Clarifications on issues associated with validation requirements for project activity Request for review "Shanxi Taigang Stainless Steel Co., Ltd. Waste Saturated Steam Recovery and Generation Project"(1711)

Comment 1: Further clarification is requested on the standard industrial practice for power generation using steam from waste heat in China and why the PP opted for the use of saturated steam.

PP Response 1: It can be seen from the website of UNFCCC that all of the waste heat projects registered in China use super-heated steam and most of these are in the cement sector rather than the Iron and Steel sector.

The option as to which type of steam is available and used for waste heat recovery is determined by the industrial sector (or industrial facility), the process by which the waste heat is generated and the equipment used for waste heat recovery.

Saturated steam is the only available type of steam for the project participant to generate power. This is principally due to the discontinuous operation process that prohibits the use of super-heaters. [1]

From the FSR of the project, it says that the *"High temperature (1400-1500℃) secondary off-gas[2] is generated discontinuously from the operation of converter, AOD (argon-oxygen decarburization) oven. The secondary off-gas has to be cooled to guarantee the converter operation[3]. In order to remove the waste heat in the secondary off-gas, considering its discontinuous operation process, a special waste heat recovery system called 'steam cooling system' is widely used in China Iron steel sector. Based on the process above, only saturated steam can be generated. "*

What's more, "*the steam cooling system is one of the components of the converter and AOD system based on the design requirement, and saturated steam is the unique product from this system, which is wasted and released into the atmosphere.*" This has been written in accordance with advice received after consultation from the Beijing Iron ad Steel Design and Research Institute. This is the Design Institute with the most authority on the iron and steel sector in China.

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[1] This has been confirmed by Mr. Yang Yuanman, who is the design engineer of Beijing Iron and Steel Design and Research Institute, stated that it is impossible to add a super heater in the steam cooling system so as to get superheated steam for power. Otherwise the super heater will be destroyed when high temperature(*1400-1500*) secondary off-gas passes it discontinuously.

[2].Page 236 "Particulate matter is emitted both during charging of scrap and hot metal and during tapping from the BOF. During charging or tapping operations, the converter is tilted. A so-called secondary ventilation system, is often installed to abate the particulate matter emissions that occur. The secondary ventilation system usually consists of a canopy hood just above the converter in tilted position and a dog house around the remaining 3/4 of the converter. Subsequent treatment of the evacuated gases is usually performed by means of a fabric filter or ESP"_ **8.2.2.1.2 Secondary off-gases, Best Available Techniques Reference Document on the Production of Iron and Steel, 2001**

[3] Steelmaking by Converter, Professor Sun Lina, Beijing Science and Technology University.

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Therefore, saturated steam is the standard waste heat source from the converters and AOD ovens and the PP has no other option when selecting to use this waste heat source. Furthermore there are no other waste heat sources on site other than from the sinter machine that is also developed as a CDM project.

Given that there is no alternative to the saturated steam in this industrial facility, the common practice analysis in the PDD demonstrates it is not standard industrial practice in the iron and steel sector to use saturated steam for power generation. Indeed this project is first of a kind in the region.

Comment 2: Further clarification is required on how the DOE has validated the suitability of the input values to the investment analysis, as per the guidance of EB 38 paragraph 54(c).

PP Response 2: The guidance of EB 38 paragraph 54(c) is as follows:

"The Board clarified that in cases where project participants rely on values from Feasibility Study Reports (FSR) that are approved by national authorities for proposed project activities, DOEs are required to ensure that:

(c) On the basis of its specific local and sectoral expertise, confirmation is provided, by cross-checking or other appropriate manner, that the input values from the FSR are valid and applicable at the time of the investment decision."

All the input values are valid and applicable at the time of the investment decision, although this guidance was not published when the proposed project submitted for registration.

