Georai | Beed | Maharashtra |
| 17 | G 17 | 6-Sep-14  | Manmodi        | Georai | Beed | Maharashtra |
| 18 | G 18 | 7-Oct-14  | Manmodi        | Georai | Beed | Maharashtra |
| 19 | G 19 | 7-Oct-14  | Khoipti        | Georai | Beed | Maharashtra |
| 20 | G 20 | 7-Oct-14  | Manyarwadi     | Georai | Beed | Maharashtra |
| 21 | G 21 | 5-Dec-14  | Khoipti        | Georai | Beed | Maharashtra |
| 22 | G 22 | 6-Sep-14  | Rajpimpri      | Georai | Beed | Maharashtra |
| 23 | G 23 | 6-Sep-14  | Rajpimpri      | Georai | Beed | Maharashtra |
| 24 | G 24 | 31-Mar-14 | Rajpimpri      | Georai | Beed | Maharashtra |
| 25 | G 25 | 31-Mar-14 | Rajpimpri      | Georai | Beed | Maharashtra |
| 26 | G 26 | 25-Jul-14 | Bangali Pimpla | Georai | Beed | Maharashtra |
| 27 | G 27 | 25-Jul-14 | Sindkhed       | Georai | Beed | Maharashtra |
| 28 | G28  | 25-Jul-14 | Kombadwadi     | Georai | Beed | Maharashtra |
| 29 | G 29 | 31-Mar-14 | Kombadwadi     | Georai | Beed | Maharashtra |
| 30 | G 30 | 31-Mar-14 | Devimpri       | Georai | Beed | Maharashtra |
| 31 | G 31 | 31-Mar-14 | Kombadwadi     | Georai | Beed | Maharashtra |
| 32 | G 32 | 25-Jul-14 | Sushi          | Georai | Beed | Maharashtra |
| 33 | G 33 | 31-Mar-14 | Sushi          | Georai | Beed | Maharashtra |
| 34 | G 34 | 31-Mar-14 | Sushi          | Georai | Beed | Maharashtra |
| 35 | G 35 | 31-Mar-14 | Sushi          | Georai | Beed | Maharashtra |
| 36 | G 36 | 31-Mar-14 | Sushi          | Georai | Beed | Maharashtra |
| 37 | G 37 | 31-Mar-14 | Kumbhejalgaon  | Georai | Beed | Maharashtra |
| 38 | G 38 | 25-Jul-14 | Sushi          | Georai | Beed | Maharashtra |
| 39 | G 39 | 31-Mar-14 | Kumbhejalgaon  | Georai | Beed | Maharashtra |
| 40 | G 40 | 31-Mar-14 | Bangalipimpla  | Georai | Beed | Maharashtra |

## 1.6 Project Crediting Period

The first crediting period details are as below

Crediting Period Start date: 31-March-2014

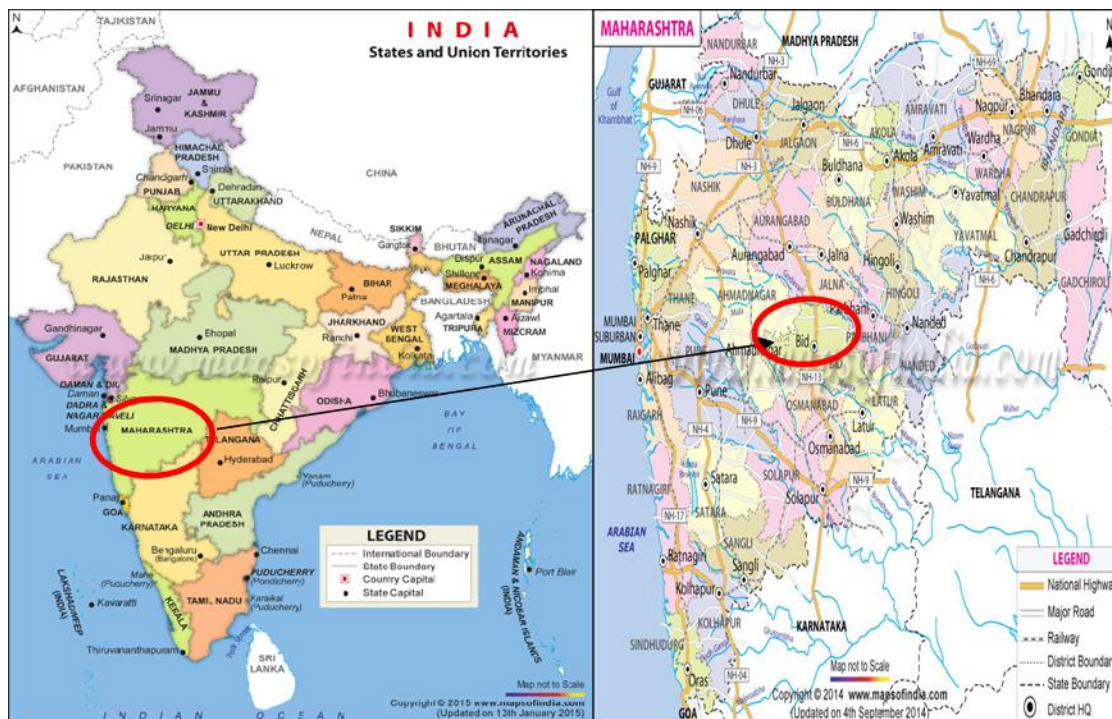
Crediting Period End date: 30-March-2024

The project activity adopts renewable crediting period of 10 years period which can be renewed for maximum 2 times.

