Project design document form for CDM project activities

(Version 06.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	LMEL 25 MW Waste Heat based Captive Power Plant.
Version number of the PDD	11
Completion date of the PDD	10/08/2015
Project participant(s)	M/s Lloyds Metals and Energy Limited. (Private entity) (Formerly known as M/s Lloyds Metals & Engineers Limited)
Host Party	India (host) Ministry of Environment and Forest
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	1,4 and ACM0012 Version 04.0.0
Estimated amount of annual average GHG emission reductions	109,660

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> ***(1) Purpose of project activity:***

The purpose of the project activity is to achieve efficient use of waste heat from waste flue gases to generate electricity. The electricity so generated shall be used to meet the power requirement of Lloyds Metals and Energy Limited (LMEL, Formerly known as M/s Lloyds Metals & Engineers Limited) sponge iron plant itself and balance will be supplied to Maharashtra State Electricity Distribution Company Limited (MSEDCL) grid to wheel the electricity to power trading company as per power purchase agreement signed for sell of up to 15MW of surplus power.

(2) Pre project Scenario:

In the scenario existing before the project activity, waste flue gases were released from ABC (After Burning Chamber) of existing 1 number 500TPD kiln started in September 1995 and existing 4 numbers 100 TPD DRI (Direct Reduction Iron) sponge iron kilns started in February 2006 in the manufacturing process of sponge iron of LMEL were passed through water scrubber. The heat contained in waste gases was transferred to water in water scrubber and thus reduces the flue gas temperature before letting them out into atmosphere through ESP. Hence the heat contained in the flue gases was completely wasted.

Project site also has 2 x 1010 KVA diesel generator sets which are installed to maintain rotary motion of kiln in case of grid power is not available. In this case no production is possible from the kilns and only rotary motion is maintain to avoid the fusing of material in the kilns.

Power requirement in pre project scenario for existing plant machinery is 3.5 MW. This power requirement is met from MSEDCL grid. LMEL has sanction connected load of 6.914 MW from MSEDCL to take care of any future expansion in production facility.

(3) Project Scenario

The purpose of the proposed project activity is to generate electricity by utilising waste heat contained in the waste flue gases released from ABC (After Burning Chamber) of existing 1 x 500TPD and existing 4 x 100 TPD DRI (Direct Reduction Iron) sponge iron kilns in the manufacturing process of sponge iron facility of LMEL. The heat contained in waste gases will be transferred to water in WHR boilers to produce 109.2 tonnes/h of steam at 70 kgs/cm2a pressure and 490deg c temperature at optimum conditions. Steam generated from 5 WHRBS is combined in a common steam header which also receives 13.2 tonnes/h of steam from coal based 90 TPH FBC boiler (FBCB) so that total 122.4 tonnes/hr of steam at and 490 deg C will be fed into the steam turbo-generator (STG) to run 30 MW turbine. However the quantity of steam from FBC boiler that is taken in to common steam header is to take care of situation of variations in waste heat gas quantity and quality and for ensuring proper working of STG (steam from FBC= 122.4 - steam from WHRBs).

This PDD is developed for the 25 MW electricity generated by STG using WHRB steam.

- Steam requirement for STG = 122.4 tonnes/h
- WHRB steam contribution = 109.2 tonnes/h
- Power generation by using steam from WHRBs = (109.2* 30)/122.4 = 26.76 MW

However we have considered WHRB contribution as 25 MW by rounding it on lower side to be conservative as steam generated in WHRB is influenced by uncertainties in flue gas conditions.

The 90 TPH FBC boiler is newly installed along with the project activity to provide steam at 70 kg/cm2a pressure and temperature of 490 deg C and the same is manufactured by Lloyds Steel Industries Ltd Engineering division. The fuel used in FBC boiler will be coal, dolachar and coal rejects which are by products of sponge iron kiln operation. The rated capacity of 90 tonnes/hr for FBC boiler

is kept to take care of situation when 500 TPD kiln and one 100 TPD kiln undergoes shut down simultaneously which will lead to a situation of generation of only 36 tonnes/hr of WHRB steam and shortage of 86.4 tonnes/hr[1] of steam (122.4 TPH – 36 TPH) for power generation. This will lead to turbine not being operated healthily as turbine manufacturer has recommended the operating load of 75-100% to achieve efficient operation of the turbine. Project proponent have signed the Power Purchase Agreement i.e. (MoU) with power trading firm M/s Indrajit Power Technology Pvt Ltd., for sale of surplus power to the extent of 15 MW or surplus from project activity after internal consumption by LMEL. Hence after meeting the internal power requirement and auxiliary consumption of power plant i.e. total up to 6 MW, remaining surplus power will be sold to power trading company by wheeling it through grid. Since reliable and firm power is only to be injected and accepted by grid MSETCL[1], it becomes imperative for PP to ensure that the power is supplied at uniform rate even during the unavailability of WHR steam for power generation. Hence uninterrupted power supply is ensured by continuous supply of required quantity of steam to the turbine generator. Therefore FBC boiler is required for supplying additional quantity of steam when WHRB are not operating due to kiln shut down and also that turbine is operated between 75% to 100% loading conditions for efficient operation as recommended by turbine manufacturer . Therefore 90 TPH FBC boiler is installed as a part of project activity considering the above practical operational scenarios.

(4) Base line Scenario:

The baseline scenario has been identified in section B.4 by following 3 steps given in approved methodology ACM0012 version 4. The baseline selected is the credible alternative grid electricity P10 as LMEL was receiving grid electricity to meet their electricity requirements in pre-project scenario. Also it is the conservative baseline scenario amongst coal based captive power plant and grid power in terms of baseline emissions.

The reduction in CO_2 emission from project facility arises from the displacement of an equivalent amount of electricity to the extent of electricity generated from project activity which would have been otherwise generated and supplied by grid which. The grid is mainly comprised of fossil fuel based power plants and thereby more carbon intensive grid power is displaced by the project activity.

The total CO_2 emission reduction for the entire crediting period of 10 years has been calculated as 1,096,599 tonne CO_2 equivalent. The other benefits considering global scenario, sustainable development through better energy efficiency and it also leads to the improvement of local environment.

LMEL will have proper monitoring system in line with approved methodology ACM0012 to calculate the power generated out of the power plant and accurately record the reduction in CO_2 emissions. LMEL will follow monitoring plan to achieve complete transparency in monitoring, recording and calculating reduction in CO_2 emissions.

(5) Sustainable Development:

The project activity will lead to sustainable development and promote sustainable Industrial growth by conserving natural resources and preventing the thermal pollution even though no such statutory requirement exists.

<u>Social well being</u>

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[1]The calculation of required quantity of steam from FBC boiler in case of non availability of WHR steam due to shut down of kilns is explained in Appendix - 1 to the PDD

[2] Maharashtra State Electricity Transmission Company Limited.

The project activity increases the employment within the company LMEL for skilled manpower and Professionals due to the installation of 5 no WHRBS and 1 no STG and other equipment. Skilled and unskilled labour will gain temporary employment while executing the project.
Maharashtra state is facing more than 5000 MW power shortage leading to power starvation and hence the project activity enables the state grid to bridge this gap by reduction in demand on grid as company generates electricity and supplies to grid for wheeling to end users.

Economical well being

The project involves investment of around 1300 million rupees and will involve more than 950 million rupees capital equipment purchase. Engineering industry will benefit and provide employment opportunity for professionals, skilled and unskilled people.
The state will generate revenue out of the manufacturing activities supported by the power generation and due to purchase of equipment for execution of project by way of Sales Tax; Excise Duty; Entry Tax etc.

Environmental well being

The Project activity is waste heat recovery based Power Plant by utilizing waste heat from flue gases coming from process and thus effectively saving environment of thermal pollution. In the absence of project activity flue gases would have been cooled in a scrubber by LMEL leading to water pollution as fly ash would pollute water. The project activity displaces power from fossil fuel based power of the grid and hence reduces CO_2 emission. In the absence of project activity LMEL would have let the hot gases into atmosphere or used a water scrubber to reduce the flue gas temperature. This is not useful use of heat and also leads to water pollution as cooling water gets mixed with ash coming with flue gases. The project activity eliminates the present wastage of water as water is put into drain after scrubber.

Technological well being

The Power generated by the project activity will be used for in house requirement of LMEL who is the waste gas generator without any T&D losses as the utility points are in the same premises and surplus power is supplied to grid/power trading company. This is significant as grid has more than 30% losses in its T&D.
The proposed project activity of power generation does not produce any ash. However ESP shall remove the ash coming with flue gases which will be collected in ash hopper. This ash will be given free of cost to cement plants & brick manufactures for further Economic benefit and use. The ash used for production of bricks replaces the fired clay bricks and reduces the air pollution caused by the conventional brick kilns due to the coal burning.

A.2. Location of project activity

A.2.1. Host Party

>> India

A.2.2. Region/State/Province etc.

>> Maharashtra, India

A.2.3. City/Town/Community etc.

>> Village: Ghugus, District: Chandrapur

A.2.4. Physical/Geographical location

>> The project activity is located within the industrial facility of Lloyds Metals and Energy Limited (Formerly known as M/s Lloyds Metals & Engineers Limited) is located at Plot No A 1-2. MIDC Area, village Ghugus about 25 KM from Chandrapur town and situated at Longitude 79^{0} 07' 15" E Latitude 19^{0} 56' 15" N. Nearest Railway station is Tadali.

A.3. Technologies and/or measures

>> The project activity may be principally categorised in category –1 Energy Industries (Renewable /non renewable) as per Scope of Projects activities enlisted in the "list of sectoral scopes and approved base line and monitoring "methodologies" on the website for accreditation of "Designated operational Entities".

The CDM PDD is based on approved methodology ACM0012 version 04.00 and sectoral scope; 01 & 04 EB 60"Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects".

The purpose of the project activity is to produce the electricity for captive consumption from available waste heat in waste flue gases at LMEL sponge iron manufacturing facility. The technology involved in project activity comprises of installation of 5 WHRB boilers for existing 1 x 500 TPD and 4 x 100 TPD sponge iron kilns to produce the 25 MW waste heat recovery power.

In pre-project scenario, waste flue gases released from ABC (After Burning Chamber) of existing 1 x 500 TPD kiln and existing 4 x 100 TPD DRI (Direct Reduction Iron) sponge iron kilns in the manufacturing process of sponge iron of LMEL were passed through water scrubber. The heat

contained in waste gases was transferred to water in water scrubber and thus reduces the flue gas temperature before letting them out into atmosphere through ESP. Hence the heat contained in the flue gases was completely wasted. The equipment list in operation in pre-project scenario is as follows.

S.N.	Equipments in Operation in Pre-project scenario	Reference document
1.	1 x 500 TPD Sponge Iron Kiln	Rapid Environment Report June 2005 of M/S Eco Engineers and Consent to operate letter dated BO/Wardha/RONR/R/C-388 Dated: 12-05-1997
2.	4 Numbers of 100 TPD Kilns	Rapid Environment Report June 2005 of M/S Eco Engineers and Consent to operate letter dated BO/PCI-II/RONG/EIC No. NG-0475-05/O/CC-138 Dated 20-02-2006
3.	Gas Conditioning Tower (Water Scrubber) for each kiln	Rapid Environment Report June 2005 of M/S Eco Engineers and above referred consent letters.
4.	Electrostatic Precipitators (1 no independent for each 100 TPD kiln and 1 number for 500 TPD kiln)	Rapid Environment Report June 2005 of M/S Eco Engineers and above referred consent letters.

The project activity is 25 MW waste heat recovery based power generation from waste flue gases which were initially treated in water scrubber in absence of project activity. The technical specification of Power Plant equipments installed in project facility is as follows.

1) *The Waste Heat Recovery Boilers (WHRB):*
A separate WHRB is provided for each kiln with specifications given below. There will be total 5 WHRBs as there are five kilns (4 numbers of 100 TPD and 1 number of 500 TPD).

PARAMETERS	WHRB Technical Data Values for each type of boiler	
Capacity tonnes/hr Max	12.7	58.4
Rated Capacity tonnes/hr	12	55
Steam pressure kg/cm2 a	70	70
Steam temperature deg c	490	490
Flue gas flow rate N m3/h	27000	120,000
Flue gas inlet temperature deg c	1000	1,000
Flue gas outlet temperature deg c	180	180
Boiler feed water temperature deg c	140	140
Sponge iron kiln number	4	1
No of boilers	4	1
Sponge iron kiln capacity TPD	100	500
Design Efficiency of boiler as per ERK data sheets	81.51%	82.8%
Manufacturer	Lloyds Steel Industries Ltd Engineering division	Lloyds Steel Industries Ltd Engineering division

2) *Steam Turbine Generator:* Project activity has set up one 30 MW steam turbine along with water cooled steam condenser and ejector system. Make of turbine: Qingdao Jieneng Power Station Engineering Co Limited, China which generate power at 11 KV.

3) *Auxiliary Equipments:* Auxiliary equipment to power plant comprise of one cooling tower with circulating water pumps, boiler feed water pumps and deaerator, all interconnecting piping with

valves, control systems like DCS for all 5 WHRB boilers and one 90 TPH FBC boiler and power evacuation systems for connecting to grid at 220 KV level.

Project facility already has the 2 X1010 KVA DG generating systems in the pre project scenario. This will continue to exist to take care of situation of power plant shut down but expected generation is negligible.

The power generated by the project activity shall be used by LMEL to meet their electricity requirements and surplus will be supplied to MSEDCL grid that will wheel the electricity to the consumers of power trading company. LMEL have entered into agreement with licensed power trading company M/s Indrajit Power Technology Private Limited for selling 15 MW surplus power.

Post project power consumption scenario is presented in following table.

1.	Existing connected machinery load	3.5 MW
2.	Power plant auxiliary consumption	2.5 MW
3.	**Total power requirement**	**6.0 MW**
4.	Expected power generation	= 30 MW * 70% PLF = 21 MW
5.	Expected surplus before expansion	**15 MW**

WHRB based Power Plant of LMEL is proposed to utilise the heat content of flue gases coming out of each ABC of existing 4 numbers of 100 TPD kiln operating since February 2006 and existing 1 number 500 TPD sponge iron kiln operating since September 1995 during sponge iron manufacturing process at LMEL. The waste heat recovery boilers are based on designs of ERK Eckrohrkessel GmbH, Germany and the licence to manufacture these boilers is with Lloyds Steel Industries Ltd Engineering division. The process technology transfer is complete. The technology is environmentally safe and abides by all boiler regulation.

The exhaust flue gases equivalent to 120,000 Nm3/h at optimum conditions from one 500 TPD rotary kiln and 26,000 Nm3/h at optimum condition from each of 4 x 100 TPD sponge iron manufacturing rotary kilns is received at individual ABC where the atmospheric air is injected and gases are completely combusted in kilns. The waste gases thus formed reaches temperature up to 1000 ^{0}C . No auxiliary fuel is fired in ABC. The generated quantity and the temperature of flue gases are influenced by a number of operating parameters of the sponge iron plant.

At the rated operating levels this waste heat of waste gases from 500 TPD kiln shall produce 55 tonnes/h of steam in one boiler and like wise waste heat from waste gases coming from 4 x 100 TPD kiln will produce 12 tonnes/h of steam at 70 kgs/cm2 abs pressure and 490±5^{0}C temperature from each of the 4 number boilers. The total steam generated is 103 tonnes/h at rated conditions. No auxiliary fuel is used in the boiler. WHRBs are designed only for waste heat recovery.

The WHRB is of single drum water tube with radiant chamber, along with convective super heater, attemperator, economiser and hoppers for ash collection as ash comes with flue gases.

The outlet boxes of the WHRBs, leads to ESPs to remove SPM from exhaust gases. The exhaust gas temperature shall be kept lower than 180^{0}C. The feed water temperature will be maintained at the inlet to economiser 140^{0}C.

The high pressure steam from each WHRB will be taken to a common header which also receives 20 tonnes/h steam from coal based FBC boiler and total 122.4 tonnes/h used to operate high efficiency extraction cum condensing multi stage STG to generate 30 MW electricity. Rated capacity of FBC boiler is 90 tonnes/h. However the FBC steam will be only 122.4 TPH minus steam generated from WHRBs. Fuel will be coal and dolachar and coal rejects which are by products of sponge iron kiln operation. The rated capacity of 90 tonnes/hr for FBC boiler is kept to take care of situation when 500 TPD kiln and one 100 TPD kiln goes for shut down simultaneously which will lead to a situation

of availability of only 36 tonnes/hr of WHRB steam for power generation. Therefore the shortage of 86.4 tonnes/hr of steam (122.4-36) will occur for power generation which will lead to turbine not being operated healthily.
Steam from FBC boiler is taken to common header to take care of situation of variations in waste gas quantity and quality for ensuring proper working of STG.

Technical Specification of steam turbine are as follows:

Type	Multi Stage Condensing
Rated capacity	30 MW
RPM	3000
Steam inlet flow	122.4 Tonnes/h
Steam pressure	65 kg/cm2a
Steam temperature	490 +/- 5 deg C
Exhaust steam pressure	0.1 ata
Make	Qingdao Jieneng Power Station Engineering Co Limited, China

Ash collected from WHRB hoppers & ESP will be conveyed pneumatically to ash silo. Other systems required are circulating water pumps, Demineralised water plant, Instrument air compressor and exhaust steam condenser. Steam from exhaust of STG rotor will be condensed in water cooled condenser. Only DM (De Mineralised) water will be used in boiler to avoid scale formation on boiler tubes. Total waste water is recycled and reused after treatment. The technology is environmentally safe and abides all legal norms and standards for SPM emissions. No supplementary fuel is used in WHRB.

(1) <u>Age and average life time of equipment, PLF expected</u>:

As this is new project activity all the equipment are new. Expected average life time is 15 years. As the project proponent is new to power plant technology, LMEL expects to operate at 70% PLF in first year and achieve 80% PLF in subsequent years of power generation. The waste heat recovery power generations depends entirely on steam generation in WHR boilers which depend on flue gas temperature and flow rate. These factors vary according to sponge iron kiln operations which is dependant on many factors.

(2) <u>How emission reductions are achieved:</u>

The reduction in CO_2 emission from facility of the project arises from the displacement of an equivalent amount of electricity to the extent of electricity generated from project activity This electricity would have been otherwise generated and supplied by grid which is mainly dependant on fossil fuel based power plants.

(3) *<u>Other activities out side the boundary:</u>*

The sponge iron kilns which provide flue gases are not in the project boundary as they are manufacturing sponge iron which is the product of the company. No other product is manufactured in the facility. Flue gases containing waste heat are generated during the manufacturing process.

(4) *<u>Supplemental electricity:</u>* Project activity does not use any supplemental electricity.

(5) *<u>Base line Scenario:</u>*

The baseline scenario has been identified in section B.4 by following 3 steps given in approved methodology ACM0012 version 4. For LMEL who is also a recipient facility of generated electricity, the option of coal based captive power plant is the cheapest and the same is the most appropriate baseline P8 scenario. The surplus power from project activity is exported to MSEDCL grid to wheel it to power trading company who in turn supply it to their consumers by wheeling electricity through grid. In this case the appropriate baseline scenario for other consumers of power is generation and sourcing of equivalent power from grid, (scenario P10). Therefore as per step 3 of the baseline identification section of ACM0012 version 4, the most conservative baseline scenario in terms of baseline emissions is generation and sourcing the power from grid. Hence the baseline scenario P10 is selected as baseline for the project activity i.e. power generation from grid.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host) Ministry of Environment and Forest	M/s Lloyds Metals and Energy Limited. (Private entity) (Formerly known as M/s Lloyds Metals & Engineers Limited.)	No

A.5. Public funding of project activity

>> No public funding from parties included in Annex-I is available for the project activity. No ODA funds are used in project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

>> Title of approved methodology: “Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects”

Methodology No &Version : ACM 0012, Version 04.0.0, Sectoral Scope: 1&4 EB 60

Tools ACM 0012 draws upon :
(1) “Tool for the demonstration and assessment of additionality” (Version 06.0.0) EB 65.
(2) “Tool to calculate the emission factor for an electricity system” Version 2.2.1, EB 63.
(3) “Tool to determine the baseline efficiency of thermal or electric Energy generation systems” Version 1 EB 48
(4) “Tool to determine the remaining lifetime of equipment” Version1 EB 50
(5) “Tool to calculate project or leakage of CO_2 emissions from fossil fuel combustion” Version 2 EB 41

B.2. Applicability of methodology and standardized baseline

>> The consolidated methodology is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried in identified WECM stream(s) into useful energy.

