



**CLEAN DEVELOPMENT MECHANISM  
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)  
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1. Title of the project activity:**

Hunan Waste Gas Based Power Project in Liangang Group

Version number of the document: 04

Date: 28/09/2011

Revision history of PDD

Version	Date	Comments
Version 01	25/06/2009	for GSC
Version 02	11/03/2010	After validation protocol
Version 03	15/04/2010	After internal QC for final
Version 04	28/09/2011	For Final

**A.2. Description of the project activity:**

The proposed project is implemented by Lianyuan Iron & Steel Group Co., Ltd. which is a joint iron & steel enterprise (hereafter referred to as “Liangang Group”). The flat steel production line in Liangang Group is in operation and includes industrial facilities<sup>1</sup>, such as blast furnace, converter, coke ovens, hot rolled steel etc. of which the surplus blast furnace gas (BFG, approx 2,647.28 million Nm<sup>3</sup>/a), converter gas (LDG, approx 14.81 million Nm<sup>3</sup>/a) and coke oven gas (COG, approx 21.62 million Nm<sup>3</sup>/a)<sup>2</sup> from the existing industrial facilities of the flat steel production line would be flared and vented into atmosphere.

To utilize these surplus gases, the Hunan Waste Gas Based Power Project in Liangang Group (hereafter as “the proposed project”) with total capacity of 142MW is planned to adopt the innovative technology, *CCPP Plus System*<sup>3</sup>.and expected to generate 853,892MWh annually. The net electricity generation will be supplied to Liangang Group and the amount is estimated as 798,602MWh annually, by deducting auxiliary power consumption of 55,290MWh.

The *CCPP Plus System* ingeniously equips a creative thermodynamic system, which can successfully conquer the technological limitation thus promotes the adjustability of the traditional design of CCPP system, (the specific explanation of this *CCPP Plus System* is responded in A.4.3.). Through adopting *CCPP Plus System*, the project activity is able to recover maximum volume of surplus gas with higher efficiency, which is also a first-example technology application among iron & steel sector in China.

In the absence of the proposed project, the flat steel production line in Liangang Group would import 1,830,000MWh electricity from Central China Power Grid (CCPG) annually. The grid power consumption will be partly displaced by the electricity supplied by the proposed project after the implementation, while the other is still remained to be imported from CCPG.

In the absence of the project activity, the surplus gases would be directly flared by existing flaring equipments to atmosphere, without additional disposal for the project activity. In the proposed project, the surplus gases will be utilized for power generation after purification by the gas treatment equipments equipped for the proposed project.

<sup>1</sup> The industrial facilities of the flat steel production line, which produces surplus waste gas for the project activity, were put into commercial operation before submission for validation, thereby being eligible as existing facilities;

<sup>2</sup> According to the “Gas balance of Flat steel production line in Liangang Group” of Feasibility Study report of the proposed project;

<sup>3</sup> CCPP Plus System, the combination of higher efficiency CCPP power unit, and gas-fired steam turbine power unit which can adjust and recover waste gas after supplying to CCPP prior;

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Overall, the proposed project activity with 142MW capacity will use the waste gases from existing industrial facilities of flat steel production line and supply net electricity of 798,602MWh to Liangang Group, which would displace equivalent electricity purchased from CCPG, dominated by the fossil fuel fired power plants in CCPG, thereby decreasing CO<sub>2</sub> emissions about 777,439 tCO<sub>2</sub>e per year accordingly.

As an environmentally sound project, the project activity will not only supply carbon-free electricity by means of utilization of waste gas, but also contribute to sustainable development of the local communities, the host country and the world by means of:

- ♦ reducing GHG emissions compared to a business-as-usual scenario;
- ♦ reducing energy waste and facilitating the technology development of integrated resource utilization in steel industry;
- ♦ reducing the emissions of other pollutants, such as SO<sub>2</sub> and NO<sub>x</sub>, resulting from the power generation industry in China, compared to a business-as-usual scenario;
- ♦ Creating totally 145 work positions for local people during operation of the Project activity.

