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Validation opinion

Request for revision of monitoring plan for project activity 0806 entitled "Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India"

We refer to the procedure for revising monitoring plans adopted at EB 26 (Annex-34) which allows for the project participants to revise the monitoring plans in order to improve accuracy and/or completeness of information.

We herewith request a revision of the monitoring plan for project activity 0806 entitled "Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper manufacturing facility in India".

The project activity involved the implementation and maintaining of energy conservative measures which lead to emission reduction due to reduction in fossil fuel combusted for generating captive electricity. The project comprises 29 energy conservation measures. A few of the measures (such as replacement of pumps and lights) are operated based on a fixed load and hence energy consumed by these measures does not get affected much by changes in the mill load. However, some measures like the installation of capacitor banks, electronic governor, and harmonic filters, operate under variable load conditions, i.e. the input (or the current drawn) changes depending on the load on the line where these installations have been incorporated.

The monitoring plan in the registered PDD assumed fixed baseline energy consumption for each of these measures (including capacitor banks, electronic governor, and harmonic filters). The fixed baseline energy consumption was the average of the 30 days measured value prior to the project implementation. While the fixed baseline concept is logical for measures which operate on fixed load (and do not get affected by the mill loads), the same does not hold good for measures which operate under variable load conditions (which depend on the mill load). The fixing of the baseline values was done at a period when the mill load was being stabilized and hence cannot be construed to be the representative baseline loads. Hence, in order to improve the accuracy of the baseline data, the revised monitoring plan adopts a dynamic baseline for the installation of capacitor banks, and harmonic filters, and a revised formula for electronic governor,

The dynamic baseline was desired for capacitor banks in SFT (secondary fiber treatment), NFL(new fiber line) and harmonic filter of PM2 (paper machine 2). The SFT plant produces secondary fiber from waste paper whereas the NFL plant produces bleached virgin pulp from wood. Both the plants produces single product as plant output. Thus, during operation of the plant, load remains constant over the period of time, as the plants are continuous process plant. The PM2

unit produces only writing and printing paper from virgin wood fiber. The machine is operated on continuous basis to meet the market requirements.

Three days of continuous operation (which constitutes 10% of the monthly operating hours) were considered as sample to arrive as the baseline power consumption by switching off the capacitor banks at SFT, NFL and harmonic filter of PM2, since it is normal in the process industry to consider 72 hours (3 days relates to 10% of a month) as the stabilization period. Since the plant operates at a constant and steady load, it is DNVs opinion that the baseline figure thus obtained is correct and reasonable.

As per the proposed monitoring plan, the following equations are proposed to be used for the capacitor banks, harmonic filters and the electronic governer.

For the measures that involves installation of power correction equipments operated at variable connected load

$$\mathbf{EB,y = \Sigma i\ (P_{base,i} - P_{project,i}) * O\text{-}hrs_{actual}} \qquad \mathbf{(4)}$$

Where: -

$P_{base,i}$ = power used by the devices/ equipment of the group of "i" devices retrofitted (pumps, fans, etc) **(at the baseline)** (kW) and calculated as **($Energy_{base}$/ $O\text{-}hrs_{corresponding,3}$)** **(4a)**

$Energy_{base}$ - Total electricity consumed during the three consecutive days of continuous operation in a month without the harmonic filter/ capacitor bank (in switched off mode) (kWh).

$O\text{-}hrs_{corresponding,3}$ - Corresponding operating hours for the 3 consecutive days of continuous operation for baseline establishment

$O\text{-}hrs_{actual}$ – Actual operating hours in the given month.

$$\mathbf{P_{project} = (Energy_{project} / O\text{-}hrs_{corresponding})} \qquad \mathbf{(4,b)}$$

Where:

$P_{project}$ = Energy consumed at project ($Energy_{project}$, kWh) and is the monthly recording of the metered energy consumed by the equipment with harmonic filter/ capacitor bank (less 3 days of the month for baseline energy measurement) and recording the corresponding operating hours of the equipment during the month (kW).

