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Standard**

13.95 MW GRID CONNECTED WIND ELECTRICITY GENERATION BY SRF LIMITED



Document Prepared by EKI Energy Services Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity has been essentially conceived to implement and generate GHG free electricity from the Wind Turbine Generators (WTGs). The generated electricity from the implemented machines is supplied to the southern regional grid¹ of India through the nearest grid substation. The generated electricity that is supplied to the grid is then wheeled to SRF's units for their technical textile business (plants).

The project activity comprises of 6 numbers of 1.5 MW, S82 type of WTGs of Suzlon make and 3 numbers of 1.65 MW, V82 type of WTGs of Vestas make. The electricity generated from the Suzlon WTGs is supplied to the Udayathoor site sub-station and the electricity generated from the Vestas WTGs is supplied to the Veeranam site substation, through local transmission lines duly metered and measured at the individual dispatching transformers at each WTG.

The project activity harnesses wind energy to generate and supply electricity to the electricity grid of India. The project displaces fossil fuel-based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel-based power plants in the electricity grid, thereby leading to reduction in emission of greenhouse gases associated with fossil fuel-based electricity generation.

The first machine under the project activity was commissioned on 27-March-2008 and the last machine under the project activity was commissioned on 03-June-2008. The expected operational lifetime of the project is for 20 years.

The total actual GHG Emission reductions achieved in current monitoring period, i.e., from 16-March-2012 to 28-February-2018 are 154,757 tCO₂e by displacing 166,533 MWh of electricity from fossil-fuel dominated electricity grid with electricity generation using wind energy resources.

1.2 Sectoral Scope and Project Type

Sectoral Scope 1: Energy industries (renewable - / non-renewable sources)

Project Type – Renewable Energy Project

The project activity is not a grouped project.

¹ The Southern regional grid is now synchronized to the Indian National grid.

1.3 Project Proponent

Organization name	SRF Limited
Contact person	Mr. Manish Mittal
Title	Senior Vice President & CFO Technical Textile Business
Address	SRF Limited, Block – C, Sector – 45, Gurugram, Haryana, India - 122003
Telephone	0124 - 4354400, 9958106661
Email	manish.mittal@srf.com

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the Project	Project Consultant
Contact person	Mr. Manish Dabkara
Title	CMD & CEO
Address	Enking Embassy, Plot 48, Scheme 78 Part-2, Behind Vrindavan Hotel, Vijay Nagar 452010, Indore (Madhya Pradesh, India) Website: www.enkingint.org
Telephone	+91 99 07 53 4900
Email	manish@enkingint.org , registry@enkingint.org

1.5 Project Start Date

The start date of the project activity is the earliest date of commissioning of the WTGs i.e., 27-March-2008 and hence it is considered as the project start date.

Therefore, the project start date is 27-March-2008.

1.6 Project Crediting Period

Crediting Period Start date: 27-March-2008

Crediting Period End date: 26-March -2018

Type of crediting period: Fixed Crediting period

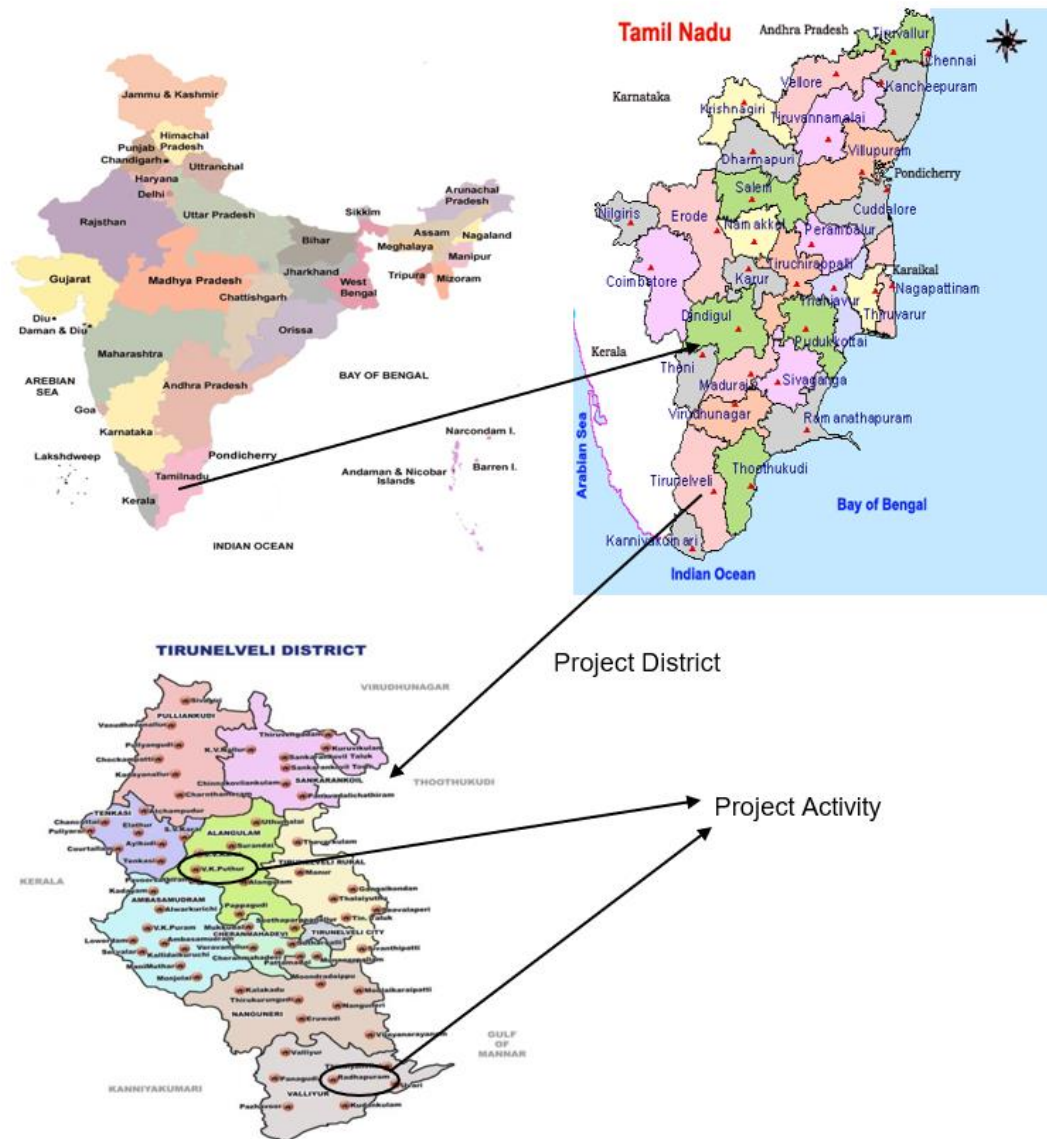
The total number of years is 10 years.

