

**CLEAN DEVELOPMENT MECHANISM  
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)  
Version 03 - in effect as of: 22 December 2006**

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**Revision history of this document**

<b>Version Number</b>	<b>Date</b>	<b>Description and reason of revision</b>
01	21 January 2003	Initial adoption
02	8 July 2005	<ul style="list-style-type: none"><li>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.</li><li>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <a href="http://cdm.unfccc.int/Reference/Documents">http://cdm.unfccc.int/Reference/Documents</a>.</li></ul>
03	22 December 2006	<ul style="list-style-type: none"><li>• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.</li></ul>

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**SECTION A. General description of small-scale project activity**
**A.1 Title of the small-scale project activity:**
**Argichi Small Hydroelectric CDM project**

Completed in October 2007. Version 3.

**A.2. Description of the small-scale project activity:**

The proposed project activity involves implementation and operation of a 8.5 MW Small Hydroelectric grid connected renewable energy project on the Argichi river, Armenia. Argichi HPP is located in Gegharkunik Marz and embraces middle site of Argichi River. Absolute altitude of the territory varies from 1970 to 2270 m. River Argichi is the largest confluent of lake Sevan. Argichi River is a typical mountain one.

The electricity generated by Argichi SHPP will be sold to the Armenian Electricity Network (AEN).

*Purpose of the project activity*

**The main purpose of the project activity is generation of clean hydroelectric energy and contribution to climate change mitigation efforts.**

*View of project participants on the contribution of the project activity to sustainable development*

Ministry of Environment Protection of Armenia as the DNA has stipulated the following draft<sup>1</sup> indicators (criteria) for assessment of the project's contribution to the country's sustainable development:<sup>1</sup>

**1. Social Criteria**

*“The project has positive effects on social development.”*

The project activity will create jobs opportunities in the area with very high unemployment level for skilled and unskilled labor during the construction and operation of the plant.

The implementation of the project will benefit the Armenia through development of additional sustainable generation capacity not dependant on the imported energy sources, which will add to the independence of the energy system of the Republic as well. During the project implementation the problem with irrigation will be solved by the Project Host. A new irrigation channel will be constructed for Madina village.

Implementation of the project will also contribute to development of experience and intellectual capacity among the local construction workers that will go through a set of trainings, organized by the Project Host during the project implementation, which will help them to become a skilled work force in future as well.

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<sup>1</sup>It is expected that these indicators will be approved by the end of 2007

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## 2. Environmental Criteria

*“The CDM project leads to positive or decreased negative environmental effects.”*

According to the Environmental Impact Assessment conducted for this project, the construction of the Argichi SHPP will not affect the quality of the river water, as well as the well being of the local population.

## 3. Economic Criteria

*“The project has positive effects on the economic development of the country.”*

During the operation of the Argichi SHPP the expected tax revenue (including local – property taxes, and state – VAT and income taxes) will account to around \$400,000 USD per annum. The project will attract around \$5,000,000 USD investment. The project implementation will also generate employment possibilities for the local population which lacks available workplaces in their region.

During the project implementation locally produced equipment will be used which will benefit the renewable energy technology an intellectual capacity development in Armenia.

## 4. Policy effect criteria

*The project has positive effects on the achievement of national, regional and sector priority objectives.”*

The project activity complies with the Energy Strategy of Republic of Armenia which promotes the development of new renewable energy technologies and capacities. In addition, implementation of the project will also contribute to the sustainable development of Armenia through reducing the dependence on imported energy carriers, such as natural gas, thereby reducing the outflow of capital from Armenia to other countries.

### **A.3. Project participants:**

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)

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<b>Republic of Armenia (host)</b>	<b>Private entity: Hydro Corporation CJSC</b>	<b>No</b>
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

**A.4. Technical description of the small-scale project activity:**

Argichi SHPP will use the hydro potential of river Argichi. The length of that section is equal to 9 km, and the fall is 287 m. All constructions of the HPP are located in that section. The hydroelectric power station is of derivation type. Its principal units are:

- Head unit
- Pressure derivation water carrier
- Station unit
- Removing water canal.

Argichi SHPP will be equipped with 4 horizontal Pelton turbines with 8.5 MW of nominal power. The electricity will be supplied to Lichk substation which is 7 km distance from the head unit.

The hydro-energy indices of Argichi HPP are as follows:

- Designed pressure – 223.0 m
- Designed outflow – 4.8 m<sup>3</sup>/sec.
- Generation capacity – 8.56 MW
- Average annual power generation– 30.5 million kWh

**A.4.1. Location of the small-scale project activity:**
**A.4.1.1. Host Party(ies):**

**Republic of Armenia**

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

**Gegharkunik Marz**

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

**Verin Getashen village**

**A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :**

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The Argichi SHPP will be located in Gegharkunik marz and embrace middle site of Argichi River. Absolute altitude of the territory varies from 1970 to 2270 m. River Argichi is the largest confluent of lake Sevan. Argichi River is a typical mountain one. The river springs from 2600 m altitude. At the connection point of mountains Geghama and Vardenis it flows south. The total reservoir square of river Argichi reaches 384 km<sup>2</sup>, and its length – 51 km. Average inclination of river Argichi is equal to 0.014, the average height of the reservoir is 2460 m.

The river basin neighbours with the following basins: Kuruget from the east, Baghtak from the northwest, Azat from the west, Vedi from the southwest, and Arpa from the south. Head unit of Argichi HPP will be located 3.5 km up the village Madina.

The Argichi SHPP has the following GPS coordinates:

Latitude: 40° 7' 29''

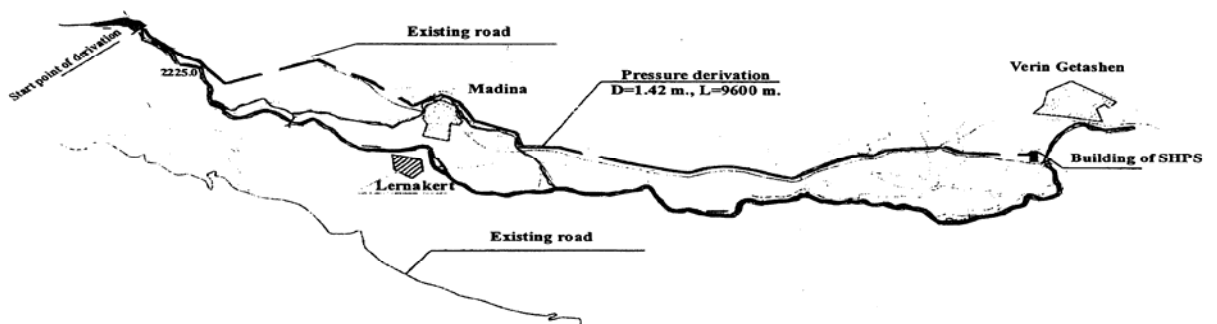
Longitude: 45° 15' 29''

Map 1 Location of Argichi SHPP

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**ARGICHI SHPS**  
**Plan of the Station**  
**M 1:25000**



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**A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:**

The project activity utilizes the hydro potential of Argichi River for power generation and exports the generated power to the grid. According to small-scale CDM modalities the project activity falls under

**Type – I – Renewable Energy Projects and  
Category I-D – Grid connected renewable electricity generation.**

The equipment used in the project will be developed and manufactured locally.

**A.4.3 Estimated amount of emission reductions over the chosen crediting period:**

Year	Estimation of emission reductions (tonnes of CO <sub>2</sub> )
2008	13 331
2009	13 331
2010	13 331
2011	13 331
2012	13 331
2013	13 331
2014	13 331
2015	13 331
2016	13 331
2017	13 331
<b>Total (tonnes of CO<sub>2</sub>)</b>	<b>133 310</b>

**A.4.4. Public funding of the small-scale project activity:**

Total funding required for the project does not include any public funding from Annex I countries. Hence, the project proponents hereby confirm that public funding from parties included in Annex -I is not involved in the project activity.

