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Members of the CDM Executive Board
UNFCCC Secretariat
Martin-Luther-King-Strasse 8
D-53153 Bonn
Germany

EcoSecurities International Ltd
40 Dawson Street
Dublin 2
Ireland

Tel +353 (0)1 6139814
Fax +353 (0)1 6724716
Email ireland@ecosecurities.com
www.ecosecurities.com

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Dear Members of the CDM Executive Board,

Request for review – 2410 Sichuan Liangtan Hydropower Station Second Phase Project

Please find below our responses to the issues raised as part of the request for review for this project. The reasons for the request are shown in shaded boxes, followed by our response.

1. Further explanation should be provided regarding: (a) the basis for the assumed electricity tariff in the PDR (b) The revised assumed electricity tariff used in the PDD submitted for registration, in particular, (i) how the price of 0.270 RMB/kWh (including VAT) agreed by the PP with the grid company has been derived and whether this tariff is in line with the general trend for similar projects exporting electricity to the same grid, which commenced after 2002, and (iii) how this tariff compares to the tariffs for thermal power plants.

Response

(a) The Design Institute for the PDR (Sichuan Nanchong Water Resource & Hydroelectric Engineering Exploration & Design Institute) clarified that the basis for the assumed tariff in the PDR is calculated backwards in order to reach the benchmark IRR of 10%[1]. The result of this calculation was 0.390 RMB/kWh, excluding VAT; when used in the financial analysis of the project, this value for the tariff resulted in an IRR of 10%.

(b) (i) The tariff agreed by the project developer with the grid company was 0.360 RMB/kWh (including VAT) (*Please note that there seems a mistake of the request which cited a tariff of 0.270 RMB/kWh*); this is the tariff stated in the Grid Connection Letter of Intent, signed 30 July 2005. The Letter of Intent is the result of negotiations between the grid company and the project developer. The Letter of Intent is dated after the PDR approval date (the PDR was approved on 26 July 2005) and before the project start date (06 September 2005, this is the date of the construction approval). Therefore, at the time when the project participant decided to go ahead with the project activity, they expected to receive the tariff in the Letter of Intent and not the tariff in the PDR as the Letter of Intent contained the most up to date tariff value. The tariff in the Letter of Intent was therefore valid and applicable at the time of the investment decision taken by the project participant in accordance with EB41, Annex 45.

[1] Clarification by Sichuan Nanchong Water Resource & Hydroelectric Engineering Exploration & Design Institute, 04/06/2009

A Power Purchase Agreement (PPA) between the project developer and the grid company was signed on 6 September 2007, at the time when commercial operation of the project began. The PPA states that the tariff will be 0.360 RMB/kWh (the same as the Letter of Intent) and that the tariff will apply for one year. This further demonstrates that the tariff stated in the Letter of Intent was reasonable.

In March 2005, The National Development and Reform Commission, which regulates power production, issued the "Provisional Measures for the Administration of On-Grid Electricity Tariffs" – document NDRC [2005] NO.514, which aims to regulate the determination of the electricity tariff offered to power producers in order to stabilize tariffs and increase competitiveness in the electricity market. Since then, consistent tariff guidance policy has also been issued in Sichuan Province: according to recent regulations (ChuanJiaFa (2005) No.91, ChuanJiaFa (2005) No. 123 and ChuanJiaFa (2006) No.145), the guide electricity tariff for hydropower plants regulated by Sichuan Provincial Price Bureau has not been increased over the past 3 years; the tariff has consistently been set at 0.288 RMB/kWh including VAT for newly operational hydropower plants.Figure 1 shows the trend of tariffs approved in the Sichuan Province since 2003, it can been seen in figure 1 that since October 2005 almost all tariffs have followed the guide electricity tariff of 0.288 RMB/kWh.