**A.3. Project participants:**

The participants involved in the project activity are shown as follow:

Name of Party involved (*) ((host) indicates a Host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
P.R.China (host)	Lianyuan Iron & Steel Group Co., Ltd. (Project owner)	No
Japan	Carbon Capital Management, Inc. (the buyer)	No

More detailed contact information on the Participants is provided in Annex 1

**A.4. Technical description of the project activity:****A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

The People's Republic of China.

**A.4.1.2. Region/State/Province etc.:**

Hunan Province

**A.4.1.3. City/Town/Community etc.:**

Loudi City

**A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):**

Loudi City is located in the middle of Hunan Province, and near the middle reach of Lian River. Figure 1 is a map showing the location of Loudi City.

Liangang Group is in the Huanghuatang District, northwest of Loudi City. The plant abuts on Lian River, and is close to Xiangqian Railroad and is 3.5 km away from the center of Loudi City. And the Project is located in Liangang Group with the geographical coordinates of east longitude of 111°58'11" and north latitude of 27°45'00". Figure 2 is a map showing the location of the Project.

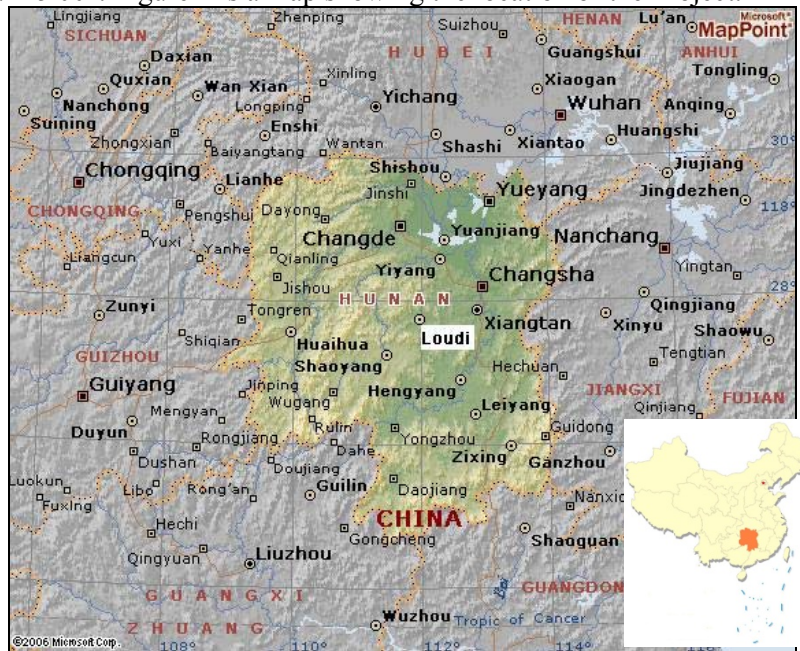


Figure1. The Location of Loudi City



Figure2. The Location of the Project

**A.4.2. Category(ies) of project activity:**

This category would fall in sectoral scope 1: Energy industries; 4: Manufacturing industries

**A.4.3. Technology to be employed by the project activity:**

***Project activity and the scenario prior to the project activity (the same as the baseline scenario in this PDD)***

According to “Surplus Gas Balance of flat steel production line in Liangang Group” of Feasibility study report (FSR) of the proposed project”, 2,674.28million Nm<sup>3</sup>/y BFG, 14.81 million Nm<sup>3</sup>/y LDG and 21.62 million Nm<sup>3</sup>/y COG produced by the existing industry facilities of the flat steel production line are surplus and waste after meeting the self gas demanding of relevant sections in production line. The surplus gas would have been flared to atmosphere without additional disposal<sup>4</sup> and the same amount electricity provided by the project activity would be supplied by the local power grid which belongs to the CCPG in the absence of the project activity.

The baseline scenario is the same as the scenario in the absence of implementation of the project activity.

***Description of the technology adopted by the project activity***

Prior to the innovation of *CCPP Plus System*, CCPP technology, is the primary choice and prevailing application among the similar waste gas recovery project activities in Iron & Steel industry in China. In particular, the CCPP unit produced by Mitsubishi<sup>5</sup> was proved being able to operate safely in Iron & Steel industry. According to the statistical data, there are 13 waste gas recovery projects in operation with CCPP technology in Iron & steel corporations of China.