## 1.7 Project Location

| Sr. No. | Locati on No. | Village   | Taluka | District | Latitude (D° M' Sec'') | Longitude (D° M' Sec'') |
|---------|---------------|-----------|--------|----------|------------------------|-------------------------|
| 1       | G01           | Mulukwadi | Georai | Beed     | N19 11 35.6            | E75 43 38.4             |
| 2       | G02           | Mulukwadi | Georai | Beed     | N19 11 12.3            | E75 42 57.5             |
| 3       | G03           | Mulukwadi | Georai | Beed     | N19 11 50.0            | E75 43 19.7             |
| 4       | G04           | Mulukwadi | Georai | Beed     | N19 11 30.1            | E75 43 13.9             |
| 5       | G05           | Khoipti   | Georai | Beed     | N19 13 35.5            | E75 41 23.4             |
| 6       | G06           | Mulukwadi | Georai | Beed     | N19 11 59.1            | E75 43 35.4             |

| Sr. No. | Locati<br>on No. | Village        | Taluka | District | Latitude<br>(D° M' Sec'') | Longitude<br>(D° M' Sec'') |
|---------|------------------|----------------|--------|----------|---------------------------|----------------------------|
| 7       | G07              | Mulukwadi      | Georai | Beed     | N19 11 20.6               | E75 43 40.8                |
| 8       | G08              | Mulukwadi      | Georai | Beed     | N19 11 59.5               | E75 43 07.2                |
| 8       | G09              | Mulukwadi      | Georai | Beed     | N19 12 04.9               | E75 42 37.4                |
| 9       | G10              | Mulukwadi      | Georai | Beed     | N19 12 24.6               | E75 43 13.1                |
| 10      | G11              | Mulukwadi      | Georai | Beed     | N19 11 35.6               | E75 43 38.4                |
| 11      | G12              | Manmodi        | Georai | Beed     | N19 12 38.0               | E75 43 18.6                |
| 12      | G13              | Manmodi        | Georai | Beed     | N19 12 23.5               | E75 42 36.7                |
| 13      | G01              | Manmodi        | Georai | Beed     | N19 12 36.0               | E75 42 18.5                |
| 14      | G14              | Manmodi        | Georai | Beed     | N19 12 50.5               | E75 42 24.3                |
| 15      | G15              | Manmodi        | Georai | Beed     | N19 12 59.8               | E75 42 10.8                |
| 16      | G16              | Manmodi        | Georai | Beed     | N19 13 17.1               | E75 42 10.1                |
| 17      | G17              | Manmodi        | Georai | Beed     | N19 13 22.3               | E75 41 58.6                |
| 18      | G18              | Khopti         | Georai | Beed     | N19 13 29.6               | E75 42 29.3                |
| 19      | G19              | Manyarwadi     | Georai | Beed     | N19 13 41.9               | E75 42 19.2                |
| 20      | G20              | Khopti         | Georai | Beed     | N19 13 45.5               | E75 42 59.5                |
| 21      | G21              | Rajpimpri      | Georai | Beed     | N19 14 06.3               | E75 41 40.6                |
| 22      | G22              | Rajpimpri      | Georai | Beed     | N19 13 54.1               | E75 41 27.6                |
| 23      | G23              | Rajpimpri      | Georai | Beed     | N19 13 46.6               | E75 41 03.1                |
| 24      | G24              | Rajpimpri      | Georai | Beed     | N19 13 34.5               | E75 40 24.8                |
| 25      | G25              | Bangali Pimpla | Georai | Beed     | N19 13 23.9               | E75 40 11.5                |
| 26      | G26              | Sindkhed       | Georai | Beed     | N19 12 40.0               | E75 37 28.9                |
| 27      | G27              | Kombadwadi     | Georai | Beed     | N19 13 09.5               | E75 40 21.9                |
| 28      | G28              | Kombadwadi     | Georai | Beed     | N19 13 25.4               | E75 39 28.6                |
| 29      | G29              | Devimpri       | Georai | Beed     | N19 13 43.7               | E75 39 29.9                |
| 30      | G30              | Kombadwadi     | Georai | Beed     | N19 13 51.7               | E75 39 06.1                |
| 31      | G31              | Sushi          | Georai | Beed     | N19 13 57.4               | E75 39 33.0                |
| 32      | G32              | Sushi          | Georai | Beed     | N19 12 16.2               | E75 37 44.2                |
| 33      | G33              | Sushi          | Georai | Beed     | N19 12 59.5               | E75 38 47.3                |
| 34      | G34              | Sushi          | Georai | Beed     | N19 13 14.9               | E75 38 57.3                |
| 35      | G35              | Sushi          | Georai | Beed     | N19 13 12.2               | E75 38 26.2                |
| 36      | G36              | Kumbhejalgaon  | Georai | Beed     | N19 13 27.1               | E75 38 20.9                |
| 37      | G37              | Sushi          | Georai | Beed     | N19 13 34.4               | E75 38 00.3                |
| 38      | G38              | Kumbhejalgaon  | Georai | Beed     | N19 12 49.7               | E75 38 08.6                |
| 39      | G39              | Bangalipimpla  | Georai | Beed     | N19 13 04.7               | E75 37 53.8                |
| 40      | G40              | Mulukwadi      | Georai | Beed     | N19 12 58.0               | E75 37 31.5                |



## 1.8 Title and Reference of Methodology

**Methodology:** ACM0002: Grid-connected electricity generation from renewable sources --- Version 16.0, Sectoral Scope: 01, EB 81, Annex 9

<https://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83>

The project activity also takes reference from following Tools from the tools prescribed by applied methodology:

1. **Tool for the demonstration and assessment of additionality** --- Version 07.0.0, EB 70, Annex 8 <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf>
2. **Tool to calculate the emission factor for an electricity system** --- Version 05.0, EB 87, Annex 09 <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf>

## 1.9 Other Programs

The Project has applied for the CDM under the Kyoto protocol which is under validation stage, however currently the PP is not willing to go ahead with CDM and existing contract of CDM validation is terminated.<sup>3</sup>

<sup>3</sup>UNFCCC web link: <http://cdm.unfccc.int/Projects/Validation/DB/3EXK45ZD9TYCX75US5098OUPIT809D/view.html>

## 1.10 Sustainable Development

Ministry of Environment and Forests, has stipulated economic, social, environment and technological well-being as the four indicators of sustainable development. The project contributes to sustainable development using the following ways.

