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	IS-CMS-MUC/RZ Rachel Zhang	+49 89 5791-3038 rachel.zhang@tuev-sued.de	+49 89 5791-2756	2009-01-09	1 of 12

Dear Sirs,

Please find below the response to the review formulated for the CDM project "Sichuan Tongjiang Gaokeng Hydropower Station Project" with the registration number 2147. In case you have any further inquiries please let us know as we kindly assist you.

Best regards

Cuiyun Zhang

Rachel Zhang
Carbon Management Service

Enclosures:

- Design Code for small hydro power projects SL76-94
- Economic Evaluation Code for small hydro power projects SL16-95
- Chapter 14 of PDR
- Statement from Grid Company
- Statement from Design Institute

Response to the CDM Executive Board

Request 1:

The DOE is requested to provide further substantiation of the suitability of the benchmark given that it was published in 1995 and the investment was made in 2005. Further, noting that the local authorities approved the PDR on the basis of an equity IRR, the DOE is requested to verify that the benchmark is a suitable comparator for an project IRR calculation.

Response by PP:

In our response we focus on the following aspects:

- Suitability of the 1995 benchmark applied in the PDD
- Clarification on the types of IRR in the project documentation

Ø *Suitability of the 1995 benchmark applied in the PDD*

The applicability of the benchmark for small-scale hydropower projects in China, originally published in 1995 in "Economic Evaluation Code for Small Hydropower Projects (SL16-95)" by the Ministry of Water Resources of the People's Republic of China, was first confirmed by the same government body in 2002 in the "Bulletin of Valid Hydropower Technical Standards No 07 (2002)"[1] and reconfirmed in 2006 still by the Ministry of Water Resources in the "Bulletin of Valid Hydropower Technical Standards No 5 (2006)[2]. Since then, no new documents prescribing benchmarks for hydropower stations with an installed capacity below 50MW have been released by the Chinese Government.

The PDR of the project was prepared in December 2004, and approved in March 2005. The investment decision was made July 2005.

Consequently, on the basis of Bulletins of 2002 and 2006, we conclude that the benchmark as set in the PDD was still applicable at the time of investment decision in July 2005.

Ø *Clarification on the types of IRR in the project documentation*

IRR in PDR report

The Gaokeng PDR prepared in December 2004 by Zigong City Construction and Survey Design Institute of Water Conservation & Power provides a detailed and comprehensive economic assessment of the project in its Chapter 14. Several economic indicators are calculated throughout the chapter including:

- Net Present Value
- Project IRR (total static investment is considered including the portion financed by debt; debt servicing is not considered a cash outflow)
- Equity IRR (based only on the portion of investment financed by equity; debt servicing is considered a cash outflow)
- Payback period
- Total Investment / profit ratio
- Total investment / profit + tax ratio

1 http://www.ches.com.cn/jishubiaozhun/001.htm
2 http://www.mwr.gov.cn/tzgg/qt/20060926000000479251.aspx

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- Equity / profit ratio

All the above indicators and their value are later listed in the conclusion of the PDR's economic assessment in no particular order of importance.

IRR in PDR Approval

The project's Preliminary Design Report (PDR) was approved by the Bazhong City Water Resources Bureau on March 9th 2005. The approval focuses on the economic assessment in its paragraph 7. Below we provide the full translation of the paragraph:

"Bazhong City Water Resources Bureau:

1. *Approve the principles and basis applied in the Preliminary Design Report (PDR);*
2. *Accept the calculations of labor costs, material costs and basic electricity power price;*
3. *Agree with the selection of 10% for elementary budget reserve ratio and, in accordance with the document [1999] #1340 issued by the State Development and Planning Commission on Investment, the budget reserve related to price difference has not been taken into consideration;*
4. *Accept that the loan interest rate during construction period is 6.12% in the PDR*
5. *Approve that the estimated total investment in the PDR of Gaokeng Station is 109.3302 Million Yuan, including 104.8471 Million Yuan as Static Investment and 4.4831 Million Yuan as Loan interest payment during construction period."*

The above transcription of the approval shows that the project was approved on the basis of the full economic assessment of the PDR, taking into account all financial indicators calculated in the PDR and listed above. This means that the premise of the second part of the issue raised above is not complete: while the PDR refers to an equity IRR, it does not do so exclusively: it also, and with equal importance, refers to the project IRR and other financial indicators.

