Replies to the clarifications requested from the Executive Board (EB) for the project activity "SRBSL –Waste heat recovery based Captive Power Project" (UNFCCCC reference number 1076)
Clarifications requested by the EB
1. The PDD refers to the installation of a 50MW captive power plant of which the 9.6MW related to waste heat recovery is the project activity. However the barrier analysis relates to the installation of the captive power plant and not just the project activity. Therefore, the additionality of the project activity requires further substantiation.
Reply of the project participant to the clarification
The project participant hereby clarifies that the Investment Barrier, Technological Barriers and Other Barriers mentioned under the 'Barrier analysis' in section B.5 of the PDD submitted for request for registration (*i.e.* PDD version 03) are related to the project activity only (*i.e.* 9.6 MW waste heat recovery based captive power generation) and not to the entire 50 MW captive power plant (CPP). 1. Investment barrier The investment barriers as elaborated in the above-mentioned PDD were related only to the project activity and not to the other components of the captive power plant (CPP). At the time of project financing, the project participant SRBSL had approached a number of banks and other financial institutions (FIs) for funding the debt component of the total investment of the CPP which consisted of Waste Heat Recovery based power generation system (the GHG abatement activity) and a Coal based CFBC boiler for power generation (not a part of the GHG abatement activity). Since at that point of time the Waste Heat Recovery (WHR) based power generation activity was not a proven technology in the sponge iron industry of India, there was a lot of apprehension on the part of the banks/FIs to sanction loans for the CPP. WHR based power generation being an integral part of the CPP, the successful operation of the CPP would be dependent to a great extent on the smooth functioning of the WHR based power generation system. Moreover there are a number of technological risks also associated with WHR based power generation as given below under

'Technological Barriers'. Due to the apprehension of WHR power generation not being a proven technology and also of the perceived technological risks of this technology, these banks/FIs initially offered loans with higher interest rates (higher than the Prevailing Lending Rate)[1] which included significant risk premium. The apprehension was there not because of the presence of coal based boiler but only because of the presence of the Waste Heat Recovery Boilers as part of the CPP. It is worth mentioning that Coal based captive power generation was the more common and prevalent practice besides being a well-established technology in the similar category of industries in India and the banks would not have had any apprehension in financing the CPP if it had been entirely coal based.

However, the project participant wished to implement the Waste Heat Recovery based power generation project as a proactive measure towards GHG abatement. Subsequently, the project participant approached IREDA (Indian Renewable Energy Development Agency), another government owned FI which performed a financial appraisal of the Waste Heat Recovery based power generation project as an energy efficiency activity and also took into consideration the potential revenue from the CDM-Kyoto Protocol route. Based on this financial appraisal, IREDA agreed to finance some part of the total cost of CPP however, with the condition that the borrower (*i.e.* SRBSL) shall agree and undertake that in case the borrower enters into any arrangement for selling Carbon Credit/ Certified Emission Reduction (CER) under CDM, IREDA shall be given/provided with first charge on the cash flow from sale such carbon credits and for such purpose the borrower shall execute such deeds in favour of IREDA as IREDA may require. Considering the potential CDM benefit and the above-mentioned condition IREDA agreed to issue loan to the project participant at an interest rate of 10% (which is lesser than the prevailing lending rate (PLR) of 10.25%-11.00%)[2]. The EB may kindly note that the only source of potential CDM benefits for the CPP is the Waste Heat Recovery based power generation. The other component of the CPP could not result in any CDM benefits as it is a conventional coal based power generation activity. Thus it is evident that IREDA's appraisal based on CDM benefit was applicable only to the project activity in particular.