**Social well-being:** The project would help in generating employment opportunities during the construction and operation phases. The project activity will lead to development in infrastructure in the region like development of roads and also may promote business with improved power generation.

**Economic well-being:** The project is a clean technology investment in the region, which would not have been taken place in the absence of the VCS benefits the project activity will also help to reduce the demand supply gap in the state.

The project activity will generate power using zero emissions wind based power generation which helps to reduce GHG emissions and specific pollutants like SO<sub>x</sub>, NO<sub>x</sub>, and SPM associated with the conventional thermal power generation facilities.

**Technological well-being:** The successful operation of project activity would lead to promotion of wind based power generation and would encourage other entrepreneurs to participate in similar projects.

**Environmental well-being:** Wind being a renewable source of energy, it reduces the dependence on fossil fuels and conserves natural resources which are on the verge of depletion. Due to its zero emission the Project activity also helps in avoiding significant amount of GHG emissions.

## 2 IMPLEMENTATION STATUS

### 2.1 Implementation Status of the Project Activity

The proposed project activity involves the installation of Wind Power Projects. The total installed capacity of the project is 80 MW; which involves operation of 40 Wind Turbine Generators (WTGs) with capacity of 2 MW each located at Maharashtra state in India. The project is promoted by **Panama Wind Energy Godawari Private Limited**.

The Project activity is a new facility (Greenfield) and the electricity generated by the Project will be exported to the NEWNE electricity grid. The Project will therefore displace an equivalent amount of electricity which would have otherwise been generated by fossil fuel dominant electricity grid. The Project Proponent plans to avail the VCS benefits for the Project.

In the Pre- project scenario the entire electricity, delivered to the grid by the project activity, would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

As per registered VCS PD, the project shall result in replacing anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 136,936 tCO<sub>2e</sub> per year, thereon displacing 140,160 MWh/year amount of electricity from the grid.

#### Wind Power Project Technology Details –

The technology employed, converts wind energy to electrical energy. In wind power generation, energy of wind is converted into mechanical energy and subsequently into electrical energy. The technology is an environment friendly technology since there are no GHG emissions associated with the electricity generation. There is no transfer of technology involved in the project activity.

The project activity comprises a total of 40 WTG's of Gamesa India Limited. The commissioning of the project activity has been completed and details are mentioned in section 1.5.

**Technical details for Gamesa G97-2.0 MW<sup>4</sup>, 2000 KW Machine**

| Particulars      | Details              |
|------------------|----------------------|
| Model            | Gamesa G97-2.0 MW    |
| Rated Power      | 2000kW               |
| Diameter         | 97 m                 |
| Swept Area       | 7,390 m <sup>2</sup> |
| Rotational Speed | 9.6 - 17.8 rpm       |
| Design Lifetime  | 25 years             |

Power generated by the wind turbines will be collected at 33 kV and fed to pooling substation near Rajpimpri village (5 kms away), where it is stepped up to 132kV. The pooling station itself is then connected to 132 kV grid at MSETCL existing Substation Georai.

**Emission Reductions from anthropogenic sources:**

The wind power generated from the Project will be displacing the electricity generated from thermal power stations feeding into NEWNE grid and will be replacing the usage of diesel generators for meeting the power demand during shortage periods. Since, the wind power is Green House Gas (GHG) emissions free, the power generated will prevent the anthropogenic GHG emissions generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas. The estimation of GHG reductions by this project is limited to carbon dioxide (CO<sub>2</sub>) only.

## 2.2 Deviations

### 2.2.1 Methodology Deviations

No methodology deviation is applied during the monitoring period

### 2.2.2 Project Description Deviations

No project description deviation is applied during the monitoring period.

---

<sup>4</sup> <http://www.gamesacorp.com/en/products-and-services/wind-turbines/gamesa-g97-20-mw-iiia-en.html>

## 2.3 Grouped Project

Not applicable as the project is not a group project.

## 2.4 Safeguards

### 2.4.1 No Net Harm

N/A

### 2.4.2 Local Stakeholder Consultation

N/A

## 3 DATA AND PARAMETERS

### 3.1 Data and Parameters Available at Validation

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | EF <sub>grid,OM,y</sub>                                                                                                                                                                                                                                                                                                                                                                           |
| Data unit                                                                                    | tCO <sub>2</sub> /MWh                                                                                                                                                                                                                                                                                                                                                                             |
| Description                                                                                  | Operating Margin CO <sub>2</sub> emission factor in year y                                                                                                                                                                                                                                                                                                                                        |
| Source of data                                                                               | Calculated from CEA database, Version 10, December 2014 <sup>5</sup>                                                                                                                                                                                                                                                                                                                              |
| Value applied                                                                                | 0.9862 (NEWNE Grid)                                                                                                                                                                                                                                                                                                                                                                               |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated as per "Tool to calculate the emission factor for an electricity system, version 05.0.0" as 3-year generation weighted average using data for the years 2011-2012, 2012-2013 & 2013-2014. The data are obtained from "CO <sub>2</sub> Baseline Database for Indian Power Sector" version 10.0, published by the Central Electricity Authority, Ministry of Power, Government of India. |
| Purpose of the data                                                                          | For the calculation of the Baseline Emission                                                                                                                                                                                                                                                                                                                                                      |
| Comments                                                                                     | This parameter is fixed ex-ante for the entire crediting period.                                                                                                                                                                                                                                                                                                                                  |

|                                                                                              |                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | EF <sub>grid,BM,y</sub>                                                                                                                                                                                           |
| Data unit                                                                                    | tCO <sub>2</sub> /MWh                                                                                                                                                                                             |
| Description                                                                                  | Build Margin CO <sub>2</sub> emission factor in year y                                                                                                                                                            |
| Source of data                                                                               | Calculated from CEA database, Version 10, December 2014                                                                                                                                                           |
| Value applied                                                                                | 0.9495 (NEWNE Grid)                                                                                                                                                                                               |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated as per "Tool to calculate the emission factor for an electricity system, version 05.0.0" for the year 2013-2014. The data is obtained from "CO <sub>2</sub> Baseline Database for Indian Power Sector" |

