



**Verified Carbon
Standard**

4 MW BIOMASS BASED COGENERATION PLANT BY GODREJ AGROVET LTD.



Document Prepared by (Infinite Solutions)

Project Title	4 MW Biomass based cogeneration plant by Godrej Agrovat Ltd.
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Monitoring Period	01-Jul-2020 to 30-Sep-2021 (Inclusive of both the dates)
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Godrej Agrovet Limited (GAVL) has implemented a greenfield renewable biomass-based co-generation project activity in his new palm oil production plant located at Seethanagaram village, District – West Godavari, Andhra Pradesh, India.

The project activity involves the utilization of in-house generated renewable biomass¹ fibre, shell and empty fruit bunches (EFB) in the palm fruit processing facility as a fuel for generating steam which is further be used for generating the electricity and catering the thermal energy requirement.

Thus, project activity generates clean electricity & helps in avoiding the fossil fuel (Coal) usage to meet its captive requirement of heat & electricity and thereby reducing the equivalent GHG emissions from the atmosphere.

The project activity involve installation of 50 TPH Boiler & 4 MW Turbine Generator. As the project activity is co-generation project i.e. generating heat & electricity simultaneously, commissioning² date of the project activity is 01-Oct-2018.

Total net electricity generated by the project activity during this monitoring period (01-Jul-2020 to 30-Sep-2021) is 9500.86746 MWh and 347.54 TJ energy from steam has been given to cater the in-house requirement.

The total GHG emission reductions or removals generated in this monitoring period (01-Jul-2020 to 30-Sep-2021) is 42,407 tCO₂e.

1.2 Sectoral Scope and Project Type

As per simplified modalities and procedures for small scale CDM project activities, the project qualifies under the:

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

Type : I - Renewable Energy Projects

Category : C. Thermal energy production with or without electricity

Project is neither an AFOLU project nor a grouped project.

¹ As the biomass is generated from agro-processing industry, it is a renewable biomass as per definitions in 'Glossary of CDM Terms Ver 07.0.

² Commissioning Certificate.

1.3 Project Proponent

Organization name	Godrej Agrovat Limited
Contact person	Mr. MSMS Kumar
Title	Dy. General Manager - Production & Projects
Address	Ch. Pothepalli, Dwaraka Tirumala Mandal, Andhra Pradesh
Telephone	+91-8829211128
Email	msms.kumar@godrejagrovat.com

1.4 Other Entities Involved in the Project

Organization name	Infinite Solutions
Role in the Project	Project Consultant
Contact person	Mr. Jimmy Sah
Title	Head – Sustainability
Address	214-215, Milinda Manor, Opp. Next Treasure Island, 2 RNT Marg, Indore - 452001, India
Telephone	+91-9644130430
Email	jimmy@infisolutions.org

1.5 Project Start Date

The commissioning date of the project activity is 01-Oct-2018.

Hence, the Project Start date should be the actual commissioning date of the Project as per the para 3.7 of the VERRA project standard version 04.2.

1.6 Project Crediting Period

The project chooses a renewable crediting period of 10 years. After 10 years, the crediting period will be renewed twice considering project life of 25 years.

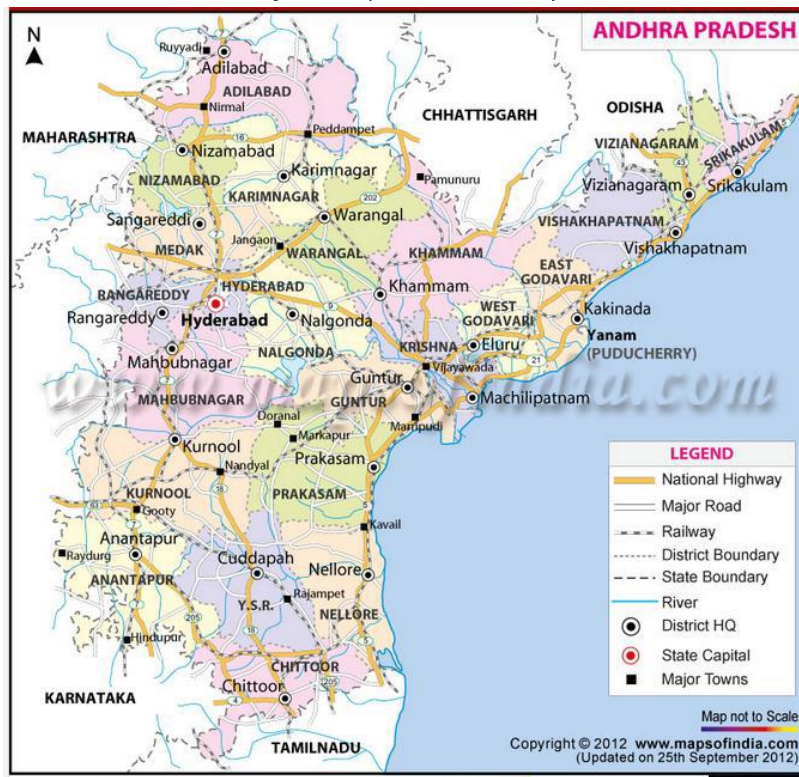
Crediting period start date : 01-Oct-2018

Crediting period end date : 30-Sep-2028

1.7 Project Location

Village : Seethanagaram
District : West Godavari
State : Andhra Pradesh
Country: India
Latitude : 17° 10' 38" N
Longitude : 81° 41' 35" E

Plant location from major town/ district headquarter – Eluru – 120 km.



1.8 Title and Reference of Methodology

Type : AMS-I.C
Title : Thermal energy production with or without electricity
Sectoral Scope : 01
Version : 20
EB : 79

Reference:

<http://cdm.unfccc.int/methodologies/DB/JSEM51TG3UVKADPA25IPUHXJ85HE8A>

In line with the applied methodology, following tools and guidelines are referred in this PD:

- Demonstration of additionality of small-scale project activities, Version 12, EB 99 annex 3
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, Version 3.0, EB 96 annex 5
- Tool to calculate the emission factor for an electricity system, Version 6, EB 97 annex 7

1.9 Participation under other GHG Programs

PP is submitting the undertaking confirming that project has not participated in any other binding and/or non-binding GHG program and any national REC scheme. Hence, there is no double accounting of emission reduction has happened.