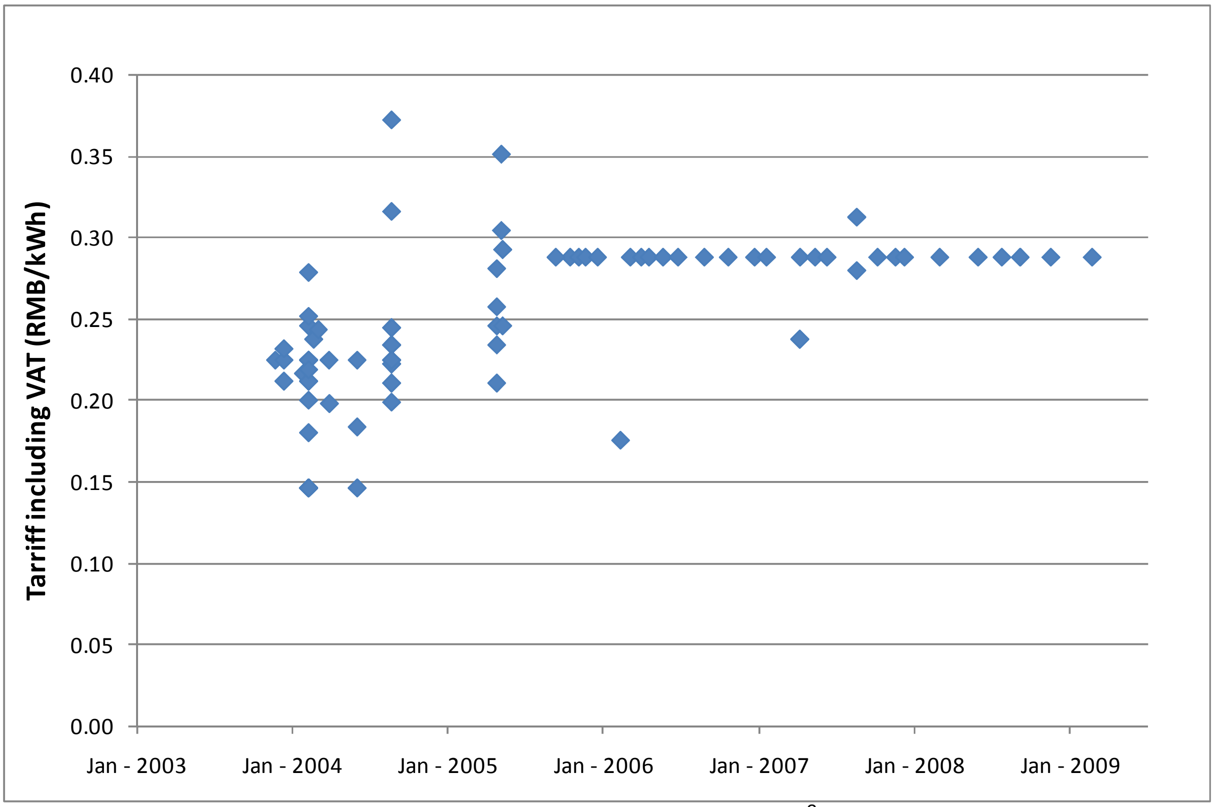

Figure 1 Trend of tariffs approved in the the Sichuan province[2]

[2] Tariff information is taken from the Price Bureau of Sichuan Province (http://www.scpi.gov.cn/newzcfg/zcfg.asp?ClassId=9), a summary of the data collected has been provided to the DOE. No data could be found for tariffs approved before November 2003.

As mentioned above, the PPA that was signed in September 2007 set the tariff for one year, in September 2008 a new PPA was signed. The tariff in the new PPA was 0.288RMB/kWh including VAT to be consistent with the tariff guidance described above. This further demonstrates that the tariff assumed in the PDD, 0.360 RMB/kWh including VAT, is conservative.

(iii) According to the Sichuan Provincial Price Bureau (Document No. ChuanJiaFa (2006) No.145), the guide tariffs for thermal power plants are 0.3328 RMB/kWh (with no desulfurization facilities) and 0.3478 RMB/kWh (with circulation sulfuration bed treatment facilities).