IRR in Official Benchmark documentation SL16-95

The official benchmark issued by the Ministry of Water Resources of the People's Republic of China states in section 4.3 that the IRR should be calculated as per the equation below:

$$\sum_{t=1}^{n}(CI - CO)_t (1 + FIRR)^{-t} = 0$$

Where:

CI	= Cash Inflow
CO	= Cash Outflow
n	= Calculation period
(CI-CO)t	= The net cash flow in year t
FIRR	= Financial IRR

Section 4.3 of SL16-95 later states that:

"In the financial assessment, if the calculated FIRR is higher than or equivalent to the financial benchmark rate of return (Ic) for small-scale hydropower projects, it is believed that the project is financially feasible. The financial benchmark rate of return (Ic) for small-scale hydropower projects is set at 10%."

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It is clear from the above that the benchmark mentioned in the official guidance refers to a *project* IRR as the equation includes all cash out- and inflows during the calculation period, while at no stage it is mentioned that investment costs must be restricted to the part which is financed by equity.

In conclusion, the benchmark applied in PDD is considered a suitable comparator for the project IRR calculated in the PDD and based on the values from the PDR, as it was determined by the Chinese authorities on the basis of IRR calculations inclusive of the portion of investment costs financed by debt.

Response by DOE:

The applied benchmark for the proposed project referred to the “Economic evaluation code for small hydropower projects” (Document No.SL16-95) issued in 1995, in which it is mentioned *“This evaluation code is applied for small hydropower projects with installed capacity no more than 25MW (all newly-built, expansion, modification or retrofit projects).*

The Ministry of Water Resources respectively issued a Bulletin on Effective Technical Standard in Hydropower and Water Resource Industry on June 18th 2002 and September 9th 2006 to confirm the valid standard and specification, which is available at the following links:
http://www.ches.com.cn/jishubiaozhun/001.htm, and
http://www.mwr.gov.cn/tzgg/qt/20060926000000479251.aspx.

The “Economic evaluation code for small hydropower projects” (Document No.SL16- 95) issued in 1995 is indicated as valid in the list for both.

Furthermore, TÜV SÜD can confirm, based on its local and sectoral expertise, that this benchmark is pretty common and widely applied in China for this type of project.

As a result, TÜV SÜD is quite confident that the 10% benchmark is appropriately applied and can be considered as suitable for the proposed project activity.

In the approved PDR, the project IRR and equity IRR of the proposed project is specified as 8% and 9.42% in chapter 14.4. Both of them are lower than the benchmark of 10% for project IRR and 12% for equity IRR in chapter 14.2.2 of the approved PDR. The local authority approved the PDR as the following description *“Approve the principles and basis applied in the Preliminary Design Report (PDR)”, and basically accept the calculations of labor costs, material costs and basic electricity power price”* in Paragraph 7.

The PDR got approved by Bazhong City Water Resources Bureau on March 9th 2005, on the basis of an equity IRR as well as a project IRR.

According to SL16-95, the IRR should be calculated per the equation below:

$$\sum_{t=1}^{n}(CI - CO)_t(1 + FIRR)^{-t} = 0$$

Where:

CI	= Cash Inflow
CO	= Cash Outflow
n	= Calculation period
$(CI\text{-}CO)_t$	= The net cash flow in year t
FIRR	= Financial IRR

Section 4.3 of SL16-95 later states that:

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"In the financial assessment, if the calculated FIRR is higher than or equivalent to the financial benchmark rate of return (Ic) for small-scale hydropower projects, it is believed that the project is financially feasible. The financial benchmark rate of return (Ic) for small-scale hydropower projects is set at 10%."