The project participant further clarifies that once IREDA agreed to part-finance the project based on their project appraisal which factored in the potential CDM

[1] ,Letter from Indian Overseas Bank (IOB) dated 28/05/2004 offering loan at an interest rate of 12.75% (PLR+1.75)

[2] Term Loan Agreement between SRBSL and IREDA offering loan at an interest rate of 10%

benefits, another bank *viz.* Indian Overseas Bank (IOB) which had earlier offered loan for the entire CPP at an interest rate much higher than the PLR (the interest rate offered by IOB before IREDA appraised the project activity was 12.75%[3]) also agreed to lower their interest rate below the PLR to 9.25%[4]. Thus it is evident that the investment barriers, outlined in the PDD (version 03) and clarified once again as above, are applicable to the WHR component of the CPP only and it can be reasonably concluded that if the WHR component were not there the project participant would not have to face the above-mentioned difficulties for project financing through banks/FIs. The prime mover for the project activity was based entirely on the potential CDM benefits appraised by IREDA.

2. Technological barriers

a. *Operational risks:* In the Indian context, regional electricity grids do not prefer to synchronize and operate in parallel to individual captive power plants primarily because of the absence of reliability of power supply from captive plants as a firm power source[5]. With the same reasoning, the captive power plant (CPP) of the SRBSL sponge iron facility is not permitted to operate in parallel to the regional electricity grid (Eastern Regional Grid of India) and the CPP will have to operate in stand alone/isolation mode and cannot import electricity from the grid[6]. Under such a situation, the production process of the sponge iron facility will be adversely affected if there is a disruption in the power generation operations of the waste heat recovery power generation system (*i.e.* the project activity). Disruption in power generation by the project activity may occur due to the reasons given below.

- Non-availability of waste gases for power generation because of some technical fault in the DRI kilns or in the quality of the raw material processed will prevent power generation in the project activity. This will result in shortage in power supplied to the CPP. Moreover if the heat content of the waste gas is not sufficient, power

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[3] Letter from Indian Overseas Bank (IOB) dated 28/05/2004 offering loan at an interest rate of 12.75% (PLR+1.75)

[4] Letter from Indian Overseas Bank (IOB) dated 28/01/2006 offering loan at lower interest rate of 9.25% (PLR-1.75%)

[5] Captive Power Scenario in India' - http://chhattisgarh.nic.in/opportunities/Annexure%203.2.pdf

[6] Source – 'Policy in respect of captive power plants utilising conventional fuel' – available at http://wbpower.nic.in/initiatives.htm

[7] 'Sponge Iron Industry – an overview of problems & solutions' by P R K Raju, GM, EICS Technology Pvt. Ltd.

[8] 'Coal : the most critical raw material for sponge iron making' sourced from Steelworld.com available at http://www.steelworld.com/coalcri.htm

generation will be adversely affected since there are no inbuilt provisions to increase waste gas temperatures through auxiliary fuel firing. Availability of waste gases from DRI kilns depend on the operating conditions of the DRI kilns which in turn depend on the raw material (such as coal). In most sponge iron plants in India DRI kilns face a number of operational problems because of poor quality of coal[7]. Frequent variations in coal quality disrupts the DRI kiln operations and hence also results in fluctuations in waste gas generation. Moreover smooth operation of sponge iron kilns are frequently disrupted due to poor quality of iron ore and high ash coal resulting in short campaign life of the kilns[8]. Such operational disruptions also result in fluctuation in the amount and quality of waste gas for power generation and hence results in disruption of the power generation activity. Thus non-availability of waste gas for power generation will lead to power shortage for the SRBSL facility which cannot be compensated by import from grid.

- It may also be noted that non-availability of waste gas at the required temperature may also result in a complete shutdown of power generation by the project activity and resumption of production process takes a long time which may result in production losses.
- Cumulative effect of sustained variable frequency operation due to fluctuations in waste gas supply (flow rate & temperature) may have substantial adverse effect on safe and sustained operation of assets like the steam turbine, generators and other power plant equipments.