The project owner made the investment decision based on FSR, and all the input values used in the investment analysis were taken from the Feasibility Study Report for the project carried out by the Taiyuan Iron and steel Group Design Institute, which is a government-accredited third party. In accordance to Chinese procedures, assumptions and data sources for the economic evaluation are based on relevant national standards and criteria. Furthermore, all the data in the FSR was assessed by designated independent experts and finally approved by the Economy and Trade Commission of Shanxi Province. Therefore, the values are considered to be reliable and suitable.

In addition, Details of the input values used in the investment analysis are given below:

- **Capital costs** – the investment in fixed assets in the IRR calculation in the PDD is consistent with the Feasibility Study Report and its approval from local government. The Capital cost doesn't include steam cooling system since it is part of the industrial facility. So the main source of investment is from saturated steam turbine system, However, PP invests more capital cost

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on saturated steam turbines than other waste heat projects in China, which use conventional super heated steam turbines. From the FSR, there is no domestic manufacture in China can produce saturated steam turbine, the PP has to imported it from abroad, Thus more investment is involved. So the capital cost reflects the actual situation of the project and reasonable.

On the other hand, when comparing the total investment in terms of RMB per kW, the project investment is less than other waste heat projects in China. For example, it is shown in the EB website that the total investment (RMB/kW) of most the registered cement waste heat projects is about 7000 RMB/kW[4], while the proposed project is 5077.4 RMB/kW. This demonstrates that the capital cost of the project used in IRR calculation is conservative.

- **Interest rate for loan** – the interest rate for the loan is taken from the FSR of the project. In China, interest rates on loans are determined by the government. The rate used in the FSR is therefore the standard loan rate for loans of this size and repayment period at the time of writing the FSR (http://www.pbc.gov.cn/detail.asp?col=462&ID=1903).

- **O&M costs--** The O&M costs for the project are taken from the FSR for the project. The equipment repairs are the main source of O&M cost for this project. We can see it takes just 3.5% of the total capital cost, which is on the lower end of the range (3%-5%) applied for FSR in China[5].

- **Electricity generated –** According to the FSR of the proposed project, the net supplied electricity amount is 100 GWh, which is calculated by average Operational Capacity and average operational hours. In the FSR the average operational capacity of the turbines is 24.656MW. This is referred to the contract between Taigang and technology supplier KK&K.

  4368 hours is the average operational hours for this project. This is because the project only operates for 7 months in a year (April to October)[6] and as such this is the only period that the project is able to generate electricity. 7 months equates to 5040 hours and 4368 hours is deducting the maintenance period on the industrial facility and on the waste saturated steam power plant.

- **Power tariff** – The power tariff used in the IRR calculation also from FSR, and the data 0.32 RMB/kWh (excl. VAT) is the actual power tariff that the project owner pays for purchasing power from North China Power Grid. The evidence for this was presented to the DOE during validation.

[4] http://cdm.unfccc.int/Projects/registered.html

[5] Page 111, Financial evaluation and difficult question analysis for FSR research and bank loan project

[6] The saturated steam is used for heating in the winter months, And it can't be used for iron steel production process, which is confirmed in the FSR.

Comment 3: Further clarification is required on how the DOE has validated the baseline determination, in particular, that the continuation of grid electricity imports is a more economically attractive alternative than the project activity undertaken without CDM.

PP Response 3: According to the methodology ACM0004, there are three steps to identify alternatives to the project activity:

1. Identification of alternative baseline scenarios.
2. Excluding baseline options that do not comply with legal and regulatory. requirements or depend on key resources such as fuels, materials or technology that are not available at the project site.
3. Identifying that among the alternatives that do not face any prohibitive barriers, the most economically attractive alternative should be considered as the baseline scenario

Also, according to the methodology ACM0004, the following five scenarios are identified as baseline alternatives for the proposed project:

(1) The proposed project activity not undertaken as a CDM project activity;
(2) The continuation of the current situation, import of electricity from NCPG grid;
(3) Existing or new captive power generation on-site, using other renewable energy sources or other resources as coal, gas, and oil, etc;
(4) A mix of options (b) and (c), in which case the mix of grid and captive power should be specified.
(5) Other uses of the waste heat and waste gas

Section B.4 of the PDD eliminates (3), (4) and (5) due to prohibitive barriers and do not comply with legal and regulation in China as well as lack of resources and materials. Therefore the only options left to consider are options (1) and (2).