TÜV SÜD can confirm that the benchmark mentioned in SL16-95 refers to project IRR for all cash outflow and cash inflows are included to the financial IRR calculation equation, without any statement that any debts should be excluded from the investment costs.

In conclusion, TÜV SÜD is confident that the applied benchmark of 10% is considered as a suitable comparator for the project IRR calculated in the PDR and the PDD.

Request 2:

The PDD states that the expected annual power generation is 59.84 million kWh. However the net export to the grid is expected to be 50.56 million kWh. This loss of in excess of 15% of power generation should be further explained.

Response by PP:

The value of 59.84 million kWh mentioned in the PDD for expected annual power generation is referred to in the Project Preliminary Design Report as **average annual power generation**[3]. The value indicates the designed theoretical annual power generation calculated by the Design Institute based on, among others, historical hydrological conditions and water head available at the location.

Besides, the Gaokeng PDR mentions another value of 50.7125 million kWh for **average annual effective electricity**[4]. This value was determined by the Design Institute and is equal to the average annual power generation multiplied by a coefficient of effective electricity.

A third value of 50.5604 million kWh is mentioned in the PDR and referred to as **annual power output**[5]. Thsi value was used to calculate the IRR in the PDD.

Finally, it is important to mention that further loss that may occur between on-site transformer station and the Grid transformer station located 8 kilometers away, known as transmission loss, was not taken into account neither in PDR or in the PDD, and therefore is assumed zero, which is conservative.

Average annual power generation Vs. average annual effective electricity

Thus, average annual effective electricity is equal to the average annual power generation multiplied by a coefficient of effective electricity. The coefficient of effective electricity reflects, among others, the capability of the local power grid to off-take all electricity generated, the electricity balance of the local grid, and the frequency of equipments overhaul and damages (a definition is provided is official documentation SL16-95 published by the Ministry of Water Resources). The average annual effective electricity (50.7125 Million kWh) for the Gaokeng project represents 84.74% of the power generation (59.84 Million kWh). Therefore the coefficient of effective electricity is 0.8474.

Clarification from the Design Institute

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3 Section 14.2.2.1 paragraph 2, page 14-3 of the PDR
4 Section 14.2.2.1 paragraph 2, page 14-3 of the PDR
5 Section 14.2.2.1 paragraph 3, page 14-3 of the PDR

Following the request from the CDM Executive Board, The Water Conservancy & Electric Power Construction Investigating and Designing Institute of Zigong City - the entity that prepared the project Preliminary Design Report - has provided a clarification[6]. The statement explains that:

"The average annual effective electricity coefficient of the plant was determined to be 84.745% in accordance to the relative design codes, regulations and experience applicable to hydropower projects. The main factors have been considered in the calculation of the coefficient are:
1. Total 43 years water flow (from 1959 to 2002) recorded by the hydrological station of project site; the intra and inter-annual variability of the water flow.
2. Characteristics of load variations of the grid
3. Operational location of the plant in the grid
4. The Electric power supply/demand balance of the grid
5. Maintenance, repair and emergency shut-down of power units, etc.

Tongjiang County Power Grid
Tongjiang County is a poverty-stricken area of Sichuan Province which is designated National Poverty County by the Chinese Government as discussed in the PDD. As per a statement provided by Tongjiang County Grid Company, the local grid does not always allow the connected power plants to run in full load especially during rainy season, due to lack of absorption capabilities. The Grid Company estimates the effective electricity coefficient factor for all hydropower stations located in Tongjiang County as between 70% to 90%[7].

Official Guidance
The Ministry of Water Resources of the People's Republic of China published official guidance on effective electricity in the following documentation:

- "Economic Evaluation Code for Small Hydropower Projects (SL16-95)"
- "Hydroenergy Design Code for Small Hydro Power Projects (SL76-94)"

The applicability of both the above documents originally published in 1995 and 1994 respectively has been confirmed by the Ministry of Water Resources of the People's Republic of China first in 2002 in the "Bulletin of Valid Hydropower Technical Standards No 07 (2002)"[8] and reconfirmed in 2006 by the same institution through the "Bulletin of Valid Hydropower Technical Standards No 5 (2006)[9].