**A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:**

According to the Appendix C of the Simplified Methodologies and Procedures for the small-scale CDM, this Project activity is not a debundled component of a larger project activity because there is not a registered small-scale CDM project activity or an application to register another small-scale CDM project:

- With the same project participants
- In the same project category and technology/measure;
- Registered within the previous 2 years;
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

**Hence, the project is eligible as a small-scale CDM project and can use the simplified modalities and procedures for small-scale CDM project activities.**

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:**

**Type I: Renewable Energy Projects**  
**I.D. ‘Grid connected renewable electricity generation’**

**B.2 Justification of the choice of the project category:**

As per the provisions of simplified modalities and procedures for small scale CDM project activities (version 12), Type I. D “comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit. If the unit added has both renewable and non-renewable components (*e.g.* a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.

Project activity meets the applicability conditions of the methodology in following manner:

1. The project activity utilizes the hydro potential of Argichi River for power generation and exports the generated power to the grid
2. The installed capacity of the proposed project is only 8,5 MW, which is less than the qualifying capacity of 15 MW.

**B.3. Description of the project boundary:**

According to methodology AMS-ID, the project boundary encompasses the physical, geographical site of the renewable electricity generation source. Hence, the project boundary is the 10.5 hectare area where the powerhouse and transmission line is placed including the connection point with AEN – Lichk Substation.

**B.4. Description of baseline and its development:****Baseline methodology**

Option (a) of paragraph 9 of the latest version of the methodology from project type “I.D Grid connected renewable electricity generation” defines the baseline as the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO<sub>2</sub>e/kWh) calculated in a transparent and conservative manner as the combination of the “operating margin” and the “build margin”, where:

(i) The “operating margin (OM)” is based on one of the following methods: a) Simple OM b) Simple adjusted OM c) Dispatch data analysis OM d) Average OM. The OM emission factor can be calculated using either of the two following data vintages for years(s) y:

Option 1: The full generation-weighted average for the most recent 3 years for which data are available at the time of submission of the PDD

Option 2: The year in which project generation occurs, if emission factor is updated based on ex post monitoring.

(ii) The “build margin” is the weighted average emissions (in kg CO<sub>2</sub>equ/kWh) of recent capacity additions to the system, based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation. Power plant capacity additions registered as CDM project activities should be excluded from the sample group m. If 20% falls on part capacity of a plant, that plant is included in the calculation.

The build margin emission factor can be calculated using either of the following data vintages for years(s) y:

- Option 1: Most recent information available on plants already built at the time of PDD submission.
- Option 2: For the first crediting period, emission factor is updated based on ex-post monitoring. For subsequent crediting periods, emission factor should be calculated ex-ante, as described in option 1 above.

Option a) is selected for this project because the project will displace mostly fossil-fuel generating sources since they are at the margin of the electricity generation system. Future capacity additions will be

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predominated on fossil fuel based power plants (particularly it is expected than in 2008-2009 two new plants will be launched – Hrazdan TPP Unit No5 (450 MW) and Yerevan TPP New Unit (215 MW).

Taking into consideration the fact that most of the generation facilities and their equipment (more than 95%) are very old, the majority of those being constructed during the mid-soviet period, and the fact that the new generation units are under construction at the Hrazdan TPP and the Yerevan TPP and about 40 new small HPPs has got licenses for construction, the power generation mix will be significantly changing in the nearest future.

Thus it makes sense to calculate the baseline in the year, in which project generation occurs, calculating the emission factor based on the ex-post monitoring during the crediting period. The data necessary for ex-post calculation is publicly available in Armenia and can be provided by PSRC upon request. The current data on Armenian power plants will be used prior to the point at which the first new plant will be added to the grid and start producing electricity. Each month the project proponent will update the information on newly constructed and commissioned power plants with the PSRC and recalculate emission factor.

The key information and data used to determine baseline scenario (variables, parameters, data sources etc) are listed in the following table.

**Table 1 Key information and data used to determine baseline scenario**

Key Parameter	Value	Data Source
Power Generation	Power generated by all sources	Public Services Regulating Commission of RA, PSRC
Fuel type and consumption	Fuel type and consumption in individual power plants	Public Services Regulating Commission of RA, PSRC, Government of Armenia, which adopted the “Energy Sector Development Strategies in the Context of Economic Development in Armenia”, August 2005
Power Plants Own Consumption (PPOC) n	Power consumed by power plants	Public Services Regulating Commission of RA, PSRC
Oxidation factor	Oxidation factor for each fuel type	IPCC default oxidation factor for fuels
EF <sub>y</sub>	Baseline emission factor of the grid	Calculated for power plants in Armenia
EG <sub>y</sub>	Electricity generated by the project per annum	Will be taken from the plant
Lambda dispatch factor	Fraction of time during which low-cost / must run	Energy Strategy Center

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	sources are on the margin	
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**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:**

**Justification for application of simplified methodologies to the project activity.**

The installed capacity of the project is 8.5 MW, which is less than the limiting capacity of 15 MW and is thus eligible to use small-scale simplified methodologies. The project activity is generation of electricity for a grid system using hydro potential. Hence, the type and category of the project activity matches with I.D. as specified in Appendix B of the indicative simplified baseline and monitoring methodologies for small-scale CDM project activities. Justification for additionality of the project under the UNFCCC simplified modalities is to establish the additionality of the project activity according to the Attachment A of Appendix B, which lists various barriers, out of which, at least one barrier shall be identified due to which the project can not occurred any way. The analysis of existing barriers is presented below. The first step in the process is to list the likely future scenarios. Two scenarios were considered:

**Scenario 1. The continuation of current activities** – This scenario represents the continuation of current practices, which includes generation of electric energy with significant domination of fossil fuel – natural gas, which currently accounts to around 30% of the total energy generation mix. Besides, there are significant generation capacity additions through one unit of Hrazdan TPP and also on additional unit of Yerevan TPP.

**Scenario 2. The construction of the new renewable energy plant – Argichi SHPP.** In this scenario, a new source of electricity generation capacity with no carbon emissions will be available that will displace the high carbon intensive electricity generation plants.

**The barriers are as follows:**

**Financial/economical:** This barrier evaluates the viability, attractiveness and financial and economic risks associated with each scenario, considering the overall economics of the project and/or economical conditions in the country.

**Technical/technological:** This barrier evaluates whether the technology is currently available, if there are indigenous skills to operate it, if the application of the technology is a regional, national or global standard, and generally if there are technological risks associated with the particular project outcome being evaluated.

**Prevailing business practice:** This barrier evaluates whether the project activity represents prevailing business practice in the industry. In other words, this barrier assesses whether in the absence of regulations it is a standard practice in the industry, if there is experience to apply the technology and if there tends to be high-level management priority for such activities.

With respect to **financial/economical** barriers:

- The continuation of current practices (Scenario 1) does not pose any financial/economical barrier to the project developer, and requires no further financing.

- The estimated investment for the Argichi SHPP project is equal to \$4.6 million USD, where debt/equity ratio was planned to be 70/30. The Project Developer has applied to a number of financial institutions that are currently providing loans for this kind of business activities. All the loan applications were denied or the offered conditions were unacceptable (18-22% interest rate, 3 years maturity etc), as a result of which the proposed activities were delayed and after paying penalties to the State the Company had to apply to the Public Services Regulating Commission with request to reissue the SHPP construction License (the documentation is available on [www.psrc.am](http://www.psrc.am)) .

The only financial institution which is planned to provide loans for implementation of this kind of projects in Armenia is the Cascade Credit Universal Credit Organization (Cascade Credit UCO). The funds of the Cascade Credit UCO are sourced from the Renewable Resources and Energy Efficiency Fund (R2E2 Fund). Nevertheless, according to the regulations of the Central Bank of Armenia the Cascade Credit UCO can only provide loans of up to \$1,000,000 USD, because the authorized capital of the Cascade Credit UCO is equal to \$4,000,000, and the loan limit for any credit organization in Armenia should be less than 25%.

