CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Increased electricity generation from existing hydropower stations through Decision Support System optimization in Azerbaijan

Version 2
November 11, 2005

A.2. Description of the project activity:

Azerenerji, the state-owned power generation and transmission company, will install an advanced Decision Support System for its hydro cascade on the Kura River. This system will replace the ad hoc operational system currently used that promulgates inefficient use of the existing generation capacity. With improved data and decision-making, Azerenerji will:

- increase the output of its four hydro plants built in a cascade that are currently operating without adequate coordination.
- reduce its fossil fuel consumption by its thermal plants
- reduce carbon emissions over the baseline case

A.3. Project participants:

Name of Party Involved	Private or Public Entities	Indicate if the Party wishes to be considered a project participant (Yes/No)
Government of Azerbaijan/ (Host)	Azerenerji Power Company	Yes
World Bank Carbon Finance Unit (Specific Fund to Be Determined)	World Bank Carbon Finance Unit	Yes

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

Azerbaijan hydro-generation units. Emission reductions will be tabulated based on the Carbon Emission Factor determined using the combined margin approach covering the Azerbaijan electricity grid.

A.4.1.1. Host Party(ies):

Azerenerji

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

This project will cover all of the hydro facilities owned by Azerenerji in Azerbaijan

A.4.1.3. City/Town/Community etc:

Azerenerji is headquartered in Baku.

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

The main waterway on which Azerbaijan's hydroelectric plants have developed is the Kura River. This river, which is more than 1500 km long, originates in Turkey flows through parts of Georgia, traverses Azerbaijan and drains into the Caspian Sea. At present, Azerenerji operates four hydroelectric plants along the river. The following sections describe Azerenerji's existing hydroelectric plants. Selected performance characteristics of the existing hydroelectric plants are presented in Appendix 5.

a. Shamkhir Hydroelectric Power Plant

Shamkhir is the uppermost plant on the Kura River. The facility was completed in 1982 and houses two 190 MW Kaplan turbines with vertical-shaft synchronous generators. The design head is 47.5 m. The annual energy expected from the facility is 830 GWh, which gives a plant factor of 24%. The actual average power production from 1986 to 2002 is reported to be 772 GWh. The catchment area at the dam site is 40,500 km^2 and the average annual inflow is 315 m^3/s. The crest length of the embankment dam is 1,700 m with a maximum height of 70m. The reservoir ensures the long-term regulation and has a useful volume of 1,420 million m^3.

b. Mingechaur Hydroelectric Power Plant

The Mingechaur plant was commissioned in 1955 and for many years was the largest source of peak power in the whole Transcausican power system. The maximum height of the earth fill dam is 80 m, the crest length is 1,500m. The reservoir has a useful volume of 9,000 million m^3, which ensures yearly regulation of the river for power generation, flood control, and irrigation. The installed capacity is 360 MW (6 x 60 MW units). The turbines are the Francis type, which operate under a maximum gross head of 65 m.

c. Varvara Hydroelectric Power Plant

The Varvara plant is immediately downstream of the Mingechaur dam. The purpose of the plant, which was commissioned in 1958, is to re-regulate the outflows from the Mingechaur station on a daily basis and satisfy the needs of the irrigation system. The plant has three 5.5 MW units, giving a plant capacity of 16.5 that have a design head of 5.5m. It was reported that the units are capable of generating 6.3 MW.

The annual generation from the plant from 1987 to 2002 is reported to be 76 GWh, giving a plant capacity factor of 52.4%. The expected annual energy is 90 GWh, a plant capacity factor of 62%. The plant was commissioned in 1955 and still utilizes its original equipment. The station was left in disrepair after the fall of the FSU and was not rehabilitated until 1993.

d. Yenikend Hydroelectric Power Plant

The Yenikend plant was planned during Soviet times as a four-unit project (4 x 37.5 MW). Construction began in 1984 but was interrupted in 1990 due to financing problems. The first three units were ultimately completed in 2000 and unit 4 was commissioned in March of 2003.

The project includes a 27.5 m high, 2900 m long zoned earthfill embankment dam, with a concrete lined upstream face to protect against erosion. The powerhouse is located in the dam embankment and houses four 37.5 MW horizontal bulb units, which have an operating head range of 12.5 to 18.5 m, and two step up transformers. The concrete spillway is located to the left of the powerhouse and has four 11 m wide chutes capable of passing a 1 in 100 probable flood.