<sup>5</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/user\\_guide\\_ver10.pdf](http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver10.pdf)

|                     |                                                                                                       |
|---------------------|-------------------------------------------------------------------------------------------------------|
|                     | version 10.0, published by the Central Electricity Authority, Ministry of Power, Government of India. |
| Purpose of the data | For the calculation of the Baseline Emission                                                          |
| Comments            | This parameter is fixed ex-ante for the entire crediting period.                                      |

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $EF_{grid,CM,y}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Data unit                                                                                    | tCO <sub>2</sub> /MWh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description                                                                                  | Combines Margin CO <sub>2</sub> emission factor in year y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Source of data                                                                               | Calculated from CEA database, Version 10, December 2014 <sup>6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Value applied                                                                                | 0.9770 (NEWNE Grid)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Justification of choice of data or description of measurement methods and procedures applied | <p>The combined margin emissions factor is calculated as follows:</p> $EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$ <p>Where:</p> <p><math>EF_{grid,BM,y}</math> = Build margin CO<sub>2</sub> emission factor in year y (tCO<sub>2</sub>/MWh)</p> <p><math>EF_{grid,OM,y}</math> = Operating margin CO<sub>2</sub> emission factor in year y (tCO<sub>2</sub>/MWh)</p> <p><math>W_{OM}</math> = Weighting of operating margin emissions factor (%) = 75%</p> <p><math>W_{BM}</math> = Weighting of build margin emissions factor (%) = 25%</p> |
| Purpose of the data                                                                          | For the calculation of the Baseline Emission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Comments                                                                                     | This parameter is fixed ex-ante for the entire crediting period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

### 3.2 Data and Parameters Monitored

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | $EG_{PJ,y}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Data unit                                                       | MWh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description                                                     | Quantity of net electricity generation supplied by the project (Wind) plant/unit to the grid in year y                                                                                                                                                                                                                                                                                                                                                                              |
| Source of data                                                  | Joint meter readings by MSECDCL                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description of measurement methods and procedures to be applied | <p>The value of net electricity generation supplied to the grid as per Joint Meter Reading Report forms the basis for calculation of the emission reductions; which can be cross checked from the invoice raised to DISCOM.</p> <p>Net electricity supplied to grid will be calculated as the difference of the measured values of “export” and “import” of electricity through the dedicated SEB energy meter installed at the delivery point (i.e. the connected substation).</p> |

<sup>6</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/user\\_guide\\_ver10.pdf](http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver10.pdf)

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | <p>Net electricity generated and supplied by the project (Wind) plant/unit to the grid = Electricity Export to the grid – Electricity Import from the grid</p> <p>Monthly meter readings are taken from the main and check meter installed at the substation and certified by the representatives of SEB Officials and the representatives of the project proponent. for apportioning procedure refer section 4.3 of the PD.</p>                                                                                                     |
| Frequency of monitoring/recording | Continuous monitoring, hourly measurement and at least monthly recording                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Value monitored                   | 130.521.32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Monitoring equipment              | <p>Monitoring: Tri vector meter will be used</p> <p>Data type: Measured</p> <p>Type of meter: Static type meter (Main &amp; Check).</p> <p>Both are Bidirectional meters. Class of meter: 0.2s</p>                                                                                                                                                                                                                                                                                                                                   |
| QA/QC procedures to be applied    | <ul style="list-style-type: none"> <li>• The energy meter reading are taken on monthly basis</li> <li>• Energy meters will be calibrated once in a five year<sup>7</sup> and faulty meters will be duly replaced immediately.</li> <li>• All the energy meters are under the control of state utility and calibration of energy meters is also under the jurisdiction of state utility.</li> <li>• The Net electricity exported to the grid will be cross checked against the invoice raised by the PP towards the DISCOM</li> </ul> |
| Purpose of the data               | Calculation of Baseline emissions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Calculation method                | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Comments                          | The data would be archived electronically and maintained for the entire crediting period plus two years.                                                                                                                                                                                                                                                                                                                                                                                                                             |

### 3.3 Monitoring Plan

#### Aim of monitoring:

The monitoring methodology specified in the methodology requires that the project-monitoring plan to consist of monitoring of quantity of net electricity supplied to the grid in the year y. In order to monitor the mitigation of GHG due to the project activity, the total energy exported needs to be measured. The net energy supplied to grid by the project activity multiplied by emission factor for regional grid, would form the baseline for the project activity.

<sup>7</sup> [http://www.aegcl.co.in/Metering\\_Regulations\\_Of\\_CEA\\_17\\_03\\_2006.pdf](http://www.aegcl.co.in/Metering_Regulations_Of_CEA_17_03_2006.pdf), page 12

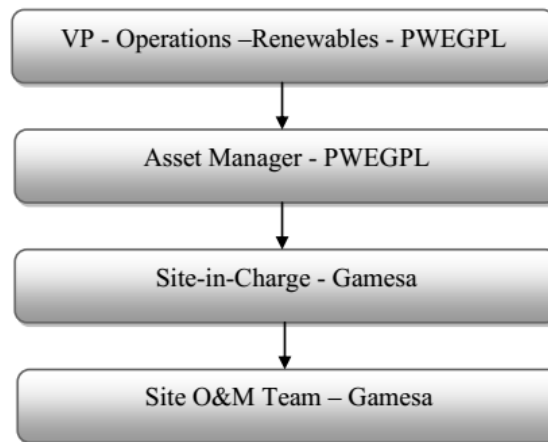
Since the baseline emission factor is based on an ex-ante determination, monitoring of this parameter is not required. The sole parameter for monitoring is the net electricity exported to the grid.

