Response on request for review 'Project 2519: Bhushan Power and Steel Limited–Waste Heat Recovery based Captive Power Project'

1. The DOE is requested to provide further justification on how it has validated the suitability of input values used in calculating the unit cost of generation for the project activity and the alternatives as per EB 41, annex 45, para 6.

According to Para 6 (EB 41 annex 45) – 'Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant. The DOE is therefore expected to validate the timing of the investment decision and the consistency and appropriateness of the input values with this timing. The DOE should also validate that the listed input values have been consistently applied in all calculations".

The project activity was conceptualized in February 2003. Quotations were seeked from equipment suppliers to prepare the financials prior to the project decision and the details are enclosed herewith as Annexure 1. The financial report prepared was initially submitted to the financial institution in October 2002 (Please refer project financials document No 20) and financial closure had been achieved in November 2003.

The table below details the assumptions for calculating the cost of generation along with the source of the data. All the assumptions has been validated and endorsed by the cost accountant and the copy has already been submitted to UNFCCC.

Assumptions to arrived Cost of Generation	**Value**	**Unit**	**Source of information**	**Remarks**
Project Cost				
Power Plant Turbine	14143	Rs. Lacs	Quotation and purchase orders (PO) – Document No 10, 11, 14 and 17	
WHRB Boiler	5012	Rs. Lacs	Quotation and purchase orders (PO) - Document No 9, 12, 13, 14 And 17	
AFBC Boiler	4866	Rs. Lacs	Quotation and purchase orders (PO)	

Assumptions to arrived Cost of Generation	**Value**	**Unit**	**Source of information**	**Remarks**
			– Document No 12, 13, 14 and 17	
Capacity				
Power Plant Turbine	100	MWPH	Technical specification Document No 10,11	
WHRB Boiler	204	MTPH	Technical specification – Document No 12	
AFBC Boiler	225	MTPH	Technical specification – Document No 9 and 12	
Auxiliary Consumption	10%		Technical assumption supported Central electricity authority. (Document no 15)	
PLF				
WHRB Boiler	60%		1. Letter from Avant Garde dated 18/10/2002. Document no 19 2. Letter from MECON dated 16.12.2002 (Document No 5)	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)
AFBC Boiler	90%		1. Letter from Avant Garde dated 18/10/2002. (Document no 19) 2. Letter from MECON dated 16.12.2002 (Document No 5)	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)

Assumptions to arrived Cost of Generation	**Value**	**Unit**	**Source of information**	**Remarks**
Rate of Depreciation				
Plant & Machinery	5.28%		Income tax act 1956	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)
Building	3.34%		Income tax act 1956	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)
Rate of Interest	10.50%		Lending rates of schedule commercial banks October – December 2002 (Document No 6)	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)
Minimum Demand Charges				
Rate / KVA (fixed charges)	200	Rs./KVA	WESCO Tariff From Feb 2001 (Document No 1)	ORIEC Tariff order 1998 (Document No 2)
Debt Equity Ratio				
Debt	66.67%		Bhushan Ltd Phase one project financial report (Document No 17, 20)	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)
Equity	33.33%		Bhushan Ltd Phase	Letter from VP

Assumptions to arrived Cost of Generation	Value	Unit	Source of information	Remarks
			one project financial report (Document No 17, 20)	projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)
O & M Charges	8%	of Project Cost	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)	
Raw Material per KWh				
Washed Coal Rejects (0-4)	0.200	MT per MW		Calculation
Coal Middling (0-6)	0.600	MT per MW		Calculation
Char	0.500	MT per MW		Calculation
Raw Material Rate				
Washed Coal Rejects (0-4)	405	Rs. Per MT	Inani coal corporation 15th Oct 2002 (INR 405/ton) Padmavati commodities 25th Sep 2002 (INR 390/ton)	Conservatively highest value has been used.
Coal Middling (0-6)	350	Rs. Per MT	Inani coal corporation 15th Oct 2002 (INR 340/ton) Padmavati commodities 25th Sep 2002 (INR 350/ton)	Conservatively highest value has been used.
Char (Waste Product From Kiln)	0	Rs. Per MT		