Participation under Other GHG Programs:

The project activity has never participated in any other GHG programs.

1.10 Other Forms of Credit

Emission Trading Programs and Other Binding Limits:

The project proponent is not part of any emission trading program. GAVL also does not have any binding GHG emission limits. The net GHG emission reductions from the project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions. A letter of this effect from the project proponent has been submitted to the validator.

The project activity has not participated under any other GHG programs. A letter of this effect from the project proponent has been submitted to the validator during validation.

Other Forms of Environmental Credit:

The project activity does not result in creation of any other kind of environmental credits. A letter from the project proponent has been submitted to the validator with an undertaking that the project has not created another form of environmental credit. PP has not participated in REC mechanism. Hence, not eligible to claim REC benefits.

1.11 Sustainable Development Contributions

Ministry of Environment & Forests, Government of India has stipulated following indicators for sustainable development in the interim approval guidelines for GHG projects.

- 1.Social well-being
- 2.Economic well-being
- 3.Environmental well-being
- 4.Technological well-being

Social well-being

The main source of fuel for this plant will be locally available agriculture waste i.e. EFB (renewable biomass). Since the project is located in a village it will assist in alleviation of poverty to certain extent by generating both direct and indirect employment in the area of skilled/unskilled jobs for regular operation and maintenance of the power plant.

Economic well-being

The biomass-based steam generation is an alternative to fossil fuel-based steam generation plants. The project shall create new rural income resulting from the sales of biomass fuel like agriculture waste. Increased income levels shall contribute to the economic safety and empowerment of the most vulnerable sections of local society.

Environmental well-being

The project is using biomass for steam generation. There is no net GHG emission from this project activity. Combustion of biomass in the proposed project does not result in net increase in GHG emissions of CO₂. Thus, the project causes no negative impact on the surrounding environment contributing to environmental well-being.

Technological well-being

The project makes use of efficient environmentally safe technology for steam generation with no Green House Gas (GHG) emission.

In view of the above, the PP has considered that the project activity profoundly contributes to the sustainable development.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	7.2.1: Renewable energy share in the total final energy consumption	Implemented activities to increase	About 9,500 MWh and 347.54 TJ energy from steam generated from renewable energy has been used to cater the captive requirement and helps in reducing the load on the fossil fuel dominated Indian grid during the reported period that helps to increase the renewable energy share in the energy mix.	A total of 25,069 MWh renewable electricity has been supplied to the Indian grid by the project activity during the reported period.
2)	8.5	8.5.2 Unemployment rate, by sex, age and persons with disabilities	Implemented activities to decrease	The project activity provides jobs to local population. The number of people employed are as follows; Total: 22 people employed.	Till now, the project activity has employed 117 people.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The project has avoided emission of 42,407 tCO ₂ in the atmosphere.	The project has avoided emission of 115,378 tCO ₂ in the atmosphere.

2 SAFEGUARDS

2.1 No Net Harm

The project activity has been installed in a Palm oil production plant which involves the utilization of in-house generated renewable biomass i.e. fibre, shell and empty fruit bunches (EFB) in the palm fruit processing facility as a fuel for generating steam.

Thus, the project activity leads to the various environmental and/or socio-economic impacts:

1. Best utilization of in-house generated renewable biomass to generate steam & electricity.
2. Avoids transportation of fuel from outside of the plant.
3. Provides Job opportunities to the locals for Operation & maintenance of biomass-based power generation project.
4. Helps in reducing the GHG emissions equivalent to the quantity of electricity & steam produced from the renewable biomass.

Thus, the project activity is having very positive impact on environment & Socio-economic parameters. There are no negative environmental and/or socio-economic impacts due to the project. Hence, no mitigation action is occupied.

The project activity does not involve any major construction activity. It primarily requires the installation of boiler and turbine within the project premises, interfacing the generators with the State Electricity Board by setting up HT transmission lines and installation of other accessories.

The report on “Developmental Impacts and Sustainable Governance Aspects of Renewable Energy Projects” prepared by MNRE dated September 2013. This report clearly mentioned that biomass power project activity operations do not result in direct air pollution, noise pollution. Please refer below web link for the same³.

Thus, there are no any significant impacts due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

2.2 Local Stakeholder Consultation

Local stakeholder consultation has already done during registration of project activity. The project proponent had organized stakeholders meeting on 5-Dec-2017, in order to take into account the concerns of the nearby villagers regarding the project implementation however there were no major comments or protest raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region.

³ <http://164.100.94.214/sites/default/files/uploads/report-on-developmental-impacts-of-RE.pdf>

Also, as a part of continuous feedback from stakeholders, the PP also placed a feedback/complaint register onsite in where the stakeholder can put down his/her complain and the same if found genuine will be addressed immediately.

However, there is no comments received in the current monitoring period.

2.3 AFOLU-Specific Safeguards

This is not applicable to the project activity as for non-AFOLU projects, this section is not required.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity has been successfully commissioned by GAVL and was registered by VCS Board subsequently (Project ID: Ref No. 1744).

The project is a cogeneration unit and had commissioned one 50 TPH biomass-based boiler and a 4 MW turbine generator (TG). The generated steam and electricity are used to meet the captive demand of a greenfield palm oil production unit.