1.7 Project Location

The project activity spreads across two locations – Radhapuram and VK Pudur Taluk, both in Tirunelveli District in Tamil Nadu. The district is well connected by railways and national highways. The villages are well interconnected by metalled and un-metalled roads. The unique identification for the different WEGs that are part of the project activity are as follows:

S.No.	Village	Taluk	Location	Latitude (N)	Longitude (E)	Indicati on Mark	Capacity (in MW)	HTSC No.
1	Navaneet hakrishn apuram	V K Pudur	Tirunelveli District in Tamil Nadu	9° 00' 57.9"	77° 28' 49.8"	Site 2/3	1.65	2550
2	Navaneet hakrishn apuram	V K Pudur	Tirunelveli District in Tamil Nadu	9° 01' 07.9"	77° 29' 07.5"	Site 12	1.65	2583
3	Melakala ngal	V K Pudur	Tirunelveli District in Tamil Nadu	9° 01' 45.2"	77° 28' 46.1"	Site 69/70	1.65	2622
4	Thiruvam balapura m	Radha puram	Tirunelveli District in Tamil Nadu	8° 15' 26.5"	77° 45' 58.5"	R231	1.5	2536
5	Thiruvam balapura m	Radha puram	Tirunelveli District in Tamil Nadu	8° 15' 32.8"	77° 48' 14.1"	R404	1.5	2537
6	Thiruvam balapura m	Radha puram	Tirunelveli District in Tamil Nadu	8° 15' 58.4"	77° 47' 43.9"	R352	1.5	2551
7	Thiruvam balapura m	Radha puram	Tirunelveli District in Tamil Nadu	8° 13' 45.6"	77° 46' 46.4"	R308	1.5	2626
8	Thiruvam balapura m	Radha puram	Tirunelveli District in Tamil Nadu	8° 14' 55.1"	77° 47' 11.7"	R325	1.5	2633

9	Thiruvambalur	Radhapuram	Tirunelveli District in Tamil Nadu	8° 14' 15.9"	77° 46' 25.2"	R367	1.5	2538
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1.8 Title and Reference of Methodology

Title: AMS I.D. "Grid connected renewable electricity generation", Version 13, EB 36.

Reference: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>

The methodological tool which the applied methodology refers to is: "Tool to calculate the emission factor for an electricity system" Version 01.1

1.9 Participation under other GHG Programs

The project activity has been registered in CDM (UNFCCC Reference No. 2365²). For the CDM project activity, previously, three verifications have already been done and issued, (1st verification period: 09-April-2009 to 15-March-2010; 2nd verification period: 16-March-2010 to 15-February-2011; 3rd verification period: 16-February-2011 to 15-March-2012). The project proponent has provided an undertaking to the VVB that it will not claim any GHG credits under any GHG program other than that under VERRA during the current monitoring period (16-March-2012 to 28-February-2018).

1.10 Other Forms of Credit

Emission Trading Programs and Other Binding Limits: India is non-annex 1 country and there is no compliance with an emission trading program or to meet binding limits on GHG emissions for this project activity. The project is not used for compliance with an emission trading program or to meet binding limits on GHG emissions. The project proponent has submitted undertaking that it would not use net GHG emission reductions by the projects for compliance with emission trading program to meet binding limits on GHG emissions.

Other Forms of Environmental Credit: The project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates, during this monitoring period. The project is not claiming any benefits from the REC mechanism of India which can be confirmed from the link below –

<https://www.recregistryindia.nic.in/index.php/publics/accreditedregens>

1.11 Sustainable Development Contributions

The project activity harnesses wind energy to generate and supply electricity to the electricity grid of India. The project displaces fossil fuel-based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel-based power plants in the electricity grid, thereby leading to reduction in emission of greenhouse gases associated with fossil fuel-based electricity generation. The project activity spreads across two locations – Radhapuram and VK Pudur Taluk, both in Tirunelveli District in Tamil Nadu.

The project contributes towards the following sustainable development goals achievement during the current monitoring period:

SDG - 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

² UNFCCC Project Page Link: <https://cdm.unfccc.int/Projects/DB/SGS-UKL1231860367.09/view>

SDG - 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, Equal pay and decent work for all and Protect labour rights and promote safe working environment.

SDG - 13: Climate Action: Take urgent action to combat climate change and its impacts.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
<i>Sequential row number</i>	<i>SDG Target number</i>	<i>Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator</i>	<i>Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)</i>	<i>Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the monitoring period.</i>	<i>Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.</i>
1)	7.2	7.2.1: Renewable energy share in the total final energy consumption	Implemented activities to increase	Activity: Renewable electricity generation The project has generated 166,533 MWh of renewable energy during the current ongoing monitoring period, 16-March-2012 to 28-February-2018.	The project has generated 166,533 MWh of net renewable energy since the start date of crediting period up to 28-February-2018.
2)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	Activity: tCO₂e Reduction The project has reduced 154,757 tCO₂e during the ongoing monitoring period, 16-March-2012 to 28-February-2018.	The project has reduced 154,757 tCO ₂ e up to 28-February-2018 since the start date of the crediting period.

3)	8.5	8.5.2 Unemployment rate, by sex, age and persons with disabilities	Implemented activities to decrease	Activity: Employment The project has employed 9 workers. Thus, the project is contributing towards SDG 8.5.2 by increasing the employment opportunities to the local people.	The project has employed 9 workers. Thus, the project is contributing towards SDG 8.5.2 by increasing the employment opportunities to the local people.
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2 SAFEGUARDS

2.1 No Net Harm

The project activity being wind power project, it does not involve any potential negative environmental and socio-economic impacts.

2.2 Local Stakeholder Consultation

A meeting for the local stakeholders of the windmill project was organized on 17-June-2008 in Tiruvambalapuram and on 18-June-2008 in Surandai (the respective project sites), Tirunelveli District to understand the concerns of the stakeholders with regard to the project activity as the involvement of the local stakeholders is very important in any project implementation. Invitation for the meeting was sent out to all pertinent stakeholders 15 days prior to the event. The stakeholders included the original landowners of the windmill farm, member of the local governing body, residents of village, representatives of the local school, TNEB Engineers, members of the Operation and Maintenance team of the EPC contractor, etc. These invitations were delivered in person to all the stakeholders and they were informed about the consultation.