**Table 1 The list of CCPP put into operation in Iron and Steel Industry of China**

No.	Iron & Steel Corporation	Capacity	Equipment Supplier	Remarks
1	Baosteel Group Corporation	150MW×1	Kawasaki	The first CCPP in China, which was operated in 1997. It is a demonstrational project which was provided by Kawasaki Heavy Industries Group and ABB Group in 1995. <sup>6</sup>
2	Jinan Iron & Steel Works	50MW×8	GE/Nanjing Turbine Machines Factory	<a href="http://cdm.unfccc.int/Projects/DB/TUEV-SUED1166194116.62/view">http://cdm.unfccc.int/Projects/DB/TUEV-SUED1166194116.62/view</a>
3	Jiangsu Shagang Group Company	50MW×4	Mitsubishi Corporation/Hangzhou Turbine Machines Factory	<a href="http://cdm.unfccc.int/Projects/Validation/DB/IE3N27IRFDCK0U504VXZGFJP41AKN/view.html">http://cdm.unfccc.int/Projects/Validation/DB/IE3N27IRFDCK0U504VXZGFJP41AKN/view.html</a>
4	Tonghua Iron & Steel Co., Ltd	50MW×1	GE/Nanjing turbine Machines Factory	<a href="http://cdm.unfccc.int/Projects/DB/JCI1227319883.15/view">http://cdm.unfccc.int/Projects/DB/JCI1227319883.15/view</a>
5	Anshan Iron and Steel Group Corporation	300MW×1 150MW×1	MitsubishiCorporation	<a href="http://cdm.unfccc.int/Projects/DB/TUEV-SUED1202299119.13/view">http://cdm.unfccc.int/Projects/DB/TUEV-SUED1202299119.13/view</a> ; <a href="http://cdm.unfccc.int/Projects/DB/TUEV-SUED1202302578.09/view">http://cdm.unfccc.int/Projects/DB/TUEV-SUED1202302578.09/view</a>
6	Baotou Iron & Steel(Group) Co., Ltd	150MW×2	Mitsubishi Corporation	<a href="http://cdm.unfccc.int/Projects/DB/TUEV-SUED1194521204.99/view">http://cdm.unfccc.int/Projects/DB/TUEV-SUED1194521204.99/view</a>
7	Handan Iron & Steel Group Co., Ltd	50MW×2	Mitsubishi Corporation/Hangzhou Turbine Machines Factory	<a href="http://cdm.unfccc.int/Projects/DB/TUEV-SUED1185365330.91/view">http://cdm.unfccc.int/Projects/DB/TUEV-SUED1185365330.91/view</a>
8	Laiwu Iron & Steel Group Corporation	50MW×1	GE/ Nanjing Turbine Machines Factory	<a href="http://cdm.unfccc.int/Projects/Validation/DB/NOYZ7WRZ08IUY58PSRP31SCA6P88Q/view.html">http://cdm.unfccc.int/Projects/Validation/DB/NOYZ7WRZ08IUY58PSRP31SCA6P88Q/view.html</a>
9	Lianyuan Iron and	50MW×1	MitsubishiCorporation	<a href="http://cdm.unfccc.int/Projects/DB/DNV-CUK1183468625.95/view">http://cdm.unfccc.int/Projects/DB/DNV-CUK1183468625.95/view</a>

<sup>4</sup> The disposal instruments, which do not exist in the absence of the project, are designed and constructed to purify the surplus gas, is to enable utilized waste gas as energy source in project activity for power generation.

<sup>5</sup> Generally, Mitsubishi can provide normal CCPP types with M251S (50MW) and M701(150MW and 300MW) for selection..