Applicable conditions of Methodology	How the project activity meets the conditions
The WECM stream may be an energy source for: (1) Generation of electricity; (2) Cogeneration; (3) Direct use as process heat source; (4) Generation of heat in element process; (5) Generation of mechanical energy; or (6) Supply of heat of reaction with or without process heating.	The project activity is for using WECM stream i.e. flue gases coming out of ABC of sponge iron kilns for generation of electricity by recovering waste heat. Therefore this applicability condition is met.
In the absence of the project activity, the WECM stream: (a) Would not be recovered and therefore would be flared, released to atmosphere, or remain unutilized in the absence of the project activity at the existing or Greenfield project facility; or (b) Would be partially recovered, and the unrecovered portion of WECM stream would be flared, vented or remained unutilized at the existing or Greenfield project facility.	In the absence of project activity the WECM stream i.e. flue gases coming out of ABC of sponge iron kilns would not be recovered and therefore would be released to atmosphere. LMEL who generate WECM i.e. flue gases coming out of ABC of sponge iron kilns presently use scrubber where the temperature is brought down by water which is then put in drain and then gases released to atmosphere through ESP. Hence waste heat is being released to atmosphere. Therefore this applicability condition is fulfilled.
Project activities improving the WECM recovery may (i) capture and utilize a larger quantity of WECM stream as compared to the historical situation in existing facility, or capture and utilize a larger quantity of WECM stream as compared to a “reference waste energy generating facility”; and/or (ii) apply more energy efficient equipment to replace/modify/expand waste energy recovery equipment, or implement a more energy efficient equipment than the “reference waste energy generating facility”.	In pre project scenario there was no recovery of heat from WECM i.e. flue gases coming out of ABC of sponge iron kilns and were being released to atmosphere after passing through scrubber, thereby heat was wasted. The project activity is new facility within the premises of LMEL and uses 100% of flue gases coming from 4x100 tpd and 1x500 tpd kilns by providing a separate WHRB for each kiln for power generation. Therefore this applicability condition is fulfilled.
For project activities which recover waste pressure, the methodology is applicable where waste pressure is used to generate electricity only and the electricity generated from waste pressure is measurable;	Project activity uses only waste heat from waste gases to generate electricity. Hence this paragraph is not applicable.

Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity.	Regulations do not require LMEL to recover and/or utilise the waste energy prior to the implementation of project activity. Consent to operate for 500 TPD kiln as received from Maharashtra Pollution Control Board (MPCB) also does not mandate to recover the waste heat The reference of consents are as follows. A) 1x500 TPD Sponge iron kilns Consent to operate letter dated BO/Wardha/RONR/R/C-388 Dated: 12-05-1997 B) Renewed consent to operate by MPCB with reference number BO/RONR/CHANDRAPUR-23/R/21-03/CC-89 dated 07/05/2003 valid up to 31/12/2007. C) Consent to Operate from MPCB for 4x100 TPD Sponge iron kilns with reference number BO/PCI-II/RONG/EIC No. NG-0475-05/O/CC-138 Dated 20-02-2006 also does not mandate to recover the waste heat for power generation for 100 TPD kiln size. Further additional Consent to Operate from MPCB for 4x100 TPD Sponge iron kilns with reference number BO/PCI-II/RONG/EIC No. NG-0475-05/O/CC-87 Dated 27-12-2006 also does not mandate to recover the waste flue gases for power generation. Therefore this applicability condition is fulfilled
The methodology is applicable to both Greenfield and existing waste energy generation facilities. If the production capacity of the project facility is expanded as a result of the project activity, the added production capacity must be treated as a Greenfield facility	The sponge iron kilns are in existing facilities generating the waste flue gases and operating prior to implementation of project activity. The details are as under: A) 1x500 TPD Sponge iron kilns Consent to operate letter dated BO/Wardha/RONR/R/C-388 Dated: 12-05-1997. B) 4x100 TPD Sponge iron kilns. The consent to operate is the date of commercial production start date. Consent to operate letter dated BO/PCI-II/RONG/EIC No-0475-05/O/CC-138 Dated 20-02-2006. The production capacity of the project facility remains same in presence of project activity. Therefore this applicability condition is fulfilled.

Waste energy that is released under abnormal operation (for example, emergencies, shut down) of the project facility shall not be included in the emission reduction calculations.	The PDD does not take into consideration any waste gas released under abnormal conditions. The possible abnormal conditions are enlisted as per consent to operate received for the existing kilns as follows: The consent to operate of 20-02-2006 for 100 tpd kilns mentions the abnormal condition when the flue gases are let into atmosphere through top of ABC (A) Process disturbance i.e. kilns are shut down (B) Non-functioning of kiln off gas system. i.e. Failure of boilers The abnormal conditions may be faced if there is boiler shut down with kiln operating and under such condition the waste flue gases are released directly to atmosphere through the top of ABC chamber. No steam is generated and hence electricity produced will be less if one or more of 5 WHRBs are affected. As the steam quantity is monitored from each WHRB to calculate the electricity generation due to waste heat, it ensures the waste energy released to atmosphere in this abnormal condition is not considered as no steam is generated in the concerned WHRB. 2) The abnormal condition of kiln shut down will result in no flow of waste flue gases and boiler shut down. No steam is generated and hence electricity produced will be less if one or more of 5 WHRBS are affected. As the steam quantity from each WHRB is monitored to calculate the electricity generation due to waste heat, it ensures the waste energy released to atmosphere in this abnormal condition is not considered as no steam is generated in the concerned WHRB. Therefore this applicability condition is fulfilled
If multiple waste gas streams are available in the project facility and can be used interchangeably for various applications as part of the energy sources in the facility, the recovery of any waste gas stream, which would be totally or partially recovered in the absence of the project activity, shall not be reduced due to the implementation of CDM project activity. For such situations, the guidance provided in Annex 3 shall be followed.	Each kiln produces single stream of WECM i.e. flue gases and was using water scrubber where the temperature was brought down by water which is then put in drain and then gases released to atmosphere for each stream. Hence waste heat was being released to atmosphere. There is no recovery of any heat before the project activity.

	In the project activity separate dedicated WHRBs are provided for each kiln for total recovery of waste heat. Therefore this applicability condition is fulfilled.
The methodology is **not** applicable to the cases where a WECM stream is partially recovered in the absence of the CDM project activity to supply the heat of reaction, and the recovery of this WECM stream is increased under the project activity to replace fossil fuels used for the purpose of supplying heat of reaction.	In pre-project scenario LMEL facility generating waste gases were using water scrubber where the temperature was brought down by water and then put in drain. The gases were released to atmosphere. Hence waste heat was being released to atmosphere. There was no recovery of any heat from waste flue gases before the project activity. Therefore this applicability condition is fulfilled.
This methodology is also **not** applicable to project activities where the waste gas/heat recovery project is implemented in a single-cycle power plant (e.g. gas turbine or diesel generator) to generate power. However, the projects recovering waste energy from single cycle and/or combined cycle power plants for the purpose of generation of heat only can apply this methodology.	Not applicable to project activity as steam is generated by recovering heat from WECM and steam is used in turbine to generate electricity. In pre-project scenario there was no single cycle power plant operating at project facility to meet the energy requirement.
The emission reduction credits can be claimed up to the end of the lifetime of the waste energy generation equipment. The remaining lifetime of the equipment should be determined using the latest version of the "Tool to determine the remaining lifetime of equipment".	The emission reductions are calculated for ten years. The life time given by manufacturers of boilers and turbine is 15 years and the project activity is a new project commissioned in 2011 after receipt of consent to operate from MPCB for operation of power plant. The reference number of consent to operate is BO/APAE/EIC No.CH-0214-10 & CH-0226-10/R/CC-299 dated 28/12/2010. Therefore this applicability condition is fulfilled.
The extent of use of waste energy from the waste energy generation facilities in the absence of the CDM project activity will be determined in accordance with the procedures provided in Annex 1 (for Greenfield project facilities) and in Annex 2 (for existing project facilities) to this methodology. As per Annex 2 it shall be demonstrated that the waste energy utilized in project activity was flared	In the absence of project activity the waste gases were passed through water scrubber and then let into atmosphere. The waste heat was not used for any purpose as water from scrubber was put into drain. This can be spot checked by DOE to establish that no equipment for waste heat recovery and use has been installed prior to the implementation of the CDM project activity. This is again proved by documentary evidence of EIA

or released into the atmosphere in the absence of project activity. This shall be proven by either one of the following 1) By direct measurements of energy content 2) Energy balance 3) Energy bills 4) Process plant manufacturer's original specifications 5) On site checks by DOE	Report of June 2005 for expansion of LMEL sponge iron generation facility. Electricity bills are made available to DOE to demonstrate that all energy required for the process has been procured from grid. The bills are part of audited balance sheets audited by competent authorities. This can be proved by annual report 2004-05, 2005-2006, 2006-07 mandatory Form –A disclosure.
In addition, the applicability conditions included in the tools referred in the methodology to apply: "Tool to calculate the emission factor for an electricity system"; "Tool for the demonstration and assessment of additionality"; "Tool to determine the baseline efficiency of thermal or electric energy generation systems"; "Tool to determine the remaining lifetime of equipment"; and "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".	1) Grid electricity emission factor calculated in line with the tool. 2) Section B.5 covers the tool applicability. 3) Base line is grid electricity and hence this tool is not applicable. 4) Life time of equipment is estimated as 15 years as per Manufacturer information for technical life for boilers and turbine in line with option (a) of the tool. 5) There is no supplementary fuel used .Hence this tool is not applicable. Therefore this applicability condition is fulfilled.

The project activity meets the applicability conditions set out in approved methodology. Hence it is concluded that the applied approved methodology ACM 0012 Version 04 is applicable for the project activity.

B.3. Project boundary

The project activity is for the recovery of waste heat from flue gases for generation of electricity in waste heat recovery based power plant. In line with methodology, the geographical extent of the project boundary shall include the relevant WECM stream(s), equipment and energy distribution system in the following facilities:

1) The "project facility" i.e. LMEL;
2) The "recipient facility (ies)", which may be the same as the "project facility" i.e LMEL where the portion of the electricity is used and power trading company with whom power purchase agreement is signed to whom surplus electricity is exported.

The spatial extent of the grid is as defined in the "Tool to calculate the emission factor for an electricity system".

The relevant equipment and energy distribution system cover:

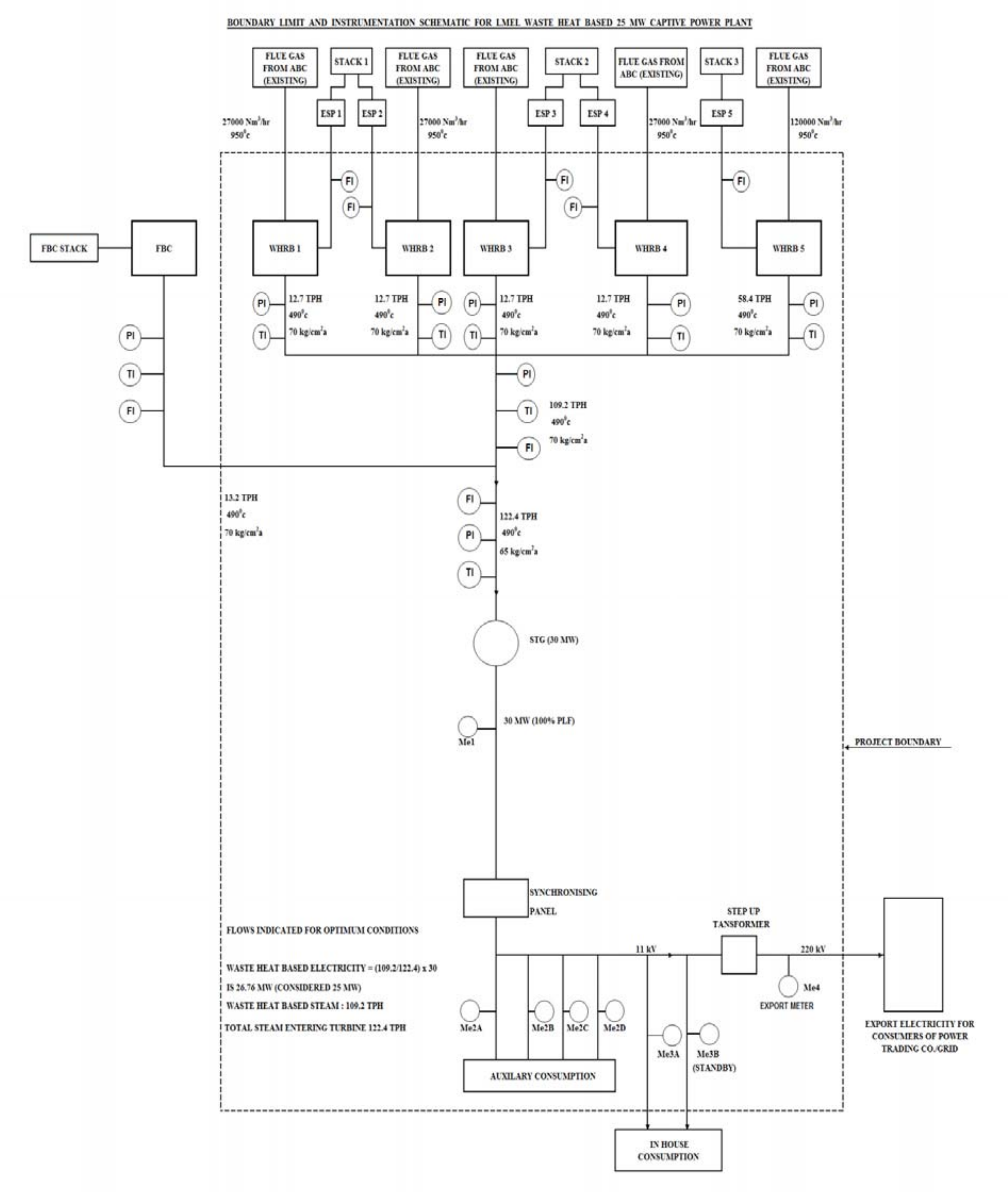
(1) In a project facility, the WECM stream(s), waste energy recovery and useful energy generation equipment, and distribution system(s) for useful project energy;

Accordingly the geographical extent of project boundary comprises of the WHRB, STG, Auxiliary equipment, Power synchronising system, steam flow piping, flue gas ducts, where project participant has full control.

Overview of emission sources included in or excluded from the project boundary is provided in Table 1

The project activity does not use any auxiliary fuel in the Waste Heat Recovery Boilers and no supplemental electricity is used in the project activity.

Schematic for project boundary and parameters are provided as below



Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Electricity generation, grid or captive source. *Applicable for project activity is the grid electricity.*	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption in elemental process for thermal energy	CO_2	Excluded	Not applicable as no fossil fuel is used in WHR boiler.
		CH_4	Excluded	Not applicable as no fossil fuel is used in WHR boiler.
		N_2O	Excluded	Not applicable as no fossil fuel is used in WHR boiler.
	Fossil fuel consumption in cogeneration plant	CO_2	Excluded	Not applicable as no cogeneration is done.
		CH_4	Excluded	Not applicable.
		N_2O	Excluded	Not applicable.
	Generation of steam used in the flaring process	CO_2	Excluded	Not applicable as no flaring is done.
		CH_4	Excluded	Not applicable.
		N_2O	Excluded	Not applicable.
	Fossil fuel consumption for supply of process heat and/or reaction heat.	CO_2	Excluded	Not applicable.
		CH_4	Excluded	Not applicable.
		N_2O	Excluded	Not applicable.
Project scenario	Supplemental fossil fuel consumption at the project plant	CO_2	Excluded	Not applicable as no fossil fuel is used in WHR boiler.
		CH_4	Excluded	Not applicable.
		N_2O	Excluded	Not applicable
	Supplemental electricity consumption	CO_2	Excluded	Not applicable as no supplemental electricity consumed
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable
	Electricity import to replace captive electricity, which was generated using waste energy in the absence of project activity.	CO_2	Excluded	Not applicable as no captive electricity was generated using waste energy in the absence of project activity.
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable

	Energy consumption of gas cleaning.	CO_2	Excluded	Not applicable as the project activity does not involve energy consumption for the gas cleaning. Flue gases after recovering the waste heat in WHRBs are sent to atmosphere via ESP.
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable

B.4. Establishment and description of baseline scenario

>> ***<u>Identification of the baseline scenario</u>***

The baseline scenario is identified as the most plausible scenario among all realistic and credible alternatives. As the project activity is to generate electricity by utilization of the waste heat from flue gases, the realistic and credible alternatives should be determined for:

(1) Waste energy use in the absence of the project activity
(2) Power generation in the absence of the project activity for each recipient facility if the project activity involves generation for that recipient facility.

While determining the baseline scenario the project participant shall identify the realistic and credible alternatives to the project activity, which would provide output equivalent to combined output of all the components of project activity. Therefore the alternatives should provide the same power output as in the project activity and should include the alternate use of the waste gas heat utilised in the project activity.

The project activity generates only power as useful energy. Hence the realistic and credible alternatives for power generation are identified in step 1.

STEP 1: Define the most possible baseline scenario for the generation of electricity using baseline options and combinations.

The baseline candidates should be considered for following facilities

(1) For the waste energy generation facility where the waste energy is generated i.e. LMEL; and

(2) For the recipient facility (ies) where the energy is consumed i.e. LMEL; and surplus electricity is exported to power trading company who in turn sell the power to the varied different consumers as per demand who are mainly dependant on grid electricity. Hence baseline remains grid for these consumers.

The project activity is executed in the existing facility without changing existing production capacity. Hence baseline study has been carried for project proponent LMEL.

A) For the use of waste energy the realistic and credible alternatives are as follows:

Baseline options	Realistic and credible alternative	LMEL
W1	WECM is directly vented to atmosphere without incineration.	**Not applicable.** Waste flue gases contain only waste heat. No incineration is possible. LMEL who generate waste gases in pre-project scenario were using water scrubber where the temperature is brought down by water by evaporative cooling and then gases released to atmosphere. Hence

		waste heat is not being released directly to atmosphere.
W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released (or vented) to atmosphere or waste gas pressure energy is not utilized.	Waste flue gases contain only waste heat. No incineration is possible. LMEL facility generating the waste gases were passing them through water scrubber where the temperature is brought down by evaporative cooling and then gases released to atmosphere. Hence waste heat is being released to atmosphere is applicable clause from applicability condition.
W3	Waste energy is sold as an energy source.	**Not applicable.** Waste flue gases containing waste heat are generated in manufacturing process of sponge iron and have low pressure and hence can not be transported long distance to different premises. The waste heat utilisation has to be immediately after the exit from kiln ABC i.e. after burning chamber. There is no demand for such waste heat in house and in neighbouring industry and hence waste gases were cooled in a gas cooler before letting out into atmosphere. ERK Eckrohrkessel GmbH data sheets indicate the low flue gas pressure and EIA Report June 2005 for gas cooling can be treated as documentary evidence for not selling the waste gas.
W4	Waste energy is used for meeting energy demand at the recipient facility.	**Not applicable.** LMEL does not have any use of waste heat in their sponge iron manufacturing process. In the absence of project activity waste energy would not have been used in any form to meet any sort of energy demand.
W5	A portion of the quantity or energy of WECM is recovered for generation of electricity energy, while rest of the waste energy produced at the project facility is flared/released to atmosphere/ unutilised.	**Not applicable** as 100% waste heat containing gases will be used for the project activity.
W6	All the waste energy produced at the industrial facility is captured and used for export electricity generation.	**Not applicable** as all the waste gases from the industrial facility of 5 kilns is utilized in WHR boiler and steam is used for production of electricity. Project activity is captive power project which fulfils first the captive requirement of 3.5 MW and only surplus power generated is exported to grid. There is no requirement to produce the extra power only for export purpose. Project activity is undertaken as surplus quantity of waste heat is available in flue gases to produce the power than captive requirement.