*taken from a Burns and Roe Enterprises report Prepared for Azerenerji and the EBRD.

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

Category 1 – Renewable Energy

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

Decision Support Tools

There is a certain amount of energy embedded in water held in a reservoir or flowing through a river. Hydropower units transfer a portion of that energy into an electrical form. The electricity generating units that execute this task perform best under certain operating conditions. The optimal operating conditions for each unit may differ based on design or other variables. By determining the optimal operating conditions for each unit – and trying to match up actual operation of the units with their optimal operation point – an operator can increase total electricity generation using the same amount of water flowing under the same conditions. This is especially true when one calculates the optimal generation scenario for multiple generating units – using all the available data including likely weather conditions, reservoir capacity, head, and other variables.

Two to ten percent increases in electricity generation have been realized for example in the reasonably well managed operations in Manitoba Hydro (Canada) and Idaho Power (USA) simply by implementation of a Decision Support system to better manage water resource decision making. [1]

Decision Support Tools are designed to calculate the optimal use of the generating capacity of a hydro generating unit or a series of units by taking advantage of all the controllable factors (head, reservoir capacity, spillage, time of use, etc.) and the best available information. If the Decision Support Tool is able to increase electricity generation from existing hydro units it is able to displace electricity generated from thermal sources and eliminate the combustion of fossil fuels. This will result in CO_2 emission reductions.

[1] For additional examples and technical papers please see http://www.synexusglobal.com/product_generators_vista_papers_sched.html and

http://www.synexusglobal.com/product_generators_vista_success.html

Two Examples of the Potential Benefits of Hydro-Optimization: In a very simplistic example the Decision Support Tool might inform an operator currently running all the generating units at between 50-75% of capacity 24 hours a day that more electricity (and revenue) can be generated by using fewer units to produce less electricity during off-peak hours. This would allow the head to build in the reservoir, which could then allow each generating unit to operate at optimal levels for shorter periods of time but producing a greater quantity of electricity.

Another very simplistic example is how the Tool collects weather data to determine water flows in a river. If the hydro operator knows that a good deal of rain is occurring upstream and it will take several days to reach the dam, it can increase generation and temporarily lower reservoir levels. That could avoid spillage when the increased flows reach the dam. What would have been spillage can now be used as useful electricity. In these two cases, this increased level of output would thus displace fossil-fuel units, reducing CO_2 emissions.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

By generating more hydropower from existing capacity, less fossil fuel will be needed to meet demand. The only way this additional power could be produced in absence of this project is from fossil fuel consumption from existing and/or additional thermal plants. Under current operating conditions, thermal load is the only other option to meet electricity demand. As demand increases beyond existing capacity, Azerenerji will most likely look to additional fossil fuels to meet most if not all of the increase. This is because fossil fuels are the least cost option for generation in Azerbaijan especially with the discovery of new fossil fuel supplies in Azerbaijan. Substantial additional hydropower sites either do not exist or have other major environmental impacts. There is no national or sectoral policy that requires or even encourages the use of hydro-optimization tools.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be in indicated using the following tabular format.

Year	Annual estimation of emission reductions in tonnes of CO_2 e
2008	202,624
2009	202,624
2010	202,624
2011	202,624
2012	202,624

2013	**202,624**
2014	**202,624**
Total estimated reductions (tonnes of CO2 e)	**1,418,368**
Total number of crediting years	**Up to 21 years**
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	**202,624 in first crediting period**

A.4.5. Public funding of the project activity:

No public funding from an annex one country will be involved.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

No approved methodology exists for this project, so the project developers are proposing a new methodology entitled 'Increased electricity generation from existing hydro power stations through Decision Support System optimization'.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology proposed captures the emission reductions of the proposed project by determining the electricity generation of the hydro units at given total flow index before the project and the actual generation after the project. These rates are used to calculate the electricity that Azerenerji would have been generated in the existing conditions in the project year, but without the benefit of the Decision support optimization tool. The difference between the expected generation at the given flow index and the actual kWh produced, is then multiplied by the actual carbon emissions factor of the electricity that is being saved. To determine the CEF, the project developers are using the combined margin approach, which has been approved by the CDM Executive Board and can be found in ACM002.