Assumptions to arrived Cost of Generation	Value	Unit	Source of information	Remarks
Consumables at WHRB	0.10%	Per MW Gen.	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)	
Consumables (Including Fuel) at AFBC	0.15%	Per MW Gen.	Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document No 4)	

It is evident from the above table that the values used in the calculations of the unit cost of generation are at the time of decision making which has been refereed in the project report and submitted to financial authorities for achieving the financial closure (Document no 20). The project proponent in the PDD have used the actual cost of the equipments based on the purchase orders as the same had been released prior to the validation process..The proposal values and purchase orders values are almost same and therefore the impact on the unit cost is negligible.

Comparison of Cost based on offers and purchase orders

Based on Proposals/offers

Project Cost		
Power Plant Turbine	14397	Rs. Lacs
WHRB Boiler	4919	Rs. Lacs
AFBC Boiler	4788	Rs. Lacs

Unit Cost[1]

AFBC 1.132 INR/kWh

WHRB 1.446 INR/kWh

[1] Refer Unit cost analysis sheet Proposal/offer– Annex 1. The assumptions and calculations had been endorsed by cost accountant.

Based on Purchase orders

Project Cost		
Power Plant Turbine	14143	Rs. Lacs
WHRB Boiler	5012	Rs. Lacs
AFBC Boiler	4866	Rs. Lacs

Unit Cost[2]

AFBC **1.131 INR/kWh**

WHRB **1.447 INR/kWh**

It is evident from the above table that the PO values are conservative as the cost of generation of power through AFBC is less and through WHRB is more in this case. DOE has validated the unit cost based on purchased orders, project financial report, letters from technical and financial organizations (Mecon, SBI CAPS) and expert interviews.

2. Further clarification is required on how the DOE has validated the unit cost of generation. The DOE is requested to substantiate that the alternatives considered will provide the similar level of output/services as that of the project activity.

The DOE has validation the unit cost analysis based on the supporting documents which has been discussed in the table above. Further to this third party cost accountant has reviewed and endorsed unit cost analysis sheet, which has confirmed the assumptions and calculations.

The project activity is energy generation from the waste heat i.e. steam which is used for power generation. The WHRB service is the steam generation which is compared with the AFBC based steam generation (Steam to electricity conversion is taking place in the steam turbine).

For an integrated steel manufacturing unit, the rate of energy output (MW) is more significant than the quantum of energy output (MWh). This is primarily because of the fluctuating nature of power demand from facility like electric arc furnace (High power demand (MW) for less duration. During the phase 1 the demand was 90 MW only for electric arc furnace). Therefore, in such a scenario, the primary service that the project proponents are seeking to fulfill is the rate of energy output that they require in terms of MW. The service of fulfilling the requirement of energy output (MWh), thus assumes secondary significance.

The capacity of the WHRB is 204 TPH which can generate upto 48 MW power. Due to fluctuating nature of DRI kiln, the quantity and quality of waste gases are varying. Due to this the

[2] Unit Cost analysis sheet – Annex 2. The calculations and assumptions had been endorsed by cost accountant.

continuous power supply is not possible in WHRB without backup power. The alternative for the project activity is any power plant which can generate around 48 MW of continuous power. The project activity is compared with the 225 TPH (52[3] MW at 100% load) coal based boiler which at 90% load can give around 47 MW[4] of power. Considering the standard size of equipments the nearest capacity of AFBC boilers has been considered.

The quantum of energy output (MWh) will be more in AFBC boiler. In the project activity this is being exported to the grid. Conservatively the revenue from export of electricity from AFBC has not been considered..In lieu of the fact, it is considered that the alternatives provide similar level of output/services as that of the project activity.