#### **Monitoring roles and responsibilities**

The operational and management structure implemented for data monitoring is as follows:

The monitoring plan is developed in accordance with the modalities and procedures for CDM project activities and is proposed for grid-connected wind power project being implemented in Maharashtra, India. The monitoring plan, which will be implemented by the project proponent describes about the monitoring organisation, parameters to be monitored, monitoring practices, quality assurance, quality control procedures, data storage and archiving.

The authority and responsibility for registration, monitoring, measurement, reporting and reviewing of the data rests with the project proponent. PP proposed the following structure for data monitoring, collection, data archiving and calibration of equipments for this project activity. The team comprises of the following members:



PP has assigned the responsibility of operation and maintenance of WTGs to Gamesa wind turbines private limited.

**Responsibilities of Head:** Overall functioning and maintenance of the project activity.

**Responsibilities of Plant In-charge:** Responsibility for Maintains the data records, ensures completeness of data, and reliability of data (calibration of equipments).

**Responsibilities of Shift In-charge:** Responsibility for day to day data collection and maintains day to day log book for monitored data.

#### **QA/QC procedures:**

The energy meters at the feeders are maintained and owned by MSEB. Neither the project proponent nor the site personnel have any control over it. The records will be cross-checked with the records of sold electricity to MSEDCL. The meters are calibrated by MSEB at-least once in three years.

**Data Archiving:**

Monthly data shall be archived electronically and in paper form and stored for the entire crediting period and two years thereafter.

**Training and maintenance requirements:**

Training on the machine is an essential pre-requisite, to ensure necessary safety of man and machine. Further, in order to maximize the output from the WTGs, it is extremely essential, that the engineers and technicians understand the machines and keep them in good health. In order to ensure, that O&M team is deft at handling technical snags on top of the turbine, the necessity of ensuring that they are capable of climbing the tower with absolute ease and comfort has been established. Each and every site personnel is provided with proper training to meet the requirements of the Operations and maintenance. This ultimately leads to creativity in problem solving.

A monthly joint meter reading of the energy meters is taken by MSEDCL officials and O&M contractors (representatives of the project investor). Apportioning of net electricity generation from each WTG connected to NEWNE grid is then determined as follows:

|   |                                                                     |   |                                                                                                            |
|---|---------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------|
| 1 | Apportioning Ratio                                                  | = | $\frac{\text{Generation at WTG Controller}}{\text{Total Generation of All WTG Controller for the feeder}}$ |
| 2 | Electricity Import from WTG by the grid ( $EG_{\text{import}}$ )    | = | Import from Main/Check Meter * Apportioning Ratio                                                          |
| 3 | Electricity Export to the WTGs by the grid ( $EG_{\text{export}}$ ) | = | Export from Main/Check Meter * Apportioning Ratio                                                          |
| 4 | Net electricity generated by WTG                                    | = | Electricity Import from WTG by the grid – Electricity Export to the WTGs by the grid                       |

Above steps for calculation of  $EG_{\text{import}}$  and  $EG_{\text{export}}$  are carried out by MSEDCL Officials & energy break-up sheet is issued by the MSEDCL Officials. Based on the break-up sheets Project investor raises invoice to DISCOM which forms the cross-check for the net electricity generated. The Project investor has no role in the entire procedure of apportioning

**Emergency Preparedness and Uncertainty Procedure:**

In case Main meter or check meter is found to be outside the acceptable limits of accuracy or faulty or not functioning properly, it will be repaired, recalibrated or replaced as soon as possible. In the event that the Main meter is not in service as a result of maintenance, repairs or calibration, the check meter will be used. In case both the main and check meter are found to be outside the acceptable limits of accuracy or faulty or not functioning properly, both the meters shall be calibrated immediately and the error percentage found in the main meter during its calibration shall be applied to its metered energy data for the entire period since its last calibration to obtain the corrected value of net electricity exported to the grid.

In case the dates of a particular monitoring period do not match with the dates of the billing cycle, the net electricity exported to the grid would be calculated from:

- Apportioning the net electricity exported to grid, as recorded in the consolidated Share Certificate / JMR Report / Credit Notes certified by the respective state discom, based on

the number of days in the monitoring period and the number of days for which Share Certificate / JMR Report / Credit Notes was prepared.

The calculated value after apportioning would be used for calculation of emission reductions during that period.

## 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

### 4.1 Baseline Emissions

$$BE_y = EG_{PJ, y} * EF_{grid, CM, y}$$

Where:

$BE_y$ : Baseline emissions in year y (tCO<sub>2</sub>e/yr)

$EG_{PJ, y}$ : Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the VCS project activity in year y (MWh/yr)

$EF_{grid, CM, y}$ : Combined margin CO<sub>2</sub> emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (tCO<sub>2</sub>e/MWh)

| Parameter            | Unit               | Value                           |
|----------------------|--------------------|---------------------------------|
| $EG_{PJ, y}$ :       | MWh                | 130,521.32                      |
| $EF_{grid, CM, y}$ : | tCO <sub>2</sub> e | 0.9770                          |
| $BE_y$               | =                  | $EG_{PJ, y} * EF_{grid, CM, y}$ |
|                      | =                  | 130,521.32 * 0.9770             |
|                      | =                  | 127,519                         |

### 4.2 Project Emissions

$PE_{FF, y} = 0$  , As per para 37 of ACM0002 version 16, “For all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected”

$$PR_{FF, y} = 0$$

### 4.3 Leakage

As per para 60 of ACM0002 version 16, No leakage emissions need to be considered for the project activity.