In Section 3.4 of the SL 16-95 guidance it is stated that:
Effective electricity = Designed electricity generation × Coefficient of effective electricity
(Formula 3.4):

Paragraph 3.2, *Clarifications on items* section of SL16-95, explains that "*the effective electricity is the key factor that influences power generation and power supply. (…) Most existing small hydropower stations failed to achieve the designed power generation due to power load conditions and other factor such as the frequency of equipments overhaul and damages.*"

[6] Statement regarding the effective electricity coefficient of Gaokeng hydropower station, Water conservancy and electric power construction investigating and designing institute of Zigong City.
[7] Statement on the average coeffcient of effective electricity of hydropower stations in Tongjiang County issued by the Power Company of Tongjiang County, Sichuan Province.
[8] http://www.ches.com.cn/jishubiaozhun/001.htm
[9] http://www.mwr.gov.cn/tzgg/qt/20060926000000479251.aspx

Section 3.2.1 of SL16-95 provides the following formula *(Formula 3.2.1):*
Electricity sales revenues = Effective electricity × (1-auxiliary power consumption) × (1- line loss) × Calculated Electricity Price

The formula above shows clearly that, in order to calculate power sales revenues, the value of effective electricity applies, not the designed power generation. Please also note that the formula above considers a "line loss" factor (transmission loss between station and Grid); this loss was assumed zero in the Gaokeng PDR and the PDD.

Furthermore, Table 3.4 of SL16-95 provides the following table for the coefficient of effective electricity:

Coefficient of effective electricity for different type of hydropower stations:

Type of hydropower stations	The coefficient of effective electricity
1.Grid connected, annual/ multi-year regulating hydropower stations	0.95-1.00
2.Grid connected, seasonal regulating hydropower stations	0.90-0.95
3. Grid connected, monthly/weekly/daily regulating hydropower stations	
The grid will take all electricity generated in rainy season and night	0.80-0.90
The grid will only take part of the electricity generated in rainy season and night	0.70-0.80
4. Not connected to the grid, Daily/No regulating capacity	0.60-0.70

As described in the PDD and PDR, the installed capacity is 15MW and the project is a daily regulating hydropower station. As per the statement from the Tongjiang County Grid Company mentioned above, the Grid will not off-take all electricity generated by the project, especially during the rainy season. Therefore, the coefficient of effective electricity generation should fall between 0.70 and 0.80 of the designed electricity generation (hydropower stations of type 3).

It can be concluded that the coefficient of effective electricity (0.8474) was calculated by the Design Institute in line with the estimate from the Tongjiang County Power Company which considers the effective electricity coefficient factor for all hydropower stations located in Tongjiang County as between 0.7 and 0.9, and higher than the range provided by the Ministry of Water Resources of the Republic of China for projects of this type (0.70-0.80).

Annual power output
The annual power output is calculated as average annual effective electricity minus internal (or auxiliary) consumption. The value for internal consumption is provided in the PDR as 0.3% of effective electricity. According to the Guidance document "Hydroenergy Design Code for Small Hydro Power Projects (SL76-94)" from the Ministry of Water Resources of the People's Republic of China, the value rate of total auxiliary power consumption should be between 0.5 % and 1.0% (see SL76-94 paragraph 4.6, page 7). Therefore, the value applied in the Gaokeng project PDR is conservative compared to the official guidance.