The unit cost of both the alternatives viz. coal washery reject and project activity, have been discussed in detail in section B.5 of the PDD and it is justified that the waste heat recovery based power generation is costlier with respect to coal washery rejects based power generation.

All the other alternatives are discussed in the detail in the PDD and those are not relevant with the project activity. The same has been mentioned below as well:

Alternative P1: Proposed project activity not undertaken as a CDM project activity:

BPSL have set up a waste heat recovery based electricity generation at its facility for meeting the captive power requirement of the integrated steel plant and if this is in surplus, the same would be exported to the state grid. This alternative is in compliance with all applicable legal and regulatory requirements. In order to implement this project activity BPSL had to face number of technological and financial barriers, which makes this alternative, less attractive for the project activity with out CDM benefits. Hence this option can be eliminated for consideration as a baseline scenario.

Alternative P2: On-site or off-site existing/new fossil fuel fired cogeneration plant

BPSL does not have any existing/new fossil fuel based cogeneration plant and also does not require steam in the processes involved in the sponge iron kiln. Further as the project activity is not a cogeneration plant, this baseline alternative is not a realistic alternative to the project, though it is in compliance with the legal and regulatory requirements.

Alternative P3: On-site or off-site existing/new renewable energy based cogeneration plant
BPSL does not have any existing/ new renewable energy based cogeneration plant and also does not require steam in the processes involved in the sponge iron kiln. Further as the project activity

[3] Please refer cost calculation sheet for capacity of WHRB and AFBC

[4] Output is within the limit of +/- 5% of the WHRB output.(Acceptable as per AM0018)

is not a cogeneration plant, this baseline alternative is not a realistic alternative to the project, though it is in compliance with the legal and regulatory requirements

Alternative P4: On-site or off-site existing/new fossil fuel based existing captive or identified plant

BPSL could implement a new fossil fuel based captive power plant in the absence of the project activity. Considering the fuel options for captive power generation, under this alternative P4, there could be 3 possible options:

Option 4a: Coal, coal washery rejects, coal char based captive power generation
Option 4b: Diesel based captive power generation
Option 4c: Gas based captive power generation

The above alternative is in compliance with legal and regulatory requirements and could be possible baseline alternative. This alternative is considered for further evaluation.

Alternative P5: On-site or off-site existing/new renewable energy based existing captive or identified plant;

There is no existing renewable energy based captive power plant at the sponge iron facility of BPSL. Renewable energy is generated from sources such as biomass, hydro, wind etc. This alternative is in compliance with the legal and regulatory requirements, and could be a possible baseline alternative. This alternative is considered for further evaluation.

Alternative P6: Sourced Grid-connected power plants

In the absence of CDM project activity, BPSL has the option of importing electricity from the Eastern regional grid, which will further lead to GHG emissions from fossil fuel based thermal power plants that form the grid. This alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline. This alternative is considered for further evaluation.

Alternative P7: Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity)

The project activity involves electricity generation from waste gas. This alternative scenario on the captive electricity generation from Waste Heat Recovery (WHR) project with lower efficiency than the proposed project activity could be a possible baseline alternative. This baseline alternative is considered for further evaluation.

Alternative P8: Cogeneration from waste gas (if project activity is cogeneration with waste gas, this scenario represents cogeneration with lower efficiency than the project activity):

BPSL's project activity does not involve cogeneration with waste gas and therefore this alternative is not considered as a baseline scenario.

Out of the above mentioned alternatives the following are relevant for power generation scenario:

- P4: On-site or off-site existing/new fossil fuel based existing captive or identified plant
- P5: On-site or off-site existing/new renewable energy based existing captive or identified plant**;**
- P6: Sourced Grid-connected power plants
- P7: Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity)

Under this step 2, the fuel that may have been used in the baseline as a choice of energy source is evaluated taking into account the national and sectoral policies as applicable. As per this step 2, it is required to demonstrate the following:

- Demonstrate that the identified baseline fuel is available in abundance in the host country and there is no supply constraint.
- Detailed justification shall be provided for the selected baseline fuel. As a conservative approach, the available fuel with the lowest carbon emission factor (e.g., natural gas) shall be used.
- In case of partial supply constraints (seasonal supply), the project participants shall consider the available alternative fuel that result in lowest baseline emissions during the period of partial supply.