<sup>6</sup> <http://www.gkcity.com/n-i-59248-c-Potpourri.htm>



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	Steel Co., Ltd		/Hangzhou Turbine Machines Factory	
10	Wuhan Iron & Steel (Group) Corp	150MW×2	GE	<a href="http://cdm.unfccc.int/Projects/Validation/DB/VCDHVDH1314X9DKTSPKPG9QIWMZKLO/view.html">http://cdm.unfccc.int/Projects/Validation/DB/VCDHVDH1314X9DKTSPKPG9QIWMZKLO/view.html</a>
11	Maanshan Iron & Steel Ltd	150MW×1	Mitsubishi Corporation	<a href="http://cdm.unfccc.int/Projects/Validation/DB/T0IFD4LLSU3B34IRNSCNZ4V2G4PPK2/view.html">http://cdm.unfccc.int/Projects/Validation/DB/T0IFD4LLSU3B34IRNSCNZ4V2G4PPK2/view.html</a>
12	Chongqing Iron & Steel Co., Ltd	50MW×1	GE/Nanjing Steam Turbine (Group) Co. Ltd.	<a href="http://cdm.unfccc.int/Projects/DB/DNV-CUK1204708331.19/view">http://cdm.unfccc.int/Projects/DB/DNV-CUK1204708331.19/view</a>
13	Zhonghang Tengjin Combined Cycle Power Plant Project	65MW*1	GE/China Aviation Gas Turbine Co., Ltd.	<a href="http://cdm.unfccc.int/Projects/completeness_check.html">http://cdm.unfccc.int/Projects/completeness_check.html</a>

(Except for first CCPP in Baosteel Group Corporation, other 12 CCPP projects have applied CDM.)

However, traditional CCPP system is technologically infeasible due to the strict technical requirements of CCPP technology as well as engineering limitations.

According the FSR of the proposed project, the reasons that traditional CCPP system is infeasible for the project activity include:

- **Insufficient land space of the project site:** the available space for the project activity could not accommodate CCPP unit which is with enough capacity to recover the same amount of surplus gas as the project activity.
- **Excessively narrow caloric value range:** In the project activity, the available waste gases include BFG, LDG and COG, however the traditional CCPP unit require a narrow range of caloric value for fuel gas.<sup>7</sup> The mix of the surplus waste gases from the flat steel production line is with much wider range thus being not suitable for CCPP technology.

For addressing above problems, Liangang Group commissioned the design institute to innovate a new system by upgrading the design of traditional CCPP system, then, the *CCPP Plus System*<sup>8</sup> was put forward to resolve thus engineering limitations.

The *CCPP Plus System* in the project activity is with capacity of 142MW, consists of two sets of CCPP unit (each unit include a 28.5MW gas turbine generator and a set of 22MW steam turbine generator unit) and a set of gas-fired steam turbine generator unit (here after referred as “STG”, which consists of a 150t/h gas-fired boiler and a 42 MW steam turbine generator unit). All these equipments are designed as combined cycle power plant (CCPP) assorted with waste gas-fired steam turbine generator (STG), which are combined in a unique thermodynamic system, namely *CCPP Plus System*.

The core design of *CCPP Plus System*, the thermodynamic system, includes one set of dynamic fuel control and distribution system and a set of unified steam distribution system. In the *CCPP Plus System*, the dynamic fuel control and distribution system can timely assign qualified fuel mix to ensure satisfying the requirements of both CCPP and STG units thus can keep the maximum capacity to recover the waste gases.

The design of *CCPP Plus System* enables CCPP unit to use purified BFG and COG with high efficiency while using STG as a dynamic “buffer” to utilize the remaining BFG, LDG and COG, which is suitable

<sup>7</sup>According to the technical specification of CCPP facility, the calorific value at the inlet of gas turbines of CCPP is required seriously then, the mixture ratio of BFG and COG shall be fixed relatively

<sup>8</sup> CCPP plus, which is a new technology consisted of CCPP generation unit and STG unit, is an innovation basing on CCPP;



for the waste gases from the existing facilities of the flat steel production line. Meanwhile the *CCPP Plus System* is more “land saving” and more tolerant for fuel composition and caloric values.

The *CCPP Plus System* is unique power generation system with advantages in both high efficiency and high flexibility in operation, and is the first attempt in iron and steel industry of China<sup>9</sup>, then can be regarded as the first-example<sup>10</sup>.