Out come : Out of the scenarios discussed above only scenario "W2" is applicable as base line for waste gases. In the absence of project activity the flue gases coming out of ABC of kiln would be taken to scrubber to bring down the temperature. Cooled flue gases would be let out into atmosphere through ESP and chimney. This is the business as usual scenario since LMEL's start of commercial production.

B) For power generation the realistic and credible alternatives are provided in following table.

Baseline options	Realistic and credible alternative	LMEL
P1	Proposed project activity not undertaken as a CDM activity.	This is possible option and applicable for further analysis.
P2	On –site or off-site existing fossil fuel fired cogeneration plant	**Not applicable** as the project activity is not for cogeneration as no steam requirement is there in the manufacturing of sponge iron.
P3	On site or offsite Green field fossil fuel fired cogeneration plant.	**Not applicable** as the project activity is not for cogeneration as no steam requirement is there in the manufacturing of sponge iron.
P4	On –site or off-site existing renewable energy based cogeneration plant	**Not applicable** as the project activity is not for cogeneration as no steam requirement is there in the manufacturing of sponge iron
P5	On –site or off-site Green field renewable energy based cogeneration plant	**Not applicable** as the project activity is not for cogeneration as no steam requirement is there in the manufacturing of sponge iron
P6	On –site or off-site existing fossil fuel based existing identified captive power plant	**Not applicable.** There is no fossil fuel based captive power plant existing at site or off-site and the electricity is sourced from grid.
P7	On-site or off-site existing identified renewable energy or other waste energy based captive power plant	**Not applicable.** There is no existing captive power plant based on renewable energy at project site or off-site. In pre-project scenario, the electricity requirement is fulfilled from the grid.
P8	On-site or off-site Greenfield fossil fuel based captive plant	Presently there is no green field fossil fuel based captive power generation. LMEL also have the option of putting captive power plants based on other fossil fuels **1.New power plant based on Diesel oil as alternative fuel** A power plant based on diesel oil/ furnace oil can be installed. The Diesel or any Petroleum Fuel based Power Plants are not feasible because of highly fluctuating rates and higher cost of generation, than the coal based power plant's power cost and even grid power cost. Also this option will add GHG gas emissions to the

		existing scenario. Hence this option is not economically feasible. This option meets all legal/statutory requirements. **2. New power plant based Gas as alternative fuels** Natural gas is not available in this area and hence ruled out as plausible fuel option for generation of power. **3. New power plant based on coal as alternative fuels** Coal is abundantly available fuel as the project activity lies within the coal belt. In addition LMEL will be generating approximately 48000 tonnes of char/dolachar which can be used. The generating cost of coal based power plant will be lower and generation will be regular and achieves more than 90 % PLF. There is no legal compulsion for Sponge Iron Plant to set up the captive power generation or to setup a waste heat recovery system. In addition to this there is also no restriction to generate own power through a power plant based on 100 % Coal or based on coal mixed with Char/ Dolachar. The consent to operate of 20/02/2006 100 tpd kilns encourages the use of char to generate power and as char is of low calorific value the same has to be mixed along with fresh coal. Hence Coal, Char/Dolachar based captive power plant is economically most attractive. This option meets all legal/statutory requirements. Hence coal based captive power plant can be one of the base line option for LMEL and considered further for evaluation of baseline scenario for the project activity.
P9	On-site or off-site Greenfield renewable energy or other waste energy based captive plant	**Not applicable** as there is no captive power plant existing based on renewable energy or other waste energy and in pre-project scenario, electricity is sourced from grid. LMEL do not have any future plans to establish power plant based on renewable sources.
P10	Sourced from grid-connected power plants	**Applicable.** Presently LMEL electricity requirement is met by MSEDCL grid since 1995. Continuation of using grid electricity is continuation of business as usual scenario. for LMEL. The surplus power

		generated by LMEL to the tune of 15MW is exported to the grid and wheeled to consumers. Since the power generated in the grid comes through a predominance of connected power plants, this option is feasible.
P11	Existing captive electricity generation using waste energy (if project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency or lower recovery than the project activity)	**Not applicable** as there is no existing captive electricity generation using waste energy. However lower efficiency alternative is not feasible as all the waste heat from flue gases have to be removed down to acceptable 180 ^{0}C temperature as per ESP requirements. The flue gas temperatures lower than 169 ^{0}C and higher than 250 ^{0}C will damage ESP. This fact is supported with ESP manufacturer specifications and letter regarding the minimum temperature gases to be passed through ESP to be above169^{0}C to avoid acid condensation. Hence flue gases temperature of 180 ^{0}C is maintained via ESP. Supporting document has been provided to DOE.
P12	Existing cogeneration using waste energy but at a lower but a lower efficiency or lower recovery.	**Not applicable** as the project activity is not for cogeneration as no steam requirement is there in the manufacturing of sponge iron
<u>Outcome:</u> From the above analysis of alternatives for power generation, following are the realistic and credible options for LMEL: P1 - The project activity without CDM consideration. P8 - Coal based power plant P10 - Continuation of use of grid power which is business as usual scenario since 1995		

As no mechanical energy is produced the alternatives for the same have not been analysed.

STEP 2: Step 2 and/or Step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" shall be used to identify the most plausible baseline scenarios by eliminating non feasible options (e.g. alternatives where barriers are prohibitive or which are clearly unattractive).

The following are credible options as discussed above
(1) P1: Project activity without CDM consideration
(2) P8: Putting coal based captive power plant.
(3) P10: Continuing to use grid power which is business as usual.

The following table gives the economic analysis i.e. Levelized cost of power generation for the remaining most credible and plausible options.

1) The assumptions for calculating financials for WHRB power have been provided in B.5 and excel spread out of financial calculations are also provided to DOE for IRR and levelized cost.

2) The assumptions for coal based electricity are same as that of 25 MW waste heat based power generation project activity. The capital cost is based on the available data provided in the offer of project power plant referred in B.5. Excel spread sheet has been provided to DOE.

3) The grid power cost is based on the actual electricity bills from February 2006 up to October 2006 as explained in B.5.

Baseline for LMEL.

Economic Indicator	**Project activity without CDM consideration. (Option P1)**	**Coal based power plant (Option P8)**	**Grid Power (Option P10)**
Project Cost (Million Rs.)	1477	1156	Nil
Levelized power cost (Rs/kWh)	2.80	2.21	3.77

It is observed from above table that Option P8 is the cheapest in terms of per unit cost of power generation. However selecting option P8 as baseline will not be easy option considering the following facts and Option P10 may continue to be baseline option for LMEL due to the following reasons.

1) LMEL is using grid electricity which is continuation of business as usual scenario since 1995 and requires no investment. Continuing with grid power would have remained an attractive base line option as the generation of 25 MW power by utilizing the waste heat in 5 WHRBs requires large investment of Rupees 1477 Million. In case of coal based power plant the investment requires to the tune of Rupees 1156 Million. Hence it would not be a viable option as LMEL had existing alternative of grid import to meet captive demand and waste gases were sent to atmosphere after passing through water scrubbers. This practise meets the legal requirements since 1995.

2) LMEL has incurred losses when the steel industry faced acute recession a few years back. The company has accumulated losses and is under BIFR (Board of Industrial and Financial Restructure) with debt restructuring of liabilities. The corresponding documentary evidences are provided to DOE. Hence the company faces the financial barrier due to the non availability of fresh funds to carry out expansion activities both from financial institutes and equity market.

LMEL took the decision to go ahead with the project after considering CDM benefits and possible income due to excess electricity supplied to grid. Further there is saving in terms of avoidance of grid power purchase due to project activity. In the absence of CDM benefits alternative P10 remains a strong baseline option for LMEL as it involves no investment at all.

Baseline for other recipients:

The maximum captive power consumption of LMEL based on the last 3 years data is 24.433877 Million units per year which approximately works out to 3 MW. The surplus power generated by project activity is 15 MW which is exported to power trading company by wheeling it through grid who further supply it to other recipients. It is assumed that once the power is injected in the grid it is indistinguishable at user end as to where it comes from. Further the purchase of grid power by end consumer implies that they rely on grid power and grid becomes one of the baseline alternatives for other recipients also. Hence P10 will continue to be baseline option for other recipients as it is business as usual scenario requiring no investment.

Hence both P8 and P10 are retained for analysis in Step 3 below.

STEP 3: If more than one credible and plausible alternative scenario remain, the alternative with the lowest base line emissions shall be considered as the most likely baseline scenario.

As per step 3 if more than one credible and plausible alternative scenario remains, the alternative with the lowest base line emissions shall be considered as the most likely baseline scenario.

1) Grid emission factor is 0.8032 t CO_2/MWh. Please refer section B.6.3 below for calculation of emission factor of NEWNE grid.

2) Coal based CPP emission factor 1.04 t CO_2/MWh based on CO_2 Database Version 4 of October 2008.

Hence we select **grid power P10** as the most likely **baseline scenario for the project activity.**

Table 2: Combinations of baseline scenarios applicable under different project situations to which this methodology is applicable

Baseline Scenario	Combination of baseline scenarios		Description of project activity
	Waste energy	Power	
Project activity: Separate generation of electricity.			
Baseline scenario-1 (1) The total or part of waste energy of WECM(s) recovered in the projects is released to atmosphere/flared/unutilised; (2) The electricity is obtained from grid.	W2	P10	Situation-1 Independent generation of electricity.

The MSEDCL grid power is being used by LMEL. We select NEWNE grid electricity of which MSEDCL is a part and hence NEWNE grid electricity emission factor used to calculate baseline emission reductions will give conservative reduction in base line emissions as grid power is mainly coal based but also comprises of diesel, hydel and nuclear power which will give lower emission factor for grid compared to independent coal based power plant.

In line with methodology emission factor will be calculated as per Tool to calculate the emission factor for an electricity system version 2.2.1 EB 63.

The methodology requires to demonstrate the additionality of project activity using the "latest version of Tool for demonstration and assessment of additionality". Additionality of project activity is demonstrated using the "Tool for demonstration and assessment of additionality version-06.0.0 EB 65'' In Section B.5

Key Information and data used to determine the baseline scenario
Government of India, Ministry of Power, Central Electricity Authority have issued "CO_2 Baseline Data base for the Indian Power Sector". This document along with CO_2 Data base excel calculations are available on web site http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
The document provides CO_2 emission factor for all grids, which has been calculated in line with Tool to calculate the emission factor for an electricity system version 02.2.1 and we have used emission factor for NEWNE grid to calculate our baseline reductions.
These data are given in Annex-3 under Base line information (Baseline calculations)

B.5. Demonstration of additionality

It is required to describe how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of registered CDM activity. The proposed CDM project activity is designed to generate power from the waste heat in the flue gases emitting out of an established industrial manufacturing process i.e. ABC of Sponge Iron Kiln of LMEL. Whereas in the absence of the proposed project activity power requirement would have been met by continuation of pre-project scenario i.e. importing power from grid.

It is required to explain how and why the proposed project activity is additional and therefore not the baseline scenario in accordance to the selected baseline methodology.

We have discussed realistic and credible alternatives available to project activity in B.4 and have come to conclusion that credible option P10 i.e. Grid electricity is the most realistic and credible baseline. We hereby proceed to establish the additionality of proposed project activity using "The tool for the demonstration and assessment of additionality" (version 06.0.0) EB 65.

As per the guidelines for PDD preparation it is needed to demonstrate the serious consideration of CDM benefits if the starting date of project activity is before 02/08/2008.

The board discussed in detailed manner regarding CDM benefits during the board meeting of 28/10/2006. We give below the Summary of the board meetings.

(1) The problem of power cuts and resulting production losses was discussed in the meeting.

(2) LSIL (Lloyds Steel Industries Ltd) who is technology supplier made presentation before the Board that waste heat available in flue gases from 5 kilns can generate more than 25 MW. LSIL suggested that one 25 MW Siemens make STG is available readily and the same can be used in captive power plant. The steam required will be generated from 5 WHRBS at optimum conditions.

LSIL informed the board regarding CDM and the fact that a project of WHRB based CPP from Chattisgarh state has been registered with CDM EB for availing CDM benefits. LSIL suggested that company can apply for CDM registration and CDM benefits would make WHRB project viable. After board deliberations it was decided to establish WHRB based captive power plant and apply for CDM benefits. Board also appointed LSIL as consultant for CDM activities.

The board also took note that the company has received consent for expansion in February 2006 for establishing additional 4x100 tpd kilns and LSIL informed the board that

(1)As and when these additional 4 kilns are installed by the company and they can be provided with the additional 4 number WHRB (from expansion of sponge iron production by adding 4x100 TPD kilns for which consent to establish received in February 2006) steam will improve the PLF of CPP. Alternatively a new turbine can be added for use along with existing turbine to increase the electricity generation at a later date.

(2) High project cost due to 9 (5 existing +4 additional boilers that will be provided when expansion activity of 4 additional kilns is completed) boilers and instead only putting one coal based FBC boiler based captive power plant was discussed in detail.

The present project activity is for 5 boilers provided on existing 5 kilns capable of giving 103 tonnes/h steam required for 25 MW electricity generations.

The extracts of the board meeting will be made available to DOE.

Following is the implementation time line of the project activity and also time line of events and actions which have been taken to achieve CDM registration.

Time line of activities for Project activity and CDM Registration

Time Line of activities for project activity	
Board resolution date	28/10/2006
Project start date is taken as order placement date on power plant supplier.	15/03/2007
Release of contract for Design, Engineering, Manufacture, Supply and commissioning	15/03/2007
Release of Turbine order	15/05/2007
Release of electrical equipment order	19/10/2007
Release of order for DCS	18/01/2008
Release of cooling tower order	04/02/2008
Mechanical completion	October 2010
Commissioning	November-December 2010
Receipt of consent to operate from MPCB	The consent to operate has been received in January 2011 by Maharashtra Pollution Control Board (MPCB) by their letter BO/APAE/EIC No CH-0214-10 &CH-0226-10/R1/CC-299 Dated 28/12/2010.

Time line of events and actions for CDM Registration	
Board resolution date	28/10/2006
Appointment of CDM consultant	15/01/2007
Application for host country approval	17/01/2007
Meeting of CDM Authority	26/02/2007
Appointment of DOE	17/01/2007
Web hosting of PDD as per ACM 0004	25/01/2007
Web hosting of PDD as per ACM 0012	05/10/2007
Re web hosting of PDD as per ACM 0012	24/07/2008
Reapplication for host country approval	08/10/2008
Meeting of NCDMA	19/01/2009
CDM process kept under hold as environment clearance and Hence HCA not available on advice of DOE	04/03/2009
Correspondence with NCDMA	Letter of 05/04/2008 E mails between07/05/2008 to 14/09/2009
Environment clearance	SEAC Minutes of Meeting took place on 30/09/2009 and Clearance letter issued dated 12/10/2009
Reappointment of DOE	14/10/2009
PDD Re web hosting	24/10/2009
NCDMA meeting	23/11/2009
HCA (Host Country Approval)	12/01/2010

Chronological events of environment approval

(1) Application for environment clearance to government of India 12/03/2007

(2) Application for environment clearance to government of Maharashtra 22/05/2007

(3) Application forwarded to Government of India Ministry of Environment & Forests as Maharashtra had not appointed expert appraisal committee in line with their letter dated 01/10/2007

(4) Meeting of expert appraisal committee for thermal power and coal mine projects 11/09/2007

(5) Clarification letter from Government of India Ministry of Environment & Forests 04/10/2007

(6) Submission of clarifications 23 /10/2007 and 06/03/2008

(7) Letter received from Government of India Ministry of Environment 04/04/2008 for clarification.

(8) Reply to The Director Thermal Power Committee Ministry of Environment 03/05/2008 giving required clarifications

(9) Appointment of State Environmental Appraisal Committee SEAC for thermal power and coal mine projects Government of Maharashtra Environmental department April 2008

(10) Return of our application by expert appraisal committee for thermal power and coal mine projects from Government of India Ministry of Environment & Forests to Government of Maharashtra Environmental department for environment clearance 16th June 2008 and advised approaching to State Level Assessment Authority. (SEAC)

(11) Letter submitted to the secretary, State Environmental Appraisal Committee SEAC on 18/06/2008

(12) Letter received from Government of India Ministry of Environment 27/11/2008 on transfer of the file

(13) State Environmental Appraisal Committee SEAC of Ministry of Environment to Government of Maharashtra Environmental department for environment clearance took our case on 24/03/2009, 29/07/2009 and finally on 30/09/2009 and accorded the environment clearance to the project activity.

(14) Receipt of environment clearance letter dated 12/10/2009

All copies of above referred letters as supporting documents will be made available to DOE.

The tool for the demonstrations and assessment of additionality (version 06.0.0) EB 65 Annex 21 requires the project participant to demonstrate and assess additionality, as per the steps given below:

(1) Step 1: Identification of alternative to project activity.
(2) Step 2: Investment analysis to determine that the project activity is either
    1) not the most economically or financially attractive, or
    2) not economically or financially feasible
(3) Step 3: Barrier analysis.
(4) Step 4: Common practice analysis.

STEP 1 - Identification of the alternatives to the project activity considered with current laws and regulations

Sub-Step 1.a Define alternatives to the project activity:

Identify realistic and credible alternatives available to the project participant that provide output comparable with outputs or services of proposed CDM project activity.

(a) Proposed activity undertaken without being registered as a CDM project activity;
(b) Other plausible and credible alternative scenarios;
(c) Continuation of current situation.

In step1, step 2 and step 3 the alternative options which are realistic and credible are discussed in B.5 and reproduced as follows:

(1) P1: Putting project activity without CDM benefits.

(2) P8: Putting coal based captive power plant.
(3) P10: Continuing to use grid power which is business as usual.

LMEL have come to the following conclusion.
(1) P1 option is ruled out due to the following reason:
LMEL has incurred losses when the steel industry faced acute recession a few years back. The company has accumulated losses and is under BIFR (Board of Industrial and Financial Restructure) with debt restructuring of liabilities. Hence the company faces the financial barrier due to the non availability of fresh funds to carry out expansion activities both from financial institutes and equity market.
Hence LMEL promoters had to arrange privately raised loans to undertake the project activity. These loans carry higher rate of interests compared to institutional loans. In the absence of CDM benefits the project activity could not be implemented as CDM benefits enable the promoters to convince private lenders on viability of the project activity. The equity IRR 7.39% is lower than the bench mark 18.2% and hence this option is economically unattractive.

(2) As coal based electricity cost is the cheapest the same is the most appropriate baseline P8 scenario. At the time of board resolution the consultant had made cost benefit analysis and informed the board of higher project cost for WHRB compared to FBC. It is most economical for LMEL to put up coal based captive power plant. Hence in the absence of project activity LMEL will put coal based captive power plant. Hence coal based captive power plant is the most plausible and credible alternative and LMEL would have decided to put coal based captive power plant in the absence of project activity.
The maximum captive power consumption based on the last 3 years data is 24.433877 Million units in a year which is approximately 3MW and surplus power is 15 MW exported to power trading company who supply the same to the other recipients by wheeling electricity through grid. Therefore this option P8 is considered further for assessment.

(3) However, no coal based power plant had existed prior to project activity. The power requirement of LMEL's industrial facility was being met from the grid in the pre-project scenario for a number of years since 1995. Also, grid power does not require a separate investment. Hence, it is more likely that the power in the baseline would be supplied by the grid than by a newly set up coal power plant, even though the per unit cost of electricity of the coal based plant is cheaper than the grid power cost. Also, the emission factor of the grid is lower than that of the coal based plant, which results in a more conservative baseline. Hence, grid power option P10 is considered as the most credible and plausible baseline.

Outcome of Step 1a: Grid electricity P10 option is identified as realistic and credible alternative to project scenario and hence is baseline of the project activity.