It appeared that the implementation of the project was only possible with the involvement of the European Bank of Reconstruction and Development (EBRD). The Company has applied to EBRD for debt financing and EBRD has agreed to provide loan \$1,800,000, which means in this situation, the developer needs to bring in additional equity financing in order to complete the proposed project. The only possible solution in this situation was to implement the project as CDM project and to attract advance payment for the CERs. In this respect, the possibility of registration of this project as a CDM project plays a vital role, since the possible prepayment for the CERs and the future purchase of actually produced CERs will create the necessary conditions for this project to be implemented.

**From the conducted analysis it is evident that the project can not succeed without additional funds that can be provided as a prepayment for the CERs by the EBRD/EIB Multilateral**

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**Carbon Credit Fund (MCCF). The prepayment from MCCF is crucial for the implementation of the projects, since both lenders EBRD and Cascade Credit has also agreed to provide financing only if the project would acquire CDM status (the letters from Cascade Credit and MCCF were provided to the validator).**

With respect to the **technical/technological** barrier:

- Neither in the case of Scenario 1, nor in the case of Scenario 2, there are no technical/technological issues. The first case represents a continuation of current practices and does not involve any new technology or innovation. In case of Scenario 2 there are no significant technical/technological barriers as well, as all the technologies involved in this scenario are available in the market, and have been used effectively in Armenia.

With respect to the analysis of **prevailing business practice**:

- In the case of Scenario 1 there are no particular barriers for the continuation of current business practices with operation of existing facilities. In case of Scenario 2 there will be no significant deviations from the existing trend in the energy sector as well. Table 4 below summarizes the results of the analysis regarding the barriers faced by each of the proposed scenarios. As the table indicates, Scenario 1 faces no barriers, whereas Scenario 2 faces one important barrier – the financial/economic barrier.

Table 2 below summarizes the results of the analysis regarding the barriers faced by each of the proposed scenarios. As the table indicates, Scenario 1 faces no barriers, whereas Scenario 2 faces one important barrier – the financial/economic barrier.

**Table 2: Summary of Barriers Analysis**

Barriers evaluated	Scenario 1	Scenario 2
	Continuation of current situation	Construction of Argichi SHPP
Financial/Economic	NO	YES
Technical	NO	NO
Prevailing Business practice	NO	NO

#### **B.6. Emission reductions:**

##### **B.6.1. Explanation of methodological choices:**

The data for the calculation of the operating and build margin were obtained from the following sources:

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- Public Service Regulatory Commission of Armenia, which provided the following data:
  - the total electricity generation of Armenian power plants
  - the type of fuels consumed in 2005, quantity of the fuel consumed by the Thermal Power Plants
- Government of Armenia, which adopted the “Energy Sector Development Strategies in the Context of Economic Development in Armenia”, August 2005 and which includes information on Armenian policies in the energy sector and fully describes the existing plants’ operations (sub-units, commissioning dates, total electric capacity etc.)
- The Energy Strategy Centre, which is responsible for the collection and analysis of statistic information on electricity and heat energy demand and supply in the Republic of Armenia provided data necessary for the calculation of Lambda factor.

**Choice of power plants for the calculation of the Operating Margin (OM).**

The approved baseline methodology AMS. I.D. requires the project developers to calculate the Operating Margin (OM) emission factor in accordance with the procedures prescribed in the approved methodology ACM0002.

As per step 1 of ACM0002, the operating Margin emission factor (EFOM,y) is calculated based on one of the four following methods:

- (a) Simple OM, or
- (b) Simple adjusted OM, or
- (c) Dispatch Data Analysis OM, or
- (d) Average OM.

The Operating Margin is calculated on the basis of the option (b) Simple Adjusted OM.

As per the ACM0002 methodology Dispatch Data Analysis is the first methodological choice. However, this method is not selected, since no detailed information is available for to apply Dispatch Data Analysis Method. Furthermore, as it is evident from the table 3 below, generation by low-cost/must-run power sources exceeds 50%, requiring the calculation of a lambda factor to modify the results of the Simple OM Method (Simple Adjusted OM).

**Table 3**

Year	2005	2004	2003	2002	2001
Percentage of low-cost/must run resources in total electricity generation	70.75%	72.91%	72%	70%	50%
Average of five years					67,13%

*Source: PSRC*

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The approved methodology ACM0002 outlines two options for data vintages for calculating the approximate operating margin emission factor and the weighted average emission factor:

- (ex-ante) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission, if or,
- the year in which project generation occurs, if EFOM<sub>y</sub> is updated based on ex-post monitoring.

The choice between ex-ante and ex-post vintage should be specified in the PDD, and cannot be changed during the crediting period.

For the calculation of the Operating Margin (OM) Option 2 is chosen, by which the OM emission factor will be updated annually ex-post for the year in which actual project generation and associated emissions reductions occur.

However, the ax-ante approach was used for the calculation of indicative operating margin. The table 4 presents all the power plants included in the operating margin. If hydro, geothermal, wind, low-cost biomass, nuclear and solar generation are excluded, then only three thermal power plants remain for the adjusted operating margin: Yerevan, Hrazdan and Vanadzor TPPs. It must be noted that Vanadzor TPP has not been running since 2001.

The imports from Iran and Artsach region are also included in the calculation of the operating margin. The emission factor of all the imports was assumed in a conservative manner to be 0 tons of CO<sub>2</sub> per MWh (as prescribed on page 4 of the ACM0002 version 6 methodology).

The power sources included in the operating margin calculation are underlined in yellow in the table below.

**Table 4**

<b>Name</b>	<b>Fuel</b>	<b>Capacity, MWh</b>	<b>Generation (2005),GWh</b>	<b>Contribution to total energy mix (2005), %</b>	<b>Contribution to the Operating Margin (2005), %</b>
International Energy Corporation	Hydro	556	519,2	7,8	
Hrazdan TPP	Gas	1110	1435,5	21,6	66,3

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Yerevan TPP	Gas	550	391,7	5,9	18,1
Vorotan Cascade	Hydro	400	1027,6	15,4	
Vanadzor TPP	Gas	96	0,0	0,0	0,0
Dzora SHPP	Hydro	25	70,0	1,1	
Small SHPPs <sup>2</sup>	Hydro	51	155,8	2,3	
ANPP	Nuclear	880	2716,3	40,8	
Imports			337,6	5,1	15,6

### Choice of power plants for the calculation of the Build Margin (OM).

Taking into consideration the fact that most of the generation facilities and their equipment (more than 5%) are very old, the majority of those being constructed during the mid-soviet period, and the fact that the new generation units are under construction at the Hrazdan TPP and the Yerevan TPP and about 40 new small HPPs has got licenses for construction, the power generation mix will be significantly changing in the nearest future. Thus it makes sense to calculate the build margin in the year, in which project generation occurs, calculating the emission factor based on the ex-post monitoring during the crediting period.

It must be noted that generation and capacity data are unavailable for each of the small hydro power plants that contribute to 27.35 MW to the 51 MW capacity and are labelled under category “Other small Hydro Power Plants”. All small hydro power plants were therefore considered as one category and the year of commissioning of the last of the small hydro power plants (2004) was used as the year of commissioning of the whole group.

The build margin can be calculated as the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently or as the five power plants that have been built most recently. As the sample group which will consist of the five most recently built power plants is unknown at the moment of PDD submission, it is assumed that the generation of the power plant capacity additions in the electricity system which will comprise 20% of the system generation will comprise larger annual generation. Thus, the plants that constitute the newest 20% of the system generation comprise hydro and thermal power plants and correspond to 1,455.9 MWh. The choice of plants for the build margin

calculation is highlighted in yellow in the table below. The highlighted plants contribute to 19.25% of total expected generation.

The data necessary for ex-post calculation is publicly available in Armenia and can be provided by PSRC upon request. The current data on Armenian power plants will be used prior to the point at which the first

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new plant will be added to the grid and start producing electricity. Each month the project proponent will update the information on newly constructed and commissioned power plants with the PSRC and recalculate emission factor.