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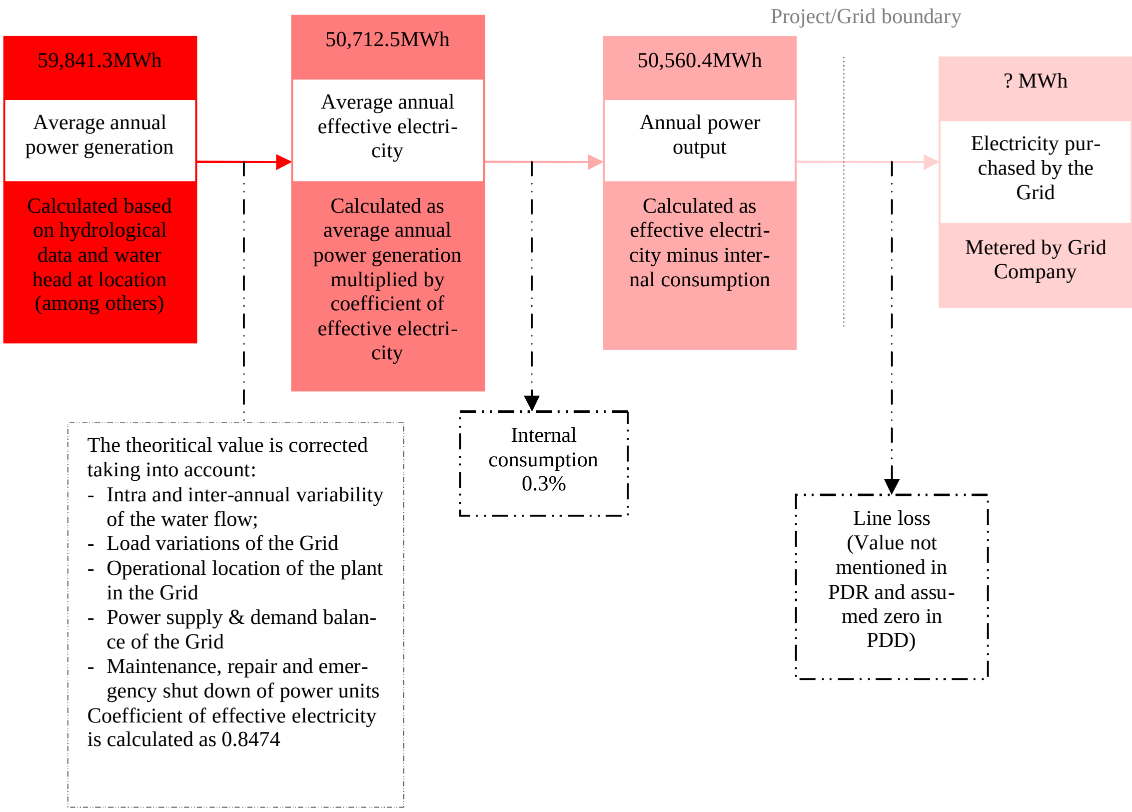
For further clarification, Figure 1 below summarizes the different power values mentioned in the project PDR

Figure 1. Power values in the project PDR



Conclusion

We conclude that the loss of 15.5% between the value of expected annual power generation and the value of net export to the grid can be further explained through the fact that:

1. A coefficient of effective electricity of 0.8474 was applied to the theoretical average annual power generation (59.84 Million KWh) in the PDR by the Design Institute in order to reflect the Intra and inter-annual variability of the water flow, the load variations of the Grid, the operational location of the plant in the Grid, the power supply & demand balance of the Grid as well as the maintenance, repair and emergency shut down of power units. First, the appropriateness of the 0.8474 value was reconfirmed by the Design Institute in a Statement dated January 8th 2009. Second, the value is in line with the estimate of the Tongjiang County Power Grid Company. Third, the appropriateness of using effective electricity generation value in the calculation of power sales revenues is confirmed by the Official Guidance of the Ministry of Water Resources of the People's Republic of China. Fourth, the value of 0.8474 used in the PDR and PDD is conservative compared with official guidance which recommends a range of 0.7-0.8 for similar projects.
2. A 0.3% rate of internal consumption was applied, which is conservative compared to the official guidance.

Transmission loss that may occur between on-site step up station and the Grid transformer station was assumed zero in the PDR and in the PDD.

Response by DOE:

The coefficient for effective supply to the grid mentioned in the PP's comment above was derived in the Preliminary Design Report which could be evidenced by *Economic Evaluation Code for Small Hydropower Project* (Document No.SL16-95) and the confirmation from the design institute of the proposed project.