The stakeholders were presented, in vernacular (Tamil), with an overview of the project activity as well as the technological, economic, environmental and social issues associated with it. After the presentation, the stakeholders were invited to come forward with their comments, suggestions and concerns regarding the project activity. A questionnaire was circulated to all the stakeholders.

Summary of the comments received:

The stakeholders gave their opinion on the project through the filled questionnaires. Overall, a positive response was received from the stakeholders. There were no negative comments received from the stakeholders during the local stakeholder meeting.

As a part of continuous feedback from stakeholders, the grievances registers are also placed at the site and is being continuously monitored. In the grievance register, the stakeholder can mention the comments or feedback related to the project activity and the actions requested by them. If any comments are received, the concerned person from the project proponent's side addresses them accordingly and proper responses are given.

2.3 AFOLU-Specific Safeguards

Not applicable to this as this is not an AFOLU project activity.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

In wind energy generation, kinetic energy of wind is converted into mechanical energy and subsequently into electrical energy. The technology is a clean technology since there are no GHG emissions associated with the electricity generation.

The Project involves 6 (WTGs) of Suzlon (Model S82) and 3 (WTGs) of Vestas (Model V82) type of Wind Turbine Generators (WTGs) with internal electrical lines connecting the project with the local evacuation facility i.e., the Udayathoor and the Veernam substations respectively. The WTGs generate 3- phase power at 690 V, which is stepped up to 33 kV. The electricity generated from the 9 WTGs is being wheeled for captive use to its technical textiles business units in Tamil Nadu.

The WTGs have been installed and commissioned between the period 27-March-2008 and 03-June-2008. Details of commissioning dates of the individual machines have been summarized in the below table:

#	Location	Indicati on Mark	Capacity (in MW)	HTSC No.	Commissioning Date
1	Village – Navaneethakrishnapuram, Taluk – V K Pudur, District – Tirunelveli in Tamil Nadu	Site 2/3	1.65	2550	29-March-2008
2	Village – Navaneethakrishnapuram, Taluk – V K Pudur, District – Tirunelveli in Tamil Nadu	Site 12	1.65	2583	31-March-2008
3	Village – Melakalangal, Taluk – V K Pudur, District – Tirunelveli in Tamil Nadu	Site 69/70	1.65	2622	30-April-2008
4	Village – Thiruvambalapuram, Taluk – Radhapuram, District - Tirunelveli in Tamil Nadu	R231	1.5	2536	27-March-2008
5	Village – Thiruvambalapuram, Taluk – Radhapuram, District - Tirunelveli in Tamil Nadu	R404	1.5	2537	27-March-2008
6	Village – Thiruvambalapuram, Taluk – Radhapuram, District - Tirunelveli in Tamil Nadu	R352	1.5	2551	29-March-2008
7	Village – Thiruvambalapuram, Taluk – Radhapuram, District - Tirunelveli in Tamil Nadu	R308	1.5	2626	17-May-2008

8	Village – Thiruvambalapuram, Taluk – Radhapuram, District - Tirunelveli in Tamil Nadu	R325	1.5	2633	03-June2008
9	Village – Thiruvambalapuram, Taluk – Radhapuram, District - Tirunelveli in Tamil Nadu	R367	1.5	2538	27-March-2008

The technical specifications of the WTGs are as follows:

Technical Specification of Suzlon S-82

WTG Parameters	Values
Rotor Diameter	82 m
Hub height	78.5 m
Power Regulation	Independent electromechanical pitch system foreach blade
Rated Voltage	3 Phase 690 V AC
Cut in wind speed	4 m/s
Cut out wind speed	20 m/s
Rated wind speed	14 m/s
Survival wind speed	52.5 m/s
Frequency variation	50 Hz – 2.5 Hz to + 2 Hz
Gear Box	
Type model make	Type: On planetary stage / Two helical stagesMake: Winergy (Flender)
Gear ratio	1: 95.09
No. of steps	3 stages
Generator	
Type of Generator	Asynchronous type single speed induction generator with slip rings, variable rotor resistance
Rated Power output	1500 kW
Type	Single
Voltage	3 phase 690 V AC +/- 15%
No. of poles / RPM	4 / 1511 rpm (at rated power and short-circuitedrotor)
Tower	
Height	76 m
Type	Tubular tower made of welded steel plates
Yawing system	

Yaw bearing type	Slide bearing with gear ring and automatic greasing system
Yaw motor & gear type	Active electric yaw drive having electric motor with brake, gearbox and pinion.
Brake System	
Aerodynamic	3 independent systems with blade pitching mechanism
Mechanical	Hydraulic disc brake, activated by hydraulic pressure + mechanical rotor lock, activated by hydraulic pressure
Rotor	
No of Blades	3
Rotor diameter	82 m
Swept Area	5281 m ²
Transformer	
Transformer Rating	1750 kVA, 50 Hz

Technical Specification of Vestas V-82

WTG Parameters	Values
Rotor Diameter	82 m
Hub height	78.5 m
Power Regulation	Active Stall
Cut in wind speed	3.5 m/s
Cut out wind speed	20 m/s
Rated wind speed	13 m/s
Gear Box	
Type model make	Planetary / Helical stages
Generator	
Type of Generator	Asynchronous water cooled
Rated Power output	1650 kW
Type	Single
Operational Data	50/60 Hz 690/600 V
Control	
Type	Microprocessor-based monitoring of all turbine functions with the option of remote monitoring. Output regulation and optimization via Active- Stall®

Weight	
Nacelle	52 t
Rotor	43 t
Rotor	
Diameter	82 m
Area swept	5281 m ²
Nominal Revolutions	14.4 rpm
No of Blades	3
Power regulation	Active stall
Air Brake	Full blade pitch by three separate hydraulic pitch cylinders.

Some breakdowns have been observed during the current monitoring period of the project activity. The breakdown details are added in Appendix 3.

3.2 Deviations

3.2.1 Methodology Deviations

This is not applicable as there is no methodology deviation during the current monitoring period.

3.2.2 Project Description Deviations

Deviation 1:

As per the CDM PDD section B.7.1, the net electricity supplied to the grid will be as per the Joint meter readings (JMR). However, the JMR readings for the months of March 2014 and September 2015 are not available with the project proponent.

Therefore, the generation value for these two months is considered for emission reduction calculation from the Monthly Allocation Statement issued by the Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)".

Deviation 2:

The current monitoring period is from 16-March-2012 to 28-February-2018. Since the JMR billing cycle and monitoring period cycle does not match, the apportioning approach has been followed for first month and last month of the monitoring period with a conservative approach. For apportioning purpose, controller meter data has been used to get the net electricity. The controller meter is microprocessor based, self-calibrated meter and does not require any calibrations, thus use of controller meter data for apportioning of export is justified.