Evaluation of P4 alternative:
In the power generation scenario, for alternative P4 there are 3 options considering the available fossil fuels in the country (India) as discussed in Step 1. These are further discussed based on fuel for baseline choice as per the requirement under Step 2:

Option 4a: Coal, coal washery rejects, coal char based captive power generation

Coal is available in abundance in the host country (India) and is one of the main fossil fuels used for power generation[5]. As per World Coal Institute, the following are some key facts on coal availability and use in the host country (India):

- Coal is the dominant commercial fuel, meeting half of commercial primary energy demand and a third of total energy needs.
- The power sector will be the main driver of India's coal consumption - currently around 69% of India's electricity is generated from coal
- Coal reserves in India are plentiful and India has 10% of the world's coal, at over 92 billion tonnes, third only to the USA and China in total reserves. At current rates of production, India has enough coal for the next 217 years
- Almost all of India's 565 mines are operated by Coal India and its subsidiaries, which account for about 86% of the country's coal production. Current policy allows private mines only if they are 'captive' operations, i.e. they feed a power plant or factory. Most of the coal production in India comes from opencast mining, contributing over 83% of the total production

Use of coal for power generation is in compliance with the legal and regulatory requirements. As apparent from Section A.2, BPSL has implemented coal, coal washery rejects and coal char based AFBC at their facility to also cater to the captive power requirements along with WHRB (the project activity). For BPSL, the coal washery reject is sourced from the coal washeries and BPSL also has sanction for captive coal mines from Ministry of Coal, Government of India[6]. This justifies the abundant availability of this fossil fuel i.e. coal as well as coal washery rejects for power generation at BPSL facility itself.

It needs to be noted that as described in Section A.2, BPSL has implemented both the WHRB and AFBC (based on coal, coal washery rejects and coal char) systems in their facility and therefore in the absence of the proposed CDM project activity, BPSL could generate electricity by expanding the capacity of its existing coal, coal washery rejects, coal char based AFBC boilers equivalent to the capacity of the four waste heat recovery boilers i.e. the project activity.

Considering that BPSL has already implemented coal, coal washery rejects, coal char based AFBC boilers 1 & 2 catering to the captive requirements of the integrated steel plant, there is a possibility that they could expand the existing capacity of AFBC boilers, the expansion being equivalent to the capacity of the WHRB system (the project activity). BPSL already had planned 2 AFBC boilers having steam generation capacities of 75 TPH and 150 TPH respectively and to put up a AFBC boiler with an additional steam generation capacity of 4 X 51 TPH (i.e. 204 TPH equivalent to the WHRB system), would have required relatively lesser investment when

[5] Reference: http://www.worldcoal.org/pages/content/index.asp?PageID=402

[6] Reference: Coal mine sanction letters pertaining to Allocation of Jamkhani Coal block and Allocation of Bijahan block by the Ministry of Coal, Government of India, provided to the DOE

compared to putting up a WHRB of equivalent capacity[7]. The cost of setting up a WHRB is much more than the cost of setting up an equivalent capacity AFBC system.

Further, coal char and coal washery wastes (from their existing coal washery) would be used in the AFBC boilers as fuel. Therefore, power generation equivalent to that generated by the WHRB system could have been achieved by the coal/ coal char/ coal washery reject based CPP with a marginal increase in cost of AFBC boiler. This is also considering the abundant availability of fuel from their existing and nearby coal washeries resulting in lesser capital cost and cost of generation per unit. Further it is to be noted that BPSL has received sanction for captive coal mines[8] which further strengthens the fact that sufficient coal is available for captive power generation and moreover it would be more economically attractive to procure coal from their captive coal mines rather than purchase coal. This justifies the fact that for BPSL, it would be most economically attractive for setting up a coal, coal char and coal washery rejects based CPP.