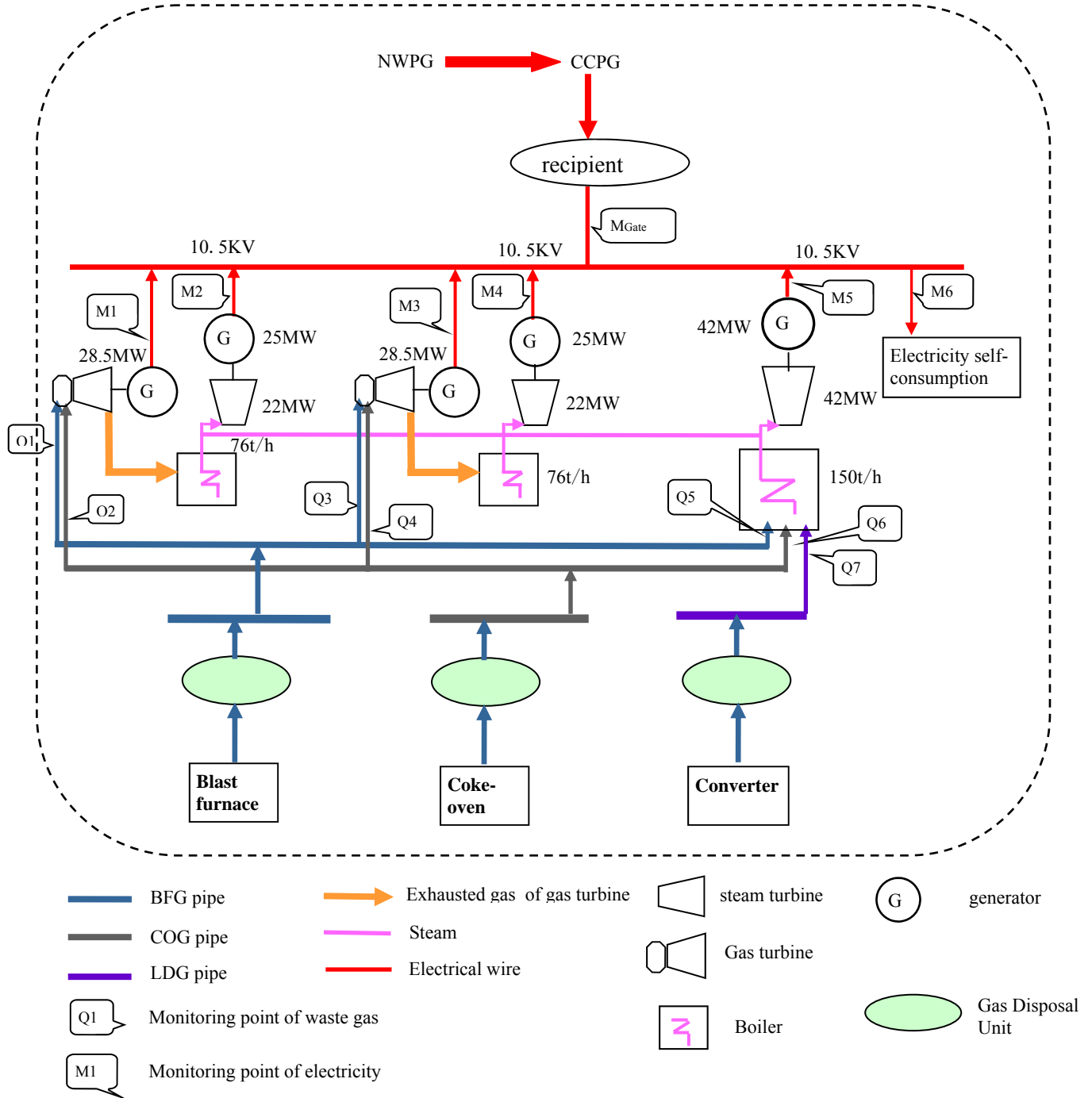
The key characteristics and flow chart of the project activity with *CCPP Plus System* is shown as Table 2 and Figure 3 respectively.