Given that the tariff used in the financial analysis is based on the Letter of Intent, which was available at the time of decision making, and that this tariff is higher than both the guide electricity tariff for hydropower projects and thermal power projects, the tariff used in the PDD is considered to be conservative and applicable at the time of decision making. Furthermore, the tariff in the PDD is the same as the tariff in the Letter of Intent and the original PPA and it is higher than the tariff in the PPA signed in September 2008, further demonstrating the conservativeness of the tariff used in the financial analysis.

2. Further clarification is required on how the DOE has validated the suitability of the input values to the investment analysis as per the requirement of the EB 38 paragraph 54(c) guidance, in particular: (a) the operating hours (4224) considering that the already operating plant runs 5570 hours and the higher operating hours for the projects considered in the common practice analysis; (b) the 8.57% power loss and (c) the investment costs.

Response
The input values used in the investment analysis are sourced from the Preliminary Design Report (PDR). The PDR was finalised in July 2005 by Sichuan Nanchong Water Resource & Hydroelectric Engineering Exploration & Design Institute, which is an independent 3rd party entity accredited by the Ministry of Construction of People's Republic of China (PRC). The PDR was audited and approved by the local government - Guan An City Water Resource Bureau on 26 July 2005. The PDR was finalized in July 2005, 2 months before the start of the project activity. The suitability of each input value used for the financial analysis is discussed in detail below.

a) The operating hours:

a.1 The design of operating hours in the PDR

The project activity utilises resources from an existing reservoir, which was built for an existing hydropower plant. The installed capacity of the original Liangtan Hydroelectric Station (original LHS), which began operation in 1985, was 8.6MW. Although the annual flow of water is 675m^3/s, the design flow for the original LHS is only 139.8m^3/s. Based on actual historical generation data, the average annual **gross** generation of the LHS was 51,300 MWh[3], this is equivalent to annual operating hours of 5965 hours (PDR Chapter 4 page 6).
Since the river flow cannot be fully utilised by the original 8.6MW hydropower plant (the original LHS), the Sichuan Liangtan Hydropower Station Second Phase Project (the project activity) was initiated to further utilize the available resources. During the design process, the

[3] annual net generation is 47,893MWh as quoted in the PDD

annual generation of the original LHS was considered to continue at the same historical level after the implementation of the Project activity. The parameters of the two projects are summarized in the Table 1.

Table 1 Parameters of the LHS and the project activity units

	Total	**Original LHS**	**Project activity units**
Installed Capacity(MW)	28.6	8.6MW	20MW
Operating hours(h)	5,027	5,965	4,623
Theoretical annual gross power generation(MWh)	143,770	51,300 (historical level)	92,470
Designed Flow(m3/s)	459.4	139.8	319.6

The project activity does not involve expansion of the existing reservoir[4] , therefore the same water resource will be available to the original LHS and the Project activity as was available to the original LHS before the implementation of the project activity.

According to the Hydrological Calculation Norms for Small Hydro Power (SL77-94) and the Hydroenergy Design Code for Small Hydro Power Projects (SL76/94) issued by the Ministry of Water Resources of China and widely used in China, Design Institutes apply the following procedures to determine the theoretical annual average power generation. This procedure was also followed for the proposed project:

1. The Design Institute calculate the theoretical runoff series with widely used professional application software based on the historical runoff data (1954-2002). The theoretical runoff series is further checked by comparing its coefficient of variation (Cv) and the relation between Cv and the coefficient of skewness Cs (Cs/Cv). Extremely abnormal years are excluded from the theoretical runoff series.
2. According to the theoretical runoff outcomes, the Design Institute determined the representative runoff of a wet year (p=10%), normal year (p=50%) and dry year (p =90%) as per the theoretical runoff series.
3. The Design Institute compare historical runoff data and determine three specific years whose average runoff are very close to the representative runoff of a wet year, normal year and dry year. The distribution of runoff within a year of the candidate of a wet year, normal year and dry year has to be similar with the theoretical runoff series as well. Three years are identified as the years representative of wet year (May 2000-April 2001), normal year (May 1994-April 1995) and dry year (May 1999-April 2000).
4. The theoretical annual average power generation is determined based on hydrological computation with the actual runoff data of the 3 representative

[4] except to add an open channel to divert water from the reservoir to the new generation units

years. The theoretical annual average power generation of the project is calculated as the sum of daily electricity output which is equal to daily useful water flow multiplied by net water head and generation efficiency. The outcome of the calculation is provided in PDR Chapter 4 page 9 with the result of total annual generation of 143,770MWh for the two projects together.