$O\text{-}hrs_{corresponding}$ - Corresponding operating hours for the month less 3 consecutive days of baseline monitoring

Only for Electronic Governor

$$\mathbf{P_{base} = P_{project} * (F_{base} / F_{project})^3} \qquad \mathbf{(4,c)}$$

Where

P_{base} = Power generated at baseline (kWh)

$P_{project}$, = (kWh) is the recorded monthly generation by the TG with electronic governor at a frequency of $F_{project}$ (Hz) (recorded monthly average).

F_{base} = (Hz) is recorded before installation of electronic governor based on monitoring for a period of month (49.89). Note - Power is proportional to cube of frequency.

It is DNVs opinion that the above calculations are complete to calculate the emission reduction during the crediting period.

The details of the proposed revision are also presented as annex 1 of this request.

(a) the proposed revision of the monitoring plan ensures that the level of accuracy or completeness in the monitoring and verification process is not reduced as a result of the revisions

The following parameter (with the IDs) will be monitored to ensure the completeness of the monitoring.

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Comment
For the measures that involves installation of power correction equipments operated at variable connected load						
$Energy_{base}$	Power	Actual energy consumed by the load connected to the common line without equipment 'i' (in switched off mode) for any 3 consecutive days of continuous operation in a month	kWh	M, C	Measured for any 3 consecutive days in a month	Equipment 'i' – Capacitor bank, harmonic filter.
$O\text{-}hrs_{corresponding,3}$	Time	Corresponding operating hours for the 3 consecutive days for baseline monitoring when the equipment 'i' is not connected to the load	hours	M	Measured for any 3 consecutive days in a month corresponding to measurement of $Energy_{base}$	Equipment 'i' – Capacitor bank, harmonic filter.
F_{base}	Frequency	Frequency at which the TG2 was being operated in absence of the electronic governor	Hz	M	Once for a month before installation of the electronic governor	Only for electronic governor. Fixed at 49.89Hz
$Energy_{project}$	Power	Actual energy consumed by the load connected to the common line with equipment 'i'	kWh	M	Monthly (less 3 days) then extrapolated for the total hours of operation in month	Equipment 'i' – Capacitor bank, electronic (for governor all days in month) harmonic filter.
$F_{project}$	Frequency	Frequency at which the TG2 is operated inline with the electronic governor	Hz	M	Monthly average	Only for electronic governor
$O\text{-}hrs_{actual}$	Operating	Operating/	hrs	M, C	Monthly	

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Comment
	hours	running hours of the equipments based on operating hours of the parent machine such as Capacitor banks connected to NFL & SFT fibre lines, harmonic filter connected to paper machine, and electronic governor connected to the generator)				
O-$hrs_{corresponding,}$	Time	Corresponding operating hours for the month when the equipment 'i' is switched on	hours	M	Measured for days in a month corresponding to measurement of $Energy_{project}$	Equipment 'i' – Capacitor bank, harmonic filter.
Others						
E_{grid} & $E_{inhouse}$	Electricity quantity	Electricity imported from the grid and generated in-house	GWh	M	Annual	Based on actual electricity bills paid and internal management reports
PN	Plant Name/ Installed Capacity and commissioning dates	Plant identification with installed capacity and commissioning dates of the power plants at the grid	Text	E	Once during PDD	Data has been collected from regional load despatch centre for the year 2004-2005 either through hard copy publication or from the website.
$\sum_k GENk,y$	Electricity quantity	Total electricity generation by the grid	GWH	E	Once during PDD	-do-
NHRk	Heat rate of the power plant	Net heat rate of the plants identified at the grid	Kcal/kWh	E	Once during PDD	-do-
COEFi	Emission co-efficient	CO_2 emission co-efficient of each fuel (i) type	tCO_2/TJ	E	Once during PDD	-do-
EFy	Emission factor	CO_2 emission factor of current generation mix of the grid	$tCO_2/$	C	Once during PDD	Project has calculated emission factor of the grid according to the given formulae described in Section E in transparent manner.
FF_i	Mass/Weight	Annual	MT	M	Monthly	The coal procured