This above alternative is in compliance with all applicable legal and regulatory requirements and may be a baseline alternative.

Option 4b: Diesel based captive power generation
In the absence of the proposed CDM Project activity, BPSL could generate power by implementing a diesel-based power plant to meet their power demand. This will lead to emission of GHG gases, by the diesel based captive power generation. This Option 4b is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline.

Option 4c: Gas based captive power generation
BPSL could generate its own power using natural gas based captive power plant. Although this alternative is in compliance with all regulatory and legal requirements, it is not a realistic alternative due to non availability of natural gas distribution network in Orissa. The documentary evidence pertaining to non-availability of gas supply to Orissa is apparent from the following information available from the Ministry of Petroleum and Natural Gas (MoPNG), Govt of India, available at the site http://petroleum.nic.in/ng.htm.

Therefore, this Option 4c may be excluded from baseline scenario.

Evaluation of P5 alternative:
Renewable energy would be primarily from biomass, hydro or wind. Considering the non – availability of renewable energy sources at the vicinity of project site and also considering that

[7] Reference: Documents provided to the DOE

[8] Reference: Coal mine sanction letters pertaining to Allocation of Jamkhani Coal block and Allocation of Bijahan block by the Ministry of Coal, Government of India, provided to the DOE

the extent of power required by BPSL's facility is quite large to be met by these renewable energy sources, this alternative is not considered for further evaluation.

Evaluation of P6 alternative: (Sourced Grid-connected power plants): The grid electricity is Orissa is costly but it is available. This meets all the legal requirements and therefore this alternative is considered for further evaluation of baseline scenario.

Evaluation of P7 alternative: (Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity): The project activity is new greenfield project activity and the waste heat recovery power plant is first time installed in the plant with this project activity therefore this alternative is not considered for further evaluation.

Based on the above, the plausible alternatives that are considered for evaluation under this Step 3 are as follows:

- P4, i.e. Option 4 (a) *Coal, coal washery rejects, coal char based captive power generation* and Option 4 (b) *Diesel based captive power generation*
- P6: Sourced Grid-connected power plants

Table B-3 (a): Comparison of Cost of Power Generation

Parameter	**Grid based power (Option P6)**	**Coal, based Power plant (Option P-4a)**	**Diesel based power plant (Option P-4b)**
Capital Cost	Nil	INR 40 Million/MW	INR 35 Million/MW
Cost of Power	INR 4.00/ KWh	INR 1.56/kWh[9] as per CEA data INR 1.13 / kWh for BPSL's coal, coal char and coal washery rejects based CPP	INR 5.96[10]/kWh

[9] Reference: Report of the Expert Committee on fuels for Power Generation, Executive Summary – By Government of India, Central Electricity Authority, Planning Wing, dated February 2004 provided to the DOE.

[10] Reference: Report of the Expert Committee on fuels for Power Generation, Executive Summary – By Government of India, Central Electricity Authority, Planning Wing, dated February 2004

It is clear from above table that the coal and coal washery rejects based CPP is the cheapest option for power generation therefore the same has been considered as baseline scenario.

3. Further clarification is required on how the DOE has validated the barrier analysis, in particular, it should be clarified what third party evidence has been assessed to determine the prohibitive nature of the barriers.

The barriers are compared with the alternative of coal washery reject based power generation and the supporting is presented in the last column to support the barrier.