From the calculation of the theoretical annual average power generation of the project, the operating hours can then be calculated by dividing the generation by the capacity of the project; please see below for further details.

a.2 Explanation of why the operating hours of the project activity are lower

Assuming that the original LHS will continue to generate electricity at historical average levels, the project activity will only be able to utilise the water resource available after the demand from the original LHS has been met. The expected gross power generation of the project activity units is therefore the difference between the total expected generation and the historical generation of the original LHS: 143,770MWh – 51,300MWh = 92,470MWh. The installed capacity of the project activity units is 20MW; therefore the 92,470MWh is equivalent to 4,623 hours of operation of the project activity units (92,470MWh divided by 20MW).

a.3 Cross check with other hydropower projects

The weighted average operating hours of the original LHS and the project activity can be calculated by dividing the total expected gross generation (143,770 MWh) by the total installed capacity (28.6MW) the result of this calculation is the combined operating hours of the hydro plant and is equal to 5027 hours. In the PDR the project is compared to the Sijiutan Hydropower Project which is located downstream of the project activity site, Sijiutan was built in late 1980s with an installed capacity of 26MW. The annual operating hours of the Sijiutan Hydropower Project are 5068h (PDR chapter 4 page 12). This demonstrates that the combined operating hours of the original LHS and project activity is reasonable.

Three of the four projects listed in the common practice analysis of the PDD have operating hours that are greater than the combined operating hours of the original LHS and the project activity. However, the combined operating hours are only slightly less than the Sijuitan Hydropower project, a similar project on the same river, and they are higher than the average operating hours of all hydro plants in the Sichuan province is 4589h (Annex: Operating hours of Sichuan Hydropower projects). This demonstrates that the combined operating hours are reasonable.

The facts and analysis presented above demonstrate that the expected gross generation of the project activity is suitable and was calculated in a transparent manner and that the combined operating hours of the original LHS and the project activity is reasonable compared to similar projects.

According to the above facts and analysis, the operating hours for the proposed project can be considered to be reasonable.

b) 8.57% is the difference between theoretical annual power generation and expected power supplied to grid. The theoretical annual power generation is the average power generation obtained according to hydrological conditions and technical performance of the turbine and generator units of certain installed capacities. The calculation of the amount of power supply to the grid used in the financial analysis is specified as below:

Calculation Process for power supply to grid in the PDR
Expected power supplied to grid = Effective electricity supply * (1-internal power use) * (1-transmission losses)

Effective electricity supply
Effective electricity supply is defined by the Economic Evaluation Code for Small Hydropower Project (SL16-95) as electricity that can be used by the system or end users. The Code explains that because of variations of the river flow changes, grid load restraints, equipment maintenance and plant shut down periods, most of the small hydropower plants cannot achieve the designed electricity generation; this significantly affects the economic analysis of a power plant. The effective electricity supply takes into account the above factors. The application of a coefficient for effective electricity supply in these circumstances is a normal, accepted approach which is also embedded in Chinese national policies and feasibility studies. The application of a coefficient factor is contained in the Economic Evaluation Code for Small Hydropower projects[5] (SLI16-95) and the Hydroenergy Design Code for Small Hydro Power Projects (SL76-94), which were issued in 1994 and 1995 respectively, prior to the commencement of the CDM.

SL16-95 also specifies the range for the coefficient for effective supply to the grid to be used depending on the particular project circumstances. For grid connected projects with monthly/weekly/daily/no regulating stations the range for coefficient shall be 0.7-0.9. The project qualifies as a project type with grid connected daily regulating capacity. The factor estimated in the PDR: 0.96, which is higher than the suggested range, and therefore can be considered to be conservative. Please refer to Annex 1 for further information

Thus, **the difference between theoretical annual power generation and effective electricity supply is not actual power loss** but the estimation of reasonable power generation considering the factors affecting realistic scenarios.