Effective factor

Type of hydropower station	**Effective Factor**
1.Grid connected, annual/pluriannual regulating stations	0.95-1.00
2.Grid connected, seasonal regulating stations	0.90-0.95
3. **Grid connected, monthly/weekly/daily regulating stations**	
The grid will take all electricity generated in rainy season and night	0.80-0.90
The grid will only take part of the electricity generated in rainy season and night	0.70-0.80
4. Not connected to the grid, Daily/No regulating capacity	0.60-0.70

Source: SL 16-95

The project qualifies as project type with daily regulating capacity as could be evidenced by the approved preliminary design report which was prepared by an independent third party, named Zigong City Construction and Survey Design Institute of Water Conservation & Power.
On 9th January 2009 the Power Company of Tongjiang County (where the project is connected to) confirmed that due to poor power transmission capacity the electrical output during wet season is restricted and that an effective electricity coefficient of 0.7~0.9 is normal in Tongjiang County.

The average effective supply to the power grid is 50,712,500KWh, and the average power generation is 59,841,300KWh. The coefficient of effective supply to the grid is 84.74% as the fraction of average effective supply to the power grid and the average power generation. This is in line with the guidance SL16-95, which actually requires a coefficient between 0.7~0.8. Hence the applied value of 0.84 is conservative.
Furthermore the effective electricity coefficient has been evidenced by Zigong City Construction and Survey Design Institute of Water Conservation & Power on 8/Jan/09.
The average effective supply from the project activity is 50,712,500kWh. This has been evidenced by above named evidences. A supply of electricity to other entities than to the grid company is unrealistic.
0.3% was selected as the auxiliary power consumption in the PDR which is lower and more conservative than the parameter in the Guidance document "Hydroenergy Design Code for Small Hydro Power Projects (SL76-94)" from the Ministry of Water Resources of the People's Republic of China. According to this document the value rate of total auxiliary power consumption should be between 0.5 % and 1.0%. For the transmission line loss rate is not specified in the PDR, and zero is assumed for the proposed project as the most conservative way.

The power supplied to the power grid was calculated by multiplying the power generation with the coefficient for the effective supply to the grid then deduct the power loss for internal use and transmission loss. The project owner calculated the power supply to the power grid as the following formula: Power supplied to the power grid=power generation* the coefficient for the effective supply to the grid power generation *(1-internal power use) * (1-transmission losses) = power generation *0.8474*0.997*1=power generation * 0.845. That means that the difference between the power generation and power supply to the power grid is 15.5%.

Recently the meth panel was requested to elaborate guidance on ACM0002, in particular how to arrive at an accurate plant load factor taking into account the variability of the wind parameters and gaps of data. Though this guidance was not yet discussed by the EB due to time constraints, and bearing in mind that this guideline is addressing wind power plants in particular, it is considered useful to assess effective power generation estimates also for hydro power. Among others, the following two recommendations were made (compare Meth panel report 35, para 37):

“After considering the case, the panel recommends the EB to consider the following options:

(a) The DOE should validate that the estimate in the CDM-PDD on the annual electricity generation is consistent with the estimate provided to banks and/or equity financiers while applying for project financing, or to the government while applying for implementation approval;

(b) The expected annual electricity generation of the project should be determined by a third party contracted by the project participants (e.g. an engineering company);”

Regarding recommendation (a) it can be confirmed by the DOE that the same net annual electricity generation was provided to the government while applying for the implementation approval, as could be evidenced by the approval of Feasibility study report by Bazhong City Development and Reform Committee on December 2, 2004. The Feasibility was prepared by the same design institute as the PDR. Referring to recommendation (b) it can also be confirmed that the estimate was made by a third party which was contracted by the project participants, named Zigong City Construction and Survey Design Institute of Water Conservation & Power, holding a C degree in Power industry (Hydropower, power transmission).