Hence this barrier is related only to the generation of power by the waste heat recovery project activity and not to the components of the CPP other than the waste heat recovery power generation system. Such operational risks/ barriers related to waste gas will not arise if the entire captive power generation capacity would have been operated on conventional coal based FBC technology.

b. Air cooled condenser: The project participant requests the EB to note that a condenser is an integral component of any power generation cycle and is thus an integral component of the Waste Heat Recovery based power generation cycle also. Thus the barrier related to the air cooled condenser is applicable to the project activity.

Clarifications requested by the EB

2. The PDD should clearly and transparently describe the project boundary, which components and fuels are included in the project activity, and which components and fuels are not included.

Reply of the project participant to the clarification

The project participant requests the EB to note that as per the ACM0004 methodology, *"The spatial extent of the project boundary comprises the waste heat or gas*

sources, captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the power plants connected physically to the electricity grid that the proposed project activity will affect"

Hence accordingly the project boundary for the project activity will include the following:

- '*waste heat or gas sources'* – The source of the waste heat is the After Burning Chambers (ABCs) in which waste gas from the DRI kiln of the sponge iron facility are combusted and heated. Therefore, the project boundary will include the ABCs.
- *'captive power generating equipments'* – The project boundary will include the power generating equipment such as the Waste Heat Recovery Boilers along with the related piping for steam distribution, the turbo generator sets (steam turbine generator) and the power evacuation system of the captive power plant.
- *'any equipment to provide auxiliary heat to the waste heat recovery process'* – There is no such equipment to provide auxiliary heat to the waste heat recovery process for the project activity under consideration. Hence any such equipment has not been considered.
- *'power plants connected physically to the electricity grid that the proposed project activity will affect'* - The project activity will displace power generation from the Eastern Regional Grid of India. Hence the project boundary will include all the power plants that are physically connected to the Eastern Regional Grid as well.
- In addition to the above the coal based Circulating Fluidised Bed Combustion boiler (CFBC) is not included in the project boundary.

The PDD submitted for request for registration (version number 03) incorporates all the above components of the project activity within the project boundary as required by ACM0004. However for further clarity, the PDD has been revised in line with the above paragraph to clearly identify the components included in the project boundary as per the provisions of ACM0004. Please refer to section B.3 of revised PDD (version 04) for details.

The project participant requests the Executive Board (EB) to refer to table B-1: Sources and types of pollution included in the project boundary on page number 10 of the PDD (version 03) submitted for request for registration. In this table the various emission sources which are included in or excluded from the project boundary have been provided along with reasons for the inclusion/exclusion.

The EB has requested to identify which fuels are included or excluded in the project boundary. The project participant has identified the fuels included in or excluded

from the project boundary. This has been given below in the form of a table which is as per the format of Table 1 in page 2 of ACM0004.

Table 1: Overview on fuels included in or excluded from the project boundary			
Source	Fuel	Included/Excluded	Justification/ Explanation
Grid electricity generation	All fuels used to generate electricity in the various power plants physically connected to the Eastern Regional Grid. These fuels include coal, gas and diesel used as fuel for power generation in various thermal power plants connected to the Eastern Regional Grid. All these fuels have been included in the project boundary as per the ACM0002 methodology used to calculate the grid emission factor.	Included	Main emission source
Captive electricity generation	Coal	Excluded	This is not applicable as the baseline scenario for the project activity is not captive electricity generation *(please refer to Section B.4 of the PDD (version 03)*.
	Gas		
	Diesel		
On-site fossil fuel consumption due to the project activity	Diesel/Coal/Gas	Excluded	There is no fossil fuel consumption in the Waste Heat Recovery Boilers for auxiliary firing. Hence this has been excluded from the project boundary. Coal which is consumed in the coal based CFBC boilers is also excluded as the CFBC boilers are excluded from the project boundary.

The above table has also been included in section B.3 of the revised PDD (version 04) that will be submitted along with this reply.