B.2. Description of how the methodology is applied in the context of the project activity:

The project is designed to improve the system-wide efficiency of the Azerbaijan electricity system by better utilizing the existing generation capacity. The Decision Support Tool will allow four Azerbaijan hydro plants in a cascade on the Kura River to produce more electricity in the given hydrological conditions. The additional electricity generated by the hydro units will offset thermal generation.

The emission reductions for each year will be determined by comparing the amount of electricity generated at a given flow index[2] in Azerbaijan under the pre-project method of controlling generation versus the kWh produced using the Decision Support Tool. The pre-project amount of electricity generated will be determined by analyzing the pre-project efficiency of generation for each of Azerenerji's 15 hydro units measured in kWh produced at various flow-rate indexes. This baseline efficiency will be compared to the actual electricity generation with the difference being the additional electricity produced.

In the baseline case, the additional electricity generated in the actual case would have been supplied by more thermal generation. The methodology determines what the hydropower generation would have been pre- and post-project. Those additional hydro kWh would have been generated by thermal units in the baseline scenario. Multiplying that number of kWh (not produced by thermal units in the business as usual scenario) by the carbon emissions factor of the existing grid in year x – determined using the combined margin approach – Azerenerji can determine the carbon emissions that would have occurred in the baseline scenario.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

There is a certain amount of energy embedded in water held in a reservoir or flowing through a river. Hydropower units transfer a portion of that energy into an electrical form. The electricity generating units that execute this task perform best under certain operating conditions. The optimal operating conditions for each unit may differ based on design or other variables. By determining the optimal operating conditions for each unit – and trying to match up the actual operation of the units with their optimal operation point – an operator can increase the total electricity generation from the same amount of water flowing under the same conditions. This is especially true when you calculate the optimal generation scenario using all the available data including likely weather conditions, reservoir capacity, head, and other variables.

Decision Support Tools are designed to calculate the optimal use of the generating capacity of a hydro generating unit or a series of hydro generating units by taking advantage of all the controllable factors (head, reservoir capacity, spillage, time of use, etc.) and best available information. If the Decision Support Tool is able to increase electricity generation from existing hydro units, especially at time of high demand, it is able to displace electricity generated from thermal sources and eliminate the combustion of fossil fuels. This will result in CO2 emission reductions.

In the absence of the CDM project, Azerenerji will either continue to generate electricity with fossil fuels to meet the existing demand and as demand grows will likely rely mainly on additional fossil fuel sources. As a result, additional hydro generation is most likely to

[2] The actual form the flow index will take will be determined after the implementation of the advanced metering and monitoring system.

exclusively displace both existing and new fossil fuel generation during the 10 year time period of the project.

The project developers also applied the CDM EB-approved Additionality Tool, and this project is additional based on the analysis in the steps below:

Step 0. Preliminary screening based on the starting date of the project activity: This project is estimated to start in 2008, and thus the crediting period will not start prior to registration as a CDM Project.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations. The potential alternatives for this project include the following (all three are compliant with Azerbaijani law):

> Alternative #1: Additional Generation Capacity Would be Built or Imported: Before Azerenerji was presented with the hydro-optimization concept, their initial assessment was that they simply needed additional generation capacity to meet growing demand. Because potential hydro sites are either tapped out or would incur major flooding and environmental impacts, the most likely (and least cost) option would be building fossil-fuel generation to meet growing energy demand in the country. Other zero-emitting sources of electricity are not the least-cost option. Importing electricity is typically expensive and not a reliable source of additional energy. This is in part due to the existing technical limits on imports, which would require major capital investments. In addition, demand is growing in the neighboring countries, making future availability uncertain.
>
> Alternative #2: Azerenerji would try to undertake this project without CDM (this is unlikely as the barriers test below describes).
>
> Alternative #3: The continuation of the current situation. Without the Decision Support tool, the hydro facilities would continue to be operated in a sub-optimal manner, reducing the potential kWh output from the existing dams. The result would be generating the same amount of fossil fuel generation from existing plants. This is the most likely option because despite growing energy demand, the utility does not have the access to capital to invest in new generation.