Option (1) is eliminated since it is proven to be economically unattractive based on IRR calculation, which uses the income from not purchasing power from grid.

Option (2) is considered to be economically attractive since the IRR calculation result of option(1) shows it is not profitable. So the continuation of the current situation is most applicable alternative for STSS.

However, to further elaborate this and in response to this question the project participant has prepared a cost comparison of the two options. This has been done through evaluation of the NPV and the levelised cost of scenarios (1) and (2) over a 20 year lifetime.

This is presented below in tables as follows.

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NPV Comparison of two scenarios:

NPV Analysis	
IRR Benchmark	13%

Baseline Continutation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Cost of electricity (RMB)	0	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432	-32,000,432
Tax saving (RMB)	0.00	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10
Total (RMB)	0.00	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29	-24,000,324.29
NPV for Purchasing electricity from Grid (RMB)	**-149,200,280**	Difference baseline and project	34,923,697		Confirmation	$0.00															

Project Conducted without CDM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Net Cash Flow (RMB)	-86,440,000.00	496,256.89	594,592.67	697,222.65	804,334.34	916,123.48	1,032,794.30	1,154,560.00	1,281,643.05	15,503,426.15	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	19,575,904.29	30,047,904.29
Less: Electricity Revenue (RMB)		-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39	-32,000,432.39
Tax Adjustment (RMB)		8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10	8,000,108.10
Total (RMB)	-86,440,000.00	-23,504,067.40	-23,405,731.62	-23,303,101.65	-23,195,989.95	-23,084,200.82	-22,967,529.99	-22,845,764.30	-22,718,681.25	-8,496,898.14	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	-4,424,420.00	6,047,580.00
NPV For Invest proposed project (RMB)	**-184,123,976**																				

The comparative NPV calculation was conducted by comparing **(1) the cost of implementing the project without CDM revenue** to **(2) the cost of continuing the baseline activity of importing electricity**. In the NPV calculation of scenario (1), no revenues were included for the avoided power supply costs, because the NPV of scenario 1 will be compared with the NPV of scenario 2, purchase from the grid. The discounting was conducted using the benchmark rate of 13%. The table below outlines the results and a revised IRR model is provided for your reference.

NPV Analysis	Unit: RMB
Continuing with importation of electricity	-149,200,280
Project conducted without CDM	-184,123,976

The values for the NPV are all negative, which is logical as the NPVs concern different ways of meeting the needs to provide an input in a production process rather than different ways to produce an output. The continuation of the importation of power from the grid has a less negative NPV than the project without CDM, which means that in the absence of CDM the importation of electricity from the grid is the cheapest manner to meet the project entity’s electricity needs. The analysis also confirms that with CDM in place, the project becomes the cheapest way to provide the project entity with electricity.

Levelized power cost comparison

Discounted Annual Power Generation of STSS

		Reference	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Annual Power Generation (MWh)	A	FSR	-	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001	100,001
Discount Factor	B	$= 1 / (1 + DR)^n$	1	0.88496	0.78315	0.69305	0.61332	0.54276	0.48032	0.42506	0.37616	0.33288	0.29459	0.26070	0.23071	0.20416	0.18068	0.15989	0.14150	0.12522	0.11081	0.09806	0.08678
Present Value of Annual Generation (MWh)	C	= A x B	-	88,497	78,316	69,306	61,333	54,277	48,033	42,507	37,617	33,288	29,459	26,070	23,071	20,416	18,068	15,989	14,150	12,522	11,081	9,806	8,678
Total Present Value of Annual Generation (MWh)	D	= Sum (C_i)	702,485																				
Power Price (RMB/MWh)	E	FSR	320																				