Clarifications requested

3. It should be clearly justified why the methodology is applicable to the project activity.
Reply of the project participant to the clarification
The applicability criteria of the approved consolidated methodology ACM0004 has been referred to for justification why the methodology is applicable to the project activity in the PDD (version 03) submitted for request for registration. The justifications of the applicability of the methodology are provided below. As stated in ACM0004, "*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities"*. The project activity under consideration recovers waste heat of the hot gases emitted from the DRI Kilns and consequently from the ABCs of SRBSL sponge iron facility to produce steam in Waste Heat Recovery Boilers which is then used to generate electricity in Steam Turbine Generator. Apart from the key applicability criteria, the project activity is also required to meet the following conditions in order to apply the baseline methodology- *The methodology applies to electricity generation project activities:* 1. *"that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels,"* As per the Baseline Scenario analysis, conducted in Section B.4 of the PDD (version 03), the project activity displaces electricity from the Eastern Regional grid which is dominated by fossil fuel (coal)[9]. Therefore the project activity meets the above applicability criteria. The Baseline Emission Factor for the grid is also more conservative than that of the coal based CPP. 2. *"where no fuel switch is done in the process where the waste heat or waste pressure or the waste gas is produced after the implementation of the project activity"* The project activity involves utilization of the heat content (waste heat) of waste gases of the sponge iron kilns, which would have been dissipated into the atmosphere in absence of project activity, for power generation. There is no fuel switch involved or to be planned in future in the sponge iron kiln operation where waste gas is generated. Furthermore, "*The methodology covers both new and existing facilities*"- The project activity has been undertaken in the existing sponge iron facility of SRBSL and

[9] Refer - http://ereb.org/ergridov.htm

waste gases used in the project activity are emitted from sponge iron kilns currently operating in the facility.

The project activity under consideration thus meets all the applicability conditions of the baseline methodology. This justifies the appropriateness of the choice of the methodology in the context of the project activity and its certainty in leading to a transparent and conservative estimate of the emission reductions directly attributed to the project activity.

Furthermore, the monitoring system or approach adopted in the PDD (version 03) by the project participant to monitor emission reductions is also in line with the monitoring methodology of ACM0004. As per section B.7.2 'Description of monitoring plan' of the PDD (version 03) the following parameters will be monitored:

- *Net Electricity Generation from Project Activity* (MWh/year) – This will be calculated as the difference of gross waste heat power generated for a year minus the auxiliary power consumption during that year.
- *Data needed to calculate carbon dioxide emissions from fossil fuel consumption due to project activity* – The project activity does not use any auxiliary fossil fuel, hence there is no carbon dioxide emissions due to fossil fuel consumption from project activity.
- *Data needed to recalculate the operating margin emission factor, if needed based on the choice of the method to determine the Operating Margin (OM), consistent with "Consolidated baseline methodology for grid connected electricity generation from renewable sources (ACM0002)"* – The Operating Margin Emission Factor for the Eastern Regional grid is calculated as per ACM0002. Data needed to calculate the emission factor are based on information available from authorised government agencies - Central Electricity Authority (CEA) sources. The OM Emission Factor has been calculated as per ACM0002 ex-ante and will remain fixed for the entire crediting period.
- *Data needed to calculate the build emission factor, if needed, consistent with" Consolidated baseline methodology for grid connected electricity generation from renewable sources (ACM0002)"* – Same as above. The Build Margin Emission Factor has been calculated as per ACM0002 ex-ante and will remain fixed for the entire crediting period.
- *Data needed to calculate emission factor for captive power generation* - Not applicable for the project activity

Thus it may be observed that

1. The project activity meets the applicability criteria of the methodology ACM0004 (page 1 of ACM0004)
2. The monitoring procedure of the project parameters is in line with the monitoring outlined in the approved methodology ACM0004

Hence, it can be concluded that the methodology is applicable to the project activity under consideration.