Step 2. Investment analysis: This step is not used for this project.

Step 3. Barrier analysis: The barriers test below will show that the project faces barriers that:
(a) Prevent the implementation of this type of proposed project activity; and
(b) Do not prevent the implementation of at least one of the alternatives (the barriers listed below do not exclude the continuation of the current situation).

Use the following sub-steps:

Investment Barrier: Azerenerji currently does not have basic cost recovery for its expenses. This makes it very difficult for the company to go to commercial lenders to get credit to implement investment projects. The hydro-optimization tool requires the hiring of a many specialists, installation of new computers and many man-months for both training and upkeep of the system. The utility currently does not have the investment capital to implement even modest projects in large part because the rates it charges customers are highly subsidized, as is typical in former-Soviet countries. The result is that the utility's cash flow is negative and is supported by very modest subsidies from the state. Even basic maintenance on existing power facilities is relatively rare.

This situation also means that local or international banks are unwilling to offer credit. This type of project is very new (see below) and barely understood by potential lenders. The World Bank's involvement is due in large part to the potential of carbon emission reductions. The involvement of the Bank as the main source of credit highlights the project's lack of attractiveness to commercial banks.

Barrier Effects:
Proposed CDM Project: As described above, Azerenerji's financial situation hinders its access to credit markets and its ability to implement this project.

Alternative #1-Investments in new generation would likely face similar barriers in terms of Azerenerji's financial position, but since a power plant is a very clear asset it would not face the same discrimination afforded to energy efficiency investments. Investments in new transmission capacity to import electricity would also face similar investment barriers
Alternative #2-The impact of this barrier would likely inhibit this project in the absence of CDM. This is a relatively untried and unfamiliar technology that would make a difficult situation in securing private sector investment even harder.
Alternative #3-This barrier would not prevent Azerenerji from doing nothing.

Lack of Financial Incentive to Reduce Fossil Fuel Use: Normally, a utility might have a strong market based price incentive to improve supply-side efficiency because it would reduce fuel costs. This is not the case in Azerbaijan. Currently, perverse subsidies exist in payments made to and from Azerenerji that would inhibit most generation efficiency projects including this one from taking place. The current subsidy is based completely on fuel used. Azerenerji does not fully recover costs. In order to maintain service without going bankrupt the Azerbaijani government provides tax relief to the fuel supplier – the Azeri State Oil Company – in exchange for eliminating fuel payments from Azerenerji. This means that investments made to reduce fuel consumption will not provide the same benefits that would occur if the Azerenerji actually paid for all its fuel. This means that new power projects that would require additional fuel resources will look significantly better than they should when compared to efficiency projects, particularly using a technology that is so poorly understood.

Barrier Effects:
Proposed CDM Project - Reduces the incentive for Azerenerji to invest in generation efficiency over new generation capacity

Alternative # 1 - Since true fuel costs are not part of the current investment equation for Azerenerji, new generation projects will look abnormally attractive although imported electricity will not be greatly affected by this issue.
Alternative #2 - The project undertaken without CDM would likely face similar barriers, but would not have the advantage of CDM revenues to help overcome the barrier.
Alternative #3 - This barrier would not immediately prohibit the inaction, but as demand increases and efficiency decreases, the subsidy will grow as a larger drag on the country's finances.

Technological/First-of-Its-Kind Barrier: This hydro-optimization tool would be a totally new aspect of utility operations in Azerbaijan. In interviews with the relatively few key developers of this software, there appears to have been no project of this type at all in Azerbaijan or in the Caucasus. Those interviewed also said this technology, to the best of their knowledge, has not been implemented in any country of the former Soviet Union. The optimization technology is in fact very rarely used in developed countries. The penetration rate is very light in North America (about 5% of utilities that own substantial hydroelectric facilities). The lack of familiarity with these optimization concepts is one of the key

reasons why this project would not be implemented without the involvement of CDM project developers. Utility managers in Azerbaijan had never heard of this technology and were initially skeptical about the potential results. Only through a detailed process of educating managers and providing actual case studies of how the system has worked – a process begun as a result of the involvement of CDM project developers (World Bank and QualityTonnes) – were the technology and "first-of-its-kind" barriers beginning to be overcome. Even after briefings on the technology, the utility staff currently does not have the capacity to operate the system effectively, which will require extensive training.