### 4.4 Net GHG Emission Reductions and Removals

| Year                     | Baseline emissions or removals (tCO <sub>2</sub> e) | Project emissions or removals (tCO <sub>2</sub> e) | Leakage emissions (tCO <sub>2</sub> e) | Net GHG emission reductions or removals (tCO <sub>2</sub> e) |
|--------------------------|-----------------------------------------------------|----------------------------------------------------|----------------------------------------|--------------------------------------------------------------|
| 02/03/2016 to 31/12/2016 | 123,700                                             | 0                                                  | 0                                      | 123,700                                                      |
| 01/01/2017 to 01/02/2017 | 3,819                                               | 0                                                  | 0                                      | 3,819                                                        |
| <b>Total</b>             | <b>127,519</b>                                      | <b>0</b>                                           | <b>0</b>                               | <b>127,519</b>                                               |

## APPENDIX 1: FEEDER AND CALIBRATION DETAILS

**Feeder and Calibration Details**

| WTG ID                               | Feeder Connectivity | No. of WTGs | Main Meter Sr. No. | Check Meter Sr. No. | Meter Make Accuracy Class | Date of Calibration                             | Validity of Calibration <sup>8</sup> |
|--------------------------------------|---------------------|-------------|--------------------|---------------------|---------------------------|-------------------------------------------------|--------------------------------------|
| Location No. - 38,26,32              | Feeder No. 1        | 8           | 5288748            | 5288752             | Elster 0.2s               | 16/07/2016 Main Meter                           | 15/07/2021                           |
| Location No. - 24,25,29,30,31        |                     |             |                    |                     |                           | 27/07/2016 Check Meter                          | 26/07/2021                           |
| Location No. - 21                    | Feeder No. 2        | 13          | 5288749            | 5288753             | Elster 0.2s               | 16/07/2016 Main Meter                           | 15/07/2021                           |
| Location No. - 5,22,23               |                     |             |                    |                     |                           | 27/07/2016 Check Meter                          | 26/07/2021                           |
| Location No. - 33,34,35,36,37, 39,40 |                     |             |                    |                     |                           |                                                 |                                      |
| Location No. - 27,28                 |                     |             |                    |                     |                           |                                                 |                                      |
| Location No. - 1,2,3,4,6,7,8,10, 11  | Feeder No. 3        | 9           | 5288751            | 5288750             | Elster 0.2s               | 16/07/2016 Main Meter<br>27/07/2016 Check Meter | 15/07/2021<br>26/07/2021             |
| Location No. - 9,12,13,16,18,1 9,20  | Feeder No. 4        | 7           | 5288755            | 5288754             | Elster 0.2s               | 16/07/2016 Main Meter                           | 15/07/2021                           |
| Location No. - 17,14,15              |                     | 3           |                    |                     |                           | 27/07/2016 Check Meter                          | 26/07/2021                           |

<sup>8</sup> Calibration frequency is of five years, thus for the current monitoring period (02/03/2016 to 01/02/2017) all the meters are calibrated in July 2016. Since PP do not have calibration certificates prior to July 2016, thus error factor is applied till 01/08/2016 conservatively.