In addition to the above the project participant requests the EB to take into consideration the fact that a number of project activities that are similar to the project activity under consideration have been registered as CDM projects with UNFCCC in which the same methodology ACM0004 has been applied. The project participant has thus referred to these registered CDM projects as well while applying ACM0004 to this particular project activity. A few of these similar registered CDM projects are mentioned below:

1. Waste heat based 7 MW Captive Power Project Godawari Power and Ispat Ltd (GPIL) – UNFCCC reference number 0264
2. JBSL–Waste Heat Recovery Based Captive Power Project – UNFCCC reference number 0433
3. 8MW Waste Heat Recovery based Captive Power Project at OCL – UNFCCC reference number 0367

Clarifications requested by the EB

4. It should be clearly stated whether there are any deviations from the methodology.

Reply of the project participant to the clarification

The project participant wishes to clarify that there are no deviations from the methodology.

There is a minor modification in the monitoring method of two parameters namely EG_{GEN} and EG_{AUX}. This modification has been adopted in view of the specific configuration of the SRBSL's captive power plant. The project activity involves generation of power by waste heat recovery in a Steam Turbine generator which is fed by HP steam from a common steam header connected to two sources *viz.*

(i) 4x10 Tonnes Per Hour Waste Heat Recovery Boilers to be installed under the project activity and

(ii) 1x170 and 1x85 Tonnes Per Hour coal based Circulated Fluidised Bed Combustion (CFBC) Boilers which however, is not the project activity.

The total power generated by the Steam Turbine generator thus includes power generated from both the Waste Heat Recovery Steam source and the CFBC boiler steam source. Under these circumstances, the power generated by the Steam Turbine generator can not be solely attributed to the waste heat recovery source and therefore it is not possible to directly measure the power generated only from the Waste Heat Recovery steam by an energy meter installed at the Steam Turbine Generator terminals.

ACM0004 requires to measure the electricity produced with the recovered waste gas/heat, in order to determine baseline emissions. If this measurement is not possible, as the waste gas/heat is used together with fossil fuel, then the proportion of the electricity that was produced with the waste gas/heat could be estimated by considering the waste gas/heat. It is required in this case to measure the amount supplied and the net calorific value of the waste gases/heat and fossil fuel. For the project activity under consideration measurement of the net calorific value or the heat content of the waste gas from the DRI kiln is practically not possible to measure due to high temperature of the gas. In this regard, there was a request of revision of approved methodology ACM0004 (AM_REV_0033) in which an alternative procedure based on 'steam-energy content (enthalpy) apportioning' of total power was proposed. The Meth Panel has agreed to the proposed procedure of steam-energy content apportioning in its reply to the above request (reference: F-CDM-AM-Rev_Resp_ver01.1 – AM_REV_0033 available at http://cdm.unfccc.int/UserManagement/FileStorage/AM_REC_MVA0P355FK7ZLTJ39U9ENNIYPEFA6V).

The Meth Panel has recommended the EB to incorporate this element of steam-energy apportioning in a new methodology in place of ACM0004. Subsequently, the same was incorporated in approved consolidated methodology ACM00012.

However at the time when the project activity of SRBSL was submitted for request for registration ACM00012 was not available. Therefore the approach (i.e. steam-energy content apportioning of total power) mentioned in AM_REV_0033 was followed in the context of the project activity. In this approach the power generated from Waste Heat Recovery source is calculated by apportioning the total power generated by the entire CPP (which will be measured by an energy meter installed at the terminals of the common Steam Turbine Generator) as per the energy (enthalpy) contribution of the Waste Heat Recovery Boilers only. This is an accepted engineering practice because in a steam turbine generator it is the enthalpy or energy content of steam which is ultimately transformed into electrical energy.

The same method of apportioning has also been adopted in a number of similar waste heat recovery power generation projects, as referred in the reply to clarification 3

given above, which have been registered as CDM projects with UNFCCC. Based on the recommendation of the Meth Panel regarding steam-energy content apportioning and the examples of similar registered waste heat recovery power generation projects, the project participant also has applied the similar approach to arrive at the 'power generation from waste heat source (EG_{GEN})' and hence the baseline emissions.