LMEL as a part of project activity have setup 90 TPH coal fired boiler which can independently supply steam to produce approximately 22 MW of power. It is to be noted that, this is one of the baseline alternatives itself and now is already part of project activity. However, 90 TPH FBC boiler was set up to take care of the situation when 500 TPD kiln and one 100 TPD kiln undergoes shut down simultaneously which will lead to a situation of generation of only 36 tonnes/hr of WHRB steam and shortage of 86.4 tonnes/hr of steam (122.4 TPH – 36 TPH) for power generation. This will lead to turbine not being operated healthily. Further LMEL will have to fulfil the commitment of exporting surplus firm power, as and when available, up to 15MW as per the PPA in continuous manner. Hence 90 TPH FBC coal fired boiler was required. This boiler will be operated on full load only in case of exigencies and power generation from this boiler will not be considered for emission reduction calculation purpose.
By setting up the 90 TPH boiler, an additional investment apart from the project activity, has been incurred by LMEL. This is because of the nature of the project activity. The financial analysis does not, however, consider the investment made in the 90 TPH boiler and only evaluates the investment in the waste heat recovery system. If the financial analysis were to consider the investment in the coal based boiler also, the internal rate of return will reduce further from the computed value of 7.39%.

Step 1.b Consistency with mandatory laws and regulations:
As per the requirement of additionality tool, the identified alternatives are in compliance with all mandatory legal and regulatory requirements.

Outcome of Step 1b: Identified alternatives are in compliance with mandatory legislation and regulations and EB decisions on national/or sectoral policies and regulations.

The additionality tool provides selection of one of the two options of step 2 or step 3 to prove additionality. The project proponent LMEL opts for step 2 i.e. investment analyses.

STEP-2 Investment analysis

This step is to determine whether the project activity is not:

a) The most economically or financially attractive
b) Economically or financially feasible, without the revenue from sale of certified emission reductions (CERS).

The following steps are given in the Tool for demonstration and assessment of additionality (version 06.0.0) EB 65. LMEL have opted to prove additionality by step 2

Sub step 2a Determine appropriate analysis method

In line with additionality tool, we select sub step 2b option III , Bench mark analysis of additionality tool.

As per paragraph 19 of "Guidance on the Assessment of Investment Analysis Version 05. EB 62": If the baseline scenario leaves the project participant no other choice than to make an investment to supply the same (or substitute) products or services, a bench mark analysis is not appropriate and investment comparison analysis shall be used. If the alternative to the project activity is the supply from grid this is not to be an investment and bench mark approach is considered appropriate.

Investment comparison analysis is selected for assessing the baseline of the project and for that Levelized cost is selected as financial indicator. Since the option P10 i.e. electricity sourced from the grid is selected as the baseline for the project activity (Please refer section B.4 above). Therefore in line with the above guidance, Bench Mark analysis has been done. Hence to demonstrate additionality we have calculated internal rate of return for the project activity and compared against benchmark. Therefore benchmark analysis selection is appropriate in line with investment guidelines.

Sub step 2b- Option III Bench Mark Analysis

The project participant proposes to use Option III – Benchmark Analysis. The financial indicator selected for the project activity is Equity IRR. Therefore cost of equity or (RoE) is selected as applicable benchmark for the project activity in line with paragraph 12 of guidelines on the assessment of investment analysis EB 62, Annex 5.

The Cost of Equity is determined by using the Capital Asset Pricing Model (CAPM) considering Beta values of listed power generating companies in India. The CAPM economic model is widely used to determine the required/expected return on equity based on potential risk of an investment. In line with the requirements of the para 15 of EB62, Annex5 ("Guidelines on the Assessment of Investment Analysis-Version 05") the data and parameters used in calculation of cost of equity i.e. beta values of power generating companies in India, risk free rate of return, market risk premium etc. have been derived based on conditions of the market that can be modelled, taking into account the history (time

series) of the market key variables (explaining variables proper of the technology and/or sector under analysis) and can be clearly validated by the DOE.

The detail calculation of Cost of Equity in-line with the CAPM model is explained below.

The formula used for calculating CAPM is as follows:

Ri= Rf + β (Rm-Rf)

where:

Ri = Rate of return on equity;
Rf = Risk-free rate of return;
B = Beta or systematic risk for this type of equity investment coefficient reflecting the volatility (risk) of the stock relative to the market,;
Rm = Expected market returns
(Rm – Rf) = Market risk premium;

Risk free rate:
Reserve Bank of India provides information on Weighted Average Yield on Market Loans, which is actually risk free return. For the project activity risk free rate is taken from following web link which is available at the time of investment decision i.e. 28/10/2006.

http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/80303.pdf

From the above link it is evident that risk free rate available for year 2005-06 which is before decision date of 28/10/2006 is **7.34%**

β Definition:
The β in the CAPM equation helps to account for the systematic risk by quantifying the sensitivity of the stocks of the companies representing a particular project type/sector with the market returns. Thus, it incorporates the risk of a specific sector in the calculation of the cost of equity.
The Beta value taken for this analysis is based on the beta values of the listed private companies engaged in similar business as the project activity (i.e. the power sector) Equity beta measures the risk that cannot be eliminated in a systematic, well balanced and diversified portfolio.

The beta value can be calculated with the formula mentioned below.

β = (Covariance between the rate of return of the market portfolio and rate of return of the Individual company selected) / (Variance of rate of return of the market)

= Cov (rm,rc) / Var (rm)

Where,

rm = Rate of Return of the Market
rc = Rate of Return of the individual company selected for beta calculation

We have referred to CAPITALINE software which directly provides the beta values for power sector companies estimated in accordance with above formula.

Following power sector companies are considered for evaluation of β parameter by CAPITALINE software. The respective β values are provided below which are estimated for period of more than 6 years (from 01/04/2000 to 15/10/2006). Also screenshot of β values taken from CAPITALINE software are provided to DOE for review.

Sr. No.	Co_Code	Company Name	β Value evaluated from BSE Sensex~Between 01/04/2000 And 15/10/2006
1	99	CESC	0.9142
2	2718	Guj Inds. Power	1.1729
3	26866	GVK Power Infra.	1.2821
4	2303	Neyveli Lignite	1.17
5	88	Reliance Infra.	0.9579
6	554	Tata Power Co.	0.962

For calculation of cost of equity, we select the lowest β value from above table. It correspond to CESC i.e. **0.9142.**

Rm – Rf (Market Risk Premium):

The market risk premium is the return that an investor expects over and above the risk free return available in the market. The market risk premium has been estimated using historical approach. It is the difference of Market rate of return and the risk free rate.

Market Rate of Return (Rm):

Market rate of return is calculated on the basis of historical market stock price. It is calculated as the compounded annual growth process. The process of calculation is given below:

[{(BSE- Sensex value a month before the time of investment decision) / (BSE- Sensex value since inception i.e. 1978-79)} ^ (1/no. of years from April 1978-79 till the time of investment decision)]-1

[Source for BSE Sensex Data: http://www.bseindia.com/histdata/hindices.asp]

Market return is evaluated equal to 19.22%. Please refer to spreadsheet calculations.

Benchmark (COE) is evaluated as given below

Sr. No.	Parameters	Values
1	Risk Free Rate (R_f)	7.34%
2	Beta (β)	0.9142
3	Market Return (Rm)	19.22%
4	Market Risk Premium (Rm – Rf)	11.88%
5	Cost of Equity (COE)	**18.20%**

Therefore benchmark cost of equity evaluated for the project activity is **18.20%**

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and
III):

Equity IRR of the project activity has been calculated and compared with the chosen benchmark (Cost of Equity). Details of the major assumptions and the financial indicator are as mentioned below:

Project Details

For calculation of Equity IRR following assumptions are considered. Detailed calculation of Equity IRR with all assumptions and justification is provided in excel spreadsheet. Kindly refer the same.

1) *Per Unit Grid Cost to LMEL*: For evaluation of per unit cost of power from the grid, we have referred to the actual MSEDCL grid electricity bills for the LMEL facility which have been submitted to DOE. The cost of power from the grid is calculated as follows.

Billed Month	Feb 06	March 06	April 06	May 06	June 06	July 06	August 06	September 06
Units consumed	1173240	1478580	1540080	1556520	1884180	1704360	1343280	1241700
Bill Amount	4145850	5047800	5947120	6246860	7233540	6592830	5589980	1241700
Grid electricity/unit (Rs/kWh)	3.53	3.41	3.86	4.01335	3.83909	3.86821	4.16441	3.48017

Average grid electricity cost = **3.77 Rs/kWh.**

2) Escalation of 1% in grid power cost is considered based on the escalation of grid electricity price by MSEDCL grid observed in electricity bills of LMEL during 1996-2006.

Grid power price during 1996-97: Rs 3.6 per unit as per balance sheet of 1996-97
Grid power price in 2006: Rs 3.77 per unit as above.
Escalation during 1996-2006: Rs 0.17 per unit = 0.45%
However for conservative estimation of IRR, 1% escalation is assumed.

3) Sales realisation on exported power is considered at Rs 3/unit for calculating IRR. This is based on power purchase agreement between LMEL and power trading company. The power purchase agreement between LMEL and grid/power trading company has been made available to DOE. Even though escalation clause is not provided in PPA .Escalation of 1% is considered in sales price based on the escalation of grid electricity price by LMEL between 1996-2006 based on grid electricity bills as explained in point 4. This is conservative.

4) Export electricity is wheeled through MSETCL grid and hence the sales income is based on electricity delivered after considering 4.85% transmission losses allowed for MSETCL grid as per MERC order of 19/10/2006 available on http://www.mercindia.org.in/pdf/Ord_19_10_2006_CNo_21_of_2006.pdf

5) Debt period is considered as 13 years based on agreement between M/s Nariman Point Finance Limited and LMEL. Equity IRR of electricity generation calculations is done for 15 years which is the entire period of life of plant based on technical life provided by equipment suppliers of boilers and turbine.

6) *Justification of Number of operating days*:

The sponge iron kilns face frequent shut down due to accretion. The 500 TPD kiln operation which generates waste flue gases is vital for 55 tonnes/hr WHRB operations for electricity generation. The kiln shut down history is as follows;

500 TPD kiln shut down history:

Shut down period	No of days of shut down
04/10/2005 -15/10/2005	12
26/11/2005 – 5/12/2005	10
27/01/2006-5/2/2006	10
23/03/2006-31/03/2006	9
15/05/2006 -30/05/2006	16
21/07/2006 – 4/08/2006	15
03/09/2006-01/10/2006	29
Total shut down days between 04/10/2005 to 01/10/2006	101

100 TPD kiln shut down history:

Kiln No	Period from	Period to	No of shut down days
1	08/10/2005	07/11/2006	77
2	29/12/2005	28/12/2006	80
3	08/05/2006	02/02/2007	46
4	14/02/2006	07/02/2007	65
Average shut down period for 100 tpd kiln			67

The sponge iron capacity mentions in consent to operate BO/Wardha/RONR/R/C-388 Dated: 12-05-1997 and Renewed consent to operate by MPCB with reference number BO/RONR/CHANDRAPUR-23/R/21-03/CC-89 dated 07/05/2003 from MPCB is 1,50,000 tonnes/year which is 300 days working for 500 tpd kiln.

Actually 500 tpd and 100 tpd kilns have operated less than 300 days in a year. Waste heat based electricity is entirely dependant on kilns operation. Hence power generation on waste heat is considered for 315 days conservatively.

(7) PLF of Waste heat power generation:
Please refer to section B.6.3 for detailed justification of PLF considered for the power generation. LMEL expects to achieve 70% PLF in first year and improve the same to 80% PLF in second year onwards.

8) *Input values for calculating equity IRR*

a) Justification of cost of production:
The project cost is Rupees 1477 Million. Excel spread sheet for equity IRR and other financial calculations have been provided to DOE.

Cost of production is subjected to 1.84% escalation based on CERC order of 16th January 2004 which allows 4% escalation in O&M cost. The O&M cost forms 46% of cost of production and hence cost of production is subjected to 46% of 4% escalation allowed for O&M i.e.1.84%. Please refer to Equity IRR spreadsheet.

Sr. No	**Cost head**	**cost calculation**	**Cost considered per unit Rs.**	**Reference**
1	Operating and Maintenance (O&M)	7% of Gross Fixed Assets. GFA 1477 Million Rupees	7x1477/ 100x 132 = 0.78.	LMEL do not have experience in the field. Hence tariff petition of MPGCL and tariff order 56 of MERC available on www.mercindia.org.in/56 Order dt 07/09/06 CN 48 of 2005.pdf has been used.
2	Water		0.03	Assumed and considered as per balance sheet of other power plant in the region
3	Start Up	Power consumption: 2.5x24x2 x4 =480 MW=480000 units	= 480000x 3.77/132000000 =0.0137	2 start ups of 4 day duration each. Cost of grid power=Rs 3.77/unit

4	Demand charges	LMEL demand load 6500 kVA. Demand charges = Rs 370 per kVA per Month	= 370x 6500x 12/132000000 =0.218	MERC Order dated 20/10/2006 available on www.mercindia.org.in/pdf/MSEDCL %20Final%20Order.pdf
5	Insurance commission	0.5% of plant and machinery cost	= 0.5x 1081/100x132 = 0.041	
6	Power trading company charges per unit		0.04	PPA with power trading company IPTL.
7	Transmission cost		=3623/(24*1000) =0.15	As per MERC order of dated 29th September 2006 avaliable on http://www.mercindia.org.in/pdf/Transmission%20Tariff%20Order%20%5BCase%2031%20of%202006%5D.pdf The transmission charges Rs 3623 / MW / Day.
8	Operating cost	Sum of point 3 to point 7 above.	0.46	
9	Mandatory spares	The approximate cost Rs 6 million.	= 6/132 = 0.0454	LMEL will maintain the following additional mandatory spares to take care of uncertainties in readings and faulty meters for proper CDM related requirements of standby monitoring as per monitoring plan in Annexure IV.
10	Welfare cost	The CDM revenue is expected as Rs 40 million per year.	=2X40/100x132 =0.006	LMEL is committed for welfare activities by spending at least 2% of CDM income.
11	Waste handling cost	This cost is estimated as @ Rs 300 per tonne	= 48000X 135.89/ 132000000 = 0.0493	The fly ash collected has to be properly taken care by providing proper dumping arrangement. The fly ash collected will be around 48000 tonnes.
12		Sum of Point 9, 10 and 11 above	0.1	
13	Sundry expenses		0.14	10% of all the above costs.

b) Input values for capital cost:

S.No	Cost head	Cost considered Rs Million	Reference document
1	Waste Heat Recovery Boilers	395	Power plant supplier offer CPP/VVS/LMEL/R1/200 Dated 15/10/2006
2	Plant and Machinery	606	Power plant supplier offer CPP/VVS/LMEL/R1/200 Dated 15/10/2006
3	Land development	25	Power plant supplier offer CPP/VVS/LMEL/R1/200 Dated 15/10/2006
4	Building and Structures	94	Power plant supplier offer CPP/VVS/LMEL/R1/200 Dated 15/10/2006
5	7km Transmission line	60.04	1) As per CERC order of 09/05/2006 on petition 133/2005 available on http://cercind.gov.in/050606/133-05a.pdf. Total of 2257 lacs for 29.47 km transmission line is considered. Therefore cost per km is (2257/29.47)=76.5863 lacs 2) Above data is of 2003 period, therefore inflation of 4% for three year i.e. from 2003 to 2006 as provided by CERC order is considered in transmission line cost.
6	Spare Parts	25.03	Power plant supplier offer CPP/VVS/LMEL/R1/200 Dated 15/10/2006. 2.5% of Plant and Machinery cost
7	Engineering and consultancy	20	Power plant supplier offer CPP/VVS/LMEL/R1/200 Dated 15/10/2006
8	Contingency	126	10% of the cost as per normal practice.
9	Preliminary Expenses and Pre-operative expenses	37.5	Budgets estimates for preliminary and pre-operative expense was analysed by management before decision date. The letter is submitted to DOE signed by project manager.
10	Interest During Construction	75	It is calculated based on 14.5% interest rate as charged by debt financers to LMEL for project activity. The value is calculated based on multiplying interest rate with 70% debt amount of project cost.
11	Margin Money for working capital	13	Calculated value. Please refer IRR sheet.

c) Justification of internal power consumption:

Year	Power consumed based on audited balance sheets Units

2007-08	24433877
2008-09	22226749
2009-10	17961254
Considered Internal power consumption based on the maximum consumption in previous 3 years	24433877 i.e. 24.43387 Million Units

By using the above assumptions and input values, Equity IRR is worked out equal to **7.39%** for 25 MW waste heat recovery based power generation project without considering the CDM benefits.

d) <u>Bench Mark comparison:</u>

Parameter	**WHRB Power**	**Bench mark**	**Remarks**
Equity IRR without CDM revenue.	7.39 %	18.2%	Equity IRR for 25 MW WHRB power project is lower than bench mark Cost of Equity. Hence project activity is not financially attractive.
Rate of return with CDM credits considered at 8$ per CER Equity IRR	13.39%	18.2%	25 MW WHRB project activity is not able to cross the bench mark even with CDM credit. However the improvement in IRR makes the project activity viable. Hence WHRB project activity is CDM Project activity.

Sub-step 2d Sensitivity analysis

Additionality tool requires showing whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. As per "Guidelines on the assessment of investment analysis" version the following guide line is available for sensitivity analysis:

Guidance 20 : only variables including the initial investment cost that constitute 20% of either total project cost or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily subjected to both negative and positive variations of same magnitude)

Guidance 21 : As a general point of parameter variations in the sensitivity analysis should cover a range of +10% or -10% unless this is not deemed appropriate in the context of project circumstances .

(1) The sales tariff sensitivity is carried out for +/-10% variations.
(2) The production cost is applied for sensitivity to the tune of +/-10%. Operating and maintenance cost sensitivity is done as any reduction in this cost increase the IRR due to cost of generation getting reduced.
(3) Operating days already considered for base calculations as 315 days and +/-10% increase is considered for sensitivity. Higher operating days results in more electricity production thereby leading to more sales and increased IRR.
(4) PLF has been analysed for +/-10% of the base PLF. PLF variation affects electricity generated and affects the income due to sale of electricity resulting in variation of IRR.

Sr.No.	Parameter	Variation	Equity IRR without CDM	Percentage constitution of project cost or revenue.
1.	Sales tariff	+10%	14.06%	100% project revenue.

		-10%	0.44%	
2.	Plant and machinery cost	+10%	4.74%	71.83% of project cost
		-10%	10.5%	
3.	Production Cost of electricity.	+10%	2.23%	55.6% of total project revenues.
		-10%	12.41%	
4.	PLF	+10%	14.77%	100% project revenues by export.
		-10%	-0.3%	
5.	Operating days	+10%	14.77%	100% project revenues by export.
		-10%	-0.3%	

It can be noted that in no case the Equity IRR exceeds the Bench Mark IRR of 18.2 %. Hence the project is not attractive economic option without CDM benefits.

Outcome of Step 2: After the sensitivity analysis it is confirmed that the proposed CDM project activity is not financially/economically attractive.

STEP-4 Common practice analysis.

Common practise has been done in line with para 6 and para 47 of additionality tool version 6 which is latest version of additionality tool available. There are 4 steps recommended and hence the project activity is analyzed in line with guidelines as follows:

Step 1: *"Calculate applicable output range as +/- 50% of the design output or capacity of the proposed project activity."*

Project Activity : 25 MW power generation using waste heat from DRI kilns having output of Sponge Iron of 270,000 tonnes per year

Output Range : Power generation in the range of 12.5MW to 37.5MW considering the ***+/-50% output range of WHRB based power generation capacity.***

Step 2 : *"In the applicable geographical area, identify all plants that deliver the same output or capacity within the applicable output range calculated in Step1, as the proposed activity and have started commercial operation before the start date of the project. Note their number as $N_{all.}$ Registered CDM project activities shall not be included in this step."*

Geographical Area: India
Project activity start date: 15/03/2007

Therefore as per Step 2, all the sponge iron industries having power generation capacity in range of 12.5MW to 37.5MW and operating in the geographical area are required to be identified. Since the project activity is in sponge iron industry utilizing the waste heat for power generation. The common practise analysis is limited to only sponge iron industries and only power plants operating in sponge iron industries at the time of start date of project activity are considered for common practise analysis.

No of large and small sponge iron manufacturing units operating in India at the time of project start date are **118**. These do not include the several small sponge iron plants which were under planning/ commissioning stage at the time of start date of project activity.