The detailed specifications of boiler and TG are as below:

Table 1: Specification of 50 TPH boiler:

Sr. No.	Specification	Value	Unit
1	Type – Pulsating grate bi-drum air cooled boiler	-	-
2	Design steam generation capacity at MCR	50	Tph
3	Steam pressure at MCR	34.65	Kg/cm ² (g)
4	Steam temperature	380±5	°C
5	Make and Model -	Thermax / Powermax - 500/1	-
6	Fuel requirement: Fuel 1: 55% Shredded Empty bunch Fiber Fuel 2: 30% palm fibre Fuel 3: 15% palm shell	9.35 Shredded EFB, 5.1 Palm Fiber, 2.55 Palm Shell	Tph
7	Efficiency of boiler	66.8±5	%
8	Feed water temperature to economiser	126	°C

Table 2: Specification of 4 MW turbine generator:

Sr. No.	Specification	Value	Unit
1	Type – multistage, impulse, nozzle governed back pressure	-	-
2	Design capacity	4	MW
3	Inlet steam pressure	33.38	kg/cm ²

4	Inlet steam temperature	370	°C
5	Specific steam consumption	11125	kg/kWh
6	Make and Model – Triveni Turbine Limited	Triveni Turbine Limited / TST-2030	-
7	Outlet steam pressure at TG	3.5	kg/cm ²
8	Electrical output at AC generator terminal (3 phase, 4 wire system, 0.8 PF)	2500 kW (415 V, 50 Hz)	-

The project activity has been in operation continuously (with outages – forced & planned) since its commissioning. The monthly running hours of the boilers and turbines included in the project activity are being submitted to the verifier. During the present monitoring period i.e. 01-Jul-2020 to 30-Sep-2021 (Both days included), the project is in normal operation status; there have been no emergencies happened to the monitoring system. There are no events or situation that occurred during the monitoring period which may impact the applicability of the methodology.

The project activity uses in-house generated renewable biomass fibre, shell and empty fruit bunches (EFB). From November to March, there is a shortage in availability of fruit (used for biomass) due to the inappropriate weather conditions. Because of which renewable biomass (fibre, shell and empty fruit bunches (EFB)) is available in least amount, which is not sufficient for 4 MW generation. Hence, the plant is shut down and its annual maintenance is done.

The shut downs taken during the current monitoring period are:

Sr. No	Months	Reason
1	Nov-2020 to Mar 2021	Because of non-availability of biomass and annual maintenance

No Generations has occurred during the shut down period.

Lifetime of the project activity

The main project activity equipment's boiler and turbine are expected to have a lifetime of 25 years⁴.

3.2 Deviations

2.1.1 Methodology Deviations

There has been no methodology deviation applied during this monitoring period of the project activity.

⁴ Default values as per Option C of 'Tool to determine and remaining lifetime of the equipment' Version 01, EB 50, Annex 15

2.1.2 Project Description Deviations

There are project description deviations applied during this monitoring period of the project activity which are transparently described under this section of MR.

In line with the Para 3.19.2 of the VCS standard version 4.3⁵, “the deviation does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology, the deviation shall be described and justified in the monitoring report. This shall include a description of when the changes occurred and the reasons for the changes. The deviation shall also be described in all subsequent monitoring reports.”

Following change applied since commissioning of the project and this is the second monitoring period. There is no replacement of monitoring equipment’s involved during the current monitoring period.

1. In Monitoring Parameter: $FC_{i,j,y}$ - Quantity of fossil fuel combusted in the project in year y.

Change: Purpose of data has been corrected in line with respective “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion, Version-02”.

Reason: Parameter’s purpose is project emission calculation which is not consistent with VCS PD.

Also, there were project description deviations applied during the previous monitoring period of the project activity which are described below:

1. In Monitoring Parameter: $EG_{PJ,thermal,y}$ - Net quantity of thermal energy supplied by project

Change: Monitoring Equipment “accuracy class” was corrected in line with the respective equipment calibration certificate.

Reason: a. Steam flow meter/Transmitter: Accuracy class was stated as $\pm 0.5\%$ in the VCS PD, which is corrected as per the equipment calibration certificate i.e. ± 0.1 of range.

b. Pressure gauges/ Transmitter: Accuracy class was stated as $\pm 1\%$ in the VCS PD, which is corrected as per the equipment calibration certificate i.e. ± 0.1 of range.

2. Monitoring Parameter: $B_{biomass,y}$ - Quantity of biomass residues of type k consumed in the boiler in year y (tonnes on dry-basis)

Change: Monitoring Equipment (weighbridge) accuracy class was corrected.

Reason: Accuracy class was mentioned as $\pm 1\%$, corrected to $\pm 0.01\%$ (i.e. 5 kg) in line with the installed equipment details and calibration certificate.

⁵ [VCS-Standard v4.3.pdf \(verra.org\)](#)

3. Monitoring Parameter: Pressure - Pressure of flowing exhaust steam at the outlet of steam turbine

Change: Monitoring Equipment Accuracy class is corrected.

Reason: "Pressure gauges/ Transmitter" accuracy class was stated as $\pm 1\%$ in the registered PD, which is corrected as per the equipment calibration certificate i.e. ± 0.1 of range.

4. Monitoring Parameter: M (Moisture content of the biomass residues) - Moisture content of each biomass residues type k

Change: Revision in the "Frequency of monitoring/recording" of the parameter to once in the first year of crediting period.

Reason: It is to be noted that this parameter is not used directly for the emission reduction calculation. Emission reduction are calculated based on the para 38 of the applicable methodology which directly requires, "Net quantity of thermal energy supplied by the project activity during the year y (TJ)" & Amount of electricity supplied by the project activity during the year y; (GWh). These two parameters are calculated based on the direct measurement of steam pressure, temperature & flow and the net electricity supplied.

As per the applicable methodology, "This parameter "Moisture content of the biomass residues" applies in the case where emission reductions are calculated based on biomass energy input. For all cases, ex ante estimates should be provided in the PDD and used during the crediting period." Therefore, PP wishes to revise the Frequency of monitoring/recording of the moisture content "should be monitored for each type of biomass used, once in the first year of the crediting period."

5. Monitoring Parameter: T - Temperature of steam generated

Change: Correction of typographical error under "Description" as "Temperature of steam extracted"

Reason: Correction of typographical error.

The above deviations do not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology.