The JMR billing cycle for all the WTGs is from 15-March-2012 to 15-April-2012 for the first month and 05-February-2018 to 05-March-2018 for the last month of the monitoring period. The export and import are monitored by the energy meters as per the billing cycle. The JMR export data is directly proportional to the controller meter reading (DGR), thus, the PP has apportioned the JMR export value for the first month and the last month of the monitoring period. As a conservative approach, PP has considered complete month import value for emission reduction calculations.

Please refer sheets “DGR March-2012” and “DGR February-2018” for the calculation of generation ratio for apportioning purpose.

Deviation 3:

In line with the Central Electricity Regulation (CEA) dated 26/11/2014³, the project proponent was requested by TNEB to change all the meters to ABT meters, PT & CT with high accuracy class & with a modem connectivity. Accordingly, the new ABT meters were installed for all the 9 WTGs involved in the project in January 2015 with below details:

HTSC No.	Installed on	Energy Meter Make	Meter Serial No.	Accuracy Class
2550	09-January-2015	Secure (Premier 300)	TNW00246	0.2
2583	09-January-2015	Secure (Premier 300)	TNW00248	0.2
2622	09-January-2015	Secure (Premier 300)	TNW00247	0.2
2538	09-January-2015	Secure (Premier 300)	TNW00169	0.2
2536	09-January-2015	Secure (Premier 300)	TNW00162	0.2
2537	11-January-2015	Secure (Premier 300)	TNW00159	0.2
2551	11-January-2015	Secure (Premier 300)	TNW00153	0.2
2633	09-January-2015	Secure (Premier 300)	TNW00149	0.2
2626	09-January-2015	Secure (Premier 300)	TNW00160	0.2

The meters change reports cum initial test certificates of the ABT meters are submitted to the DoE for verification.

The above-mentioned deviations are of permanent nature and does not have any impact on the project applicability, baseline scenario and additionality.

3.3 Grouped Projects

This is not applicable as it is not a grouped project.

³ https://cea.nic.in/wp-content/uploads/2020/02/amend_15122014.pdf

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	EF _{OM, y}						
Data unit	tCO ₂ e/MWh						
Description	Operating Margin Emission Factor of Southern Regional Electricity Grid						
Source of data	“CO₂ Baseline Database for Indian Power Sector” published by the Central Electricity Authority, Ministry of Power, Government of India (Version 3, December 2007). The “CO₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in						
Value applied	<table border="1"> <tr> <td>2004-05</td><td>1.00088</td></tr> <tr> <td>2005-06</td><td>1.00789</td></tr> <tr> <td>2006-07</td><td>1.00302</td></tr> </table> The final value of OM is 1.00393	2004-05	1.00088	2005-06	1.00789	2006-07	1.00302
2004-05	1.00088						
2005-06	1.00789						
2006-07	1.00302						
Justification of choice of data or description of measurement methods and procedures applied	Operating Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with “Tool to calculate the emission factor for an electricity system, Version 01.1”.						
Purpose of Data	Calculation of baseline emissions						
Comments	None						

Data / Parameter	EF _{BM, y}
Data unit	tCO ₂ e/MWh
Description	Build Margin Emission Factor of Southern Regional Electricity Grid
Source of data	“CO₂ Baseline Database for Indian Power Sector” published by the Central Electricity Authority, Ministry of Power, Government of India (Version 3, December 2007). The “CO₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in
Value applied	0.70545 for the year 2006-07
Justification of choice of data or description of	Build Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with “Tool to calculate the emission factor for an electricity system, Version 01.1”.

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	None

4.2 Data and Parameters Monitored

Data / Parameter	EG _y
Data unit	MWh (Mega-watt hour)
Description	Net electricity supplied to the grid by the Project
Source of data	Electricity supplied to the grid as per the joint meter readings
Description of measurement methods and procedures to be applied	Net electricity supplied to grid is measured through meter readings of the two-way export meter installed by TNEB.
Frequency of monitoring/recording	Monthly
Value monitored	166,533 MWh
Monitoring equipment	Net electricity supplied to grid is measured through meter readings of the two-way export meter installed by TNEB. The meters were changed in January 2015. The earlier and current meter details are mentioned in appendix 2.
QA/QC procedures to be applied	The meters are calibrated every year. The calibration details are mentioned in appendix 2. The energy meters were not calibrated from January 2016 to February 2018. As per paragraph 366 of the CDM Validation and Verification Standard for project activities (Version 03.0), it is mentioned that if during verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e., the results of delayed calibration are available), the DOE may conclude its verification provided that a conservative approach is adopted in the calculation of emission reductions, the error factor identified in the delayed calibration test can be applied. The post calibration of the energy meters revealed that the meter was working accurately and the deviation of the errors were found to be within the permission limit (0.2 accuracy). Therefore, in line with the guidelines, maximum permissible error (0.2%) is applied in the readings for the above-mentioned period during which the energy meters were not calibrated. The latest calibration certificates are provided to the assessment team.

Purpose of the data	Calculation of Baseline Emissions
Calculation method	Net electricity supplied to grid is measured through meter readings of the two-way export meter installed by TNEB. The procedures for metering and meter reading are as per the provisions followed by the TNEB.
Comments	None

4.3 Monitoring Plan

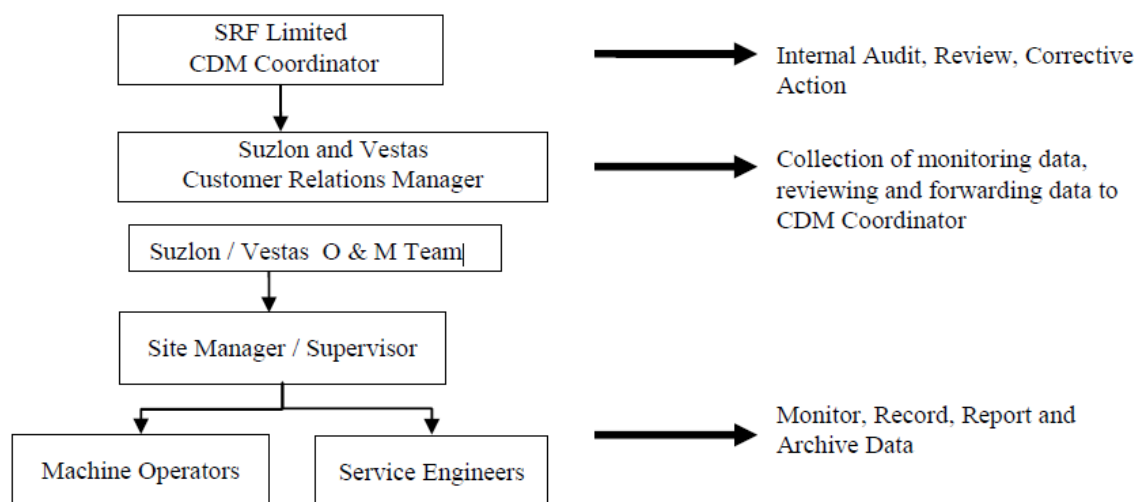
The project activity falls in the technology measure as described in the paragraph 1 of the indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. The applicable simplified baseline and monitoring methodology for selected small scale CDM project activities AMS-I.D. Version 13 requires monitoring of the following:

- **Metering the electricity generated by the renewable technology –**

Wind-based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the net electricity supplied to the grid. The project is operated and managed by the respective EPC contractors i.e., Suzlon and Vestas. Being ISO certified organizations, they follow the documentation practices to ensure the reliability and availability of the data for all the activities as required from the construction, commissioning and operation of the wind power project.

The accuracy of monitoring parameter is ensured by adhering to the calibration and testing procedure as set in the power wheeling agreement with the state electricity board. The project adheres to all the mandatory regulatory and statutory requirements at the state as well as national level.

The operational and management structure implemented by SRF along with Suzlon and Vestas is as follows:



Internal audit procedure:

The operation and maintenance team records the monitored data and then share the consolidated reports with the customer relations manager. The manager then reviews the data and forward the same to the CDM Coordinator. The coordinator conducts the internal audit and share the findings (if any) with the team. If any non-conformities are observed, then necessary actions are taken to address them and resolve all the non- conformities.

During the current monitoring period, no non-conformities were identified during the internal audit.

The monitored data is maintained as hard copies in the form of Joint Meter Readings (JMR) as well as in the soft copy for a minimum period of 10+2 years. A copy of this data is available at the site with the TNEB officials as well as with SRF at their plant site.

A line diagram showing relevant monitoring points is given in Appendix 1.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO₂e/kWh) calculated in a transparent and conservative manner as the weighted average emissions (in kg CO₂e/kWh) as described in registered PDD.

$$BE_y = EG_y * EF_y$$

where,

BE_y is baseline emissions in year y, tCO₂e.

EG_y is the net electricity supplied to the grid in year y and is applied directly from JMR certified by state utility.

EF_y is the CO₂ emission factor of the grid.

To calculate the combined margin emission factor (EF_y):

As per the registered PDD, the emission factor EF_y of the grid is represented as a combination of the operating margin (OM) and the build margin (BM).

$$EF_y = w_{OM} * EF_{grid, OM, y} + w_{BM} * EF_{grid, BM, y}$$

where,

EF_{grid, OM, y} = Operating margin CO₂ emission factor in year y (tCO₂ /MWh)

$EF_{grid, BM, y}$ = Build margin CO₂ emission factor in year y (tCO₂ /MWh)

w_{OM} = Weighting of operating margin emissions factor (%)

w_{BM} = Weighting of build margin emissions factor (%)

For wind projects, w_{OM} is 0.75 and w_{BM} is 0.25

Using the values for operating and build margin emission factor provided in the CEA database (Version 3, December 2007) and their respective weights for calculation of combined margin emission factor, the baseline carbon emission factor (CM) is 929.31 tCO₂e/GWh or 0.92931 tCO₂e/MWh.

Emission reduction calculation for the period 16-March-2012 to 28-February-2018 is:

$EG_y = 166,533$ MWh

$EF_y = 0.92931$ tCO₂e/MWh

Therefore, $BE_y = (166,533 \text{ MWh}) * (0.92931 \text{ tCO}_2\text{e/MWh})$

$BE_y = 154,757$ tCO₂e

5.2 Project Emissions

Since the project activity is a wind power project, a zero-emission source, there are no associated project emissions.

Hence, $PE_y = 0$

5.3 Leakage

No leakage emissions are considered for this Project activity since there is no transfer of energy generating equipment from another activity.

Hence, $LE_y = 0$

5.4 Net GHG Emission Reductions and Removals

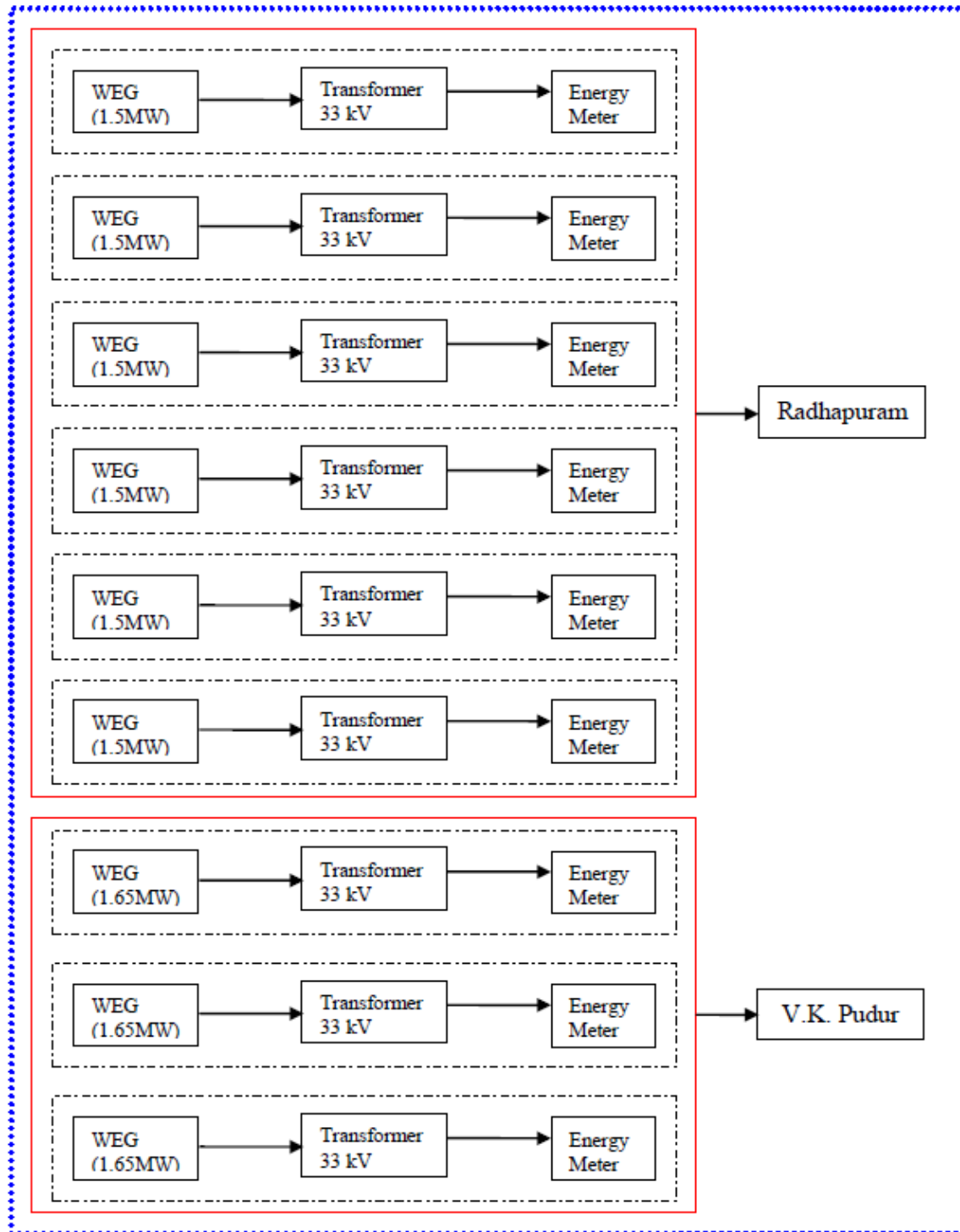
Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2012	29,874	0	0	29,874
2013	23,330	0	0	23,330