## APPENDIX 2: MAJOR BREAKDOWN DETAILS

| Date      | Turbine No | WTG / GENERATION N- GEN/DAY | WTG / GENERATION Hrs-Hrs/Day | Grid Failure | GRID FAILURE- %Ava | WTG TOTAL B/D TIME (BM) | SCHE DULE D (PM) | STOPPAGE DETAILS                                                                                                                                                                                                                                 | WTG AVAIL (%) | PLF   |
|-----------|------------|-----------------------------|------------------------------|--------------|--------------------|-------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------|
| 22-Mar-16 | G 37       | 7786                        | 13:57:57                     | 0:00         | 100.00             | 10:02                   | 0:00             | error 5215 rotor protection thermal magnetic failure from 13:57 to 23:59                                                                                                                                                                         | 58.19         | 16.22 |
| 23-Mar-16 | G 37       | 1                           | 0:20:59                      | 0:00         | 100.00             | 23:39                   | 0:00             | error 5215 rotor protection thermal magnetic failure from 0:01 to 17:54 , 18:13 to 23:59                                                                                                                                                         | 1.46          | 0.00  |
| 24-Mar-16 | G 37       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 5215 rotor protection thermal magnetic failure from 0:01 to 23:59                                                                                                                                                                          | 0.14          | 0.00  |
| 25-Mar-16 | G 37       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 5215 rotor protection thermal magnetic failure from 0:01 to 23:59                                                                                                                                                                          | 0.14          | 0.00  |
| 26-Mar-16 | G 37       | 3303                        | 7:27:58                      | 0:00         | 100.00             | 16:32                   | 0:00             | error 5215 rotor protection thermal magnetic failure from 0:01 to 16:33                                                                                                                                                                          | 31.11         | 6.88  |
| 20-Apr-16 | G 27       | 3003                        | 14:38:00                     | 0:00         | 100.00             | 9:22                    | 0:00             | error 305 high (atmospheric) T from 13:13 to 22:35                                                                                                                                                                                               | 60.97         | 6.26  |
| 21-Apr-16 | G 07       | 6338                        | 6:42:48                      | 0:00         | 100.00             | 17:17                   | 0:00             | error 416 vibration sensor from 0:27 to 17:08 & 23:38 to 23:59 & error 523 high T of coolant in input of the cooling circuit from 22:09 to 22:24                                                                                                 | 27.99         | 13.20 |
| 21-Apr-16 | G 08       | 7615                        | 11:43:49                     | 0:00         | 100.00             | 12:16                   | 0:00             | error 207 high T (HG) from 0:01 to 2:57 & 3:25 to 7:57 & error 305 high (atmospheric) T from 14:54 to 19:42                                                                                                                                      | 48.89         | 15.86 |
| 21-Apr-16 | G 27       | 7962                        | 12:56:49                     | 0:03         | 99.79              | 11:00                   | 0:00             | error 305 high (atmospheric) T troubleshooting work from 11:10 to 15:46 & error 305 high (atmospheric) T from 15:47 to 18:01 & error 5216 grid voltage failure from 18:02 to 18:05 & error 305 high (atmospheric) T from 18:07 to 22:17          | 54.17         | 16.59 |
| 22-Apr-16 | G 07       | 4145                        | 8:43:50                      | 0:00         | 100.00             | 15:16                   | 0:00             | error 318 necelle temp. from 16:29 to 19:40 & error 10007 manual stop for vibration error from 0:01 to 7:48 & 19:41 to 23:59                                                                                                                     | 36.39         | 8.64  |
| 22-Apr-16 | G 09       | 312                         | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor error from 0:01 to 23:59                                                                                                                                                                            | 0.14          | 0.65  |
| 23-Apr-16 | G 07       | 14834                       | 12:38:00                     | 0:00         | 100.00             | 11:22                   | 0:00             | error 10007 manual stop for vibration error from 0:01 to 8:34 & 21:44 to 23:59 & error 523 high T coolant in input of the cooling circuit from 11:39 to 11:53 & 15:27 to 15:47                                                                   | 52.64         | 30.90 |
| 23-Apr-16 | G 09       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                             | 0.14          | 0.00  |
| 24-Apr-16 | G 07       | 6841                        | 11:33:49                     | 1:35         | 100.00             | 10:51                   | 0:00             | error 416 vibration sensor from 0:01 to 3:53 & error 9905 lc taken from 10:25 to 12:00 & error 10007 manual stop for vibration sensor troubleshooting work from 13:12 to 15:28 & error 10007 manual stop for vibration error from 19:16 to 23:59 | 54.79         | 14.25 |
| 24-Apr-16 | G 09       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                             | 0.14          | 0.00  |
| 25-Apr-16 | G 07       | 6033                        | 15:11:00                     | 0:00         | 100.00             | 8:49                    | 0:00             | error 10007 manual stop for vibration sensor error from 0:01 to 6:11 & 21:25 to 23:59 & error 426 S reading failure (rotor) from 9:42 to 9:47                                                                                                    | 63.26         | 12.57 |
| 25-Apr-16 | G 09       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                             | 0.14          | 0.00  |
| 26-Apr-16 | G 07       | 2346                        | 8:21:49                      | 0:00         | 100.00             | 15:38                   | 0:00             | error 10007 manual stop for vibration error from 0:01 to 4:17 & 21:41 to 23:59 & error 10007 manual stop for vibration sensor troubleshooting work from 11:46 to 20:50                                                                           | 34.86         | 4.89  |
| 26-Apr-16 | G 09       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                             | 0.14          | 0.00  |
| 27-Apr-16 | G 09       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                             | 0.14          | 0.00  |
| 28-Apr-16 | G 09       | 0                           | 0:02:00                      | 0:00         | 100.00             | 23:58                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                             | 0.14          | 0.00  |
| 29-Apr-16 | G 07       | 1670                        | 12:03:00                     | 0:00         | 100.00             | 11:57                   | 0:00             | error 10007 manual stop for vibration sensor troubleshooting work from 12:02 to 23:59                                                                                                                                                            | 50.21         | 3.48  |

[illegible]