3.3 Grouped Projects

The project is not a grouped project hence this section is not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$\eta_{BL,cogen/trigen}$
Data unit	%
Description	The total annual average efficiency of the cogeneration plant using coal
Source of data	Default efficiency of new coal fired boiler as per Appendix of the applied methodology and taking steam turbine efficiency of 100% as per Para 40(b)
Value applied	85%
Justification of choice of data or description of measurement methods and procedures applied	Default value as per SSC methodology guidance is used here. Efficiency of a new coal fired boiler = 85% (as per 'Tool to determine the baseline efficiency of thermal or electric energy generation systems', Ver. 01) Efficiency of turbine = 100% (as per Para 29(b) of SSC methodology AMS I.C) Thus, efficiency of cogeneration plant = $85 \times 100 = 85\%$
Purpose of Data	Baseline emission calculation
Comments	NA

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO ₂ /MWh
Description	Operating Margin CO ₂ emission factor in year y
Source of data	CEA "CO ₂ baseline database for the Indian Power Sector, Version 12, May 2017" ⁶
Value applied	0.9843
Justification of choice of data or description of measurement methods and procedures applied	Calculated using "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	The emission factor will be fixed ex-ante and will not be monitoring throughout the crediting period

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO ₂ /MWh

⁶ https://cea.nic.in/wp-content/uploads/baseline/2020/07/user_guide_ver12.pdf

Description	Build Margin CO ₂ emission factor in year y
Source of data	CEA “CO ₂ baseline database for the Indian Power Sector, Version 12, May 2017 ⁷ ”
Value applied	0.9083
Justification of choice of data or description of measurement methods and procedures applied	Calculated using “Tool to calculate the emission factor for an electricity system”
Purpose of Data	Calculation of baseline emissions
Comments	The emission factor will be fixed ex-ante and will not be monitoring throughout the crediting period

Data / Parameter	EF _{grid,CM,y}
Data unit	tCO ₂ /MWh
Description	Combined margin emission factor of the Indian grid
Source of data	CEA “CO ₂ baseline database for the Indian Power Sector, Version 12, May 2017 ⁸ ”
Value applied	0.9462
Justification of choice of data or description of measurement methods and procedures applied	Calculated using “Tool to calculate the emission factor for an electricity system”
Purpose of Data	Calculation of baseline emissions
Comments	The emission factor will be fixed ex-ante and will not be monitoring throughout the crediting period

4.2 Data and Parameters Monitored

Data / Parameter	EF _{CO₂,i,y}
Data unit	tCO ₂ /TJ
Description	CO ₂ emission factor of fossil fuels: coal and diesel

⁷ https://cea.nic.in/wp-content/uploads/baseline/2020/07/user_guide_ver12.pdf

⁸ https://cea.nic.in/wp-content/uploads/baseline/2020/07/user_guide_ver12.pdf

Source of data	Appendix B of CEA "CO2 baseline database for the Indian Power Sector, Version 17.0 ⁹ , October 2021"
Description of measurement methods and procedures to be applied	The database is an official publication of the Government of India for the purpose of CDM baselines. Thus, the value is taken as country specific emission factor of coal and diesel.
Frequency of monitoring/recording	Once in a monitoring period – latest database version is being used
Value monitored	Coal = 95.80 Diesel: 72.6
Monitoring equipment	Default value
QA/QC procedures to be applied	The data is taken from an official publication of the Government of India for the purpose of CDM baselines and is available from authentic source, thus no additional QC is required
Purpose of the data	Calculation of Project Emissions
Calculation method	NA
Comments	NA

Data / Parameter	EG _{PJ,thermal,y}
Data unit	TJ
Description	Net quantity of thermal energy supplied by project
Source of data	Calculated parameter. Parameter EG _{PJ,thermal,y} for project activity boiler is calculated from net steam output (ton) and its net enthalpy. Source for net steam output is steam production data log and corresponding enthalpy (at operating temperature) is inferred from steam table with respect to operating pressure and temperature.
Description of measurement methods and procedures to be applied	<u>Monitoring:</u> This is calculated on the monthly basis. The monthly average value of steam flow meter and pressure gauge is used to calculate enthalpy of the steam supplied using steam table in tonnes/TJ. This value is multiplied with the monthly average of steam generated by project activity boiler Q _{steam} , to calculate enthalpy of steam supplied in a month. The enthalpy of feed water calculated using the measured values of flow meter (1 number) and its temperature (using meter: 1 number) will be subtracted to get EG _{PJ,thermal,y} . The sum of EG _{PJ,thermal} of all the months will provide a yearly value. <u>Data type:</u> Calculated and archived

⁹ Amt für Umweltschutz (cea.nic.in)

	<u>Archiving Procedure</u> : Electronic												
Frequency of monitoring/recording	Monitoring Frequency: Continuous measurement for steam flow and pressure Recording Frequency: Monthly calculation for enthalpy												
Value monitored	347.54												
Monitoring equipment	Equipment ¹⁰ accuracy class Steam flow meter/Transmitter: ± 0.1 of range <table border="1"> <tr> <td colspan="2">Boiler main steam flow transmitter - 1 (TAG.NO:11-FT-211A)</td></tr> <tr> <td>Serial No</td><td>Y1TA17589</td></tr> <tr> <td colspan="2">Boiler main steam flow transmitter - 2 (TAG.NO:11-FT-211B)</td></tr> <tr> <td>Serial No</td><td>Y1TA17590</td></tr> </table> Pressure gauges/Transmitter : ± 0.1 of range <table border="1"> <tr> <td colspan="2">Turbine extraction steam pressure transmitter (TAG.NO:PT-140)</td></tr> <tr> <td>Serial No</td><td>Y1TA16783</td></tr> </table>	Boiler main steam flow transmitter - 1 (TAG.NO:11-FT-211A)		Serial No	Y1TA17589	Boiler main steam flow transmitter - 2 (TAG.NO:11-FT-211B)		Serial No	Y1TA17590	Turbine extraction steam pressure transmitter (TAG.NO:PT-140)		Serial No	Y1TA16783
Boiler main steam flow transmitter - 1 (TAG.NO:11-FT-211A)													
Serial No	Y1TA17589												
Boiler main steam flow transmitter - 2 (TAG.NO:11-FT-211B)													
Serial No	Y1TA17590												
Turbine extraction steam pressure transmitter (TAG.NO:PT-140)													
Serial No	Y1TA16783												
QA/QC procedures to be applied	The steam temperature and steam mass flow meters will be calibrated once in three years.												
Purpose of the data	Calculation of Baseline Emissions												
Calculation method	Steam generated in a year (ton) x average enthalpy of steam (kJ/kg) / 10^6												
Comments	NA												

Data / Parameter	EGPJ,electrical,y
Data unit	MWh
Description	Net electricity supplied by the project activity
Source of data	Cogen plant log book
Description of measurement methods and procedures to be applied	<u>Monitoring</u> : Electricity meter in control room measures the net quantity of electricity supplied by the project activity cogen plant. <u>Data type</u> : Measured <u>Archiving procedure</u> : Paper and Electronic <u>Responsibility</u> : Turbine operator would be responsible for monitoring and checks for regular calibration of electricity meter and Shift In-charge will be responsible for calibration of the electricity meters. <u>Calibration Frequency</u> : Once in five years

¹⁰ All the monitoring equipment details has been provided under Appendix 1 of the MR.