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Comment
		quantity of coal utilized by the project				will be measured after procurement at time of storage, plus during feed charge for boiler input.
$NCV_{FF,i}$	Energy	Average gross calorific value of coal	Kcal/kg	Estimated	Monthly	The NCV will be determined based the following formula – NCV = GCV – 10.2*Moisture %

It is DNVs opinion that the monitoring of the above mentioned parameters are adequate to calculate the emission reduction during the crediting period from the capacitor banks, harmonic filters and the electronic governer.

As seen from the analysis of the estimated emission reductions (given below), as per the registered PDD, emission reduction calculated as per the monitoring plan of the registered PDD for the first monitoring period (01/01/2006 to 31/12/2006) and the emission reductions calculated as per the proposed revision of the monitoring plan (with dynamic baseline for some components), the last option results in lesser emission reductions and is conservative.

For the period 1/1/06 to 31/12/06	CERs	Deviation from ex-ante estimation at registered PDD
Ex-ante estimation in the registered PDD	21505	0
Actual CERs as per monitoring plan in PDD for the period	23136	+1631
Actual CERs as per proposed monitoring plan in Deviation	20833	- 672

(b) the proposed revision of the monitoring plan is in accordance with the approved monitoring methodology applicable to the project activity

The proposed revision of the monitoring plan is in accordance with the approved monitoring methodology of AMS II.D version 8, which states that

"In the case of replacement, modification or retrofit measures, the baseline consists of the energy baseline of the existing facility or sub-system that is replaced, modified or retrofitted."

And monitoring for replacement, modification and retrofit measures as:

"(a) Documenting the specifications of the equipment replaced;

(b) Metering the energy use of the industrial or mining and mineral production facility, processes or the equipment affected by the project activity;

(c) Calculating the energy savings using the metered energy obtained from subparagraph (b)"

Thus, the approved monitoring methodology is open to both dynamic as well as fixed baseline

(c) the findings of previous verification reports, if any, have been taken into account

DNV's verification activities for the project in question reveal that fixing the baseline for measures involving capacitor banks, electronic governors and harmonic filters is technically not correct and the actual measuring without the system in line constitutes a more accurate and conservative approach.

Validation Opinion.

Hence it is DNVs opinion that the revised monitoring plan as proposed is accurate and conservative and that the parameters proposed to be monitored are adequate to estimate the emission reduction during the rest of the crediting period. DNV hence request the acceptance of the proposed revision to the monitoring plan of the registered project activity 0806 entitled "Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India"

Yours faithfully
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Michael Lehmann
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Annex 1