The project participant wishes to clarify that though it was recommended in ACM0004 that the auxiliary electricity consumption of the project activity (EG_{AUX}) would be 'measured', for the project activity under consideration there is an inherent difficulty in doing so. This is because there are a number of auxiliary equipments which are common to both the Waste Heat Recovery boilers and the CFBC Boilers. Such equipment includes the boiler feed water pump and cooling water system. Thus it is not possible to isolate the auxiliary consumption of the Waste Heat Recovery based power generation only and measure the same by an energy meter. It is however possible to measure the total auxiliary consumption of the CPP by an energy meter (denoted as $EG_{AUX\ CPP}$ in the PDD (version 03)). Under this situation, the project participant has used the same approach of apportioning the total auxiliary energy consumption of the entire CPP as per the energy contribution of steam from the Waste Heat Recovery source to obtain the auxiliary consumption of the project activity (EG_{AUX}). This approach is based on the same reasoning behind apportioning the total power generation by the CPP as per the steam contribution of the Waste Heat Recovery source to obtain the auxiliary consumption of the project activity only.

The project participant requests the EB to also to refer to the reply to clarification number 5 below for further clarification of the above points.

Clarifications requested by the EB

5. It should be clearly justified that the methodology has been applied correctly. In doing so, why formulae and parameters that are not in the methodology have been used and if any parameters have been calculated when they should be measured.

Reply of the project participant to the clarification

With reference to the replies to the clarifications 3 and 4 provided above the project participant clarifies that the project activity under consideration meets all the applicability criteria of the Approved Consolidated Methodology ACM0004 and that there are no deviations from the methodology. However as mentioned in the reply to clarification 4, there are two parameters which have been calculated in the PDD (version 03) while the same were recommended to be measured according to the methodology ACM0004. These parameters are:

EG_{GEN} : Total Electricity Generated (MWh/yr)

EG_{AUX} : Auxiliary Electricity (MWh/yr)

The project participant requests the EB to note the distinct configuration of the Captive Power Plant (CPP) of the SRBSL facility and the difficulty in measuring the electricity generated exclusively from the Waste Heat Recovery source by an energy meter for a system with common steam header receiving steam for power generation in a common Steam Turbine generator system from both the Waste Heat Recovery source and the CFBC steam source. The EB may also kindly refer to Figure 3. 'Schematic Diagram of SRBSL's CPP' given in Annex 4 – Monitoring Information of the PDD (version 03) for the configuration of electricity generation in SRBSL's CPP. The CPP includes the following:

- Power generation equipment:
  - 2 x 25 MW Steam Turbo Generators
- Steam Sources:
  - 4 x 10 TPH Waste Heat Recovery Boilers
  - 1 x 170 TPH and 1 x 85 TPH coal based Circulating Fluidised Bed Combustion Boilers
- Steam from all the above boilers is fed to a Common Steam Header which supplies steam for power generation to the Steam Turbo Generators. Hence the total electricity generated by the Steam Turbo Generators will consist of electricity generated from CFBC supplied steam and the electricity generated from dedicated Waste Heat Recovery Boilers' steam (project activity).

It may be noted that the project activity is electricity generation only from Waste Heat Recovery source and not from the Circulating Fluidised Bed Combustion (CFBC) Boilers. Hence any electricity generated by the CFBC Boiler steam source will not be a part of the project activity. With the above configuration of the CPP, it is not possible to separately measure by an energy meter the electricity generated by the steam solely sourced from the dedicated Waste Heat Recovery Boilers (*i.e.* EG_{GEN}). However the total electricity ($EG_{GEN\ CPP}$) generated by the Steam Turbo Generators will be measured by installed energy meters. The electricity generated from the waste heat recovery alone (*i.e.* EG_{GEN}) has thus been calculated by multiplying the total electricity generated by the entire CPP ($EG_{GEN\ CPP}$) by the ratio of the enthalpy *i.e.* energy contribution from the Waste Heat Recovery Boiler steam (H_1 which is a function of temperature T_1 and pressure P_1 of the waste heat recovery steam) and the sum of the enthalpy of CFBC steam (H_2 which is a function of temperature T_2 and pressure P_2 of the CFBC steam) and enthalpy of the Waste Heat