Barrier	***Coal washery rejects based power generation***	***Waste heat recovery based power generation***	***Supporting document***
The capital cost of the coal based CPP is lower when compared to the project activity (WHRB based power with high pressure and temperature configuration) as detailed above in the investment barrier section. An equivalent capacity AFBC boiler would have been much cheaper than the four WHRBs	Less costly	More costly	Quotations/Purchase orders
Technological Barriers			
Training related	No training required	Training required due to high pressure and temperature	Letter from Thermax (Document no 3) and Directorate of Factories (Document no 8) stating that this was the first project operating with high pressure and temperature attached to the DRI kiln waste

			gases. AFBC was available in these configurations in India before the project activity.
Risk of technological failure			
Waste gas quality	Not applicable because plant will be operated on coal/ independent of waste heat from Kiln	Due to the poor quality of coal and Iron ore the quality of waste gas will not be consistent.	Report from Outokumpu Lurgi Metallurgie (Document 18).
Temperature control	Not applicable as the plant is stand alone and no intervention from any other unit.	The temperature of waste gases has a big impact on temperature of steam generated. It is maintained by spraying water in flue gases which makes cake in the after burning chamber.	Letter from Mecon (Document No 16)
Boiler operation related	Time tested technology working from many years	New technology- implemented first time in the plant	1. Letter from Thermax (Document no 3) and directorate of factories (Document no 8) as first time this pressure and temperature is attached with the DRI kiln waste gases. 2. Letter from VP projects to Director commercial

			Bhushan Limited dated 1/10/2002 (Document No 4)
Low capacity utilization of WHRB	This is independent plant	The plant is related with the operation of the DRI kiln and any kiln shut down and its performance has a direct impact on the operation and performance of the WHRB.	1.Avant Garde letter 18/10/2002 (Document no 19) 2.Mecon letter 16/12/2002 (Document no 5) 3.Letter from VP projects to Director commercial Bhushan Limited dated 1/10/2002 (Document no 8)
Barriers due to prevailing practices	Well establish technology	First of its kind	JPC report (Available in web with the project activity) (Discussed in detail in response below). Letter from Thermax and directorate of factories.

It is evident from the above table that all the barriers are supported with necessary documentary evidences and communications with the technical experts. The barriers discussed above do not prevent the implementation and the operation of an AFBC boiler and therefore the project activity is additional.

4. Further details regarding the common practice should be provided in accordance with the requirements of step 4 of the additionality tool, i.e. similar project activities should be described and the differences between each of these activities and the project should be clearly indicated.

As per the additionality tool, first of its kind project activities need not to conduct the common practice analysis. It is evident from the third party letters of Thermax and Directorate of Factories that the project activity is first of its kind in the region. In order to further substantiate the fact, the project proponent has presented the common practice analysis as a credibility check.

As per additionality tool "Provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis. Provide documented evidence and, where relevant, quantitative information. On the basis of that analysis, describe whether and to which extent similar activities have already diffused in the relevant region."

In India all individual states have their own rules/regulation for the investment and as the project activity is located in Orissa state, the state of Orissa has been considered as the region to demonstrate the common practice.

In Orissa, about 33 Sponge Iron units were operating during the project commissioning period, of which only 4 units had the waste heat recovery based power generation, which contributed to about a mere 12%. (JPC report – it covers the data till 31st August 2005).

The four sponge iron plants which had captive power plants are:

1. Tata Sponge Iron Limited (http://cdm.unfccc.int/Projects/DB/DNV-CUK1140622960.5/view)
2. Orissa Sponge Iron Limited (http://cdm.unfccc.int/Projects/DB/TUEV-RHEIN1152711605.33/view)
3. OCL India limited (http://cdm.unfccc.int/Projects/DB/SGS-UKL1145002776.48/view)
4. Sree Metaliks Limited (http://cdm.unfccc.int/Projects/DB/SGS-UKL1204734963.42/view)

All the four plants are similar in technology with respect to project activity. Based on web available information all the projects are registered with UNFCCC EB. Therefore no project activity which is similar to the project activity was operating in the state without CDM benefits. It establishes that the project activity is unique in nature and is not a common practice.