According to the information provided by PSRC the future capacity additions will be as presented in the Table 5.<sup>3</sup>

**Table 5. Future Capacity Additions**

Power plants	Fuel	Commissioning date	Capacity	Generation	Contribution to total energy mix of the capacity additions
Existing Plants			MW	GWh	(%)
				2005 Generation	
Gerger	Hydro	1996	1,26	3,8	0,26
Yerevan reservoir 1	Hydro	1997	0,75	2,3	0,16
Kotayk canal	Hydro	2000	2,20	6,7	0,46
Yeghegis	Hydro	2004	6,40	19,6	1,35
Other SHPPs	Hydro	2004	27,35	83,6	5,74
New Plants				Expected Generation	
Talin	Hydro	obtained license	5,14	28,4	1,95
Chichan	Hydro	obtained license	0,6	0,4	0,03
Apres	Hydro	obtained license	1,5	11,7	0,80
Hermon	Hydro	obtained license	1,2	4,1	0,28
Getik-1	Hydro	obtained license	6,5	21,1	1,45
Getik-2	Hydro	obtained license	0,9	4,3	0,30
Aghstev-6	Hydro	obtained license	6,52	16,8	1,15
Meghri	Hydro	obtained license	2	11,5	0,79
Pambak	Hydro	obtained license	21	79,2	5,44
Bovadzor	Hydro	obtained license	0,38	1,8	0,12
Manushakadzor	Hydro	obtained license	0,35	1,433	0,10
Kurtan-1	Hydro	obtained license	0,67	2,9	0,20
Kurtan-2	Hydro	obtained license	5,2	17	1,17
Ayri	Hydro	obtained license	1,1	4,6	0,32
Argichi	Hydro	obtained license	8,6	29,1	2,00
Rine	Hydro	obtained license	0,09	0,8	0,05
Tatev	Hydro	obtained license	2,35	13	0,89
Eghvard	Hydro	obtained license	0,9	4	0,27
Spitak-1	Hydro	obtained license	0,5	2,3	0,16
Chanachchi	Hydro	obtained license	1,4	6,2	0,43
Jradzor	Hydro	obtained license	4,84	17,3	1,19

<sup>2</sup> Electric energy generated by the Lori-1 wind power plant is included in this category

<sup>3</sup> The power plants which have licenses for construction

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Hoktember	Hydro	obtained license	0,06	0,5	0,03
Ler Eks-1	Hydro	obtained license	0,28	2,4	0,16
Ler Eks-2	Hydro	obtained license	0,25	2,2	0,15
Ler Eks-3	Hydro	obtained license	0,37	2,7	0,19
Ler Eks-4	Hydro	obtained license	0,23	1,8	0,12
Ler Eks-5	Hydro	obtained license	0,24	1,8	0,12
Ler Eks-6	Hydro	obtained license	0,34	2,6	0,18
Vahagni	Hydro	obtained license	1	8	0,55
Sandaghbyur	Hydro	obtained license	0,66	2,4	0,16
Dzor-Dzor	Hydro	obtained license	0,3	1,8	0,12
Elegis-1 (retrofit)	Hydro	obtained license	3,16	5,3	0,36
Amasia	Hydro	obtained license	0,9	1	0,07
Sisakan	Hydro	obtained license	0,5	1,9	0,13
Eghvard-2	Hydro	obtained license	9,31	18,2	1,25
Geghi-1	Hydro	obtained license	4,09	15,4	1,06
Haghpat-1	Hydro	obtained license	0,32	1,05	0,07
Haghpat-2	Hydro	obtained license	1,9	8,09	0,56
Aygezard	Hydro	obtained license	0,84	3,32	0,23
Saravan	Hydro	obtained license	2,488	7,7	0,53
Aghstev-1	Hydro	obtained license	3,6	14,4	0,99
Jermuk-2	Hydro	obtained license	2,35	10,2	0,70
Gevorgavan	Hydro	obtained license	0,06	0,32	0,02
Pambak-1	Hydro	obtained license	1,91	13,9	0,95
Tej	Hydro	obtained license	2,26	7,01	0,48
Ajgedzor-2	Hydro	obtained license	2	6	0,41
Hnevank-1	Hydro	obtained license	0,967	5,75	0,39
Hnevank-2	Hydro	obtained license	0,5	2,7	0,19
Hrazdan TPP Unit-5	Natural gas	obtained license	400	717,75	49,30
Yerevan TPP New Unit	Natural gas	obtained license	215,00	195,85	13,45
				<b>1455,973</b>	<b>100</b>

**B.6.2. Data and parameters that are available at validation:***(Copy this table for each data and parameter)*

<b>Data / Parameter:</b>	<b>CO<sub>2</sub> operating margin emission factor of the grid</b>
Data unit:	kg CO <sub>2</sub> /kWh
Description:	The CO <sub>2</sub> operating margin emission factor is calculated according to the simple adjusted operating margin methodology detailed in Section B.6.3. and B.6.4.
Source of data used:	<ul style="list-style-type: none"> <li>• Public Service Regulatory Commission of Armenia, which provided the following data: <ul style="list-style-type: none"> <li>- the total electricity generation of Armenian power plants</li> <li>- the type of fuels consumed in 2005, quantity of the fuel and power (energy own consumption) consumed by the Thermal Power plants</li> </ul> </li> <li>• Government of Armenia, which adopted the “Energy Sector Development Strategies in the Context of Economic Development in Armenia”, August 2005 and which includes information on Armenian</li> </ul>

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	policies in the energy sector and fully describes the existing plants' operations (sub-units, commissioning dates, total electric capacity etc.)
Value applied:	0.535
Justification of the choice of data or description of measurement methods and procedures actually applied :	The justification for using the adjusted operating margin method is presented in Section B.6.1. The actual steps of the calculation are detailed in Section B.6.3. and B.6.4.
Any comment:	

<b>Data / Parameter:</b>	<b>CO<sub>2</sub> build margin of the grid</b>
Data unit:	kg CO <sub>2</sub> /kWh
Description:	The CO <sub>2</sub> build margin emission factor is calculated according to the simple adjusted operating margin methodology detailed in Section B.6.3. and B.6.4.
Source of data used:	<ul style="list-style-type: none"> <li>Public Service Regulatory Commission of Armenia, which provided information on future capacity additions in the grid</li> </ul>
Value applied:	0.398
Justification of the choice of data or description of measurement methods and procedures actually applied :	The justification for using the adjusted operating margin method is presented in Section B.6.1. The actual steps of the calculation are detailed in Section B.6.3. and B.6.4.
Any comment:	

<b>Data / Parameter:</b>	<b>Fuel consumption in thermal power plants</b>
Data unit:	g <sub>eqv</sub> /kWh <sub>e</sub>
Description:	The quantity of fuel consumed in thermal power plants for the electricity generation
Source of data used:	Public Service Regulatory Commission of Armenia
Value applied:	0,385 kg <sub>ce</sub> /kWh in Hrazdan TPP 0,398 kg <sub>ce</sub> /kWh in Yerevan TPP
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data were provided by PSRC, based on the statistical information provided by thermal power plants.
Any comment:	kg <sub>ce</sub> – kilogram of coal equivalent, reference unit for the energetic evaluation of various energy carriers. 1 kg coal equivalent corresponds to a value specified as 7,000 kilocalories (7,000 kcal ~ 29.3 MJ ~ 8.141 kWh).