Recovery Steam.

$$EG_{GEN} = \left(\frac{H_1}{H_1 + H_2} \right) \times EG_{GEN\ CPP}$$

As mentioned in the PDD that the parameters viz. $EG_{GEN\ CPP}$, H_1, H_2, T_1, T_2, P_1 and P_2 are all regularly measured parameters.

As direct measurement of electricity generated by project activity is not possible, the above method of apportioning the total power based on energy contributions has been followed in the PDD version 03. The EB may please note that the same approach has also been adopted by similar waste heat recovery for power generation projects registered as CDM projects with UNFCCC. Such projects include the ones that have been provided in the reply to the clarification number 3 above.

The project participant requests the EB to note that since there was no guidance in the ACM0004 regarding situations for which direct measurement of power generated only by waste heat recovery is not possible (because of presence of other boilers supplying steam for power generation to a common turbine-generator through common steam header), the project participant has followed the commonly accepted way of apportioning the total power generated according to energy contribution of individual steam sources. Similar approach has also been adopted in the new approved consolidated methodology ACM00012 which got approved recently (however, was not available when the project activity was submitted for request for registration). This new approved methodology ACM0012 also follows the same approach of apportioning total power generated according to heat energy contribution from waste heat recovery in case there are boilers other than the waste heat recovery ones which supply steam for power generation to a common steam turbine generator in order to arrive at the power generated from waste heat recovery-utilization only.

The project participant wishes the EB to note the factor f_{wg} in the formula to estimate baseline emissions in ACM00012 (please refer equation (1a-1))

$$BE_{Elec,y} = f_{cap} * f_{wg} * \sum_j \sum_i ((EG_{i,j,y} * EF_{Elec,i,j,y})) \quad \text{.....(1a-1)}$$

The EB may please note that f_{wg} is the fraction of total electricity generated by the project activity using waste gas. If the steam used for generation of electricity is produced in dedicated boilers but supplied through common header, this fraction is estimated according to equation (1d/1e) of ACM00012.

As per equation (1e) of ACM00012,

$$f_{wg} = \frac{ST_{whr,y}}{ST_{whr,y} + ST_{other,y}} \text{.....(1e)}$$

where,

$ST_{whr, y}$ is the energy content of the steam generated in waste heat recovery boiler fed to turbine via common steam header.

$ST_{other, y}$ is the energy content of steam generated in other boilers fed to turbine via common steam header.

The above equation is analogous to the equation used to calculate EG_{GEN} and consequently baseline emissions BE_y as given in the Annex 4 of the PDD version 03.

From the equations (1) in Annex 4 of the PDD (version 03) and equation to calculated BE_y in the PDD (version 03) the following may be deduced.

$$EG_{GEN} = \left(\frac{H_1}{H_1 + H_2} \right) \times EG_{GEN\,CPP}$$

$$BE_y = EG_{GEN} \times EF_y$$

or, $$BE_y = \left(\frac{H_1}{H_1 + H_2} \right) \times EG_{GEN\,CPP} \times EF_y \text{.....(2)}$$

Equation (2) above is analogous to equation (1a-1) of ACM00012. The same equation has been used to calculate baseline emissions in the project activity as well.

Hence the approach adopted by the project participant in arriving at the electricity generated by the project activity is similar to the approach adopted in Approved Consolidated Methodology ACM00012.