Frequency of monitoring/recording	Continuous monitoring with monthly recording								
Value monitored	9500.86746								
Monitoring equipment	Electric meter Accuracy class: 0.2s <table border="1"> <tr> <td>Equipment Name</td><td>Gross Gen Meter</td></tr> <tr> <td>S.No</td><td>X0465806</td></tr> </table> <table border="1"> <tr> <td>Equipment Name</td><td>Cogen Auxiliary Meter</td></tr> <tr> <td>S.No</td><td>1712057761</td></tr> </table> All the monitoring equipment details has been provided under Appendix 1 of the MR.	Equipment Name	Gross Gen Meter	S.No	X0465806	Equipment Name	Cogen Auxiliary Meter	S.No	1712057761
Equipment Name	Gross Gen Meter								
S.No	X0465806								
Equipment Name	Cogen Auxiliary Meter								
S.No	1712057761								
QA/QC procedures to be applied	Electric meter/s is calibrated once in five years at accredited third- party laboratory								
Purpose of the data	Calculation of Baseline Emissions								
Calculation method	Total generation from the project activity – auxiliary consumption – import from grid (if any used for cogen plant during cogen plant shutdown). The trivector meter will give net generation directly by doing above calculation.								
Comments	NA								

Data / Parameter	B _{biomass,y}
Data unit	Ton
Description	Quantity of biomass residues of type k consumed in the boiler in year y (tonnes on dry-basis)
Source of data	Measured using weighbridge
Description of measurement methods and procedures to be applied	Will be monitored ex-post. Adjust for the moisture content in order to determine the quantity of dry biomass. If more than one type of biomass fuel is consumed, each shall be monitored separately. Project activity is utilizing the inhouse-generated renewable biomass: Palm fibre, Nut shell and shredded fibre within the palm fruit processing facility as a fuel. For the case of processed renewable biomass (e.g. briquettes) data shall be collected for mass, moisture content, NCV of the processed biomass that is supplied to users with an appropriate sampling frequency. However, same is not used during the current monitoring period.

Frequency of monitoring/recording	<u>Monitoring</u>: The quantity of the biomass consumed will be measured using weigh bridge. <u>Data Type</u>: Measured and archived <u>Archiving Procedure</u>: Electronic <u>Responsibility</u>: Stores in-charge is responsible for maintaining the records of the biomass consumed in project. Stock in charge maintains an inventory recording the opening and closing balance annually. <u>Cross-check</u>: Cross checking the measurements using mass/energy balance.		
Value monitored	61076 Tons		
Monitoring equipment	Weighbridge Accuracy class: $\pm 0.01\%$ (i.e. 5 kg) <table border="1"> <tr> <td>Weigh Bridge S.NO</td><td>2717131579</td></tr> </table> All the monitoring equipment details has been provided under Appendix 1 of the MR	Weigh Bridge S.NO	2717131579
Weigh Bridge S.NO	2717131579		
QA/QC procedures to be applied	Weigh bridge used is calibrated by an external agency once in a year.		
Purpose of the data	Baseline emissions calculations		
Calculation method	Sum of quantities of "Palm fibre, Nut shell and shredded fibre" consumption in a monitoring period The moisture content in order to determine the quantity of dry biomass is determined by reputed laboratory.		
Comments	The parameter monitors quantities of all biomass used palm fiber, palm shell and EFB separately		

Data / Parameter	$NCV_{k, \text{biomass}}$
Data unit	kcal/kg
Description	Net Calorific Value of biomass type k
Source of data	Lab analysis report of NCV
Description of measurement methods and procedures to be applied	<u>Monitoring</u>: The NCV of biomass will be measured once in the first year of the crediting period (3 samples in each quarter) by third party laboratory/ in-house as per national/ international standard. <u>Data Type</u>: Measured and Archived <u>Archiving Procedure</u>: Electronic <u>Recording frequency</u>: once in the first year of the crediting period <u>Responsibility</u>: Chief Chemist will be responsible for getting the lab analysis for the NCV.

Frequency of monitoring/recording	Once in the first year of the crediting period
Value monitored	Avg. NCV of Biomass fuel mix (kcal/kg) (43% SEFB+43% Fibre+14% shell) is 2107 kCal/kg
Monitoring equipment	Calorimetry - third party lab analysis
QA/QC procedures to be applied	Average value obtained using third party analysis using three samples for each measurement every quarter in the first year of operation and will be compared with any public literature if available and IPCC default values. If the measurement results differ significantly from previous measurements or other relevant data sources, additional measurements will be conducted.
Purpose of the data	Baseline emissions calculations
Calculation method	Calorimetry
Comments	The parameter will monitor NCV of all biomass used palm fibre, palm shell and EFB separately

Data / Parameter	Extracted steam Enthalpy
Data unit	kJ/kg
Description	Enthalpy of exhaust steam at the outlet of the steam turbine
Source of data	Plant log books
Description of measurement methods and procedures to be applied	<u>Calculation Procedure:</u> Enthalpy of steam from turbine is calculated from steam tables based on the corresponding values of quantity of steam and pressure. <u>Data type:</u> Calculated <u>Recording Frequency:</u> Daily <u>Archiving procedure:</u> Paper and/or Electronic <u>Responsibility:</u> Boiler operator is responsible for monitoring and checks for regular calibration of temperature meter and pressure gauge. The Shift In-charge will be responsible for calibration of the temperature meter and pressure gauge.
Frequency of monitoring/recording	Continuous monitoring with monthly recording
Value monitored	2737.88
Monitoring equipment	Pressure of steam is measured by pressure gauge and temperature by temperature transducer. Turbine extraction Steam Pressure transmitter (Tag.no:pt-140)