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<b>Data / Parameter:</b>	<b>CO<sub>2</sub> emission coefficient of each fuel type</b>
Data unit:	tC/TJ
Description:	The CO <sub>2</sub> emission coefficient of a fuel type is the carbon content of each fuel type, adjusted by the combustion efficiency factor (or oxidation factor) of 0.995
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Workbook, Vol. 2., Table 1-2, page 1.6 ( <a href="http://www.ipccnggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf">http://www.ipccnggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf</a> )
Value applied:	Natural gas (dry), adjusted: 15.22 Nuclear: 0 Hydro: 0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data given by the IPCC is considered to be authoritative in this field.
Any comment:	

<b>Data / Parameter:</b>	<b>Electricity generation of each power plant</b>
Data unit:	GWh
Description:	The amount of electricity generated by each power plant in the grid
Source of data used:	PSRC
Value applied:	See table 4
Justification of the choice of data or description of measurement methods and procedures actually applied :	The aforementioned information represents the most accurate data on electricity generation level in 2005 from all existing generation facilities supplying the electric grid of Armenia. The aforementioned information was used during the calculation of the adjusted operation margin.
Any comment:	

<b>Data / Parameter:</b>	<b>Identification of power plants for the OM</b>
Data unit:	Name of the plant
Description:	The methodology ACM0002 provides for options for the calculation of operating margin. The adjusted simple operating margin was chosen for this CDM project.
Source of data used:	PSRC
Value applied:	Hrazdan TPP, Yerevan TPP, Vanadzor TPP
Justification of the choice of data or description of measurement methods and procedures actually applied :	The calculation of the adjusted operating margin implies the division of generation sources in low cost must run resources (hydro, geothermal, wind, low-cost biomass, nuclear and solar generation) and other resources. If the low-cost must-run resources are excluded, then only three thermal power plants can be included in the calculation of the adjusted operating margin
Any comment:	

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<b>Data / Parameter:</b>	<b>Lambda Factor of the grid</b>
Data unit:	
Description:	<b>Fraction of time during which low-cost / must run sources are on the margin</b>
Source of data used:	PSRC
Value applied:	The Energy Strategy Center has provided project proponent with the data necessary for plotting the Load Duration Curve and estimating the factor lambda for the year 2005 for the Armenian electricity grid.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The calculation of the adjusted operating margin implies the division of generation sources in low cost must run resources (hydro, geothermal, wind, low-cost biomass, nuclear and solar generation) and other resources. If the low-cost must-run resources are excluded, then only three thermal power plants can be included in the calculation of the adjusted operating margin
Any comment:	

<b>B.6.3 Ex-ante calculation of emission reductions:</b>
--

**In the current section the derivation of baseline emission coefficient is presented.**

AMS I.D. (Version 12) offers the following the following choices for the preparing the baseline calculation for this type of project activity:

a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered.

OR

(b) The weighted average emissions (in kg CO<sub>2</sub>e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option a) was used

**Step 1. Calculate the simple adjusted operating margin (see Annex 3).**

- a. Contribution to the total thermal power produced in the grid. (%)

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*Data source: PSRC - 2005*

$$\text{Percentage contribution} = \frac{\text{Generation in 2005, including imports (MWh)}}{\text{Total thermal generation in 2005 (MWh)}}$$

b. Determine each plant's heat rate (MJ/MWh)

$$\text{Plant heat rate (MJ/MWh)} = \frac{\text{Plant's fuel consumption, including auxiliary consumption (kg}_{ce}/\text{kWh)} \times 7000^4 \text{ (kcal/kgce)} \times 4.1868 \text{ (MJ/kcal)}}{\text{Plant's fuel consumption, including auxiliary consumption (kg}_{ce}/\text{kWh)}}$$

*Data Source: fuel consumption and auxiliary consumption in thermal power plants, PSRC*

c. Estimated carbon content (adjusted) of each type of the fuel (tons of C/TJ)

$$\text{Carbon content (adjusted) of each fuel (tons of carbon/TJ)} = \frac{\text{Carbon content of each fuel (tons of carbon/TJ)} \times \text{Combustion efficiency of each plant (\%)}}{\text{Combustion efficiency of each plant (\%)}}$$

*Data Source: Carbon content (unadjusted) & combustion efficiency: WB GHG Assessment Handbook PDD of Yeghegis Small Hydro Power Plant published on UNFCCC website*

d. Emission factor of each power plant (specific to each fuel consumed) (kgC/MWh):

$$\text{Emission factor of each power plant (specific to each fuel consumed) (kgC/MWh)} = \frac{\text{Heat Rate (MJ/MWh)} \times \text{Carbon content (adjusted) of each fuel (tons of Carbon/TJ)}}{\text{Heat Rate (MJ/MWh)}}$$

e. Emission factor converted into CO<sub>2equ</sub> (specific to each fuel consumed) (kg CO<sub>2</sub>/kWh):

$$\text{CO}_{2equ} \text{ emissions of each power plant (kg CO}_2/\text{kWh)} = \frac{\text{Emission factor of each power plant (specific to each fuel consumed) (kg C/MWh)} \times (44/12)}{\text{Emission factor of each power plant (specific to each fuel consumed) (kg C/MWh)}}$$

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f. Weighted average emissions of each power plant (specific to each fuel consumed):

**Weighted CO<sub>2</sub><sub>equ</sub> emissions of each plant for every kWh in the grid (kg CO<sub>2</sub>/every kWh in the grid) = CO<sub>2</sub><sub>equ</sub> emissions of each plant X Percentage contribution to the grid in 2005**

g. Calculate the operating margin for 2005

**Operating margin (kgCO<sub>2</sub><sub>equ</sub>/kWh) = Sum of weighted CO<sub>2</sub><sub>equ</sub> emissions of each plant for every kWh in the grid (kg CO<sub>2</sub>/kWh)**

h. Calculate λ for 2005

**λ = number of hours per year for which low - cost/must run sources are on margin / 8760 hours per year**

i. Apply (1-λ) to the operating margin

**Simple adjusted operating margin = (1-λ) X Operating margin (kg CO<sub>2</sub><sub>equ</sub>/kWh)**

**Step 2: Calculate the emission factor of each plant and develop the build margin (See Annex 3).**

**Build Margin (kg CO<sub>2</sub><sub>equ</sub>/kWh) = Sum of weighted CO<sub>2</sub><sub>equ</sub> emissions of each plant for every kWh in the grid generated by the 20% newest plants (kg CO<sub>2</sub><sub>equ</sub>/kWh)**

**Step 3: Calculate the baseline emission factor of the grid (see Annex 3)**

**Emission coefficient of the grid (kg CO<sub>2</sub><sub>equ</sub>/kWh) = Build Margin (kg CO<sub>2</sub><sub>equ</sub>/kWh) + Simple Adjusted Operating Margin (kg CO<sub>2</sub><sub>equ</sub>/kWh) / 2**

**Step 4: Calculate the baseline emissions of the project activity (see Annex 3)**

**Baseline emission of the project (tons of CO<sub>2</sub>) = Electricity generation in Argichi SHPP over 10 X Emission coefficient of the grid (kg CO<sub>2</sub><sub>equ</sub>/kWh) / 10<sup>3</sup>**

<sup>4</sup> kg<sub>ce</sub> – kilogram of coal equivalent, reference unit for the energetic evaluation of various energy carriers. 1 kg coal equivalent corresponds to a value specified as 7,000 kilocalories (7,000 kcal ~ 29.3 MJ ~ 8.141 kWh)

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**years crediting period**

Emissions from leakage are not considered, since the energy generating equipment will not be transferred from another activity.