Measuring the auxiliary consumption of only the project activity in an energy meter is also not possible because of the difficulty of individually measuring the auxiliary consumption of the Waste Heat Recovery source as there are a number of common systems consuming auxiliary electricity. With the CPP configuration only the total auxiliary consumption of the entire CPP can be measured (same difficulty as that for the case of measuring EG_{GEN}) . Thus following the same approach of apportioning according to energy content, the auxiliary consumption of the project activity has also been calculated by apportioning the total auxiliary consumption of the power plant (a metered parameter) according to heat energy contribution from waste heat recovery. The formula used is

$$EG_{AUX} = \left(\frac{H_1}{H_1 + H_2} \right) \times EG_{AUX\,CPP}$$

Clarifications requested by the EB

6. The calculation of parameters EGy, EG_{GEN} and EG_{AUX} should be transparently described in the PDD.

Reply of the project participant to the clarification

The calculation of parameters EG_y, EG_{GEN} and EG_{AUX} have been provided in a transparent manner in the revised PDD (version 04) which is being submitted along with these replies. The same has also been provided below for reference.

1. Calculation of EG_{GEN}

$$EG_{GEN} = \left(\frac{H_1}{H_1 + H_2} \right) \times EG_{GEN\,CPP}$$

where,

EG_{GEN} : Energy generated by the project activity (MWh/yr)

$EG_{GEN\,CPP}$: Total energy generated in the CPP (MWh/yr)

H_1 : Energy content of the steam from the dedicated Waste Heat Recovery Boilers supplying steam to the common steam header (kCal)

H_1 will be calculated as product of specific enthalpy (h_1) and the flow rate (S_1) of the steam from the dedicated Waste Heat Recovery Boilers. Thus,

$$H_1 = h_1 \times S_1$$

h_1 will be estimated from steam tables or Mollier diagram according to the measured temperature (T_1) and measured pressure (P_1) of the steam supplied by the dedicated Waste Heat Boilers to the common steam header. The flow rate S_1 will be measured by a flow meter installed in the line connecting the Waste Heat Recovery Boilers to the common steam header. The measurement and monitoring of the relevant parameters have also been included in the monitoring plan of the

PDD (version 04).

H_2 : Energy content of the steam from the CFBC Boilers supplying steam to the common steam header (kCal). H_2 will be calculated in a manner similar to H_1 with the corresponding parameters h_2, S_2, T_2 and P_2 being monitored and measured by meters installed in the line connecting the CFBC Boiler to the common steam header. The measurement and monitoring of the relevant parameters have also been included in the monitoring plan of the PDD (version 04).

2. Calculation of EG_{AUX}

$$EG_{AUX} = \left(\frac{H_1}{H_1 + H_2} \right) \times EG_{AUX\,CPP}$$

where,

EG_{AUX} : Auxiliary consumption of the project activity (MWh/yr)

EG_{AUXCPP} : Auxiliary consumption of the entire CPP(MWh/yr)

3. Calculation of EG_y

$$EG_y = EG_{GEN} - EG_{AUX}$$

Where,

EG_y : Net electricity supplied to facility (MWh/yr)

Annexure – List of supporting documents

1. Letter from Indian Overseas Bank (IOB) dated 28/05/2004 offering loan at an interest rate of 12.75% (PLR+1.75)

2. Term Loan Agreement between SRBSL and IREDA offering loan at an interest rate of 10%

3. Letter from Indian Overseas Bank (IOB) dated 28/01/2006 offering loan at lower interest rate of 9.25% (PLR-1.75%)

4. Captive Power Scenario in India' - http://chhattisgarh.nic.in/opportunities/Annexure%203.2.pdf

5. 'Sponge Iron Industry – an overview of problems & solutions' by P R K Raju, GM, EICS Technology Pvt. Ltd.

6. 'Policy in respect of captive power plants utilising conventional fuel' – available at http://wbpower.nic.in/initiatives.htm

7. 'Coal : the most critical raw material for sponge iron making' sourced from Steelworld.com