	Serial No	Y1TA16783
	Turbine extraction steam temperature transmitter (Tag.no:TT-141)	
	Serial No	C2T502618
	All the monitoring equipment details has been provided under Appendix 1 of the MR	
QA/QC procedures to be applied	QA/QC procedures is ensured as the temperature meter and pressure gauge would be calibrated at regular intervals.	
Purpose of the data	Baseline emissions calculations	
Calculation method	Enthalpy of steam at end of TG – enthalpy of feed water	
Comments	NA	

Data / Parameter	Pressure
Data unit	kg/cm ²
Description	Pressure of flowing exhaust steam at the outlet of steam turbine
Source of data	Pressure gauge
Description of measurement methods and procedures to be applied	<u>Monitoring</u>: Pressure gauge measures the pressure of the steam at the turbine outlet <u>Data type</u>: Measured and archived <u>Recording Frequency</u>: Hourly <u>Archiving procedure</u>: Paper and Electronic <u>Responsibility</u>: Turbine operator is responsible for monitoring and checks for regular calibration of pressure gauge and Shift In-charge is responsible for calibration of the pressure gauge. <u>Calibration Frequency</u>: Calibration will be carried out once in a year.
Frequency of monitoring/recording	Continuous monitoring with monthly recording
Value monitored	3.03
Monitoring equipment	Pressure gauge Accuracy class: +/-0.1% of range Turbine extraction Steam Pressure transmitter (Tag.no:pt-140) Serial No Y1TA16783 All details provided under Appendix 1 of the MR.
QA/QC procedures to be applied	Pressure gauge will be calibrated once in a year.

Purpose of the data	Baseline emissions calculations
Calculation method	Direct reading from Pressure gauge
Comments	NA

Data / Parameter	FC _{i,j,y}
Data unit	MT/year
Description	Quantity of fossil fuel combusted in the project in year y
Source of data	Measured using weigh bridge for coal and level gauge for diesel
Description of measurement methods and procedures to be applied	<u>Monitoring</u>: Type and quantity of fossil fuel combusted in the project activity is measured using electronic weigh bridge (or recorded in challans provided by the supplier and handed over to the plant people by the truck driver). <u>Data Type</u>: Continuously Measured and archived <u>Archiving Procedure</u>: Electronic <u>Responsibility</u>: Plant head with Officer (stores) is responsible for monitoring and checks for regular calibration of weigh bridge
Frequency of monitoring/recording	Continuous measurement with monthly recording/ compilation
Value monitored	Coal = 0 Diesel = 26,618 Lit
Monitoring equipment	Weigh bridge for coal and level gauge for diesel Accuracy class: ±1%
QA/QC procedures to be applied	Weigh bridge is calibrated by an external agency once in a year. The consistency of metered fuel consumption quantities will be cross-checked by an annual energy balance that is based on purchased quantities and stock changes.
Purpose of the data	Project emissions calculations
Calculation method	Sum of total fuel consumed in boiler
Comments	NA

Data / Parameter	M (Moisture content of the biomass residues)
Data unit	%
Description	Moisture content of each biomass residues type k

Source of data	Onsite measurement		
Description of measurement methods and procedures to be applied	The biomass residue moisture content is monitored and registered by taking periodic samples from each biomass type flow to the power boiler, is measured once in the first year of the crediting period (3 samples in each quarter) by third party laboratory/ in-house as per national/ international standard. Humidity content is calculated by evaporating the water of the samples and measuring the weight before and after the water has been evaporated. This process will be carried out in dedicated scales. Lab reports from in-house/third party shall be used.		
Frequency of monitoring/recording	The moisture content should be monitored for each type of biomass used once in the first year of the crediting period.		
Value monitored	Palm Fiber (MT)	Shell (MT)	Shredded fiber (MT)
	30.00%	15.00%	50.00%
Monitoring equipment	Not applicable. Moisture content is measured locally, in reputed laboratories.		
QA/QC procedures to be applied	-		
Purpose of the data	To calculate dry basis weight of biomass		
Calculation method	-		
Comments	-		

Data / Parameter	T
Data unit	°C
Description	Temperature of steam extracted
Source of data	Plant log book
Description of measurement methods and procedures to be applied	The temperature of steam extracted is measured using temperature gauge on hourly basis, the monthly average value is applied to calculate enthalpy of steam.
Frequency of monitoring/recording	Every hour reading, monthly recording
Value monitored	192.21
Monitoring equipment	Temperature gauge/ Turbine extraction steam temperature transmitter (TAG.NO:TT-141)

	Serial No C2T502618
	All the monitoring equipment details has been provided under Appendix 1 of the MR
QA/QC procedures to be applied	Calibration of Temperature transducer is done as per the applicable national or international standard or manufacturer's specification or at least once in three years
Purpose of the data	Calculation of baseline emission
Calculation method	Where relevant, provide the calculation method, including any equations, used to establish the data/parameter
Comments	Data will be archived for crediting period +2 years

Data / Parameter	NCV _{fossil fuels}
Data unit	kcal/kg
Description	Net Calorific Value of fossil fuels
Source of data	Lab analysis report of NCV
Description of measurement methods and procedures to be applied	<u>Monitoring</u>: The NCV of fossil fuel type if used is measured once in the year by third party laboratory/ in-house as per national/ international standard. <u>Data Type</u>: Measured and Archived <u>Archiving Procedure</u>: Electronic <u>Recording frequency</u>: once in the first year of the crediting period <u>Responsibility</u>: Chief Chemist is responsible for getting the lab analysis for the NCV.
Frequency of monitoring/recording	Once in the first year of the crediting period
Value monitored	2384.082 kcal/ Kg ¹¹ (Diesel)
Monitoring equipment	Calorimetry – third party lab analysis
QA/QC procedures to be applied	Lab reports from in-house/third party shall be used.
Purpose of the data	Baseline emissions calculations
Calculation method	Calorimetry
Comments	The parameter will monitor NCV of all fossil fuels used separately

¹¹ NCV of diesel is taken from CEA database version 17.