Internal power use
1% loss is stated in the PDR. This can be cross-checked by Hydroenergy Design Code for Small Hydro Power Document No.SL 76-94 (a technical regulation and standard applicable to hydropower projects below 25 MW published by the Ministry of Water Resources of the People's Republic of China, still valid as published by the Ministry of Water Resources of the People's Republic of China[6]). The range for the internal power use specified in this document is 0.5%-1.0% which can demonstrate that the 1% internal power use is reasonable.

Transmission loss

[5] Hydropower projects with a capacity less than 50MW are considered "small"
[6] http://www.mwr.gov.cn/tzgg/qt/20060926000000479251.aspx

3.8% is used in the PDR. This can be also cross-checked by Document No.SL 76-94 which stated that the reasonable range for the transmission loss should between 0-11%.

The historical power generation for the LHS is 51300MWh (gross) and 47893MWh is supplied to grid (net); it can be calculated that the actual power loss (internal power use and transmission loss) is 6.64%. The estimated loss for the Project (4.8% in total from internal power use and transmission loss) is lower than the actual situation and is therefore conservative.

To address the request for review, we have calculated the IRR with no co-efficient factor considered, only internal power use and transmission loss are deducted from the theoretical annual power generation. The calculator has been provided to the DOE with this change and the IRR is 8.92%, which is still lower than the benchmark (10%).

In conclusion, the 8.57% difference of theoretical annual power generation and expected power supplied to grid can be considered to be suitable.

c) The investment costs for the project activity as per the PDR were RMB172 million. This figure was used in the financial analysis in the PDD. According to the investment audit report which was made by Zhongruiyuehua Accounting Firm Co. Ltd., Sichuan sub-firm, a credit independent third party, the investment costs actually incurred for the construction of the project activity as of 05/06/2009 were RMB165 million according to the investment audit report of the project activity, the outstanding investment costs are estimated to be RMB6 million. The outstanding investment costs include planting of trees and grass around the hydro power station, stabilization of the channel walls, completion of the flood defences, removal of the old buildings in the hydro power station and building walls around the hydro power station. This would make the total investment RMB171 million which is very close to the total investment estimated in the PDR. The actual costs are evidenced by contracts and invoices provided to DNV; documents provided include the equipment purchase agreements and the main construction work contracts. The approach followed in the PDD using the estimated investment costs from the PDR (valid at the time of decision making) is thus reasonable.

3. Further clarification is required on how the DOE has validated the investment analysis as appropriate, in line with EB 41, Annex 45; in particular the exclusion of a fair value considering that the operational lifetime is 23 years and the investment analysis considers a 20 year period.

Response

The PDD states the project lifetime is 23 years; this includes 3 years of construction and 20 years of the operation, consistent with the PDR (PDR chapter 15 page 3). 20 years of operational lifetime is common practise for small hydropower projects in China and can be confirmed by the Economic Evaluation Code for Small Hydropower Projects (SL16-95, term 1.7.3) For simplification, a conservative assumption was made in the financial analysis that

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the construction period was one year. The operational lifetime used in the financial analysis is 20 years, consistent with the PDR. This explains why the assessment period for the IRR calculation is 21 years (1 year of construction plus 20 years of operation) and not 23 years,as the 2 years of construction prior to the operation of the project activity were not included. However, the attached spreadsheet shows the more realistic situation of a 3 year construction period and 20 years lifetime (total of 23 years); in this scenario, the IRR would be lower. This shows that it was conservative to assume a one year construction period. In both cases (one year construction or three years construction) the financial analysis covers the entire period of expected operation of the project activity, therefore it is not necessary to include the fair value of the project activity at the end of the assessment period. This is in accordance with EB 41, Annex 45.
We hope that the information provided adequately addresses the concerns raised.