2014	23,946	0	0	23,946
2015	17,755	0	0	17,755
2016	26,984	0	0	26,984
2017	29,979	0	0	29,979
2018	2,889	0	0	2,889
Total	154,757	0	0	154,757

During the present monitoring period, actual emission reductions achieved are 154,757 tCO₂e whereas estimated emission reductions was 207,978 tCO₂e. The project witnessed 25.59% decrease in the emission reductions as compared to ex-ante emissions, which is due to natural phenomena and nature dependent. The variability in the environmental conditions is beyond the control of the project participant which is the main reason for the variation in emission reductions values. Also, some breakdowns have been observed during the monitoring period of the project activity.

APPENDIX 1: MONITORING POINTS

Line diagram showing metering points:



APPENDIX 2: METER AND CALIBRATION DETAILS

In 2011:

Meters	HTSC No.	Accuracy Class	Make	Meter Serial No.	Dates of calibration	Validity of calibration
Main	2550	0.5	Wallaby	208320404	14-December-2011	13-December-2012
Check		0.5	Wallaby	208320405	14-December-2011	13-December-2012
Main	2583	0.5	Wallaby	208320406	14-December-2011	13-December-2012
Check		0.5	Wallaby	208320407	14-December-2011	13-December-2012
Main	2622	0.5	Wallaby	208320408	14-December-2011	13-December-2012
Check		0.5	Wallaby	208320409	14-December-2011	13-December-2012
Main	2536	0.5	Wallaby	208320410	16-December-2011	15-December-2012
Check		0.5	Wallaby	208320411	16-December-2011	15-December-2012
Main	2537	0.5	Wallaby	208320412	16-December-2011	15-December-2012
Check		0.5	Wallaby	208320414	16-December-2011	15-December-2012
Main	2551	0.5	Wallaby	208320415	16-December-2011	15-December-2012
Check		0.5	Wallaby	208320416	16-December-2011	15-December-2012
Main	2626	0.5	Wallaby	208320419	16-December-2011	15-December-2012
Check		0.5	Wallaby	208320420	16-December-2011	15-December-2012
Main	2633	0.5	Wallaby	208320302	16-December-2011	15-December-2012
Check		0.5	Wallaby	208320614	16-December-2011	15-December-2012
Main	2538	0.5	Wallaby	208320417	16-December-2011	15-December-2012
Check		0.5	Wallaby	208320418	16-December-2011	15-December-2012

In 2012:

Meters	HTSC No.	Accuracy Class	Make	Meter Serial No.	Dates of calibration		Test Results Validity of calibration
Main	2550	0.5	Wallaby	208320404	11-June-2012	03-December-2012	10-June-2013
Check		0.5	Wallaby	208320405	11-June-2012	03-December-2012	10-June-2013
Main	2583	0.5	Wallaby	208320406	11-June-2012	03-December-2012	10-June-2013
Check		0.5	Wallaby	208320407	11-June-2012	03-December-2012	10-June-2013
Main	2622	0.5	Wallaby	208320408	11-June-2012	03-December-2012	10-June-2013
Check		0.5	Wallaby	208320409	11-June-2012	03-December-2012	10-June-2013

Main	2536	0.5	Wallaby	208320410	15-June-2012	10-December-2012	14-June-2013
Check		0.5	Wallaby	208320411	15-June-2012	10-December-2012	14-June-2013
Main	2537	0.5	Wallaby	208320412	15-June-2012	10-December-2012	14-June-2013
Check		0.5	Wallaby	208320414	15-June-2012	10-December-2012	14-June-2013
Main	2551	0.5	Wallaby	208320415	15-June-2012	10-December-2012	14-June-2013
Check		0.5	Wallaby	208320416	15-June-2012	10-December-2012	14-June-2013
Main	2626	0.5	Wallaby	208320419	15-June-2012	10-December-2012	14-June-2013
Check		0.5	Wallaby	208320420	15-June-2012	10-December-2012	14-June-2013
Main	2633	0.5	Wallaby	208320302	15-June-2012	10-December-2012	14-June-2013
Check		0.5	Wallaby	208320614	15-June-2012	10-December-2012	14-June-2013
Main	2538	0.5	Wallaby	208320417	15-June-2012	10-December-2012	14-June-2013
Check		0.5	Wallaby	208320418	15-June-2012	10-December-2012	14-June-2013

In 2013:

Meters	HTSC No.	Accuracy Class	Make	Meter Serial No.	Date of calibration	Validity of calibration
Main	2550	0.5	Wallaby	208320404	05-June-2013	04-June-2014
Check		0.5	Wallaby	208320405	05-June-2013	04-June-2014
Main	2583	0.5	Wallaby	208320406	05-June-2013	04-June-2014
Check		0.5	Wallaby	208320407	05-June-2013	04-June-2014
Main	2622	0.5	Wallaby	208320408	05-June-2013	04-June-2014
Check		0.5	Wallaby	208320409	05-June-2013	04-June-2014
Main	2536	0.5	Wallaby	208320410	12-June-2013	11-June-2014
Check		0.5	Wallaby	208320411	12-June-2013	11-June-2014
Main	2537	0.5	Wallaby	208320412	12-June-2013	11-June-2014
Check		0.5	Wallaby	208320414	12-June-2013	11-June-2014
Main	2551	0.5	Wallaby	208320415	12-June-2013	11-June-2014
Check		0.5	Wallaby	208320416	12-June-2013	11-June-2014
Main	2626	0.5	Wallaby	208320419	12-June-2013	11-June-2014
Check		0.5	Wallaby	208320420	12-June-2013	11-June-2014
Main	2633	0.5	Wallaby	208320302	12-June-2013	11-June-2014
Check		0.5	Wallaby	208320614	12-June-2013	11-June-2014
Main	2538	0.5	Wallaby	208320417	12-June-2013	11-June-2014
Check		0.5	Wallaby	208320418	12-June-2013	11-June-2014

In 2014:

Meters	HTSC No.	Accuracy Class	Make	Meter Serial No.	Date of calibration	Validity of calibration
Main	2550	0.5	Wallaby	208320404	01-February-2014	31-January-2015
Check		0.5	Wallaby	208320405	01-February-2014	31-January-2015
Main	2583	0.5	Wallaby	208320406	01-February-2014	31-January-2015
Check		0.5	Wallaby	208320407	01-February-2014	31-January-2015
Main	2622	0.5	Wallaby	208320408	01-February-2014	31-January-2015
Check		0.5	Wallaby	208320409	01-February-2014	31-January-2015
Main	2536	0.5	Wallaby	208320410	07-February-2014	06-February-2015
Check		0.5	Wallaby	208320411	07-February-2014	06-February-2015
Main	2537	0.5	Wallaby	208320412	07-February-2014	06-February-2015
Check		0.5	Wallaby	208320414	07-February-2014	06-February-2015
Main	2551	0.5	Wallaby	208320415	07-February-2014	06-February-2015
Check		0.5	Wallaby	208320416	07-February-2014	06-February-2015
Main	2626	0.5	Wallaby	208320419	07-February-2014	06-February-2015
Check		0.5	Wallaby	208320420	07-February-2014	06-February-2015
Main	2633	0.5	Wallaby	208320302	07-February-2014	06-February-2015
Check		0.5	Wallaby	208320614	07-February-2014	06-February-2015
Main	2538	0.5	Wallaby	208320417	07-February-2014	06-February-2015
Check		0.5	Wallaby	208320418	07-February-2014	06-February-2015

The earlier meters were changed to ABT meters in January 2015⁴.

Calibration of the energy meters for all WTGs was not found to be valid from January 2016 to February 2018. As per paragraph 4 of Annex 60 - Guidelines for Assessing compliance with the calibration frequency requirements (Version 01), it is mentioned that if during verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e., the results of delayed calibration are available), the DOE may conclude its verification provided that a conservative approach is adopted in the calculation of emission reductions, the error factor identified in the delayed calibration test can be applied. The post calibration of the energy meters revealed that the meter was working accurately and the deviation of the errors were found to be within the permission limit (0.2 accuracy). Therefore, in line with the guidelines, maximum permissible error (0.2%) is

⁴ In line with the Central Electricity Regulation (CEA) dated 26/11/2014, the PP was requested by TNEB to change all the meters to ABT meters, PT & CT with high accuracy class & with a modem connectivity. Accordingly, the new ABT meters were installed for all the 9 WTGs involved in the project in January 2015. The meters change reports cum initial test certificates of the ABT meters are submitted to the DoE for verification.

applied in the readings for the above-mentioned period (January 2016 to February 2018) during which the calibration of the energy meter was not valid.

The latest calibration details of the meters are given below:

HTSC No.	Energy Meter Make	Meter Serial No.	Accuracy Class	Calibration Date	Calibration due date
2550	Secure (Premier 300)	TNW00246	0.2	10-August-2022	09-August-2023
2583	Secure (Premier 300)	TNW00248	0.2	10-August-2022	09-August-2023
2622	Secure (Premier 300)	TNW00247	0.2	10-August-2022	09-August-2023
2538	Secure (Premier 300)	TNW00169	0.2	16-August-2022	15-August-2023
2536	Secure (Premier 300)	TNW00162	0.2	16-August-2022	15-August-2023
2537	Secure (Premier 300)	TNW00159	0.2	23-July-2022	22-July-2023
2551	Secure (Premier 300)	TNW00153	0.2	23-July-2022	22-July-2023
2633	Secure (Premier 300)	TNW00149	0.2	16-August-2022	15-August-2023
2626	Secure (Premier 300)	TNW00160	0.2	16-August-2022	15-August-2023

APPENDIX 3: BREAKDOWN DETAILS

The major breakdown details for the WTGs have been incorporated in the below tables. The complete breakdown details for the entire monitoring period are provided to the assessment team.

HTSC No. 2536:

Date	From	To	Duration (Hours)	Error Details
13-April-2015	00:00	00:00	24	Forced Backdown
25- May -2015	03:23	23:59	20.6	Line Breakdown due to Earthfault
12-Decemeber-2016	00:00	00:00	24	EXTL_WTG Forced Backdown
30-November-2017	00:00	00:00	24	Natural Calamities
01-December-2017	00:00	00:00	24	Natural Calamities
02- December -2017	00:00	00:00	24	Natural Calamities
03- December -2017	00:00	00:00	24	Natural Calamities
04-December-2017	00:00	21:36	21.6	Natural Calamities

HTSC No. 2537:

Date	From	To	Duration (Hours)	Error Details
21-July-2012	00:00	23:59	24.0	SE RebootPLC
13-April-2015	00:00	00:00	24	Forced Backdown
23-May-2015	01:44	23:20	21.6	Forced Backdown
02-November-2017	00:00	00:00	24	INTL_Feeder BreakDown
30- November-2017	00:00	00:00	24	Natural Calamities
01-December-2017	00:00	00:00	24	Natural Calamities
02-December-2017	00:00	00:00	24	Natural Calamities
03-December-2017	00:00	00:00	24	Natural Calamities
04-December-2017	00:00	00:00	24	Natural Calamities
05-December-2017	00:00	00:00	24	Natural Calamities
06-December-2017	00:00	00:00	24	Natural Calamities
07-December-2017	00:00	00:00	24	Natural Calamities
28-February-2018	00:00	21:30	21.5	EXTL_WTG Forced Backdown

HTSC No. 2551:

Date	From	To	Duration (Hours)	Error Details
13-April-2015	00:00	00:00	24	Forced Backdown