Data / Parameter	EC _{PJ,j,y}				
Data unit	MWh				
Description	Electricity taken from grid for the cogeneration plant startup/ emergency operations.				
Source of data	Cogen plant log book				
Description of measurement methods and procedures to be applied	<u>Monitoring</u> : Electricity meter in control room <u>Data type</u> : Measure <u>Archiving procedure</u> : Paper and Electronic <u>Responsibility</u> : Turbine operator is responsible for monitoring and checks for regular calibration of electricity meter and Shift In-charge is responsible for calibration of the electricity meters. <u>Calibration Frequency</u> : Once in five years				
Frequency of monitoring/recording	Continuous monitoring with monthly recording				
Value monitored	527				
Monitoring equipment	Electric meter <table border="1"> <thead> <tr> <th>Equipment Name</th><th>Import Meter</th></tr> </thead> <tbody> <tr> <td>S.No</td><td>17230314</td></tr> </tbody> </table> Accuracy class: 0.2s All the monitoring equipment details has been provided under Appendix 1 of the MR	Equipment Name	Import Meter	S.No	17230314
Equipment Name	Import Meter				
S.No	17230314				
QA/QC procedures to be applied	Electric meter/s are under the control of State utility and PP has no control over it.				
Purpose of the data	Baseline emissions calculations				
Calculation method	The trivector meter will give net generation directly by doing above calculation.				
Comments	NA				

4.3 Monitoring Plan

The Monitoring and Verification procedures define a project-specific standard against which the project's performance and conformance with all relevant criteria will be monitored and verified. It includes:

- Suitable data collection, collation and archiving methods consistent with good practices
- Data interpretation techniques for monitoring and verification of GHG emissions.

These procedures provide for a clear, credible, and accurate set of monitoring, evaluation and verification procedures. The purpose of these procedures would be to direct and support

continuous monitoring of the key performance indicator for the project, i.e. Greenhouse Gas (GHG) emission reductions.

All instruments will be calibrated and marked in accordance with information in Section 4.2 so that the accuracy of measurement can be ensured all the time.

The general monitoring principles are based on:

- Frequency of monitoring
- Minimizing uncertainties and increasing reliability of performance of the project by an emergency preparedness plan
- Reporting and archiving the data used in monitoring and accounting for the emission reduction from the Project
- QA/QC

Frequency of monitoring

The project developer has installed all metering facilities within the plant premises. The measurements are monitored as per the frequency described in above sections, and the values of the parameters are recorded in the automatic reports generated by the PLC (only for parameters: Steam flow, Steam pressure and temperature at boiler, feed water temperature) and in log books. The monitored values will be transferred to the excel spreadsheet on monthly basis to prepare monthly reports. These monthly reports are used by the VCS Coordinator to calculate the reduction in GHG emissions and to generate monthly reports that form a necessary component of the Management Information System.

The VCS Coordinator will be responsible for

- Monitoring the project on a day to day basis,
- Co-coordinating with the Sr. Manager/Manager- projects and other internal and external agencies/authorities for the purpose of smooth operation of the project and accrual of emission reduction.

Emergency preparedness plan

The amount of emission reduction units is proportional to the steam generation using the biomass residues in the Project. Measurement devices having good accuracy and procured from reputed manufacturers have been installed at site for the purpose of monitoring the various parameters of the project. Since the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment for reproducibility, all instruments will be calibrated as per the planned frequency for ensuring reliability of the system.

In the event that a particular instrument malfunctions or breaks down, all efforts will be made to restore or replace that instrument within short span of time of such eventuality. The data used in calculating the emission reduction for that particular parameter will be taken as zero from the last recorded reading.

This will ensure that the uncertainties in the parameters used for calculating the emission reductions from the project are consistent, verifiable and reliable, and any uncertainty is minimal.

Reporting and archiving

Verification is done on the basis of monthly reports that are prepared by the concerned sections covering all the monitoring parameters.

The VCS coordinator will be responsible for

- Collection and updating of all data in the project monitoring worksheet,
- Generation and distribution of monthly reports to the Management accounting for the actual emission reduction achieved during the month,
- Any specific event affecting emission reduction due to the project during the month

Reporting data on monthly basis for the calculation and estimation of emission reductions.

This data will be checked against initial estimates. If the project is not performing as expected or if there are any negative impacts on the volume of emission reductions obtained, on the basis of the monthly data being monitored, analysis will be carried out to identify where the project is deviating in its generation of emission reductions and the immediate measures will be taken to maintain the expected generation of emission reductions from the operation of this project.

All data will be kept for a minimum of 2 years following last issuance of VCUs or the end of the crediting period, whichever is later, and the storage of this data will be the responsibility of the project proponents.

QA/QC procedures

The quality assurance and quality control over the data monitored will be done by the manager as follows:

- The monitored data will be verified for the completeness and consistency.
- It will be ensured that the plant personnel receive adequate training
- It will be ensured that the equipment's in the project activity undergo periodic maintenance as recommended by the manufacturer.
- It will be ensured that the monitoring instruments are calibrated as per the specified frequency.
- It will be ensured that there is an adequate storage of the data monitored.

Any non-conformance will be identified and a corrective action will be taken.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per para 38 of AMS I.C. *“For electricity and thermal energy produced in a baseline cogeneration or trigeneration unit, using fossil fuel (case 28(d)), the following equation shall be used to determine baseline emissions”:*

$$BE_{cogen/trigen,CO2,y} = \left[\frac{(EG_{PJ,thermal,y} + EG_{PJ,electrical,y} \times 3.6)}{\eta_{BL,cogen/trigen}} \right] \times EF_{FF,CO2}$$

Where:

- BE_{cogen/trigen,CO2,y}** = Baseline emissions from electricity and thermal energy displaced by the project activity during the year y (t CO₂)
- EG_{PJ,electrical,y}** = Amount of electricity supplied by the project activity during the year y; (GWh)
- 3.6** = Conversion factor (TJ/GWh)
- EG_{PJ,thermal,y}** = Net quantity of thermal energy supplied by the project activity during the year y (TJ)
- EF_{FF,CO2}** = CO₂ emission factor of the fossil fuel that would have been used in the baseline cogeneration plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO₂/TJ)
- η_{BL,cogen/trigen}** = Total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel determined as per paragraph 39 or 40

Now,

η_{BL,cogen} = 85% (Default efficiency of new coal fired boiler as per Appendix of the applied methodology)

EF_{FF,CO2} = EF_{CO2,i,y} = 95.8 tCO₂/TJ (CO₂ emission factor of the fossil fuel (Coal) - as per Central Electricity Authority (CEA) CO₂ Baseline Database for the Indian Power Sector; Ver. 16)

During this monitoring period

EG_{PJ,thermal,y} = 347.54 TJ

EG_{PJ,electrical,y} = 9.50 GWh

Thus,

BE_{cogen,CO2,y} = 43,023 tCO₂

Refer the ER sheet for detailed calculations.