Yours sincerely

Belinda Kinkead
Head of Implementation
belinda.kinkead@ecosecurities.com
Direct line +44 (0) 1865 297 132
Direct fax +44 (0) 1865 251 438

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Annex 1

Determination of the effective power generation capacity of the power plant
The concept of effective power generation capacity takes into account
1. the estimated absorptive capacity of the power grid
2. the regulating capacity of the power plant
3. the estimated plant maintenance and emergency shut down

Because of these 3 factors, the power that can effectively be generated by the power plant is significantly lower than the designed power generation capacity.

1. *Estimated absorptive capacity of the power grid*

The absorptive capacity of the grid is determined by the demand of power user, which differs from season to season in a year and even hour to hour in a day. All units are required to be in full operation during the peak load period. But in valley load period, hydropower stations are usually required to decrease their outputs firstly since thermal power generating units need much more time to response to rapid variation of power demand load. It takes only minutes to dispatch a hydro project, whereas it takes up to days to turn on/off a thermal plant (thermal power generating units need more than 10 hours from start-up to beginning generating power and the frequent rapid variation of thermal power generating units decreases their service life and stability). In other words, there is a difference between the project owner's priorities to sell a maximum amount of electricity (that is why it is called low-cost must-run) and the grid operator's priorities, which is to coordinate a stable and predictable offer so as to meet demand in a most efficient way.

2. *Regulating capacity of the power plant*

Power generation capacity of hydropower project is subject to water power resource, such as annual rainfall within drainage basin, mean annual runoff and water head, etc. Obviously the water flow in wet season is much larger than in dry season. In wet season, the power generation capacity of water-rich provinces such as Sichuan province will significantly exceed the electrical load of the local grid[7]. Hydropower projects with regulating capacity can reserve part of surplus water in wet season for utilization when there is not enough water, but those hydropower projects with no or small regulating capacity have to release all or most of the surplus water without utilising the water power resource.

3. *Estimated plant maintenance and emergency shut down*

In addition to the grid operation effect on the power plant, power plants are usually stopped a certain number of days each year for maintenance or due to emergency shutdown.
In accordance with regulations applicable to hydropower projects, the Design Institute factors points 1, 2 and 3 above in to derive the effective power generation capacity from the theoretical power generation capacity. The effective power generation capacity is the

[7] http://www.sichuandaily.com.cn/2005/01/07/20050107349224659761.htm

electricity that is likely to be generated, based on characteristics of the grid to which the proposed project is connected, the average values for annual maintenance and shut down for hydropower plants and the regulating capacity of the power plant, as opposed to the theoretical electricity generation capacity that assumes that all available water resources is used.

A useful cross-check of the suitability of the value of the effective power generation capacity is provided in the Economic Evaluation Code for Small Hydropower Projects (Document No. SL16-95) issued by the Ministry of Water Resources of China for small hydropower projects with the installed capacity less than 25MW or less than 50MW in rural area in China in the form of the "coefficient for effective supply to the grid"[8]. This coefficient can be used to derive the effective power generation capacity from the theoretical power generation capacity based on the type of power plant and the operation of the grid (i.e. points 1 and 2 above).The values of the "coefficient for effective supply to the grid" given in SL16-95 are based on statistical analysis of actual electricity output of small hydropower stations with different regulating capacity in China.

Table A-1. Default values of Coefficient of effective electricity provided by the Code SL16-95.

The type of hydropower project		Coefficient of the effective electricity
1	grid-connected power projects, regulating annual/several years;	0.95-1.00
2	grid-connected power projects, regulating seasonal;	0.90-0.95
3	grid-connected power projects, regulating monthly, weekly, daily and no regulating ;	
3.1	(when the grid takes all electricity generated in wet season and nighttime)	(0.80-0.90)
3.2	(when the grid takes part of the electricity generated in wet season and nighttime)	(0.70-0.80)
4	Not connected to the grid, regulating daily and no regulating;	0.60-0.70

[8] The effective power generation capacity is obtained by multiplying the theoretical power generation capacity by the "coefficient for effective supply to the grid".