Barrier Effect:
Proposed CDM Project: There has been a significant amount of education required to overcome the uncertainty, lack of familiarity and perceived risk associated with this type of project.
Lack of proper training on a hydro-optimization system could lead to poorly installed and operated systems undermining the potential savings. CDM revenues can provide Azerenerji with both the resources and incentive to ensure their staff is properly trained to make best use of the energy efficiency potential of the system.

Alternative #1- The existing staff is properly trained to operate generation facilities and would only need limited training to operate new capacity or import additional electricity.
Alternative #2- This option would face the same barrier as the CDM project, but could not rely on the resources or incentive to over come the barrier.
Alternative #3- This barrier would not hinder the company from operating as usual.

Step 4. Common practice analysis

This hydro-optimization system is the first-of-its-kind project in the Azerbaijani electricity system. As indicated above, no similar project has been implemented in Azerbaijan or any neighboring country. Documentation will be provided to the DOE on project validation that will indicate this fact. This will include letters from the Azerbaijani utility, from the key developer(s) of the hydro-optimization technology and other sources if they are available. The project developers can also conduct additional research to confirm whether this technology has been used at all in other former Soviet countries.

Step 5. Impact of CDM registration: The impact of CDM Registration would have the following impacts on overcoming the barriers described above. The perceived risk of investing in a first of its kind project in Azerbaijan is muted somewhat by the involvement and additional revenue brought by the World Bank as a purchaser for the CDM credits. Generation projects – with which Azerenerji managers have more experience – have made it through the decision making process. This type of system energy efficiency project will be a first of its kind with all the perceived risk attached to its implementation.

- The potential for CDM revenues has brought in project developers that are capable of conducting the training needed to install the system. Without the incentive of gaining CDM revenues, the project developers would not be interested and would not consider financing the project.

- CDM finance would help reduce the perceived risks to the utility and the financier of this project (the World Bank). Because this type of technology is so new in this environment, there may be factors inhibiting its performance and the ease of installation – as compared to, for instance, a Canadian utility. Having the potential for CDM revenues reduces the risk for the Azerenerji that the project will under perform and not generate the expected benefits, which would increase its burden of

repayment to the World Bank. For example, if the project generates half the expected benefits, at least there would be some CER revenues, which would not otherwise be the case – it therefore acts as a risk-mitigation tool.

- Because this is an international loan, the payments from Azerenerji would have to be made in dollars or euros, but the means to make those repayments (income from electricity sales) would be made in local currency. Given the high currency risk in the country, Azerenerji would – under this CDM project – be generating CERs, which are also sold in hard currency. CDM registration would thus significantly lower currency risk and again, the debt burden to the World Bank.

- The CDM revenue earned by this project could help distinguish this project in the decision making process of Azerenerji management as it decides whether to move forward with this approach or pursue additional generation capacity. In discussion on the project the potential of CDM revenues has garnered significant attention of senior management of Azerenerji and the Ministry of Industry and Energy. Parts of this project such as the improved management of the hydro cascade system have been proposed before, but have not made it through the decision-making process of senior management while new capacity projects have made it through. The implementation of this project is gaining acceptance in part due to the revenue, visibility, and partners (World Bank) the CDM has brought.

For the additionality test, the Project Developers will work to provide the following evidence to the DOE:

- Letters from the utility indicating their unfamiliarity with the hydro-optimization technology before this project;

- Letters from one or more developers of the technology that indicate average penetration rates in developed markets and the fact that no similar project has been developed in Azerbaijan or neighboring countries;

- Financial statements indicating the revenue losses and overall financial health of Azerenerji; and

- Any least-cost planning or feasibility studies (if done) that show examination of potential capacity expansion projects – this would indicate the focus of the utility in looking at fossil fuel generation instead of supply-side efficiency in its hydro plants. This could include a list of priority investments for the utility. If the list does not include hydro-optimization but includes other projects, it shows that the CDM project is having an impact in bringing this investment to the "front burner."