(Reference document Sponge Iron Industry March 2007 Central Pollution Control Board Ministry of Environment & Forests Government of India. Table 2.4, Page 10-14. http://www.cpcb.nic.in/upload/NewItems/NewItem_102_SPONGE_IRON.pdf)

Out of above 118 sponge iron manufacturing units there are only **16** units which have the captive power generation plants. This is evident from following web-link.[2]
http://cdm.unfccc.int/filestorage/7/Q/2/7Q2KJZ3UEL2RWWO8B44D7XBSEEKBFH/Survey%20of%20Indian%20sponge%20iron%20Industry.pdf?t=N218bThoaWZhfDDtEd7CD2Y4moIyEHiO5t_x

The referenced document is Survey carried out by Joint Plant Committee on Indian sponge iron industry in year 2005-06 which is under Ministry of Steel, Government of India. Hence this is credible document and available on UNFCCC website.
We have listed below the captive power plants set up in sponge iron industries at the time of start date of project activity.

The data is based on CPCB report and UNFCCC CDM registered projects.

Sr. No.	Plant Name	Capacity (MW)	CDM Status
1.	HEG limited	12.8	Not Considered under CDM
2.	Jindal steel	33.0	CDM Registration 0325
3.	Vandana global Pvt. Ltd.	32.0	CDM Registration 0432
4.	Orissa Sponge Limited	12	CDM Registration 0515
5.	Raipur alloys & Steel Limited	32	Not Considered under CDM
6.	Jai Balaji Sponge Limited	12	CDM Registration 0433
7.	Godavari Power & Ispat Limited	7	CDM Registration 0264
		10	CDM Registration 0772
8.	Bajarang power & Ispat Limited	18	CDM Registration 0528
9.	Monnet Ispat Limited	37	CDM Registration 0394
10.	Rashmi Sponge Iron Pvt Ltd.	4.75	CDM Registration 0556
11.	Usha Martin Limited	10	CDM Registration 0696
12.	SKS Ispat Limited	25	CDM Registration 0674
13.	MSPSPL	16	CDM Registration 0818
14.	Tata Sponge iron limited.	7.5	CDM Registration 0274
15.	OCL India Limited	8	CDM Registration 0367
16.	Nakoda Ispat Limited	6	CDM Registration 0678

From above list only power plants which are in the range of 12.5MW to 37.5 MW are considered. Therefore captive power plants in above range are 8.

Further the registered project activities are required to be excluded from the list of plants considered under Nall. Therefore it was found that out of remaining 8 captive power plants there are 6 captive power plants which are registered under CDM. The CDM registration reference number for these plants is provided in above table.

Hence $\mathbf{N_{all}}$ = 8 - 6 **= 2**

Please note that the all other types of power plants viz biomass, hydro, wind etc. operating in the above capacity range are not considered in the Step2, because all other kind of power plants will get eliminated in step 3 below. As per following step 3, all the other power plants apply different technology than the technology applied in proposed project activity. Referring to paragraph 9a and 9b of additionality tool, all other kind of power plants differs in terms of Energy source/fuel and feedstock used for power generation.
Project activity uses waste heat coming from sponge iron producing DRI kilns for power generation. However for other kind of power generation project activities, power is generated by using wind, hydro, thermal heat from fossil fuels etc which differs in terms of fuel or feed stock used for power

[2] The reference document can be searched by putting google search as "Survey of Indian Sponge iron industry 2005-06, prepared by Joint Plant Committee".

generation. Therefore other plants are not enlisted in step 2 as they will subsequently get eliminated in step3 below as Ndiff.

Step 3: *"Within the plants identify those that apply technologies different than the technology applied in the project activity. Note their number as $N_{diff.}$"*

From the analysis in Step 2, following are the plants identified as "N_{All}"

Sr. No.	Plant Name	Capacity (MW)	CDM Status
1.	HEG limited	12.8	Not Considered under CDM
2.	Raipur alloys & Steel Limited	32	Not Considered under CDM

However, both the units have only 2x100 TPD kilns. Please refer table 5.1 on page no. 87 of CPCB report. The web link is *http://www.cpcb.nic.in/upload/NewItems/NewItem_102_SPONGE_IRON.pdf* As per technical specification provided by project equipment supplier, it is evident that to produce the 1 MW of power approximately 4 Tonnes of steam is required. 100 TPD kiln can have WHRB which will produce on an average 8 to 10 TPH steam. Hence it is possible to produce the approximately 2 MW of power from utilization of waste heat of flue gases from 100 TPD kilns.

Therefore it can be said that, in case of HEG limited out of total 12.8 MW the contribution of WHRB based power is only 4 MW and rest 8.8 MW is generated by utilizing the steam from coal based FBC boiler. Also in case of Raipur Alloys & Steel limited, out of 32 MW only 4 MW power is from WHRB whereas rest of the 28 MW power is generated by utilizing the steam from coal based FBC boiler.

Hence it can be said that both the plants are predominantly dependent on coal based steam generation to produce the power. Whereas project activity involves the 25MW waste heat recovery power generation. Further above two power plants will get eliminated as they are outside the limit of 12.5MW to 37.5MW WHRB based power generation capacity range selected for common practice analysis.

Therefore Number of units that are technologically different from that of proposed project activity are $N_{diff.}$: **2**

Step 4: *"Calculate factor F =1- N_{diff} / N_{all} representing the share of plants using technology similar to the technology used in the project activity in all plants that deliver the same output or capacity as the proposed project activity."*

$$F = 1- 2/2 = 1-1 = 0$$

The proposed project activity is a common practice within the sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all} - N_{diff} is greater than 3

F for the project activity is 0 which is lesser than 0.2 and N_{all} - N_{diff} = 2 – 2 = 0 is not greater than 3. Hence project activity is not a common practice.

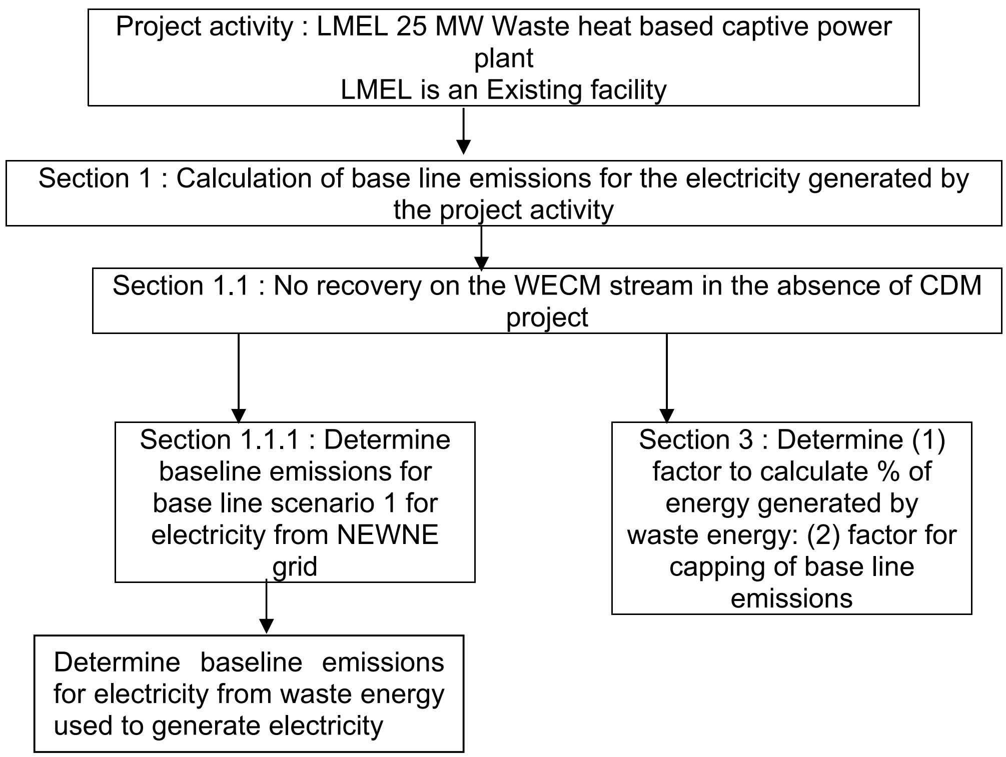
Therefore from above analysis it is confirmed that project activity is additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>> Selected methodology is “Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects” ACM 0012, Version 04.0.0, Sectoral Scope: 1&4 EB 60.

A) Baseline Emissions: The flow chart for base line calculations is



The project activity meets the applicability conditions of baseline methodology, namely.

The methodology gives 3 steps to determine the baseline. All these 3 steps have been discussed in B.4 and arrived at baseline scenario of W2/P10.

The MSEDCL grid power is being used by LMEL at the moment. We select NEWNE grid electricity of which MSEDCL is a part and hence NEWNE grid electricity emission factor used to calculate baseline emission reductions which will give conservative reduction in base line emissions as grid power is mainly coal based but also comprises of diesel, hydel and nuclear power which will give lower emission factor for grid compared to coal based power plant.

The emission reductions are achieved by displacing fossil fuel based grid electricity with WHRB based electricity which uses only waste heat and does not use any fuel. The reduction in GHG emission from facility of the project arises from the replacement / displacement of an equivalent amount of electricity to the extent of electricity generated from steam which is produced from waste heat recovered from waste gases in WHRB, which would have been otherwise generated and supplied by grid which is mainly dependant on fossil fuel based power plants.

The baseline emissions have been calculated for scenario applicable for grid electricity baseline using equations

The baseline emissions for the year y are determined as follows

$$BE_{y} = BE_{En,y} + BE_{flst,y} \qquad \text{(Equation 1)}$$

$= BE_{En,y} + 0 = BE_{En,y}$

Where,

BE_{y} = Total baseline Emissions during a given year y.

$BE_{En\,y}$ = Baseline emissions from energy generated by the project activity during a given year y.

$BE_{fist,y}$ = Baseline emission from fossil fuel consumption, if any, either directly for flaring of waste gas or for steam generation that would have been used for flaring the waste gas in the absence of the project activity. This is Nil.

Hence the baseline emissions are due to only "$BE_{En,y}$".

ACM 0012 covers many options. We give below the explanation for selected options:

(1) Base line emissions from energy generated by the project activity ($BE_{En\,y}$):

Baseline emissions are calculated for baseline scenario-1 provided in Table 2 of methodology. Accordingly, the applicable options are 1 and 3 from baseline scenario-1, in Table 2 of methodology to calculate baseline emissions. They are stated as below.

(a) Electricity is obtained from the grid and (b) Total WECM is released to atmosphere.
Applicable equation to calculate baseline emissions from energy generated by project activity is equation no. 2 as stated below.

$$BE_{En,y} = BE_{Elec,y} + BE_{Ther,y} \qquad \text{(equation 2)}$$

$BE_{En\,y}$ - base line emissions from energy generated by project activity

$BE_{Elec,y}$ - base line emissions due to electricity that is displaced by the project activity

$BE_{Ther,,y}$ - base line emissions from thermal energy generated by project activity. This parameter is Nil as project activity does not involve heat generation in elemental process in baseline scenario.

Therefore, $BE_{En\,y} = BE_{Elec,y} + 0$
$= BE_{Elec,y}$

(2) Base line emissions from electricity ($BE_{Elec,y}$) that is displaced by the project activity:

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_{j}\sum_{i}(EG_{i,j,y} * EF_{Elec,i,j,y}) \qquad \text{(Equation 3)}$$

Where,

$EG_{i,,j\,y}$ = quantity of electricity supplied to the recipients by generator

$EF_{Elec,i,j,\,y}$ = CO_2 emission factor for the grid electricity displaced due to project activity

f_{cap} = Factor that determines the energy that would have been produced in project year *y* using waste energy generated at a historical level, expressed as a fraction of the total energy produced using waste source in year *y*.

f_{wcm} = Fraction of total electricity generated by the project activity using waste energy

(3) Calculation of energy generated (electricity) in units supplied by waste heat:

As the steam from 5 WHRBs goes to a common header which also receives the steam from other source i.e. 90 TPH FBC boiler, applicable calculation will be as per section 1.1.1 and equation 34 of applied methodology ACM0012 version 4. Equation 34 is selected for calculation of fraction of total electricity from waste heat as it is not possible to measure the net calorific value of the waste gas/heat and steam generated with different fuels in dedicated boilers which is fed into turbine through the common steam header.

Applicable equation as per in section 3.1.2 for calculating f_{wcm} is as follows.

$$f_{WCM} = \frac{ST_{whr,y}}{ST_{whr,y} + ST_{other,y}}$$ (Equation 34 as per methodology)

Where,

$ST_{whr,y}$ = energy content of the steam generated by WHRB fed into turbine via common steam header

$ST_{other,y}$ = energy content of the steam generated by other boilers fed into turbine via common steam header

The applicable conditions of methodology for choosing this alternative are

(a) All the boiler has to provide superheated steam
(b) The calculation should be based on energy supplied to the steam turbine. The enthalpy and the steam flow rate must be monitored for each boiler to determine the steam energy content. The calculation implicitly assumes that properties of steam (temperature and pressure) generated from different sources are same. The enthalpy of steam and feed water will be determined at measure temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter. Any vented steam should be deducted from steam produced with waste heat.
(c) Any vented steam should be deducted from the steam produced with waste gas/heat

(4) Capping of baseline emissions:

The methodology requires capping for element of conservativeness. We have selected Method 2 using manufacturer's data and applicable equation 38 to calculate baseline cap f_{cap}.

$$f_{cap} = \frac{Q_{WCM,BL}}{Q_{WCM,y}}$$ (Equation 38 as per methodology)

$$Q_{WCM,BL} = Q_{BL,product} \times q_{wcm,product}$$ (Equation 39 as per methodology)

Where,

$Q_{WCM,BL}$ = Quantity of waste gas generated prior to start of the project activity, Nm3
$Q_{WCM,Y}$ = Quantity of waste gas used for energy generation during the year, Nm3
$Q_{BL,product}$ = Production associated with the relevant waste energy generation as it occurs in the baseline scenario. The minimum of the following two figures should be used: (1) average annual historical production data from start-up of the facility, if the facility's operational history is less than three years, or (2) the most relevant manufacture's data for normal operating conditions, tonne.
$q_{wcm,product}$ = Amount of waste energy per unit of product generated by process in Nm^3/tonne of product.

The capping factor has been assumed to be 1 for calculating emission reductions achieved. However the capping factor will be calculated every year based on actual flue gas quantity monitored during the year.

The CO_2 emission factor has been calculated as per "Tool to calculate the emission factor for an electricity system", version 2.2.1, EB 63.

Tool to calculate the emission factor for an electricity system version 2.2.1 EB 63 requires calculation of $EF_{OM,simple}$, EF_{BM}, and combined $EF_{CM,y}$ using formulae given in section B.6.3. Government of India, Ministry of Power, and Central Electricity Authority in technical cooperation with Indo-German Energy Programme have issued "CO_2 Baseline Data base for the Indian Power Sector' User Guide Version 4.0, Oct 2008. This document along with CO_2 Data base excel calculations are available on web site http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

The objective is to facilitate adoption of authentic baseline emission data and also to ensure uniformity in the calculation of CO_2 emission reductions by CDM Project developers, the Central Electric Authority in cooperation with GTZ CDM-India has compiled a database containing the necessary data on CO_2 emissions for all grid connected power stations in India.

The calculations provide EF_{OM} , EF_{BM} and combined margin emission factor for each year from 2005-06 to 2007-08. As per methodology calculations for combined margin must be based on data from official source (where available) and made publicly available. CO_2 Baseline Data base for the Indian Power Sector' User Guide Version 4.0 Oct 2008 is prepared by Central Electricity Authority, Government of India. This document along with CO_2 Data base excel calculations are available on web site www.cea.nic.in .

The NEWNE grid emission factor estimated equal to 0.8032 t CO_2/MWh by following the steps given in Tool to calculate emission factor for an electricity system version 2.2.1. The calculations are provided in B.6 and in separate excel sheet.

The emission reductions achieved are calculated considering 70 % PLF in the first year and 80% PLF from second year onwards. Emission reductions calculated in first year are 97,167 t-CO_2 and from second year onwards 111,048 t-CO_2/year. The total emission reductions achieved for crediting period of 10 years is 1,096,599 tCO_2.

B) Project Emissions:
According to the methodology ACM0012 version 4, project emissions are to be considered for following options.

1) Combustion of auxiliary fuel to supplement waste gas/ heat and
2) Electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of energy or other supplementary electricity consumption.

In project activity, there is no consumption of auxiliary fuel to supplement waste gas/ heat. Also project activity does not involve the gas cleaning before being used for generation of energy hence there is no electricity consumption required as well as no other supplementary electricity consumption is involved in project activity. Therefore in line with requirement of methodology project emissions are not applicable for the project activity.

C) Leakage is applicable under this methodology.

D) Emission Reductions:
Emission reductions for the project activity are calculated by using the equations no. 42 of the methodology which is as stated below.

$$ER_y = BE_y - PE_y$$ (Equation 42 as per methodology)

Where,

ER_y = Total emission reductions tonnes/year
BEy = $BE_{Elec,y}$ i.e. Baseline emissions for the project activity during the year y.
PE_y = 0

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	$EF_{Elec\ i,j,y}$
Unit	tCO_2/MWh
Description	The CO_2 Emission factor for the grid displaced due to project activity, during year y.
Source of data	CEA CO_2 baseline database version 7.0, Jan 2012.
Value(s) applied	0.8032
Choice of data or Measurement methods and procedures	Government of India, Ministry of Power, and Central Electricity Authority have issued "CO2 Baseline Database for the Indian Power Sector' User Guide Version 7.0 Jan 2012. This document along with CO2 Database excel calculations are available on web site http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm The document follows "Tool to calculate the emission factor for an electricity system" Version 2.2.1, EB 63 to calculate emission factors for electricity grids in India.
Purpose of data	For calculating baseline emissions.
Additional comment	Calculated value for EFElec y =0.8032 tCO2/MWh is fixed Ex-ante for entire credit period.

Data / Parameter	Steam generation by WHRBs
Unit	Tonnes/hr
Description	Steam generated from all the five WHRBs
Source of data	Boiler Manufacturer's rated capacity as per IBR approved drawings.
Value(s) applied	103
Choice of data or Measurement methods and procedures	Boiler Manufacturer's rated capacity as per IBR approved drawings for 4 WHRBs on 4x 100 TPD kilns and 1 WHRB on 1x500 TPD Kiln.
Purpose of data	
Additional comment	Nil

Data / Parameter	Steam flow to STG
Unit	Steam flow to STG
Description	Tonnes/hr
Source of data	Steam quantity required to generate electricity
Value(s) applied	Steam turbine manufacturer's(Qingado Jieneng Steam Turbine Co Ltd, China) specifications and purchase order
Choice of data or Measurement methods and procedures	122.4
Purpose of data	Steam turbine manufacturer's (Qingado Jieneng Steam Turbine Co Ltd, China) specifications and purchase order provides the design quantity of steam required to operate the 30 MW turbine.
Additional comment	
	Nil

Data / Parameter	$Q_{WCM,BL}$
Unit	Nm^3/ year
Description	Average quantity of WECM i.e. waste gas released in atmosphere in three years prior to start of the project activity.
Source of data	Actual production data of LMEL facility
Value(s) applied	$1.068*10^9$
Choice of data or Measurement methods and procedures	The quantity of WECM i.e. waste gas is calculated by multiplying the actual production data of sponge iron production by LMEL per year (tonnes) and multiplying it with WECM generated per unit of product in (Nm^3/tonne). The specific WECM generation per unit of product is based on manufacture's supplied data as per operational manual. For 1 x 500 TPD, Specific WECM generation per unit of product = 5,280 Nm^3/tonne. For 4 x 100 TPD, Specific WECM generation per unit of product = 6,240 Nm3/tonne.
Purpose of data	For calculation of baseline cap f_{cap} used in calculating baseline emissions.
Additional comment	Nil

Data / Parameter	$Q_{BL,product}$
Unit	tonnes/year
Description	Production of Sponge Iron in industrial facility
Source of data	Actual production data of industrial facility of LMEL sponge iron plant.