29-May-2015	00:00	00:00	24	Equipment failure at SS
02-November-2017	00:00	00:00	24	INTL_Feeder BreakDown
30-November-2017	00:00	00:00	24	Natural Calamities
01-December-2017	00:00	00:00	24	Natural Calamities
02-December-2017	00:00	00:00	24	Natural Calamities
03-December-2017	00:00	00:00	24	Natural Calamities
04-December-2017	00:00	00:00	24	Natural Calamities
05-December-2017	00:00	00:00	24	Natural Calamities
06-December-2017	00:00	00:00	24	Natural Calamities
07-December-2017	00:00	00:00	24	Natural Calamities
08-December-2017	00:00	00:00	24	Rep Pitch FreqConvPitch1 ErrStop

HTSC No. 2626:

Date	From	To	Duration (Hours)	Error Details
08-Aug-2012	02:05	23:59	21.9	FSS Fault
13-May-2014	02:29	23:59	21.5	Pitch CAN1ComFail
23-Nov-2014	00:00	23:59	24.0	Rep Pitch FreqConvPitch1 ErrStop
13-April-2015	00:00	00:00	24	Forced Backdown
23-May-2015	01:44	23:20	21.6	Forced Backdown
21-September-2015	00:00	00:00	24	Elec FB GearOilCooler Stop
22-September-2015	00:00	00:00	24	Elec FB GearOilCooler Stop
02-April-2017	00:00	00:00	24	Blade Problem
03-April-2017	00:30	00:00	23.5	Blade Problem
01-November-2017	00:00	21:00	21	Pitch BatterySurveillance3
02-November-2017	00:00	00:00	24	INTL_Feeder BreakDown
30-November-2017	00:00	00:00	24	Natural Calamities
01-December-2017	00:00	00:00	24	Natural Calamities
02-December-2017	00:00	00:00	24	Natural Calamities
03-December-2017	00:00	00:00	24	Natural Calamities
05-December-2017	00:00	00:00	24	Natural Calamities
06-December-2017	00:00	00:00	24	Natural Calamities
07-December-2017	00:00	00:00	24	Natural Calamities
08-December-2017	00:00	00:00	24	Rep Pitch CANComFail
09-December-2017	00:00	00:00	24	Natural Calamities
10-December-2017	00:00	00:00	24	Natural Calamities
11-December-2017	00:00	00:00	24	Pitch CAN3ComFail
12-December-2017	00:00	00:00	24	Natural Calamities

HTSC No. 2633:

Date	From	To	Duration (Hours)	Error Details
13-May-2014	00:00	00:00	24	Forced Backdown
23-November-2014	00:00	00:00	24	Equipment failure at SS
13-April-2015	00:00	00:00	24	INTL_Feeder BreakDown
23-May-2015	00:00	00:00	24	Natural Calamities
02-November-2017	00:00	00:00	24	Natural Calamities
30-November-2017	00:00	00:00	24	Natural Calamities
01-December-2017	00:00	00:00	24	Natural Calamities
02-December-2017	00:00	00:00	24	Natural Calamities
03-December-2017	00:00	00:00	24	Natural Calamities
04-December-2017	00:00	00:00	24	Natural Calamities
05-December-2017	00:00	00:00	24	Natural Calamities
06-December-2017	00:00	00:00	24	Rep Pitch CANComFail
07-December-2017	00:00	00:00	24	Rep Pitch CANComFail
08-December-2017	00:00	00:00	24	Rep Pitch CANComFail
09-December-2017	00:00	00:00	24	Rep Pitch CANComFail
10-December-2017	00:00	00:00	24	Natural Calamities
11-December-2017	00:00	00:00	24	Rep Pitch CANComFail
12-December-2017	00:00	00:00	24	Pitch CAN3ComFail
13-December-2017	00:00	00:00	24	Rep Pitch CANComFail
14-December-2017	00:00	00:00	24	Rep Pitch CANComFail
15-December-2017	00:00	00:00	24	Forced Backdown
16-December-2017	00:00	00:00	24	Equipment failure at SS

HTSC No. 2538:

Date	From	To	Duration (Hours)	Error Details
13-May-2014	00:00	20:36	20.6	SFS IGBT Fail Stop
13-April-2015	00:00	00:00	24	Forced Backdown
26-May-2015	00:00	00:00	24	SE RebootPLC
27-May-2015	00:00	20:30	20.5	SE RebootPLC
03-June-2015	00:00	00:00	24	SE RebootPLC
19-May-2016	00:23	23:59	23.6	Forced Backdown
02-November-2017	00:00	00:00	24	INTL_Feeder BreakDown
23-November-2017	00:00	00:00	24	Slew ring Failure
24-November-2017	00:00	00:00	24	Slew ring Failure

25-November-2017	00:00	00:00	24	Slew ring Failure
26-November-2017	00:00	00:00	24	Slew ring Failure
27-November-2017	00:00	00:00	24	Slew ring Failure
30-November-2017	00:00	00:00	24	Natural Calamities
01-December-2017	00:00	00:00	24	Natural Calamities
02-December-2017	00:00	00:00	24	Natural Calamities
03-December-2017	00:00	00:00	24	Natural Calamities
06-December-2017	00:00	00:00	24	Natural Calamities

HTSC No. 2550:

Date	From	To	Duration (Hours)	Error Details
10-March-2013	00:00	24:00	24	(H005) Rotor de-erection and LM blade work
11-March-2013	00:00	24:00	24	(H005) Rotor de-erection and LM blade work
12-March-2013	00:00	24:00	24	(H005) Rotor de-erection and LM blade work

HTSC No. 2583:

Date	From	To	Duration (Hours)	Error Details
20-August-2014	00:32	18:20	17.44	(G002) Grid drop 6.13 to 6.17 (U 359) Pitch oil low fault and work

HTSC No. 2622:

Date	From	To	Duration (Hours)	Error Details
20-August-2012	00:00	24:00	24	(H005) Blade bearing failure-(WTG trial running) (H005) Blade bearing inspection work 00.00to24.00 (G001) Grid drop 2.32to4.01(LS)
10-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
11-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
12-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
13-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work

14-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
15-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
16-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
17-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
18-September-2012	00:00	24:00	24	(H005) Blade bearing inspection work
28-February-2013	00:00	21:00	21	(H005) Blade bearing inspection work
31-May-2013	00:00	24:00	24	(H005) Blade bearing inspection work
01-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
02-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
03-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
04-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
05-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
06-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
07-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
08-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
09-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
10-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
11-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
12-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
13-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
14-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
15-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
16-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
17-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
18-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
19-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work

20-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
21-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
22-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
23-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
24-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work
25-June-2013	00:00	24:00	24	(H005) Blade bearing inspection work