|           |      |       |          |      |        |       |      |                                                                                                                                                                                                                                        |       |       |
|-----------|------|-------|----------|------|--------|-------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 11-May-16 | G 31 | 3079  | 10:20:59 | 0:00 | 100.00 | 13:39 | 0:00 | error 804 difference between 2 blade very high from 1:36 to 1:41 , 2:03 to 2:34 , 2:52 to 7:55 ,error 2118 bus error / interbus failure from 10:07 to 10:51 , error 800 pitch activation error from 13:26 to 18:10 , 18:41 to 21:13    | 43.13 | 6.41  |
| 12-May-16 | G 07 | 0     | 0:02:00  | 0:00 | 100.00 | 23:58 | 0:00 | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                   | 0.14  | 0.00  |
| 12-May-16 | G 09 | 0     | 0:02:00  | 0:00 | 100.00 | 23:58 | 0:00 | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 23:59                                                                                                                                                   | 0.14  | 0.00  |
| 12-May-16 | G 31 | 6837  | 11:41:00 | 0:00 | 100.00 | 12:19 | 0:00 | error 2118 bus error/interbus failure from 3:05 to 4:45 & error 800 pitch activation error from 6:00 to 16:39                                                                                                                          | 48.68 | 14.24 |
| 13-May-16 | G 07 | 426   | 2:01:00  | 0:00 | 100.00 | 21:59 | 0:00 | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 22:00                                                                                                                                                   | 8.40  | 0.89  |
| 13-May-16 | G 09 | 170   | 1:33:00  | 0:00 | 100.00 | 22:27 | 0:00 | error 10007 manual stop for vibration sensor troubleshooting work from 0:01 to 22:28                                                                                                                                                   | 6.46  | 0.35  |
| 18-May-16 | G 11 | 7751  | 13:48:49 | 0:00 | 100.00 | 10:11 | 0:00 | error 318 high nacelle temp from 12:54 to 23:05                                                                                                                                                                                        | 57.57 | 16.15 |
| 18-May-16 | G 20 | 10605 | 15:11:59 | 0:00 | 100.00 | 8:48  | 0:00 | error 318 hgh nacelle temp from 12:46 to 21:34                                                                                                                                                                                         | 63.33 | 22.09 |
| 18-May-16 | G 24 | 6428  | 14:39:00 | 0:00 | 100.00 | 9:21  | 0:00 | error 318 high necelle temp. from 12:06 to 21:27                                                                                                                                                                                       | 61.04 | 13.39 |
| 29-May-16 | G 12 | 12519 | 15:04:48 | 0:00 | 100.00 | 8:55  | 0:00 | error 205 low level hydraulic group refrigeration oil from 15:04 to 23:59                                                                                                                                                              | 62.85 | 26.08 |
| 30-May-16 | G 12 | 4580  | 12:35:00 | 0:00 | 100.00 | 11:25 | 0:00 | error 205 low level hydraulic group refrigeration oil from 0:01 to 10:54 & error 203 low pressure on hydraulic unit from 16:55 to 17:27                                                                                                | 52.43 | 9.54  |
| 5-Jun-16  | G 21 | 1001  | 1:06:00  | 0:13 | 99.10  | 22:41 | 0:00 | error 5216 grid voltage failure from 18:19 to 18:32 & error 716 wind measurement failure from 00:01 to 18:18 & 18:33 to 22:57                                                                                                          | 5.49  | 2.09  |
| 12-Jul-16 | G 30 | 0     | 0:02:00  | 0:00 | 100.00 | 23:58 | 0:00 | error 212 leak in the hub from 0:01 to 23:59                                                                                                                                                                                           | 0.14  | 0.00  |
| 13-Jul-16 | G 30 | 4801  | 3:58:58  | 0:00 | 100.00 | 20:01 | 0:00 | error 212 leak in the hub from 0:01 to 20:02                                                                                                                                                                                           | 16.60 | 10.00 |
| 1-Aug-16  | G 26 | 13322 | 13:09:50 | 0:00 | 100.00 | 10:50 | 0:00 | error 700 plc converter failure from 3:56 to 6:06 , 10:47 to 13:10 , 15:48 to 21:03 & error 907 hub emergency mode trigger from 10:52 to 11:54                                                                                         | 54.86 | 27.75 |
| 7-Aug-16  | G 12 | 21884 | 14:57:57 | 0:00 | 100.00 | 9:02  | 0:00 | error 5235 rectifier of inverter drives from 4:30 to 13:32                                                                                                                                                                             | 62.36 | 45.59 |
| 16-Aug-16 | G 24 | 10436 | 12:42:59 | 0:03 | 99.79  | 11:14 | 0:00 | error 5216 grid voltage failure from 07:47 to 07:50 & error 1822 disconnection due to low temp from 07:51 to 19:05                                                                                                                     | 53.19 | 21.74 |
| 1-Sep-16  | G 11 | 2137  | 10:47:00 | 0:00 | 100.00 | 13:13 | 0:00 | error 5224 out of range in slipage from 1:46 to 4:40 & error 621 maximum synchronization time from 6:43 to 11:21 & error 410 ogs sensor from 15:20 to 17:19 ,18:00 to 20:23 & error 907 hub emergency mode trigger from 22:40 to 23:59 | 44.93 | 4.45  |
| 2-Sep-16  | G 11 | 5257  | 0:00:01  | 0:00 | 100.00 | 12:24 | 0:00 | error 907 hub emergency mode trigger from 00:01 to 1:25 & error 410 ogs sensor from 2:47 to 4:48 ,5:05 to 5:16 ,5:41 to 9:05 ,17:34 to 20:32 ,21:42 to 23:59 & error 5204 emergency series not ok from 4:50 to 4:59                    | 48.33 | 10.95 |
| 3-Sep-16  | G 11 | 7619  | 11:18:59 | 0:00 | 100.00 | 12:41 | 0:00 | error 410 ogs sensor from 00:01 to 00:44 ,1:11 to 5:05 ,5:22 to 6:13 ,6:40 to 9:54 ,17:27 to 19:15 & error 10007 manual stop for ogs error trouble shutting work from 11:41 to 13:52                                                   | 47.15 | 15.87 |
| 3-Sep-16  | G 23 | 5811  | 11:00:00 | 0:00 | 100.00 | 13:00 | 0:00 | error 509 generator slipping ring high temperature from 00:01 to 2:34 ,4:10 to 8:01 ,9:56 to 16:42                                                                                                                                     | 45.83 | 12.11 |
| 10-Sep-16 | G 03 | 2588  | 6:31:00  | 0:00 | 100.00 | 17:29 | 0:00 | error 5219 coolant of the coolant circuit failure from 00:01 to 17:30                                                                                                                                                                  | 27.15 | 5.39  |
| 27-Sep-16 | G 10 | 5842  | 14:01:00 | 0:00 | 100.00 | 9:59  | 0:00 | error 213 HG pump magneto open from 0:1 to 09:17 & error 10007 trouble shooting work gearbox thermal fan relay from 15:35 to 16:18                                                                                                     | 58.40 | 12.17 |
| 4-Nov-16  | G 32 | 112   | 4:18:00  | 0:00 | 100.00 | 19:12 | 0:30 | error 5215 rotor protection thermal magnetic failure from 4:47 to 23:59 & error 10007 manual stop for software uploading work from 13:00 to 13:30                                                                                      | 17.92 | 0.23  |
| 5-Nov-16  | G 32 | 495   | 1:25:00  | 0:00 | 100.00 | 22:35 | 0:00 | error 5215 rotor protection thermal magnetic failure from 0:01 to 22:36                                                                                                                                                                | 5.90  | 1.03  |
| 15-Jan-17 | G 27 | 1373  | 12:56:58 | 0:00 | 100.00 | 11:03 | 0:00 | error 5238 error in phase T of the inverter from 00:01 to 11:04                                                                                                                                                                        | 53.96 | 2.86  |