As a result, TÜV SÜD validated that the calculation process for power supplied to the power grid was correct and transparent, and that the 15.5% difference between power generation and power supply to the power grid is reasonable in the context of the project activity and the characteristics of the local Grid.
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Request 3:
The PDD published for global stakeholder consultation applied a grid emission factor of 0.89961 tCO2/MWh. The PDD submitted for registration applies a factor of 0.97455 tCO2/MWh. The validation report does not explain the reasons why a change to the factor was requested. The DOE is requested to provide justification.

Response by PP:
Table 3 below summarizes the grid emission factor values applied in both the Global Stakeholder Consultation (GSC) version of the PDD and in the version of the PDD Submitted for Registration (SR).

Please note that in the SR version of the PDD, the emission factors calculated by the entity responsible for the Baseline were compared with the emission factors published by the Chinese DNA on August 9th 2007. In keeping principles of conservativeness, the lowest results (Chinese DNA) were applied in the calculation of annual Emission Reductions, as described in section B.6.1 of the PDD.

Table 3. Emission factors applied the Sichuan Tongjiang Gaokeng PDD

	GSC PDD	PDD submitted for registration	
	Emission factors calculated by the entity responsible for the Baseline	Emission factors calculated by the entity responsible for the Baseline	Emission factors published by Chinese DNA on August 9th 2007
Operating Margin (OM)	1.29093	1.29093	1.2899
Build Margin (BM)	0.50830	0.66344	0.6592
Combined Margin (CM)	0.89961	0.97718	0.97455
Comment			Selected in SR Version of the PDD

Operating Margin:
Table 3 show that the OM calculated by the entity responsible for the Baseline is identical in both versions of the PDD (1.29093). The OM applied in the SR version of the PDD (1.2899) is the value published by the Chinese DNA on August 9th 2007, as it is conservative compared to the value calculated by the entity responsible for the Baseline.

The difference between the OM calculated by the entity responsible for the Baseline (1.29093) and the OM published by the Chinese DNA on August 9th 2007 (1.2899) is due to the values for carbon coefficients of Coke and Refinery Gas applied in the Chinese DNA calculations, which differ from the values published by IPCC in 2006 applied by the entity responsible for the Baseline. In addition, Chinese DNA OM calculations do not comprise the consumption of 9,200 tons of briquettes as fuel in thermal power production in Hunan province in 2004, which is listed in the China Energy Statistical Yearbook 2005.

Build margin:
Table 3 show that the BM calculated in the GSC version of the PDD by the entity responsible for the baseline is lower than in the SR version of the PDD. The difference lies in the fact that, in the GSC PDD, values for installed capacity of hydropower in Hubei Province in 2003, 2004 and 2005 were taken from the publicly available Electric Power Yearbooks of 2004, 2005 and 2006 respectively, whereas the SR version of the PDD was updated with the values more recently published by the Chinese DNA.

The difference between the updated calculations in SR PDD by the entity responsible for the Baseline (0.66344) and the BM published by the Chinese DNA on August 9th 2007 (0.6592) is due to the different weighted average carbon coefficients applied.

The BM value published by the Chinese DNA on August 9th 2007 is applied in the SR PDD, as it is conservative compared to the updated value calculated by the entity responsible for the Baseline.

We conclude that the update of the emission factor following validation was executed to ensure consistency with the most recent data published by the Designated National Authority of the People’s Republic of China. As our own calculations on the basis of the most recent data published yield a slightly higher emission factor and the baseline emissions and emission reductions should be calculated in a conservative manner, we have adopted the emission factors calculated by the Chinese DNA.

<u>Response by DOE:</u>

The values for the emission factors for the operating margin and build margin applied in the various PDDs are listed below:
GSP PDD: EF_{OM}= 1.29093 tCO2/MWh EF_{BM} = 0.50830 tCO2/MWh
Sub for Reg PDD: EF_{OM}= 1.2899 tCO2/MWh EF_{BM} = 0.6592 tCO2/MWh
The emission factors have been revised during the validation process because a new data source has been published by the Chinese DNA.
It is required by the methodology to use the most recent data available and hence the newest values from the Electric Power Yearbooks have been used for the Emission Factor calculation.

TÜV SÜD considers the applied values can be accepted for the calculation of the combined margin emission factor.