Measures	Monitoring Plan as per registered PDD	Proposed Monitoring Plan
Installation of capacitor banks at SFT A&B Installation of capacitor banks at NFL	For baseline – P_{base} = Power consumed at baseline (kW) $P_{base} = Energy_{base} / Ohrs_{base}$ Total energy consumed by load for a period of month once before the installation of the capacitor bank and dividing by the operating hours of the corresponding month. For Project – $P_{project}$ = Energy consumed at project (kWh) Monthly recording of the metered energy consumed by the equipment with online capacitor bank and recording the corresponding operating hours of the equipment during the month.	For baseline – P_{base} = Power consumed at baseline (kW) $P_{base} = Energy_{base} / Ohrs_{base}$ Total energy consumption on three consecutive days of a month without the capacitor bank (in switched off mode) from the installed energy meter and then extrapolating the same for equivalent number of days as in the project in that particular month (kWh). For Project – $P_{project}$ = Energy consumed at project (kWh) Monthly recording of the metered energy consumed by the equipment with online capacitor bank (less 3 days of the month) and recording the corresponding operating hours of the equipment during the month.
Installation of harmonic filters at PM2	For baseline – P_{base} = Power consumed at baseline (kW) $P_{base} = Energy_{base} / Ohrs_{base}$ Total energy consumed by load for a period of month once before the installation of the capacitor bank and dividing by the operating hours of the corresponding month For Project – $P_{project}$ = Energy consumed at project (kWh) Monthly recording of the metered energy consumed by the equipment with online capacitor bank and recording the corresponding operating hours of the equipment during the month.	For baseline – P_{base} = Power consumed at baseline (kW) $P_{base} = Energy_{base} / Ohrs_{base}$ Total energy consumption on three consecutive days of a month by the drives of PM2 without the harmonic filter (in switched off mode) from the installed energy meter and then extrapolating the same for equivalent number of days as in the project in that particular month (kWh). For Project – $P_{project}$ = Energy consumed at project (kWh) Monthly recording of the metered energy consumed by the equipment with online capacitor bank (less 3 days of the month) and recording the corresponding operating hours of the equipment during the month.
Installation of electronic governor for 7.5MW TG unit to reduce bandwidth of frequency	For baseline – P_{base} = Power consumed at baseline (kW) $P_{base} = Energy_{base} / Ohrs_{base}$ Total energy consumed by load for a period of month once before the installation of the Electronic governor and dividing by the	For baseline – P_{base} = Power generated at baseline (kW) Power is proportional to cube of speed (frequency) $P_{base} = P_{project} \times \{ F_{base} / F_{project} \}^3$

variation.	operating hours of the corresponding month For Project – $P_{project}$ = Energy consumed at project (kWh) Monthly recording of the metered energy consumed by the equipment with online Electronic governor and recording the corresponding operating hours of the equipment during the month.	$P_{project}$, is the recorded monthly generation by the TG with electronic governor at a frequency of $F_{project}$ (recorded monthly average). F_{base} is recorded before installation of electronic governor based on monitoring for a period of month. For Project – $P_{project}$ = Energy consumed at project (kWh) Monthly recording of the metered energy consumed by the equipment with online Electronic governor and recording the corresponding operating hours of the equipment during the month.

Why is a revision of the monitoring plan necessary

Capacitor banks are used to eliminate the voltage drop in the system caused by inductive reactive loads. Thus they work based on the connected load which varies according to the mills operational requirements and accordingly the reduced voltage drop and thereby improves efficiency at the consumption line. Therefore, electricity consumed by the connected load/ process equipments (connected to the line to which the capacitor is also connected) without a capacitor bank is likely to consume more due to additional reactive load on the supply line (baseline) than compared to consumption with capacitor bank with same load pattern (project). Hence, a dynamic baseline is required to be determined which allows for changes in the load pattern which in turn depends on the operation of the mill.

The installed **harmonic filter** filters the 5^{th} and 7^{th} harmonics that is predominant due to usage of VSD (Variable speed drives) and thereby reduces the losses at the supply line. The quantity of harmonic depends on the connected load. Therefore, electricity consumed by the connected load/ process equipment (connected to the line to which the filter is also connected) without the filter is likely to consume more due to additional reactive load on the supply line (baseline) than compared to consumption with filter with same load pattern (project). Hence, a dynamic baseline is required to be determined which allows for changes in load pattern which in turn depends on the operation of the mill.

Purpose of the **electronic governor** is to operate the generator in narrow bandwidth of frequency and optimize the generation frequency which in turn depends on the consumption pattern of the connected load. Thus the amount of bandwidth correction and reduction in generation frequency depends on the variability in bands of operation of the connected load. Therefore, electricity drawn by the connected load/ process equipment (connected to the line to which the electronic governor is also connected) without the electronic governor is likely to consume more due to higher frequency of generation (baseline) than compared to consumption with electronic governor with same load pattern (project). Hence, a dynamic baseline is required to be determined which allows for changes in load pattern which in turn depend on the operation of the mill.

Annex 2

Revised Monitoring Plan (section D and E of the revised PDD)