5.2 Project Emissions

During the project operation, there are two sources for project emissions;

1. Coal Consumption in Boiler: There was no coal consumption in boiler.

2. Diesel consumption in DG: $PE_{diesel,y} = \text{Quantity of diesel consumed (Lit)} \times \text{Density of diesel} \times \text{NCV of diesel} \times \text{EF of diesel}$

$$= 26,618 \text{ (L)} \times 0.83 \text{ (kg/L)} \times 9975 \text{ (kJ/kg)} \times 72.6 \text{ (tCO}_2\text{/TJ)} / 10^9$$

$$= 16 \text{ tCO}_2\text{e (Rounded Up Value)}$$

3. $PE_{grid,import,y} = (EC_{PJ,j,y}) \text{ Total Electricity Import (MWh)} \times (1+\text{TDL}) \times \text{GEF (tCO}_2\text{/MWh)}$

$$= 527 \times (1+20\%) \times 0.9462$$

$$= 599 \text{ tCO}_2\text{e (Rounded Up Value)}$$

$EC_{PJ,j,y}$ is measured as electricity taken from grid for the cogeneration plant start-up/ emergency operations. The transmission and distribution losses are calculated using the recent, accurate and reliable data available within the host country.

Total Project Emission:

$$PE_y = PE_{fossil \text{ fuel},y} + PE_{diesel,y} + PE_{grid,import,y}$$

$$= 0 + 16 + 600$$

$$= 616 \text{ tCO}_2\text{e (Rounded up Value)}$$

5.3 Leakage

Since the biomass is sourced from the plant itself, thus leakage is zero.

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)
2020 (01-Jul-2020 to 31-Dec-2020)	20,239	307	0	19,932
2021 (01-Jan-2021 to 30-Sep-2021)	22,784	309	0	22,475
Total	43,023	616	0	42,407

It is to be noted here that as per the estimated emission reduction from the project activity for the current monitoring period is 122,289 tCO₂e, whereas actual emission reductions achieved are 42,407 tCO₂e, which is approximately – 65.32% lower than the estimated emission reductions. The co-generation plant operation depends upon various factors, one of them is

process requirement and solely operates on process plant need basis. Also, during the current monitoring period second wave of the global pandemic COVID-19 come out as a hurdle for stopping the operation. Hence, during the current monitoring period requirement of process steam was less. Also, the project activity was not operational for the period Nov-2020 to Mar-2021. Thus, the difference in the generation during the current verification period is hence due to certain conditions which are beyond PP control and hence acceptable.

APPENDIX 1: <METER CALIBRATION>

BOILER MAIN STEAM FLOW TRANSMITTER - 1 (TAG.NO:11-FT-211A)		
Equipment Name	STEAM FLOW TRANSMITTER	
Make	YOKOGAWA	
Serial No	Y1TA17589	
Accuracy Class	+/- 0.1 of Range	
Date of Calibration	25-Feb-20	
Due Date	24-Feb-23	

Frequency
Once in 3 years

BOILER MAIN STEAM FLOW TRANSMITTER -2 (TAG.NO:11-FT-211B)		
Equipment Name	STEAM FLOW TRANSMITTER	
Make	YOKOGAWA	
Serial No	Y1TA17590	
Accuracy Class	+/- 0.1 of Range	
Date of Calibration	25-Feb-20	
Due Date	24-Feb-23	

Frequency
Once in 3 years

(Generation) kWh Meter		
Equipment Name	Tri vector Meter MWh	
S.No	X0465806	
Make	SECURE	
Accuracy Class	0.2s	
Date of Calibration/Date of Installation	29-Feb-20	
Due Date	28-Feb-25	

Frequency
Once in 5 years

TURBINE EXTRACTION STEAM TEMPERATURE TRANSMITTER (TAG.NO:TT-141)		
Equipment Name	STEAM TEMP.INDICATOR	
Make	YOKOGAWA	
Serial No	C2T502618	
Accuracy Class	+/- 0.1 of Range	
Date of Calibration	27-Feb-20	
Due Date	26-Feb-23	

Frequency
Once in 3 years

TURBINE EXTRACTION STEAM PRESSURE TRANSMITTER (TAG.NO: PT-140)		
Equipment Name	Flow Transmitter	
Make	YOKOGAWA	
Serial No	Y1TA16783	
Accuracy Class	+/- 0.1 of Range	

Frequency Once in 3 year	Date of Calibration	27-Feb-20	
	Due Date	26-Feb-23	

Auxiliary meter Details			
Frequency Once in 5 year	Equipment Name	Cogen Auxiliary Meter	
	S.No	1712057761	
	Make	Rishabh	
	Accuracy Class	0.2s	
	Date of Calibration	29-Feb-20	
	Due Date	28-Feb-25	

Import meter Details			
Frequency Once in 5 year	Equipment Name	Import Meter	
	S.No	17230314	
	Make	L & T	
	Accuracy Class	0.2s	
	Date of Calibration	25-Nov-17	
	Due Date	24-Nov-22	

Biomass quantity			
Frequency Once in a year	Weigh Bridge	2717131579	2717131579
	Equipment Name	2019	2020
	Make	METLER	METLER
	Accuracy Class	5 kg	5 kg
	Date of Calibration	8-Nov-19	03-Nov-20
	Due Date	7-Nov-20	02-Nov-21