Value(s) applied	185,493
Choice of data or Measurement methods and procedures	Actual sponge iron production data of LMEL for three years prior to project start date (Start date- 15/03/2007) 1) Sponge Iron production data considered from 01/04/2004 up to 31/03/2007 for 1 x 500 TPD Kiln. Average of three year production data is considered to arrive at annual average sponge iron production. The annual average production figure for 1x500 TPD kiln is 93,288 Tonnes/yr. 2) Other 4 x 100 TPD kilns start full operation from April 2006. Therefore sponge iron production data for 4x100 TPD kilns taken from April-2006 to March-2007. Data is selected for one year only as operational history of all four 100 TPD kilns is less than three years. The annual average production figure for 4x100 TPD kiln is 92,205 Tonnes/yr.
Purpose of data	For baseline
Additional comment	Nil

Data / Parameter	$q_{wcm,product}$
Unit	Nm^3/tonne
Description	Specific waste energy production per tonne of sponge iron manufactured.
Source of data	Manufacturer's data on waste gas generation for each type of sponge iron kiln.
Value(s) applied	1) For 4x100 TPD kiln – 6240 Nm^3/tonne 2) For 500 TPD kiln 5280 Nm^3/tonne
Choice of data or Measurement methods and procedures	Prior to the start date of project i.e. 15/03/2007, flue gases were not monitored before letting into the atmosphere. Hence sponge iron kiln manufacturers operating manual data for generation of flue gas per hour is used for calculating the flue gas per tonne.
Purpose of data	For baseline
Additional comment	Nil

Data / Parameter	TE_p
Unit	TJ/Tonnes
Description	Specific enthalpy of steam from steam table.
Source of data	http://www.spiraxsarco.com/resources/steam-tables/superheated-steam.asp
Value(s) applied	0.003383
Choice of data or Measurement methods and procedures	Enthalpy of steam is taken from standard steam table available on the above weblink.
Purpose of data	For baseline
Additional comment	NIL

Data / Parameter	$d_{wcm,BL}$
Unit	Kg/Nm^3
Description	Density of WECM i.e. waste flue gases
Source of data	Process data sheets for waste heat recovery boilers at LMEL by process design licensor M/s ERK Eckrokessel GmbH.
Value(s) applied	1.335 kg/Nm^3 for WECM from 100TPD kiln and 1.3649 kg/Nm^3 for WECM from 500 TPD kiln.
Choice of data or Measurement methods and procedures	Densities for waste flue gases at normal conditions were provided by licensor M/s ERK Eckrokessel GnbH to boiler manufacturer (i.e. M/s Llyods Steel Industries Ltd) based on the composition of flue gases from each type of kiln.
Purpose of data	For calculating mass flow rate of waste gas used in calculating baseline emissions.
Additional comment	NIL

B.6.3. Ex ante calculation of emission reductions

>> The MSEDCL grid power is being used by LMEL at the moment. We select NEWNE grid electricity of which MSEDCL is a part and hence NEWNE grid electricity emission factor used to calculate baseline emission reductions which will give conservative baseline emission reductions as grid power is mainly coal based but also comprises of diesel, hydel and nuclear power which will give lower emission factor for grid compared to coal based power plant.

We have followed the "CO_2 Baseline Data base for the Indian Power Sector' User Guide Version 4.0, Oct 2008. This document along with CO_2 Data base excel calculations are available on web site www.cea.nic.in. The CO_2 Data base is designed to be consistent with "The tool to calculate emission factor for an electricity system version", 2.2.1 EB 63.

A base line emission factor $EF_{grid,CM,Y}$ is calculated as combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to following three steps.

***Step 1* -Identify the relevant electricity systems:**

Project activity is located in Chandrapur district of Maharashtra state in India and connected to Maharashtra State Electricity Distribution Company Ltd (MSEDCL). So project electricity system identified is MSEDCL regional grid which is part of NEWNE grid of India. Therefore we identify NEWNE grid electric system as relevant electricity system to which project activity is connected to.

***Step 2* –Choose whether to include off-grid power plant in project electricity system (Optional):**

The CEA user guide version 4 dated Oct-2008 provides the calculation of emission factors for all grid connected power stations in India. Therefore Option 1 i.e. "Only connected grid power plants" are included in emission factors calculations by CEA database.

Step 3 –*Select a method to determine operating margin (OM):*

The Simple OM method (a) is used by CEA database. This method is used where Low cost/must run resources constitute less than 50% of NEWNE region grid generation in (1) average of five most recent years or (2) based on long term averages for hydroelectricity production.

We have selected ex-ante option where a 3 year generation weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE during validation, without requirement to monitor and recalculate the emission factor during the crediting period.

Step 4 –*Calculate the operating margin emission factor according to the selected method:*

The CEA database has selected simple OM method to calculate operating margin emission factor by Option A stated in emission factor tool.

Simple OM emission factor ($EF_{gridOM,simple,\ Y}$) is calculated as the generation –weighted average emission per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low operating cost & must run power plants.

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$ (Equation 1 as per Tool)

Where, "$FE_{EL,m,y}$" is CO_2 emission factor of power unit m in year y in (tCO_2/MWh). It is calculated by using option A1 of emission factor tool by CEA database.

$$EF_{EL,m,y} = \frac{\sum_m FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$ (Equation 2 as per Tool)

Where,

$FC_{i,\ m,\ y}$ - is the amount of fuel i in tonnes consumed by relevant power sources m in years y.

j - refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants and including import to the grid.

$EG_{\ m,y}$ - Is the net electricity (MWh) delivered to the grid by power unit m.

NCV_{iy} - Is the net calorific value GJ /tonnes of fossil fuel type I in yr y (GJ/mass unit),

$EF_{CO2,iy}$ - Is the CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)

Step 5 –*Calculate the build margin (BM) emission factor:*

The selected power units are based on"CO_2 Baseline Data base for the Indian Power Sector' User Guide Version 4.0 Oct 2008. This document along with CO_2 Data base excel calculations are available on web site www.cea.nic.in

To calculate the build margin emission factor option 1 of step 5 of emission factor tool is chosen. For the fixed crediting period selected for the project activity, build margin emission factor is calculated on ex-ante basis based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation.

In accordance with the emission factor tool, the build margin is calculated in the CEA CO_2 database as a average emission intensity of the 20% most recent capacity additions in the grid based on net generation and covers units commissioned in the last five to ten years.

***Step 6* -Calculate the combined margin emission factor:**

The combined margin emission factor is calculated as follows.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,,y} \times w_{BM}$$ (Equation 13 of Tool)

Where,

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
W_{OM} = Weighting of operating margin emission factor (%)
W_{BM} = Weighting of build margin emission factor (%)

As per emission factor tool, by default, we have Considered $w_{OM} = w_{BM} = 0.5$

Therefore, $EF_{grid,CM,y}$ = (1.0086 x 0.5) + (0.60 x 0.5)
= 0.8032 tCO_2/MWh

Source: Government of India, Ministry of Power, and Central Electricity Authority issued "CO_2 Baseline Data base for the Indian Power Sector' User Guide Version 8 Oct 2008. The detailed calculation of emission factor for NEWNE grid is provided in table below.

Emission factor	**units**	**2005-06**	**2006-07**	**2007-08**
$EF_{gridOM,simple, Y}$	tCO_2/MWh	1.02	1.01	1.00
$EF_{gridBM, y}$	tCO_2/MWh			0.60
Net generation in operating margin	GWh	359,271	379,471	401,642
Weighted average $EF_{gridOM,simple, Y}$ for 3 years	tCO_2/MWh	1.0086		
Net generation in build margin	GWh			100,707
Combined margin $EF_{Eleci,j, y}$ **=** 0.5* $EF_{gridOM,simple, Y}$ +0.5* $EF_{gridBM, y}$	tCO_2/MWh	**0.8032**		

A) <u>Ex-ante Calculation of Baseline Emissions:</u>

To calculate the baseline emissions equation no. 3 as stated in section B.6.1 above is followed. The baseline emissions are due to electricity displaced by the project activity in NEWNE grid. The baseline emissions for the year y i.e. "$BE_{Elec,y}$" are determined as follows.

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_{j} \sum_{i} (EG_{i,j,y} * EF_{Elec,i,j,y})$$

Calculation of each of the component of above formulae is provided below.

<u>a) Calculation of Baseline cap " f_{cap}"</u>

For capping the emission reductions due to quantity of waste gas generation, equation no. 38 and 39 of methodology as stated below are used.

$$f_{cap} = \frac{Q_{WCM,BL}}{Q_{WCM,y}}$$ (Equation 38 as per methodology)

$$Q_{WCM,BL} = Q_{BL,product} \times q_{wcm,product}$$ (Equation 39 as per methodology)

Where,

$Q_{WCM, BL}$ = Quantity of waste gas generated prior to start of the project activity, Nm3
$Q_{WCM, Y}$ = Quantity of waste gas used for energy generation during the year, Nm3
$Q_{BL,product}$ = Production associated with the relevant waste energy generation as it occurs in the baseline scenario. The minimum of the following two figures should be used: (1) average annual historical production data from start-up of the facility, if the facility's operational history is less than three years, or (2) the most relevant manufacture's data for normal operating conditions, tonne.

$q_{wcm,product}$ = Amount of waste energy per unit of product generated by process in Nm^3/tonne of product.

Sr. No.	Parameter/ Description	Units	Values for 100 TPD Kiln	Values for 500 TPD Kiln
1	Rated capacity of kiln	Tonnes/ day	100	500
2	Flue gas generated from kilns as per manufacturer's operating manuals.	Nm^3/hr	26,000	110,000
3	Rated capacity of sponge iron production,	Tonnes/ hour	4.167	20.834
4	Amount of waste gas generation per tonne of sponge iron produce.	Nm^3/ton ne	6,240	5,280
5	Actual sponge iron produced previous to the start of project activity.	Tonnes /year	92,205	93,288 (Average of 3 years) 2004-05: 91,934 2005-06: 93,565 2006-07: 92,205
6	Total Average Sponge Iron production from both the Kilns. i.e. "$Q_{BL,product}$"	Tonnes /year	92,205 + 93,288 =185,493	
7	Actual flue gas generated prior to the start of project activity	Nm^3/year	575,359,200	492,562,400
8	Total Actual average flue gas generation previous to the start of project activity. *i.e.* "$Q_{WCM,BL}$"	Nm^3/year	492,562,400 + 575,359,200 = $1.068X10^9$	
9	Calculation of "$q_{wcm,product}$"	Nm^3/ton	= ($1.068X10^9$)/ 185,493 = 5,757.2	
10	$Q_{WCM,y}$ = Quantity of waste gas used for energy generation during the year Nm^3/year	To be measured every year by gas flow meter.		
11	Baseline cap, the value of capping considered as required by methodology $f_{cap} = Q_{WCM,BL} / Q_{WCM,,y}$	Considered as 1 but same will be calculated using actual values of $Q_{WCM,Y}$ i.e. Quantity of waste gas used for energy generation during the year in Nm^3 by flow meter.		

b) <u>Calculation of fraction of total electricity generated by the project activity using waste energy " f_{wcm}":</u>

Calculation of fraction "f_{WCM}" as per equation 39 of ACM0012 version 4 to calculate electricity supplied by waste heat is as below.

$$f_{WCM} = \frac{ST_{whr,y}}{ST_{whr,y} + ST_{other,y}}$$

(Equation no. 39 as per methodology)

Where,

$ST_{whr,y}$ = energy content of the steam generated by WHRB fed into turbine via common steam header

$ST_{other,y}$ = energy content of the steam generated by other boilers fed into turbine via common steam header

The applicable conditions of methodology are

1) All the boilers have to provide superheated steam

2) The calculation should be based on energy supplied to the steam turbine. The enthalpy and the steam flow rate must be monitored for each boiler to determine the steam energy content. The calculation implicitly assumes that properties of steam (temperature and pressure) generated from different sources are the same. The enthalpy of steam and feed water will be determined at measure temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter. any vented steam should be deducted from steam produced with waste heat.

Following table provide the calculation of ***"fwcm"***. All the steam enthalpy data is taken from following web link having the standard steam table.

http://www.spiraxsarco.com/resources/steam-tables/superheated-steam.asp

Enthalpy of feed water is taken from following web link.
http://www.spiraxsarco.com/resources/steam-tables/sub-saturated-water.asp

Parameter	**WHRB1**	**WHRB2**	**WHRB3**	**WHRB4**	**WHRB5**	**FBC**
Design Boiler Capacity, Tonnes/hr	12	12	12	12	55	20
Steam Pressure, Kg/cm^2a	63.76	63.76	63.76	63.76	63.76	63.76
Steam temperature, In deg C	485	485	485	485	485	485
Enthalpy of steam fed to turbine, TJ/Tonne	0.003383	0.003383	0.003383	0.003383	0.003383	0.003383
Enthalpy of boiler feed water at 140 deg C, In TJ/Tonne	0.000593	0.000593	0.000593	0.000593	0.000593	0.000593
Enthalpy difference of steam and boiler feed water, In TJ/Tonne	0.002790	0.002790	0.002790	0.002790	0.002790	0.002790
Energy content of steam fed to turbine, (TJ)	0.03348	0.03348	0.03348	0.03348	0.15345	0.0558
$ST_{whr,y}$ TJ Energy content of the steam generated by WHRB fed into turbine via common steam header	0.28737					
$ST_{other,y}$ TJ Energy content of the steam generated by other boilers fed into turbine	0.00558					

via common steam header	
f_{WCM} (for situation 2 of methodology applicable as justified above equation 1e) $= ST_{whr,y} / ST_{whr,y} + ST_{other,y}$ (equation 34)	= 0. 28737/(0.28737+ 0.0055) = 0.8374

a) Calculation of Quantity of electricity supplied by project activity " ***EGi,j,y*** **"**

Sr. No.	Parameter /Description	Units	Values for First year; 2012	Values from Second year onwards; 2013 to 2021
1	Rated capacity of turbine	MW	30	30
2	No of days of operation	days	315	315
3	Electricity generating capacity in one year at 100% PLF	MWh	= 30 x 315 x 24 = 2,26,800	= 30 x 315 x 24 = 2,26,800
4	PLF considered	%	70	80
5	EG_{gross}	MWh	= 2,26,800x 70% = 1,58,760	= 2,26,800x 80% = 1,81,440
6	Auxiliary Consumption (9%) of power plant, EG_{Aux}	MWh	=1,58,760x 9% =14288.4	=1,81,440x 9% =16329.6
7*	$EG_{i,j,y}$	MWh	= 1,58,760– 14288.4 = 144,471.6	= 1,81,440 – 16329.6 = 165,110.4
8	*Fraction of total electricity* by project activity using waste energy, f_{WCM}		0.8374	0.8374
9	Electricity supplied by project activity, $EG_{j,y}$	MWh	= 144,471.6x 0.8374 = 120980.283	= 165,110.4x 0.8374 =138263.18

**If there is any import of electricity during synchronisation with grid or other problems the same is available through Me4 export meter and the same is metered and total import from grid due to such reasons will be be deducted from net generation of electricity arrived as above for the sake of conservativeness .For conservativeness the metered readings of in house consumption Me3A,Me3B,export meter readings of Me4 are added and substracted by metered readings of import Me4 to arrive at net generation which is used for calculating baseline emissions.*

Justification of PLF considered

To arrive at the PLF figure, following three methods are followed.

Method 1: *Based on actual sponge iron and flue gas produced:*

Sr. No.	Parameter	For 4X100 TPD Kilns	For 500 TPD Kiln
1	Installed capacity of sponge iron during the year prior to start of project activity, Tonnes/year	120,000	150,000
2	Actual sponge iron produced previous to the start of project activity, Tonnes /year	92,205	93,288.34

3	Actual flue gas generated previous to the start of project activity, Nm^3/year	492,562,400	575,359,200
4	Waste gas generation for installed capacity previous to the start of project activity, Nm^3/year	748.8 x 10^6	792 x 10^6
5	Total Actual average flue gas generation, Nm^3/year	1068 x 10^6	
6	Design average flue gas generation for installed capacity, Nm^3/year	1540 x 10^6	
7	PLF achievable as waste heat is directly proportional to the flue gas quantity	= $(1068 \times 10^6)/(1540 \times 10^6)$ = 0.6931 i.e. 69.31%	

Method 2: *Based on design steam generation data as provided to Boiler Manufacturer by licensor M/s ERK Eckrokessel, Germany:*

Sr. No.	Parameter	Data
1	Rated capacity of steam from WHR Boilers, Tonnes/hr	(4x12) + (1x55) = 103
2	Minimum capacity of steam from WHR boilers as provided by licensor, Tonnes/hr	(4x8.3) + (1x35.2) = 68.4
3	PLF achievable is directly proportional to steam generation in WHR boiler using waste heat. Hence PLF achievable equal to	= (68.4) / (103) = 0.6264 i.e. 62.64 %

Method 3: *Based on Sponge iron production data of the industrial facility from the start date:*

As the annual flue gas generation is proportional to the annual sponge iron production, Following production figures are provided based on audited balance sheets.

Year as on 31st March	Sponge Iron produced during the year, Tonnes	Installed capacity, Tonnes	Percentage achieved%
1996	67802	150000	45.2
1997	122564	150000	81.7
1998	112555	150000	75.03
1990	97041	150000	64.69
2000	117653	150000	78.43
2001	110668	150000	73.77
2002	107811	150000	71.87
2003	107562	150000	71.7
2004	120356	150000	80.23
2005	91934	150000	61.28
2006	115480	240000	48.11

Production has varied between 60 to 80 % and majority years around 70 %.

Hence assumed PLF in the first year is 0.7 and project participant hopes to achieve PLF of 0.8 from second year onwards by improving working efficiency of the plant.

Justification for Auxiliary consumption of 9% :

SR. No	Equipment Name	No of equipment	Power rating KW	Power consumption KW
1	Boiler feed pump	2	350	700
2	Main cooling water pump	2	350	700
3	Aux cooling water pump	1	110	110
4	SOP	1	132	132
5	Turning gear motor/Ash handling system	1	5.5	5.5
6	Jacking oil pump-1/Soot blower	1	11	11
7	CEP	1	55	55
8	Instrument air compressor	1	55	55
9	DM transfer pump	1	15	15
10	DM water pumps and blowers		50	50
11	OVEF		2	2
12	Gland sealing exhaust fan	1	2	2
13	AC/Lighting load	1	25	25
14	Clarified water pump	1	45	45
15	CT Fan	2	110	220
16	Wet scrapper			25
17	FD Fan	2	325	325
18	ID Fan	2	132	132
19	PA fan	1	90	90
20	Drag Chain feeder	5	5	25
21	Coal handling unit		200	200
	Total power consumption			2924.5
	Maximum consumption			9.74%
	Considered auxiliary consumption after considering diversity factor			**9%**

Calculation of Baseline emissions from electricity ($BE_{Elec,y}$} that is displaced by the project activity as per equation 3 stated above:

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_{j} \sum_{i} (EG_{i,j,y} * EF_{Elec,i,j,y})$$

(Equations 3)

Where,

$EG_{j,y}$ = quantity of electricity supplied to the recipients by generator

Sr. No.	Parameter	Values
1	Baseline cap f_{cap}	1
2	Fraction of total electricity by the project activity using waste gas f_{wcm}	0.8374
3	$EG_{i,j,y}$ = quantity of electricity supplied to the recipients by generator	144471.6MWh for 2012 165110.4 MWh for 2013-21

4	$EF_{Eleci,j,y}$ = CO_2 emission factor for the grid electricity displaced due to project activity	0.8032
5	$BE_{Elec,y}$ baseline emissions due to electricity that is displaced by the project activity in tCO_2/yr as per equation 3 above.	= 97,167 for year 2012 = 111,048 for year 2013 to 2021

B) <u>Ex-ante Calculation of Project Emissions:</u>

In project activity, there is no consumption of auxiliary fuel to supplement waste gas/ heat. Also project activity does not involve the gas cleaning before being used for generation of energy hence there is no electricity consumption required as well as no other supplementary electricity consumption is involved in project activity. Therefore in line with requirement of methodology project emissions are not applicable for the project activity.

Therefore, ***PEy* = 0**

C) Leakage: Leakage is not applicable as per ACM0012 version 4 of methodology.