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

Year	Estimation of baseline emissions (tonnes of CO <sub>2</sub> e)	Estimation of project activity emission reductions (tonnes of CO <sub>2</sub> e)	Estimation of Leakage (tonnes of CO <sub>2</sub> e)	Estimation of emission reductions (tonnes of CO <sub>2</sub> e)
Year 1	13 331	0	0	13 331
Year 2	13 331	0	0	13 331
Year 3	13 331	0	0	13 331
Year 4	13 331	0	0	13 331
Year 5	13 331	0	0	13 331
Year 6	13 331	0	0	13 331
Year 7	13 331	0	0	13 331
Year 8	13 331	0	0	13 331
Year 9	13 331	0	0	13 331
Year 10	13 331	0	0	13 331
<b>Total (tonnes of CO<sub>2</sub>)</b>	<b>133 310</b>	<b>0</b>	<b>0</b>	<b>133 310</b>

**B.7 Application of a monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:**

*(Copy this table for each data and parameter)*

<b>Data / Parameter:</b>	<b>Electricity supplied to the grid</b>
Data unit:	MWh
Description:	Electricity supplied to the grid by the Argichi SHPP
Source of data to be used:	The electric meter installed in Argichi SHPP will measure the electricity supplied to the grid.
Value of data	The projected electricity generation by Argichi SHPP is presented in the section A.4
Description of measurement methods and procedures to be applied:	For the monitoring of electricity generation inspected and certified (according to national regulations) monitoring equipment (electric meter) will be installed in place. The data will be monitored and recorded by qualified engineers according to the monitoring plan. Electric meter readings will be double-checked with the

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	records of the AEN.
QA/QC procedures to be applied:	The Hydro Corporation will appoint a designated engineer on site who will be responsible for collecting and compiling the necessary data for the monitoring plan. The data will be collected in a transparent way and provided to the third party audit entity for the DOE validation and certification.
Any comment:	

<b>Data / Parameter:</b>	<b>Minimum water flow in the river</b>
Data unit:	m <sup>3</sup> /s
Description:	Minimum water flow in the river in accordance with environmental legislation.
Source of data to be used:	The meters will be installed in Argichi SHPP which will measure minimum water flow in the river.
Value of data	1 m <sup>3</sup> /s
Description of measurement methods and procedures to be applied:	The minimum water flow in the river of 1.0m <sup>3</sup> /s required for ecological reasons will be monitored by the Hydro Corporation personnel and Ministry of Environment Protection.
QA/QC procedures to be applied:	The designated engineer responsible for the monitoring will monitor the minimum water flow in the river. The monitoring
Any comment:	

<b>Data / Parameter:</b>	<b>Identification of power source plant for the BM</b>
Data unit:	Name of plant
Description:	The build margin includes either the newest five power plants or newest power plants that have been built more recently and contributed to 20% of electricity generation of a certain year, whichever definition includes the largest generation.
Source of data to be used:	PSRC
Value of data	The names of the plants currently included in the build margin are detailed in Section B.6.1. The names of plants to be included in the build margin will be determined annually ex-post.
Description of measurement methods and procedures to be applied:	The names of plants to be included in the build margin will be determined annually ex-post. The data on the plants to be included in the Build margin is available in Armenia and can be provided by PSRC upon request. The current data on Armenian power plants will be used prior to the point at which the first new plant will be added to the grid and start producing electricity. Each month the project proponent will update the information on newly constructed and commissioned power plants with the PSRC and recalculate emission factor.
Any comment:	

<b>Data / Parameter:</b>	<b>Identification of power source plants for the OM</b>
Data unit:	Name of plant
Description:	The power plants to be included in the operating margin will be identified as it is

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	detailed in the section B.4 and B.6.
Source of data to be used:	PSRC
Value of data	The names of the plants currently included in the operating margin are detailed in Section B.6.1. The names of plants to be included in the operating margin will be determined annually ex post.
Description of measurement methods and procedures to be applied:	The names of plants to be included in the operating margin will be determined annually ex-post. The data on the plants to be included in the Operating margin is available in Armenia and can be provided by PSRC upon request. The current data on Armenian power plants will be used prior to the point at which the first new plant will be added to the grid and start producing electricity. Each month the project proponent will update the information on newly constructed and commissioned power plants with the PSRC and recalculate emission factor.
Any comment:	

<b>Data / Parameter:</b>	<b>CO<sub>2</sub> operating margin of the grid</b>
Data unit:	kgCO <sub>2</sub> /kWh
Description:	Calculated as the weighted emission factor of all the power plants included in the operating margin.
Source of data to be used:	PSRC
Value of data	0.535
Description of measurement methods and procedures to be applied:	The detailed calculations of the emission factor of the electricity grid are presented in the section B.6.3 and can be checked by the DOE.
Any comment:	

<b>Data / Parameter:</b>	<b>CO<sub>2</sub> build margin of the grid</b>
Data unit:	kgCO <sub>2</sub> /kWh
Description:	Calculated as the weighted emission factor of all the power plants included in the build margin.
Source of data to be used:	PSRC
Value of data	0.398
Description of measurement methods and procedures to be applied:	The detailed calculations of the emission factor of the electricity grid are presented in the section B.6.3 and can be checked by the DOE.
Any comment:	

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<b>Data / Parameter:</b>	<b>CO<sub>2</sub> emission factor of the grid</b>
Data unit:	kgCO <sub>2</sub> /kWh
Description:	Calculated as the average of the Operating Margin emission factor and the Build Margin emission factor
Source of data to be used:	PSRC Government of RA Energy Strategy Center
Value of data	<b>0,437</b>
Description of measurement methods and procedures to be applied:	The detailed calculations of the emission factor of the electricity grid are presented in the section B.6.3 and can be checked by the DOE.
Any comment:	

<b>Data / Parameter:</b>	<b>Lambda factor of the grid</b>
Data unit:	
Description:	Fraction of time during which low-cost / must run sources are on the Margin.
Source of data to be used:	PSRC Energy Strategy Center
Value of data	<b>0.11</b>
Description of measurement methods and procedures to be applied:	The detailed calculations of the emission factor of the electricity grid are presented in the section B.6.3 and can be checked by the DOE.
Any comment:	

**B.7.2 Description of the monitoring plan:**

Name: **Monitoring methodology for Project activity I.D “Grid connected renewable electricity generation”**

Reference: Article 9 Type I.D. **Appendix B of the simplified modalities and procedures for small-scale CDM project activities.**

The project activity is generation of electricity for a grid system using water potential. Hence, the type and category of the project activity matches with I.D. as specified in Appendix B of the indicative simplified baseline and monitoring methodologies for small-scale CDM project activities.

The Hydro Corporation will appoint a designated engineer on site who will be responsible for collecting and compiling the necessary data for the monitoring plan. The data will be collected in a transparent way and provided to the third party audit entity for the DOE validation and certification.

No leakage is expected.

For the monitoring of electricity generation inspected and certified (according to national regulations) monitoring equipment (electric meter) will be installed in place. The data will be monitored and recorded by qualified engineers according to the monitoring plan. Electric meter readings will be double-checked with the records of the AEN. The data will be electronically archived. Receipts of electricity sales will be obtained. The rest of the data to be monitored for the emission factor calculation will be obtained from the Public Services Regulatory Commission of RA.

The minimum water flow in the river of 1.0m<sup>3</sup>/s required for ecological reasons will be monitored by the Hydro Corporation personnel and Ministry of Environment Protection.

The Managing Director of Hydro Corporation - Mr. Ashot Sargsyan will be responsible for the full implementation of the monitoring methodology outlined in the PDD for their respective



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ID number	Data Type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived (electronic/paper)	For how long data to be kept?	Comment
D.3.1	Electricity generation	Electricity supplied to the grid by the project	MWh	M	Hourly	100%	Electronic and paper	During the credit period + two years	
D.3.2	CO <sub>2</sub> emission factor	CO <sub>2</sub> emission factor of the grid	t CO <sub>2</sub> /MWh	C	Monthly	100%	Electronic and paper	During the credit period + two years	
D.3.3	Min. water flow in the river	Minimum water flow in the river for ecological reasons	m <sup>3</sup> /sec	M	Daily	100%	Electronic and paper	During the credit period + two years	
D.3.4	CO <sub>2</sub> Build Margin emission factor	CO <sub>2</sub> build margin emission factor of the grid	t CO <sub>2</sub> /MWh	C	Monthly	100%	Electronic and paper	During the credit period + two years	
D.3.5	CO <sub>2</sub> Operating Margin emission factor	CO <sub>2</sub> operating margin emission factor of the grid	t CO <sub>2</sub> /MWh	C	Monthly	100%	Electronic and paper	During the credit period + two years	
D.3.6	Lambda	Lambda		C	Monthly	100%	Electronic and paper	During the credit	