**Table 2 Key Characteristics of Main Equipment of *CCPP Plus System***

<b>Gas Turbine</b>	<b>Gas Turbine Generator</b>	
Type: M251S Number: 2 sets Rated Power: 28.5MW Load: 100% Power Factor: 0.85  Manufacturer: Mitsubishi Heavy Industries	Type: 16Z-037LLT Number: 2 sets Rated Power: 28.5MW Rated Voltage: 10.5kV Rated Speed: 3000r/min Power Factor: 0.85 (Lag) Manufacturer: Mitsubishi Heavy Industries	
<b>Waste Heat Recovery Boiler</b>	<b>Steam Turbine</b>	<b>Generator</b>
Type: Q427/571-76(9.6)-6.1(0.4)/485(210) Number: 2 sets Rated Main Steam Flow: 76t/h Rated Main Steam Temperature: 485°C Rated Main Steam Pressure: 6.1MPa(g)  Manufacturer: AE&E Nanjing Boiler Co., Ltd	Type: LZN22-5.88/0.4 Number: 2 sets Rated Power: 22MW Rated Steam Pressure at Inlet: 5.88MPa(a) Rated Steam Temperature at Inlet: 480°C Rated Steam Flow at Inlet: 76t/h Rated Speed: 3000r/min Manufacturer: Nanjing Turbine & Electric Machinery (Group) Co., Ltd.	Type: QFW-25-2A Number: 2 sets Rated Power: 25MW Rated Voltage: 10.5KV Power Factor: 0.8 Rated Speed: 3000r/min  Manufacturer: Nanjing Turbine & Electric Machinery (Group) Co., Ltd.
<b>Gas-fired Boiler</b>	<b>Steam Turbine</b>	<b>Generator</b>
Type: JG-150/6.1/0.3-Q Number: 1 set Rated Main Steam Flow: 150t/h Rated Main Steam Temperature: 485°C Rated Main Steam Pressure: 6.1MPa(g)  Manufacturer: Jiangxi Jianglian Energy and Environment Co., Ltd.	Type: N42-5.88 Number: 1 set Rated Power: 42MW Rated Steam Pressure at Inlet: 5.88MPa(a) Rated Steam Temperature at Inlet: 480°C Rated Steam Flow at Inlet: 150t/h Rated Speed: 3000r/min Manufacturer: Nanjing Turbine & Electric Machinery (Group) Co., Ltd.	Type: QFW-42-2 Number: 1 set Rated Power: 42MW Rated Voltage: 10.5KV Power Factor: 0.8 Rated Speed: 3000r/min  Manufacturer: Nanjing Turbine & Electric Machinery (Group) Co., Ltd.

<sup>9</sup> As statistical date of Mistubishi Corporation, total 12 steel corporations of China have equipped and operated CCPP. All of these CCPP are designed individually.

<sup>10</sup> According to Annex-10 of EB Thirty-fourth meeting report of Note on the barrier “first-of-its-kind”.



**Figure 3 Flow Chart of Project Activity**

**A.4.4. Estimated amount of emission reductions over the chosen crediting period:**

It is expected that the project activity will generate emission reductions within the Central China Power Grid for about 777,439 tCO<sub>2</sub>e per year over a 10-year fixed crediting period from 01/12/2011 to 30/11/2021.

Years	Annual estimation of emission reductions in tonnes of CO <sub>2</sub> e
01/12/2011-31/12/2011	64,787
2012	777,439





2013	777,439
2014	777,439
2015	777,439
2016	777,439
2017	777,439
2018	777,439
2019	777,439
2020	777,439
01/01/2021 ~ 30/11/2021	712,652
<b>Total estimated reductions (tonnes of CO<sub>2</sub>e)</b>	<b>7,774,390</b>
<b>Total number of crediting years</b>	<b>10</b>
<b>Annual average over the crediting period of estimated reductions (tonnes of CO<sub>2</sub>e)</b>	<b>777,439</b>

**A.4.5. Public funding of the project activity:**

There is no public funding from Annex I Parties for this Project.





































































































