D) <u>Ex-ante Calculation of Emission Reductions:</u>

Emission reductions for the project activity are calculated by using the equations no. 42 of the methodology which is as stated below.

$$ER_y = BE_y - PE_y$$ (Equation 42 as per methodology)

Where,

ER_y = Total emission reductions tonnes/year
BEy = $BE_{Elec,y}$ i.e. Baseline emissions for the project activity during the year y.
PE_y = 0

Therefore Emission Reduction for the project activity on annual basis,
ERy = BEy – PEy
= BEy – 0
= BEy

ERy = **97,167** for Year 2012
= **111,048** for Year 2013 to 2021

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2012	97,167	0	0	97,167
2013	111,048	0	0	111,048
2014	111,048	0	0	111,048
2015	111,048	0	0	111,048
2016	111,048	0	0	111,048
2017	111,048	0	0	111,048
2018	111,048	0	0	111,048
2019	111,048	0	0	111,048
2020	111,048	0	0	111,048
2021	111,048	0	0	111,048

Total	**1,096,599**	0	0	**1,096,599**
Total number of crediting years	10			
Annual average over the crediting period	**109660**	0	0	**109660**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter	$Q_{WCM,y}$
Unit	Kg/year
Description	Quantity of waste gas used to generate electricity during the year y
Source of data	Individual WHR boiler log book records for each kiln mentioning the waste gas generation quantity in Nm^3.
Value(s) applied	To be monitored
Measurement methods and procedures	Quantity of waste gas is metered at the exit of boiler before ESP by an electronic flow meter. The measurement of waste gas will be in Nm^3 which is maintained by DCS facility. The quantity of waste gas for the year monitored is based on historical data and equal to 1.068 x 10^9 Nm^3/yr. Mass of waste gas is calculated by multiplying the Nm^3 quantity of gas with density at NTP conditions. Density of waste gas at NTP conditions is provided in section B.6.2 under parameter “$d_{wcm,BL}$” above. Metering is done volumetrically on continuous basis and DCS will show the final value in Nm^3 or/and Kg/hr as required. WECM i.e. waste flue gas meter reading is maintained in Log book from DCS system in control room on hourly basis and same is signed by plant manager daily. The difference between end reading and start reading of the day is taken to arrive at the day’s flow of flue gas. The total quantity per year is calculated using daily record. The monitoring point is after the boiler before ESP as no meter is suitable for metering the high temperatures waste flue gases at temperatures of 950 deg c before boiler inlet. Therefore the metering is done after the WHR boiler exit at 140 deg centigrade. The flow meter is calibrated according to temperature and pressure of WECM. Type of meter: Ultrasonic Make: GE Sensing Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy : +/- 2% as provided by GE Specifications
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	Meters are calibrated once every year to maintain the required accuracy in data measurement.
Purpose of data	For calculation of baseline cap f_{cap} used in calculating baseline emissions
Additional comment	Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$EG_{i,j,y}$
Unit	MWh/yr
Description	Quantity of electricity supplied to the recipient plants by generator which in the absence of project activity would have been sourced from grid during the year
Source of data	1) Recipient plants records maintained in log book (i.e. LMEL and Power trading company receiving the surplus electricity from project activity) and 2) Generation plant i.e. LMEL measurement records as maintained in log book.
Value(s) applied	144471.6 in first year of operation and; 165110.4 from second years onwards

Measurement methods and procedures	Power plant has been provided with four meters for metering the auxiliary consumption and one meter for metering the gross energy generation. The location of meters is provided in project boundary diagram in section B.3 of PDD. 1) Gross generation "EG_{gross}" is metered by "Me1" 2) Auxiliary consumption "$EG_{Auxilary}$" is metered by "Me2" which is sum of readings of "Me2A", "Me2B", "Me2C", "Me2D" sub-meters. The quantity of electricity supplied to the recipient facility is calculated by sum of export electricity metered by energy meter "Me4" and in house consumption electricity meter "Me3" which is sum of Me3 A and Me3 B. The meter "Me4" also records the import of electricity (from grid) due to reasons of synchronisation with grid, MSETCL repairs etc. This import (from grid) value even though small will be deducted from the sum of readings of export Me3A +Me3B+Me4export-Me4 import. Me4 is bidirectional and provided by MSETCL. The in house consumption of LMEL is supplied through two transformers out of which one is standby. The transformer with Me3 A meter is on line normally. The standby transformer is also charged with Me3 B meter. The standby transformer is not taken on line unless required. Occasionally it is possible that both transformers have to be taken on line to meet demand of the electricity consumption of recipient LMEL and Me3B readings will then be taken continuously. Thus there are two meters to record electricity consumption of LMEL and "Me3" is taken as sum of Me3A and Me3B. Normally Me3B reading is zero. This calculation can be cross-checked from metered values of gross electricity generation minus auxiliary consumption of power plant. i.e. $EG_{gross} - EG_{Auxilary}$. Further Export meter "Me4" value can be cross checked with official MSEDCL meter used for billing. Log book of hourly reading is signed by plant manager daily. The difference between end reading and start reading of the day is taken to arrive at the day's energy generation and export data. The meters reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge daily. <u>Meter details:</u> Me1 - Generator end, Type- E3-M Premier, Make-SEMS Me2 - Auxiliary consumption meter (4 numbers), Models-Alpha M++, Make: ELSTER Me3 - In house LMEL consumption meter, Type Alpha M++, Make ELSTER Me4 - Export meter, Type Alpha M++, Make: ELSTER <u>Frequency of data measurement :</u> On continuous basis <u>Recording frequency :</u> On hourly basis in logbook <u>Responsible Person for recording data:</u> Shift Engineer- operations <u>Accuracy :</u> +/- 0.2%
Monitoring frequency	On continuous basis but recording on hourly basis

QA/QC procedures	Quality control of monitored data from energy meters will be ensured. The energy meters "Me1", "Me2A", "Me2B", "Me2D", "Me3A" and "Me3B" will undergo calibration once every year. The energy meter "Me4" is not under the control of the project proponent. MSEDCL has the authority to conduct testing/calibration of the meter. MSEDCL will perform testing of the meter "Me4" atleast once in 3 years.
Purpose of data	For calculating EGj,y used in calculation of base line emissions
Additional comment	Total energy supplied to recipients can be cross checked with in-house consumption record of LMEL and export electricity sales invoices. Sales receipts will be used for verification. The total electricity supplied by the generator is equal to total electricity received by recipient plants. Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$EG_{j,y}$
Unit	MWh
Description	Quantity of electricity supplied to recipient facilities (i.e. LMEL and Power Trading Company) by the project activity during the year y
Source of data	Recipient plants records maintained in log book at LMEL facility (i.e. LMEL and Power trading company receiving the surplus electricity from project activity)
Value(s) applied	120,980.283 MWh/year for first year and ; 138,263.18 MWh/year from second year onwards
Measurement methods and procedures	Calculated by using the following formula $EG_{j,y} = f_{WCM} * EG_{i,j,y}$ where $f_{WCM} = ST_{whr,y} / (ST_{whr,y} + ST_{other,y})$ $ST_{whr,y}$ = energy content of the steam generated by WHRB fed into turbine via common steam header $ST_{other,y}$ = energy content of the steam generated by other boiler FBCB fed into turbine via common steam header Log book of hourly reading is signed by plant manager daily. The difference between end reading and start reading of the day is taken to arrive at the day's to arrive at the day's energy. The records and monitoring procedure will be same as stated in "EGi,j,y" above.
Monitoring frequency	Calculated based on hourly data
QA/QC procedures	Quality control of monitored data from energy meters will be ensured. The energy meters "Me1", "Me2A", "Me2B", "Me2D", "Me3A" and "Me3B" will undergo calibration once every year. The energy meter "Me4" is not under the control of the project proponent. MSEDCL has the authority to conduct testing/calibration of the meter. MSEDCL will perform testing of the meter "Me4" at least once in 3 years.
Purpose of data	For calculating base line emissions
Additional comment	Total energy supplied to recipients can be cross checked with in-house consumption record of LMEL and export electricity sales invoices. Sales receipts will be used for verification. The total electricity supplied by the generator is equal to total electricity received by recipient plants. Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$EG_{export,y}$
Unit	MWh
Description	Quantity of electricity supplied to the recipient plants by generator which in the absence of project activity would have been sourced from grid during the year y
Source of data	Recipient plants records maintained in log book at LMEL facility (i.e. LMEL and Power trading company receiving the surplus electricity from project activity)
Value(s) applied	113 Million units (Export to Power trading company) 24.45 Million units (Captive Consumption in LMEL)
Measurement methods and procedures	Internal captive consumption of LMEL will be metered via meter “Me3”. Surplus export of power is exported to power trading company and metered via meter “Me4”. Export meter Me4 is the official MSEDCL meter used for billing installed in plant premises. Log book of hourly reading is signed by plant manager daily. The difference between end reading and start reading of the day is taken to arrive at the day’s energy. The meters reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge daily. Meter details: Me3 - In house LMEL consumption meter, Type Alpha M++, Make ELSTER Accuracy of Meter : 0.2% Me4 - Export meter, Type Alpha M++, Make : ELSTER Accuracy of Meter : 0.2%
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	Quality control of monitored data from energy meters will be ensured. The energy meters “Me1”, “Me2A”, “Me2B”, “Me2D”, “Me3A” and “Me3B” will undergo calibration once every year. The energy meter “Me4” is not under the control of the project proponent. MSEDCL has the authority to conduct testing/calibration of the meter. MSEDCL will perform testing of the meter “Me4” at least once in 3 years. Sale records and purchase receipts will be used to ensure consistency. This meter (Me4) is under the custody of MSEDCL so PP has no control over it.
Purpose of data	To cross check $EG_{i,j,y\ y}$ used in calculation of base line emissions
Additional comment	Data will be measured and cross checked. Sales receipts will be used for verification. The total electricity supplied by the generator is equal to total electricity received by recipient plants. Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$F_{j,y}$
Unit	%
Description	Fraction of total electricity generated by the project activity that is supplied to the recipients
Source of data	Recipient plants records maintained in log book (i.e. LMEL and Power trading company receiving the surplus electricity from project activity)
Value(s) applied	1) For LMEL facility = 17.7% 2) Export to Power Trading Company = 81.3%

Measurement methods and procedures	Production of power from WHR based power plant in a year is evaluated equal to 158 Million units by considering 80% PLF. Supply to LMEL is based on the actual consumption of LMEL facility for previous three year which is equivalent to 24.45 million units. The auxiliary consumption is taken as 9% of total generation which is equivalent to 14 Million units. The rest of surplus 120 Million units is export to third party i.e. power trading company. The detail calculation is provided in financial excel sheet.
Monitoring frequency	Calculated yearly
QA/QC procedures	Sale records and purchase receipts will be used to ensure consistency.
Purpose of data	
Additional comment	Data will be measured and cross checked at the recipient plants and at generation plant. Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$t_{wcm,h}$
Unit	Deg C
Description	WECM(Flue gas) temperature at WHR boilers inlet.
Source of data	LMEL Plant Records.
Value(s) applied	950 deg c (Average monitored temperature value per day)
Measurement methods and procedures	Direct measurement by Instrument type: Smart Temperature Transmitter with out put 4-20 MA analogue signal going to DCS. Make: ABB Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy: 0.075%
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	QA/QC will be maintained as temperature transmitter will be calibrated once a year.
Purpose of data	For calculating EGj,y used in calculation of base line emissions
Additional comment	Records will be maintained for 12 years as required.

Data / Parameter	$Q_{whr\ Steam}$
Unit	tonnes/hr
Description	Quantity of steam from WHRB used for electricity generation.
Source of data	LMEL Plant WHR boilers log book records for 5 WHR boilers on 4x100 TPD and 1x500 TPD kilns.
Value(s) applied	103

Measurement methods and procedures	Quantity of steam generation from all WHR boilers will be individually monitored by electronic steam flow meters. Instrument type: Smart Transmitter with out put 4-20 MA analogue signal going to DCS. Make: Yokogawa Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy : 0.075% as provided by supplier Log book of hourly reading is signed by plant manager daily. The difference between end reading and start reading of the day is taken as the day's generation of steam. The log book total can be cross checked with totalised data provided in the instrument.
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	Calibration of meter is carried out once a year. QA/QC of monitoring equipment will be maintained.
Purpose of data	To calculate f_{WCM}" used in calculating baseline emissions.
Additional comment	Records will be maintained for 12 years as required. If metered value is m^3/h then steam density from steam tables will used to calculate kgs/h.

Data / Parameter	$Q_{Other\ Steam(FBC\ Steam)}$
Unit	Tonnes/hr
Description	Quantity of steam from other boilers used for electricity generation.
Source of data	LMEL Plant 90 TPH FBC boilers log book records.
Value(s) applied	20
Measurement methods and procedures	Quantity of steam generation from FBC boiler will be monitored by electronic steam flow meters. Instrument type: Smart Transmitter with out put 4-20 MA analogue signal going to DCS. Make: Yokogawa Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy : 0.075% as provided by supplier Log book of hourly reading is signed by plant manager daily. The difference between end reading and start reading of the day is taken as the day's generation of steam. The log book total can be cross checked with totalised data provided in the instrument.
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	Calibration of meter is carried out once a year. QA/QC of monitoring equipment will be maintained.
Purpose of data	To calculate f_{WCM}" used in calculating baseline emissions.
Additional comment	Records will be maintained for 12 years as per CDM requirement. If metered value is m^3/h then steam density from steam tables will used to calculate kg/hr

Data / Parameter	$ST_{whr,y}$
Unit	TJ

Description	Energy content of Steam generated by WHRBs fed to turbine via common steam header
Source of data	Data is calculated from enthalpies taken from steam table. Alternatively steam table available at following link will be followed. http://www.spiraxsarco.com/resources/steam-tables/superheated-steam.asp
Value(s) applied	0.28737
Measurement methods and procedures	Enthalpy of steam fed to turbine from the WHR boilers is calculated by taking the difference of enthalpy of steam and enthalpy of feed water. Enthalpy of steam from WHR boiler will be taken at 63.76 kg/cm^2 and 485 ^{0}C conditions. Also feed water enthalpy at 140 deg cent and will be taken from steam tables.
Monitoring frequency	Calculated value
QA/QC procedures	Not Applicable.
Purpose of data	To calculate f_{WCM}" used in calculating baseline emissions.
Additional comment	Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$ST_{other,y}$
Unit	TJ
Description	Energy content of Steam generated by other boiler fed to turbine via common header
Source of data	Data is calculated from enthalpies taken from steam table. Alternatively steam table available at following link will be followed. http://www.spiraxsarco.com/resources/steam-tables/superheated-steam.asp
Value(s) applied	0.0558
Measurement methods and procedures	Enthalpy of steam fed to turbine from the FBC boiler is calculated by taking the difference of enthalpy of steam and enthalpy of feed water. Enthalpy of steam from FBC boiler will be taken at 63.76 kg/cm^2 and 485 ^{0}C conditions. Also feed water enthalpy at 140 deg cent and will be taken from steam tables.
Monitoring frequency	Calculated value
QA/QC procedures	Not Applicable.
Purpose of data	To calculate f_{WCM}" used in calculating baseline emissions.
Additional comment	Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$t_{whrsteam}$ / $t_{othersteam}$
Unit	Deg C
Description	Steam temperature at inlet to Steam turbine generator.
Source of data	LMEL Plant Records.
Value(s) applied	485

Measurement methods and procedures	Direct measurement. Instrument type: Smart Transmtter with out put 4-20 MA analogue signal going to DCS. Make: ABB Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy : +/- 0.075% as provided by supplier
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	Calibration of transmitter is carried out once a year. QA/QC of monitoring equipment will be maintained.
Purpose of data	To calculate $ST_{whr,y}$ $ST_{whr,y}$ used to calculate f_{WCM}" used in calculating baseline emissions
Additional comment	Data used for referring steam table for calculating steam enthalpy. Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	$P_{whr\ steam}$/ $P_{other\ steam}$
Unit	Kg/cm^2 abs
Description	Steam pressure at inlet to STG
Source of data	LMEL Plant Records.
Value(s) applied	63.76
Measurement methods and procedures	Direct measurement. Instrument type: Smart Transmtter with out put 4-20 MA analogue signal going to DCS. Make: Yokogawa Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy : +/- 0.075% as provided by supplier
Monitoring frequency	On continuous basis but recording on hourly basis
QA/QC procedures	Calibration of transmitter is carried out once a year. QA/QC of monitoring equipment will be maintained.
Purpose of data	To calculate $ST_{whr,y}$ $ST_{whr,y}$ used to calculate f_{WCM}" used in calculating baseline emissions
Additional comment	Data used for referring steam table for calculating steam enthalpy. Records will be maintained for 12 years as per CDM requirement.

Data / Parameter	T_{BFW}
Unit	Deg C
Description	Boiler feed water temperature at all boilers.
Source of data	LMEL Plant Records.
Value(s) applied	140

Measurement methods and procedures	Direct measurement. Instrument type: Smart Transmitter with out put 4-20 MA analogue signal going to DCS. Make: ABB Frequency of data measurement : On continuous basis Recording frequency : On hourly basis in logbook Responsible Person for recording data: Shift Engineer- operations Accuracy : +/- 0.075% as provided by supplier
Monitoring frequency	On continuous basis but recording on hourly basis
kQA/QC procedures	Calibration of transmitter is carried out once a year. QA/QC of monitoring equipment will be maintained.
Purpose of data	To calculate $ST_{whr,y}$ $ST_{whr,y}$ used to calculate f_{WCM}" used in calculating baseline emissions
Additional comment	Data used for referring steam table for calculating steam enthalpy. Records will be maintained for 12 years as per CDM requirement.

B.7.2. Sampling plan

>> Not Applicable as no sampling plan used.

B.7.3. Other elements of monitoring plan

>>

(A) Purpose

To define the procedures and responsibilities for GHG Performance, monitoring, measurement and reporting of data and dealing with uncertainties and covers the responsibilities regarding plant operation and maintenance.

(B) Scope

This procedure is applicable to waste heat based WHRB power project of LMEL.

(C) Responsibilities for measurements.

We define below the responsibilities of the professionals involved in running the project activity.

Shift Engineer (Operations): Responsible for proper operation of the mechanical equipment and reporting hourly and eight hourly data and measurements of steam generated from WHRB, steam fed to turbines, parameters of steam and waste gas flow meters. The report is then sent to the Plant Manager for his review.

Shift Engineer (Electrical): Responsible for proper operation of electrical equipment and taking meter reading /measurement for electricity generation and export. The report is then sent to the Plant Manager for his review on a daily basis.

Shift Engineer (Maintenance): Responsible for proper maintenance management. The report is then sent to the Manager (plant) for his review on a daily basis.

Manager (Plant): Responsible for operation, maintenance and management of plant and calibration of monitoring equipments. He will be reviewing the monitored parameters/measurements shift-wise and presenting a daily executive summary report, duly signed by himself, to the General Manager (Plant).

General Manager: Responsible and in charge of complete operation, maintenance and management of all plant and CDM related matters

He will be in charge of all CDM related matters and CDM officer will be directly reporting to him

CDM officer: He will be reporting to General Manager and will be responsible for preparing required documentation and reviewing the accuracy of various reports with counter checks along with project developer. He will be responsible for internal audit and archiving of data every month regarding CDM project matter.
The detail monitoring plan is provided in Annex 4 of the PDD.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
Preparation of this document has been done by "Lloyds Steel Industries Ltd, Engineering division." CDM Consultant for project participant.

Date of completion of baseline study: 28/10/2011

General Manager of LMEL will be responsible for execution of monitoring methodology.

Responsible person for baseline and monitoring methodology covered in this PDD. Lloyds Steel Industries Ltd engineering division is not a project proponent.

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SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>> 15/03/2007 (Date of placement of order for power plant which is the earliest real action for the project activity is taken as start date in line with the definition of start date provided by EB)

C.1.2. Expected operational lifetime of project activity

>> 15 Years 0 Months (180 months)

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>> Project activity will use fixed crediting period.

C.2.2. Start date of crediting period

>> 01/06/2012 or date of registration of the project with UNFCCC (which ever is later).

C.2.3. Length of crediting period

10 Years 0 Months (120 months)

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> The Project activity is to produce electricity based on waste heat recovery based steam generation (WHRB) and steam turbines. There are no additional GHG emissions other than the existing GHG emissions in the absence of project activity.

The installation of WHRB and Power plant requires approvals of IBR (Indian Boiler Regulation) and Maharashtra State Pollution Control Board (MSPCB) and both the approvals have been received before the Commissioning of project activity.