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	factor	factor of the grid						period + two years	
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**B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)**
**Date of completing the final draft of the baseline and monitoring methodology:**

August 2007

**Name of person/entity determining the baseline and monitoring methodology:**

Mr. Karen Arabyan

Energocor Ltd

[k.arabyan@energocor.am](mailto:k.arabyan@energocor.am)
**SECTION C. Duration of the project activity / crediting period**
**C.1 Duration of the project activity:**
**C.1.1. Starting date of the project activity:**

01.02.2008

**C.1.2. Expected operational lifetime of the project activity:**

40 years

**C.2 Choice of the crediting period and related information:**

The project activity has chosen a fixed ten-year crediting period

**C.2.1. Renewable crediting period**

N/A

**C.2.1.1. Starting date of the first crediting period:**

N/A

**C.2.1.2. Length of the first crediting period:**

N/A

**C.2.2. Fixed crediting period:**
**C.2.2.1. Starting date:**

01.12.2008

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**C.2.2.2. Length:**

10 years

**SECTION D. Environmental impacts****D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:**

All power generation projects carried out in Armenia are required to conduct an environmental impact assessment in conformity with Order on Environmental Protection. The project compiled the environment impact assessment report (EIA) in July 200605 and submitted it to the Commission in Ministry of Nature Protection which is responsible for EIA. The Commission has given the positive opinion for the project (see Annex 2). The followings are main restrictions and requirements set by the ministry of environment protection:

1. Maintaining one cubic meter per second water level at the river for environmental purposes.
2. Construct a fishpass
3. improve surrounding environment of the HPP (plants, green lawns, bushes, trees, etc) by investing 11,561.09 thousand AMD (approx. USD 30 000).

The minimum water flow in the river of 1.0m<sup>3</sup>/s will be regular monitored by the local environmental authorities and the data will be submitted to Ministry of nature Protection. The construction of the fish pass, as well as improvement of surrounding environment of the HPP are included in design solutions of Argichi SHPP. The construction report and expertise are required for commission of hydro plant.

**D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

N/A

**SECTION E. Stakeholders' comments****E.1. Brief description how comments by local stakeholders have been invited and compiled:**

Hydro Corporation organized stakeholder consultation with objective to inform interested stakeholders on the environmental and social impacts of the project activity and discuss their concern regarding project activity. Invitations for stakeholders were sent one week before the meeting. On the day of the meeting representatives of Hydro Corporation presented project activity to the stakeholders and requested their suggestions/objections. The meeting is recorded and is available on request. Invitations were sent out to:

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**Representatives of neighboring villages (Madina, Verin Getashen)**

**Municipality of Martuni city**

**Ecological Dept of Gegharcunic Marz**

**Ministry of Nature Protection**

**Ministry Of Energy**

**Public services regulating commision**

**NGOs**

**Armenian Electricity Network (AEN)**

The following issues were discussed during the meeting: project impact on ecology, social-economic situation, and government policy for renewable energy projects in Armenia, existing barriers for renewable energy projects implementation.

**E.2. Summary of the comments received:**

As a result of the meeting with the stakeholders the following comments were received:

1. Due to fact that Armenia in future will face problems with energy generation (Armenian Nuclear Power Plant will be shut down in 2014) the project will contribute to the economic development in Armenia.
2. As Armenia has no own resources of fossil fuels use of renewable energy becomes very important.
3. The project design is developed in correspondence with existing legislation.
4. The project will provide good job opportunities for the local population.
5. The project activity doesn't require displacement of any local population. Therefore the project will not cause problems on local populace. On the other hand creation of new vacancies, education and solving the problem with irrigation will improve their quality of life.
6. The project will not have adverse impact on ecology. Rather, it will reduce GHG emissions in the country.

**E.3. Report on how due account was taken of any comments received:**

No major concern was raised during the meeting and satisfactory answers were provided issues discussed during the meeting.

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**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	CJSC "Hydro Corporation"
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E-Mail:	<a href="mailto:hydro.corp@xter.net">hydro.corp@xter.net</a>
URL:	
Represented by:	
Title:	Mr.
Salutation:	Director
Last Name:	Sargsyan
Middle Name:	
First Name:	Ashot
Department:	Management
Mobile:	+374 91 54 37 89
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

**INFORMATION REGARDING PUBLIC FUNDING**

Total funding required for the project does not include any public funding from Annex I countries.

**Hence, the project proponents hereby confirm that public funding from parties included in Annex - I is not involved in the project activity**



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**Annex 3**

**BASELINE INFORMATION**

**Step 1.** The table below calculates the relative energy contribution of each of the thermal plant connected to the grid, calculates the emission factor of each plant and develops the future simple operating margin .

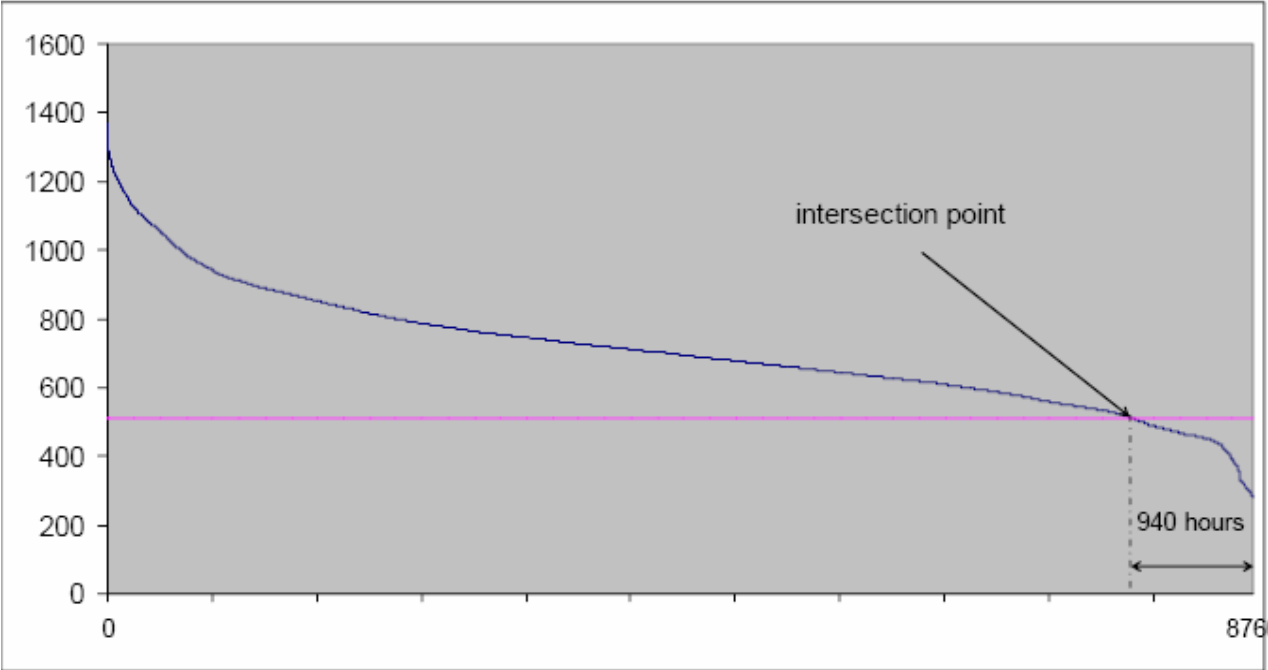
			A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	International Energy Corporation	Hydro	556	519,2	7,8											
2	Hrazdan TPP	Gas	1110	1435,5	21,6	1435,5	66,31%	0,385	11277,564	15,300	0,995	15,224	171,684	0,630	0,417	
3	Yerevan TPP	Gas	550	391,7	5,9	391,7	18,09%	0,398	11658,563	15,300	0,995	15,224	177,484	0,651	0,118	
4	Vorotan Cascade	Hydro	400	1027,6	15,4											
5	Vanadzor TPP	Gas	96	0	0,0	0	0									
6	Dzora SHPP	Hydro	25	70	1,1											
7	Small SHPPs	Hydro	51	155,8	2,3											
8	ANPP	Nuclear	880	2716,3	40,8											
9	Imports			337,6	5,1	337,6	15,59%	0,000	0,000	15,300	0,995	15,224	0,000	0,000	0,000	
	<b>Total</b>			<b>6653,7</b>		<b>2164,8</b>										<b>0,535</b>
<b>Sources</b>	Energy Sector Development Strategies in the Context of Economic Development in Armenia, Public Services Regulating Commission of RA (PSRC)	PSRC	Energy Sector Development Strategies in the Context of Economic Development in Armenia, PSRC	PSRC, Energy Sector Development Strategies in the Context of Economic Development in Armenia, Public Services Regulating Commission		Calculated		PSRC	Calculated F X 4,1868 X 7000	GHG Assesment Handbook: World Bank	GHG Assesment Handbook: World Bank	Calculated: (H x I)	Calculated: G x J/10 <sup>3</sup>	Calculated: K x (44/12)/(10 <sup>3</sup> )	Calculated: E x H	Calculated: Sum of all in N