Where DR = Discount Rate = 13% and n = year (1-21)

Levelised Cost of Scenario (1): The proposed project activity not undertaken as a CDM project activity

		Reference	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Capital Cost	F	FSR	86,440,000																				
Principal and Interests repayments	S	FSR		21,186,022	20,869,163	20,538,466	20,193,328	19,833,119	19,457,180	19,064,824	18,655,334	4,138,811	-	-	-	-	-	-	-	-	-	-	-
O&M Cost	I	FSR		19,163,760	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360	9,215,360
Production cost	J	FSR		19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760	19,163,760
Residue	H	FSR																					10,472,000
Income Tax saved (@ 25%)	k	= (J-H)x 0.25	-	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	4,790,940	2,172,940
Total Cost of this scenario	L	= F + I - K	86,440,000	35,558,842	25,293,583	24,962,886	24,617,748	24,257,539	23,881,600	23,489,244	23,079,754	8,563,231	4,424,420	4,424,420	4,424,420	4,424,420	4,424,420	4,424,420	4,424,420	4,424,420	4,424,420	4,424,420	7,042,420
Discount Factor	M	$= 1 / (1 + DR)^n$	1.0000	0.8850	0.7832	0.6931	0.6133	0.5428	0.4803	0.4251	0.3762	0.3329	0.2946	0.2607	0.23071	0.20416	0.18068	0.15989	0.1415	0.12522	0.11081	0.09806	0.08678
Present Value of Total Annual Cost	N	= LxM	86,440,000	31,468,153	19,808,669	17,300,528	15,098,557	13,166,022	11,470,810	9,984,338	8,681,680	2,850,528	1,303,390	1,153,446	1,020,758	903,290	799,404	707,421	626,055	554,026	490,270	433,859	611,141
Total Present Value of Annual Costs(RMB)	**O**	**= Sum (N_i)**	224,872,346																				
Levelised Cost (RMB/MWh)	**P**	**= O / D**	**320**																				

Levelised Cost of Scenario (2): The continuation of the current situation, import of electricity from NCPG grid;

		Reference	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Capital Cost	F	FSR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost of power purchase	G	FSR	0	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432	32,000,432
Income Tax saved (@ 25%)	H	= G x 0.25		8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108	8,000,108
Total Cost of this scenario	J	= F + G - H	-	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324	24,000,324
Discount Factor	K	$= 1 / (1 + DR)^n$	1	0.88496	0.78315	0.69305	0.61332	0.54276	0.48032	0.42506	0.37616	0.33288	0.29459	0.2607	0.2307	0.2042	0.1807	0.1599	0.1415	0.1252	0.1108	0.0981	0.0868
Present Value of Total Annual Cost	L	= J x K	-	21,239,327	18,795,854	16,633,425	14,719,879	13,026,416	11,527,836	10,201,578	9,027,962	7,989,228	7,070,256	6,256,885	5,537,115	4,899,906	4,336,379	3,837,412	3,396,046	3,005,321	2,659,476	2,353,472	2,082,748
Total Present Value of Annual Costs(RMB)	**M**	**= Sum (L_i)**	168,596,518																				
Levelised Cost (RMB/MWh)	**N**	**= M / D**	**240**																				

The tables above show that the levelised cost of power generation obtained for scenario 2 **(240 RMB / MWh)** is less than the levelised costs for scenario 1 **(320 RMB / MWh).**

Whilst this difference may be considered small when you compare the two scenarios there is no risk or indeed effort required to purchase power from the grid. Whereas, there are enormous risks associated with the investment of a new technology that is reliant on an unstable fuel source. Therefore the rational decision is to do nothing rather than risk capital on something that does not bring about any additional benefits. As such it can be confirmed that the baseline is indeed purchase of power from the grid and not the proposed project undertaken without the CDM.

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