Environmental impact is negligible as the project activity benefits the local, regional and global environment by,
(1) Reducing the thermal pollution which could have been caused by emitting waste gases at 1000^0C into atmosphere. Project activity recovers the waste heat and save energy and reduces thermal emission by controlling gas temperature below 200^0C.
(2) Generates electricity without adding any additional GHG emissions.

(3) The power generated by new project activity will be used for in house requirement and consumption of own and export without T&D losses.
(4) The generated waste water shall be used for plantation to create green belt.
(5) Noise level from equipments shall be kept within legal limits.
(6) The project will not generate on its own any Fly Ash due to Power generation from the project activity. But ash contained in flue gases will be collected in ash hoppers provided in WHR boiler.
(7) The proposed ESP shall remove the ash from flue gases which will be collected in Ash Hopper. This ash will be given free of cost to cement plants and brick manufacturers for further economics benefits and use. The ash used for production of bricks saves the valuable productive soil; also it reduces the Air Pollution caused by the conventional brick kilns, due to the coal burning. The Ash consumed in Cement making reduces the limestone and coal consumption, thus natural resources are saved.

LMEL have carried out EIA Study for setting up of power plant and the project activity has been accorded environment clearance as required by regulation of government of Maharashtra on 12/10/2009.

D.2. Environmental impact assessment

>> Environmental impacts are considered insignificant as enumerated in section D.1 above. No adverse impact on environment will be there due to project activity.

Noise Pollution
Equipments like Boiler and STGs shall be provided with noise depressing facilities to dampen and to reduce the noise level to permissible levels at the nearest village.

Thermal Pollution:
The heat shall be recovered in the boiler and the flue gases will be let out by stack of 70 m height below 200^0C and hence thermal pollution shall be reduced considerably.

Air emission:

An ESP provided at the outlet of boiler effectively reduces the flue dust level below to 100 mg/nm^3 which is as per environmental clearance accorded by government of Maharashtra, environment department.

Impact on Water environment
Blow down water shall be used for plantation. Sources of waste water are DM Plant and Blow down.

All the waste water will be neutralized before using for plantation.

Monitoring of waste water will be done to limit pH, BOD and COD levels within the stipulated levels.

No discharge will be there outside the premises. Hence due to the zero discharge condition, no adverse impact will be there in the water regime.

Solid waste management: Ash collected from bottom of hopper of ESP shall be transported to Ash Silo equipped with bag filters to ensure clean air. Ash collected shall be supplied to cement manufacturing/ brick manufacturing units.

Safety Management: To ensure safe working conditions:

1. All moving parts shall be provided with guards/ hoods.
2. Insulation of all hot parts shall be done.
3. Full fledged maintenance department shall ensure the healthy condition of equipments.
4. A disaster management plan already exists to handle crisis situation.

All efforts will be done to create clean environment. Parameters like Noise, Fugitive Emission as well as point source emissions will be monitored regularly.
Conclusion:
Project activity is environment friendly and creates employment and other benefits and promotes sustainable developments

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>> LMEL identifies the local stake holders for the project activity who are residing in the vicinity of project activity at Ghugus Village of Chandrapur district in Maharashtra state. The local authority of village is Gram Panchayat headed by a “Surpanch”.
The company officials met the representative of Panchyat and appraise the details of project activity in a personal meeting. Then the meeting with village Surpach and other villagers was held after fortnight on 09/02/2007 to receive comments from public gathering. The clarifications were given by the company officials immediately during the meeting. The minutes of meeting were compiled and No Objection Certificate (NOC) was received from Grampanchayat.

The other indirect local stakeholders in the project activity are enlisted below.

(1) Local Authority (Member of Legislative Assembly of Maharashtra)
- They were appraised of project details in personal meeting and letter encouraging the project activity was received from him.

(2) Maharashtra State Pollution Control Board, (MPCB)

Necessary consent to establish and environment clearances were received after submitting all necessary details to the authorities.

Permission has been sought from the State agencies like MSEDCL, MSPCB, etc. wherever required legally by putting proper applications to concern authorities. Also consent to establish and environment clearances have been received as per legal requirement to proceed with implementation of project activity.

E.2. Summary of comments received

>> The stakeholder's meet was arranged on 09/02/2007 at Ghugus village in presence of company official local villagers and Surpach of Grampanchayat. The members of Panchayat appreciated and had expressed their no objection for project activity. Following are the queries raised during meeting held on 09/02/2007.

Following Persons attended the meeting from Ghugus village, at Chandrapur district.
(1) Mrs Shobha Thakre, Village Sarpanch
(2) Mr Sheshrao .D.Thakre
(3) Mr Dayashankar.R.Tiwari
(4) Mr Ganesh.Bapurao.Vitre

Officials from LMEL who were present during the meeting are as follows.
(1) Mr Sunil Gupta
(2) Mr G. M. Purohit

Head of Gram Panchayat body is Surpanch who is elected by villagers and looks after the interests of the village as whole. Questions were normally put by Sarpanch i.e. Mrs Shobha Thakre who was representing all villagers after mutual discussion among villagers. The queries were raised during the meeting and clarified immediately by company officials. Following is the summary of local stakeholders comments and their clarification provided by LMEL.

Question	Reply by LMEL
(1) How the village is benefited	1 As waste heat is recovered and flue gases will be entering atmosphere at lower temperature, the environment of village will improve. 2 Expansion activity will increase employment opportunities
(2) Criteria for local people employment	Project will require qualified technicians, professionals, skilled and unskilled labour. Local people will be given preference if qualified technicians who have required qualification and experience are available. In case of commercial jobs where specific professional qualification is not required all efforts will be made to employ only local people.
(3) Dust emission problem	Project does not generate any ash as it is only waste heat based. However the dust from incoming flue gases is separated in ESP being provided. Hence the dust emission will be as per government environment rules
(4) Plans for village development	Company informed that they will be pleased to contribute to sustained development of the village. The company will address the issues of helping local students in their studies by providing scholarships and help in meeting water problem faced by village. The company also will make their dispensary available to local villagers in case of urgent needs. The company will make efforts to coordinate with gram panchayat in any manner that will help the villagers.

Similarly LMEL management apprised MLA regarding the project activity who also appreciated and expressed no objection for the project activity. MLA is a Maharahtra Legislative Assembly member elected by people from the area of which Ghugus is a constituent.

Sarapanch, village Ghugus raised the points of activities required to be carried out by company for benefiting the village.

E.3. Report on consideration of comments received

>> All the comments from local stakeholders were answered to their satisfaction. The details are provided in section E.2 above.

SECTION F. Approval and authorization

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HCA & MOC provided.

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Lloyds Metals and Energy Limited (Formerly known as M/s Lloyds Metals & Engineers Limited)
Street/P.O. Box	
Building	A 1-2 MIDC Area
City	Ghugus
State/Region	Maharashtra
Postcode	442505
Country	India
Telephone	07172-285071/285103
Fax	07172-285003
E-mail	www.lloydsin.com
Website	www.lloydsin.com
Contact person	
Title	Chairman
Salutation	Mr
Last name	Gupta
Middle name	R
First name	Mukesh
Department	
Mobile	9892251000
Direct fax	022-30418260
Direct tel.	022-30418111
Personal e-mail	mrgupta@lloyds.in

Appendix 2. Affirmation regarding public funding

No public funding and No ODA funds are available from Annexure-1 country.

Appendix 3. Applicability of methodology and standardized baseline

The methodology gives 3 steps to determine the baseline. All these 3 steps have been discussed in B.4 and arrived at baseline scenario of W2/P10.

Appendix 4. Further background information on ex ante calculation of emission reductions

The MSEDCL grid power is being used by LMEL at the moment. We select NEWNE grid electricity of which MSEDCL is a part and hence NEWNE grid electricity emission factor used to calculate baseline emission reductions which will give conservative reduction in base line emissions as grid power is mainly coal based but also comprises of diesel, hydel and nuclear power which will give lower emission factor for grid compared to coal based power plant.

The emission reductions are achieved by displacing fossil fuel based grid electricity with WHRB based electricity which uses only waste heat and does not use any other fuel. The reduction in GHG emission from facility of the project arises from the replacement / displacement of an equivalent amount of electricity to the extent of electricity generated from steam which is produced from waste heat recovered from waste gases in WHRB, which would have been otherwise generated and supplied by grid which is mainly dependant on fossil fuel based power plants.

Calculation of emission factor for NEWNE grid

Source: Government of India, Ministry of Power, and Central Electricity Authority issued.
“CO_2 Baseline Data base for the Indian Power Sector’ User Guide Version 4 dated Oct 2008.

Simple Operating Margin (tCO2/MWh) (incl. Imports) (

	2006-07	2007-08	2008-09	2009-10	2010-11
NEWNE	1.01	1.00	1.01	0.98	0.97
South	1.00	0.99	0.97	0.94	0.94
India	1.01	1.00	1.00	0.97	0.96

Simple Operating Margin (tCO2/MWh) (incl. Imports)

	2005-06	2006-07	2007-08	
NEWNE	1.02	1.01	1.00	*
South	1.01	1.00	0.99	*
India	1.02	1.01	1.00	

Build Margin (tCO2/MWh) (not adjusted for imports)

	2005-06	2006-07	2007-08
NEWNE	0.67	0.63	0.60
South	0.71	0.70	0.71
India	0.68	0.65	0.63

Net Generation in Operating Margin (GWh)

	2005-06	2006-07	2007-08
NEWNE	359,271	379,471	401,642
South	100,978	109,116	114,702
India	460,249	488,587	516,343

Net Generation in Build Margin (GWh)

	2005-06	2006-07	2007-08
NEWNE	87,764	93,524	100,707
South	28,228	30,442	31,613
India	115,991	123,965	132,320

Based on above data the emission factor calculation is provided in following table.

Emission factor	units	2006-07	2007-08	2008-09
$EF_{gridOM,simple, Y}$	t CO_2/MWh	1.02	1.01	1.00
$EF_{gridBM, y}$	t CO_2/MWh			0.60
Net generation in operating margin	GWh	359,271	379,471	401,642
Weighted average $EF_{gridOM,simple, Y}$ for 3 years	t CO_2/MWh	= {(1.02 * 359,271) + (1.01 * 379,471) + (1.00 * 401,642)}/(359,271 + 379,471+ 401,642) = 1.0086		
Net generation in build margin	GWh			100,707
Combined margin $EF_{Eleci,j, y}$ = 0.5* $EF_{gridOM,simple, Y}$ +0.5* $EF_{gridBM, y}$	t CO_2/MWh	= (1.0086 * 0.5 + 0.60 * 0.5) = 0.8032		

Appendix 5. Further background information on monitoring plan

MONITORING INFORMATION

Serial No.	Activity
1.0	**GHG Performance Parameter**
1.1 1.2	▪ The following parameters will be monitored : ▪ Gross generation of electricity by the power plant ▪ Auxiliary consumption. ▪ Steam availability from WHRB boilers/other boiler ▪ Steam flow entering to STG. ▪ Temperature and pressure of steam entering STG. ▪ Net electricity generation from waste heat recovery. ▪ Energy content of WHRB steam and other steam ▪ Waste gas quantity ▪ Exported electricity ▪ In house electricity consumption **Plant operation and maintenance**: Plant manager will be responsible for total plant operation and maintenance of all project equipment and monitoring equipment.
2.0	**Metering System**

2.1	The metering system for the waste heat based power plant shall consist of • In house metering system of LMEL (for metering the generation of power, auxiliary consumption, In-house consumption and LMEL meters to monitor the export of power to third party) • Export electricity meters of MSEDCL grid. • Flow meters for monitoring steam flow from WHRBS/other boilers • Flow meter for steam inlet to turbine. • Flow meters on waste gas duct. • Steam Temperature gauge for WHRB boiler/other boiler outlets and at inlet of TG • Steam Pressure gauge for WHRB boiler/other boiler and at inlet of TG
3.0	**Calibration of the Metering System once a year**
3.1	All the metering devices shall be calibrated at regular intervals so that the accuracy of measurement is ensured.
4.0	**Reporting of the Monitored Parameters/ Authority and Responsibility of monitoring and reporting**
4.1	**<u>In-house Metering System LMEL</u>** The Shift Engineer (Electrical) shall monitor hourly and eight hourly data on total generation, auxiliary consumption, in-house consumption and net electricity available for export. The hourly data shall be recorded in the generation log book and the eight hourly data shall be recorded in the plant log book. The complete and accurate records in the plant log book shall be signed by the Shift Engineer (Electrical). Both of these reports shall be sent to the Manager (Plant) The Steam flow meter reading, temperature and pressure gauge and DCS will measure the respective parameters and reporting will be done shift wise by shift in-charge (operations) based on the online measurements.
5.	**<u>Uncertainties and Adjustments: procedure for identifying and dealing with uncertainties</u>**
5.1	The hourly, eight hourly, daily and monthly data shall be recorded at various points as stated above. Any observations (like inconsistencies of report parameters) and/or discrepancies in the operation of the power plant will be documented as "History" in the daily report prepared by the General Manager (Plant) along with its time of occurrence, duration and possible reasons behind such operational disruptions. Necessary corrective actions will be undertaken at the earliest. Furthermore, as a safety measure, the total power generating system shall be equipped with an Automatic Alarming System which gives a prior indication of any fluctuations in the operating parameters of the power plant thereby enabling the operators to take necessary preventive measures. These measures will be undertaken in order to detect and minimize the uncertainty levels in data monitoring. <u>Flow, temperature and pressure meters:</u> 1 number of mandatory spare for each type of transmitter will be maintained so that the failed transmitter can be replaced immediately. <u>Energy meters:</u> 1 number of mandatory spare for each type of energy meter will be maintained so that the failed meter can be replaced immediately. <u>Auxiliary meters:</u> "Me2A" and "Me2B" are suitable for metering either or both transformers. Hence failure can be immediately attended. "Me2C" presently provided

	is spare and hence the uncertainty of measurement of auxiliary consumption is negligible. Export meter has in built alternative standby arrangement for failure of main meter. Additionally MSETCL have their dedicated billing meter which acts as additional standby. *Prevention of data loss:* All the data from DCS will be regularly fed into stand by computer for archiving. Log book entries also stored electronically in the stand by computer.
6.0	**Experience and Training**
6.1	All the Shift Engineers (Electrical and Instrumentation, Operations) shall be qualified engineers/ technologists. All the operators of the boiler power plant shall be IBR certified and they shall also undergo an exhaustive on-the-job training program including plant operations, data monitoring and report preparation. The technical staff will also be trained by OEM representatives.
6.2	**Emergency Preparedness Plan** The total power generating system of the waste heat based power plant will be equipped with an “Automatic Alarming System” which helps the operators to take necessary preventive actions before any kind of non-functioning of the power plant which may results. LMEL shall have a fire fighting system in place.
6.3	**<u>Internal audit</u>** CDM officer will carry out internal audit every month as per internal audit plan and prepare all necessary CDM related documentation. He will be reporting to General Manager. **Archiving of CDM related documents**. As per the requirement of CDM EB all the documents mentioned under monitoring section will be archived electronically in a dedicated computer. Responsibility of archiving will rest with CDM Officer and the GM of the power plant will be final responsible person. **Project Performance Review** The company has in place “Audit Plan” which envisages regular monitoring and audit of CDM project. The project performance review will be carried out under this audit plan by CDM officer of the company who will be directly reporting to General Manager. **Reference** Project Design Document, maintenance manuals, standard OEM procedures and CDM documentation.

Appendix 6. Summary of post registration changes

Change	Type	Details and reasoning of change
Change#01	Permanent change from registered Monitoring Plan	The registered PDD showed the meter on the 11 KV line which is before the transformer. However, on the project site, the energy meter "Me4" is located on the 220 KV line which is after the transformer. Therefore, the schematic diagram of the project boundary has been corrected in the revised PDD to present the actual position of the "Me4" meter. The change is proposed as per Appendix 1, paragraph 5(c) of Project Standard Version 7 and does not require prior approval from board.
Change#02	Correction	The make of energy meters "Me2A", "Me2B", "Me2C", "Me2D", "Me3" and "Me4" was mentioned as CONZERVE (model – EM 6400) in the registered PDD. However, the actual meters installed were of the make ELSTER (model – Alpha M++). In the revised PDD, the section has been modified to present the correct information. This was an inadvertent typographical error in reporting the name and accuracy of the meters in the PDD Version 9 since the meter specifications were available at the time of PDD completion. The change is proposed as per Appendix 1, paragraph 1 of Project Standard Version 7 and does not require prior approval from board.
Change#03	Correction	The make for all temperature thermocouples have been revised to ABB from Yokogawa and the accuracy class has been revised to 0.075% from 0.2% to make it consistent with the actual project site. This was an inadvertent typographical error in reporting the name and accuracy of the meters in the PDD Version 9 since the meter specifications were available at the time of PDD completion. The change is proposed as per Appendix 1, paragraph 1 of Project Standard Version 7 and does not require prior approval from board
Change#04	Correction	The accuracy class of all flow meters has been revised to 0.075% from 0.2% to make it consistent with the project site. This was an inadvertent typographical error in reporting the accuracy of the meters in the PDD Version 9 since the meter specifications were available at the time of PDD completion. The change is proposed as per Appendix 1, paragraph 1 of Project Standard Version 7 and does not require prior approval from board
Change#05	Permanent Change from registered monitoring plan	The data source and calculation of the parameter EGi,j,y (Quantity of electricity supplied to the recipient plants by generator which in the absence of project activity would have been sourced from grid during the year) has been changed from Me1 and Me2 to Me3 and Me4. The revised approach applies the sum of readings from "Me3" (Consumption by LMEL facility) and "Me4" (Net export to Grid) as the value of EGi,j,y. The revised approach is followed as it has been found to be more conservative since it removes transformer losses from the emission reduction calculation. The change is processed as per Appendix 1, paragraph 5(c) of Project Standard Version 7 and does not require prior approval from board.
Change#06	Correction	The accuracy class of all pressure meters has been revised to 0.075% from 0.2% to make it consistent with the project

		site. This was an inadvertent typographical error in reporting the accuracy of the meters in the PDD Version 9 since the meter specifications were available at the time of PDD completion. The change is proposed as per Appendix 1, paragraph 1 of Project Standard Version 7 and does not require prior approval from board.
Change#07	Permanent Change from Registered Monitoring Plan	The registered PDD described calibration frequency of the “Me4” energy meter as annual. However, the meter is not controlled by the project participant. The grid authority i.e. MSEDCL is solely authorized and responsible for the calibration of the meter. Therefore, the calibration frequency is revised from “annual” to “at least once in 3 years”. The change is proposed as per Appendix 1, paragraph 5(a) of Project Standard Version 7 and does not require prior approval from board.
Change#08	Correction	The legal name of the project participant is changed from “Lloyds Metals & Engineers Limited” to “Lloyds Metals and Energy Limited”. The change is proposed as per Appendix 1, paragraph 1 of Project Standard Version 7 and does not require prior approval from board.

Attachment-1

Kiln capacity	Steam generation Minimum As per ERK datasheets Tonnes/hr	Steam generation Average As per ERK datasheets Tonnes/hr	Steam generation Maximum As per ERK datasheets Tonnes/hr	Rated steam generation Of boiler as per manufacturer Tonnes/hr
Kiln 1100 TPD	8.3	10.9	12.7	12
Kiln 2100 TPD	8.3	10.9	12.7	12
Kiln 3100 TPD	8.3	10.9	12.7	12
Kiln 4100 TPD	8.3	10.9	12.7	12
Kiln 5500 TPD	35.2	50	58.4	55
Total Steam generation	**68.4**	**93.6**	**109.2**	**103**
Steam generation if one kiln of 100 TPD and 500 TPD are simultaneously shut down	24.9	32.7	38.1	36
Steam required in 30 MW turbine which at 80-85% PLF will generate 25 MW electricity	123 TPH (This is as per technical design provided in P&ID diagram for steam and feed water by Manufacturer Lloyds Steel Industries Ltd)			
Short fall in steam availability to generate 25 MW electricity	98.1	90.3	84.9	87
This Short fall is met by FBC boiler. Hence the designed capacity of FBC boiler is selected as 90 TPH.	90			

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Document information

Version	Date	Description
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-PDD* to *CDM-PDD-FORM;* • Editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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