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**Calculation of lambda.**

**The number of hours for which low-cost/must-run sources are on the margin for 2005 =940 (See figure below).**



**Lambda for 2005 = 940/8760=0.11**

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Step 2: The table below calculates the emission factor of each plant included in the build margin and develops the build margin

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Power plants	Fuel	Commissioning date	Capacity	Generation	Contribution to total energy mix of the capacity additions	Emission factor	Weighted average	Build margin
Existing Plants			MW	GWh	(%)	kg CO2/kWh	kg CO2/kWh	kg CO2/kWh
				2005 Generation				
Gerger	Hydro	1996	1,26	3,8	0,26	0	0	0
Yerevan reservoir 1	Hydro	1997	0,75	2,3	0,16	0	0	0
Kotayk canal	Hydro	2000	2,20	6,7	0,46	0	0	0
Yeghegis	Hydro	2004	6,40	19,6	1,35	0	0	0
Other SHPPs	Hydro	2004	27,35	83,6	5,74	0	0	0
New Plants				Expected Generation				
Talin	Hydro	obtained license	5,14	28,4	1,95	0	0	0
Chichan	Hydro	obtained license	0,6	0,4	0,03	0	0	0
Après	Hydro	obtained license	1,5	11,7	0,80	0	0	0
Hermon	Hydro	obtained license	1,2	4,1	0,28	0	0	0
Getik-1	Hydro	obtained license	6,5	21,1	1,45	0	0	0
Getik-2	Hydro	obtained license	0,9	4,3	0,30	0	0	0
Aghstev-6	Hydro	obtained license	6,52	16,8	1,15	0	0	0
Meghri	Hydro	obtained license	2	11,5	0,79	0	0	0
Pambak	Hydro	obtained license	21	79,2	5,44	0	0	0
Bovadzor	Hydro	obtained license	0,38	1,8	0,12	0	0	0
Manushakadzor	Hydro	obtained license	0,35	1,433	0,10	0	0	0
Kurtan-1	Hydro	obtained license	0,67	2,9	0,20	0	0	0
Kurtan-2	Hydro	obtained license	5,2	17	1,17	0	0	0
Ayri	Hydro	obtained license	1,1	4,6	0,32	0	0	0
Argichi	Hydro	obtained license	8,6	29,1	2,00	0	0	0
Rine	Hydro	obtained license	0,09	0,8	0,05	0	0	0
Tatev	Hydro	obtained license	2,35	13	0,89	0	0	0
Eghvard	Hydro	obtained license	0,9	4	0,27	0	0	0
Spitak-1	Hydro	obtained license	0,5	2,3	0,16	0	0	0
Chanachchi	Hydro	obtained license	1,4	6,2	0,43	0	0	0
Jradzor	Hydro	obtained license	4,84	17,3	1,19	0	0	0
Hoktember	Hydro	obtained license	0,06	0,5	0,03	0	0	0
Ler Eks-1	Hydro	obtained license	0,28	2,4	0,16	0	0	0
Ler Eks-2	Hydro	obtained license	0,25	2,2	0,15	0	0	0
Ler Eks-3	Hydro	obtained license	0,37	2,7	0,19	0	0	0
Ler Eks-4	Hydro	obtained license	0,23	1,8	0,12	0	0	0
Ler Eks-5	Hydro	obtained license	0,24	1,8	0,12	0	0	0
Ler Eks-6	Hydro	obtained license	0,34	2,6	0,18	0	0	0
Vahagni	Hydro	obtained license	1	8	0,55	0	0	0
Sandaghbyur	Hydro	obtained license	0,66	2,4	0,16	0	0	0
Dzor-Dzor	Hydro	obtained license	0,3	1,8	0,12	0	0	0
Elegis-1 (retrofit)	Hydro	obtained license	3,16	5,3	0,36	0	0	0
Amasia	Hydro	obtained license	0,9	1	0,07	0	0	0
Sisakan	Hydro	obtained license	0,5	1,9	0,13	0	0	0
Eghvard-2	Hydro	obtained license	9,31	18,2	1,25	0	0	0
Geghi-1	Hydro	obtained license	4,09	15,4	1,06	0	0	0
Haghpat-1	Hydro	obtained license	0,32	1,05	0,07	0	0	0
Haghpat-2	Hydro	obtained license	1,9	8,09	0,56	0	0	0
Aygezard	Hydro	obtained license	0,84	3,32	0,23	0	0	0
Saravan	Hydro	obtained license	2,488	7,7	0,53	0	0	0
Aghstev-1	Hydro	obtained license	3,6	14,4	0,99	0	0	0
Jermuk-2	Hydro	obtained license	2,35	10,2	0,70	0	0	0
Gevorgavan	Hydro	obtained license	0,06	0,32	0,02	0	0	0
Pambak-1	Hydro	obtained license	1,91	13,9	0,95	0	0	0
Tej	Hydro	obtained license	2,26	7,01	0,48	0	0	0
Ajgedzor-2	Hydro	obtained license	2	6	0,41	0	0	0
Hnevank-1	Hydro	obtained license	0,967	5,75	0,39	0	0	0
Hnevank-2	Hydro	obtained license	0,5	2,7	0,19	0	0	0
Hrazdan TPP Unit-5	Natural gas	obtained license	400	717,75	49,30	0,62950801	0,310	
Yerevan TPP New Unit	Natural gas	obtained license	215,00	195,85	13,45	0,650775173	0,088	
				<b>1455,973</b>	<b>100</b>	<b>BM</b>	<b>0,398</b>	
PSRC and PDD of Yeghegis SHPP published on UNFCCC website	PSRC	PSRC	Energy Sector Development Strategies in the Context of Economic Development in Armenia.	PSRC	Calculated	Calculated in the OM table	Calculated: contribution to total energy mix times to the emission factor	Calculated: Sum of weighted average emissions

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**Step 3: The table below calculated the emission factor of the grid**

Operating margin	Lambda	Adjusted Operating Margin	Build Margin	Emission factor of the grid
0,53518449	0,11	0,47631419 6	0,397867057	0,437091

**Calculating emission reductions: The table below calculates the baseline**

Year	Annual generation	Estimation of emission reductions (tones of CO <sub>2</sub> )
2008	30,50	13331
2009	30,50	13331
2010	30,50	13331
2011	30,50	13331
2012	30,50	13331
2013	30,50	13331
2014	30,50	13331
2015	30,50	13331
2016	30,50	13331
2017	30,50	13331
<b>Total (tones of CO<sub>2</sub>)</b>		<b>133312,6</b>

**Annex 4**

**MONITORING INFORMATION**

All monitoring information is contained in section B.7

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