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The proposed baseline methodology asks for that the project boundaries be set at the hydro generation units in cascade in operation at the start of the project. This project includes only those hydro plants in operation at the start of the project. It will also drop out any plants that undergo major renovations that would change the efficiency rate of the generation units.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

A feasibility study was undertaken by Kevin James of Quality Tonnes and Lasse Ringius of the World Bank to gauge the emission reduction potential of this project based on current data. The complete baseline study is not planned until after the installation of advanced meters in the year prior to the installation of the full SCADA system. Azerenerji and a consulting company to be determined will be responsible for this study.

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:

January 1, 2008

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

20 years

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

C.2.1. Renewable crediting period

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

NA

C.2.1.2. Length of the first crediting period:

NA

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

January 1, 2008

C.2.2.2. Length:

10 years

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

A new monitoring methodology entitled, '*Increased electricity generation from existing hydro power stations through Decision Support System optimization',* is being proposed for this project.

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

No current methodology covers this type of project so this methodology is being proposed because it can quantify the emission reductions resulting from the improved hydro system performance in this proposed project resulting from the implementation of a more advanced Decision Making system.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	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)	Comment

There will be no emissions from the project activity.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

There will be no emissions from the project since the project is just expanding the generation of a renewable energy resource.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number	Data	Source of	Data unit	Measured (m),	Recording	Proportion	How will the data	Comment

(Please use numbers to ease cross-referencing to table D.3)	variable	data		calculated (c), estimated (e),	frequency	of data to be monitored	be archived? (electronic/ paper)	
A-1	Generation for each generation unit	Measured at each hydro generation unit	Kwh	m	Hourly, cumulated Weekly	100%	electronic	The monitoring system used to inform the Decision Support System will gather and archive this data
A-2	Total water flow index	Measured as a flow rate, a total flow volume across all generating units including spillage, or total volume at a representative point such as the most downstream plant	m3 or m3/second	*c*	Weekly*(based on hourly data)* (measured both in the baseline *period* and in the project years)	100%	electronic	*Flow through each generating unit is determined for each hour, based on the unit performance "hill diagram", which defines the three dimensional relationship between power output, head and flow (and associated efficiency). Flows are aggregated at all units and all plants in the cascade to yield the flow index.* The monitoring system used to inform the Decision Support System will gather and archive this data.
A-3	*Headwater level*	*Measured in meters at head water entering generating unit*	*m*	*m*	*hourly*	*100%*	*electronic*	*The monitoring system used to inform the Decision Support System will gather and archive this data*

A-4	*Tail water level*	*Measured in meters tailwater leaving generation units*	*m*	*m*	*hourly*	*100%*	*electronic*	*The monitoring system used to inform the Decision Support System will gather and archive this data*
A-5	*Gross Head*	*Difference between head and tail water*	*m*	*c*	*hourly*	*100%*	*electronic*	*The monitoring system used to inform the Decision Support System will gather and archive this data*
A-*6*	Carbon emissions factor	Calculated using the combined margin approach outlined in ACM002	KgCO2/kwh	m and c	Annually (in project years)	100%	electronic	IPCC data may be used to determine carbon content for fuels.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The project is designed to increase the generation of electricity from existing hydro units by optimizing their operations. The formulae are designed to calculate the total increase in generation in MWh from either a single hydro station or a series of hydro stations in a cascade. The project developer will have to calculate separately any geographically separated units (ie on a different unconnected river).

The baseline for year x will be determined by first measuring the pre-project efficiency of generation in the project area in total kWh produced at particular weekly[3] total flow index. This means in practical terms that in the baseline *period*, for each week, the total flow of water through the

[3] The time period of a week was selected as the default because unlike a day or hour it should capture all of the various usage peaks that typically fall within a week (weekend versus weekday). It also is preferable to longer periods such as a month, since an average flow over this longer period would mask the hydrologic variability. In specific cases, the project developer can propose a different time period to the DOE by demonstrating and documenting how a different timeframe produces a more accurate result.

project area will be calculated and the total kWh generated will also be recorded. The relationship between the flow index and the actual aggregate generation will be established, as seen graphically below. A best-fit line using a polynomial trend equation (like that typically found using Excel 'TREND' function) will be established. This relationship will be used to define the baseline energy production for a given weekly flow index.

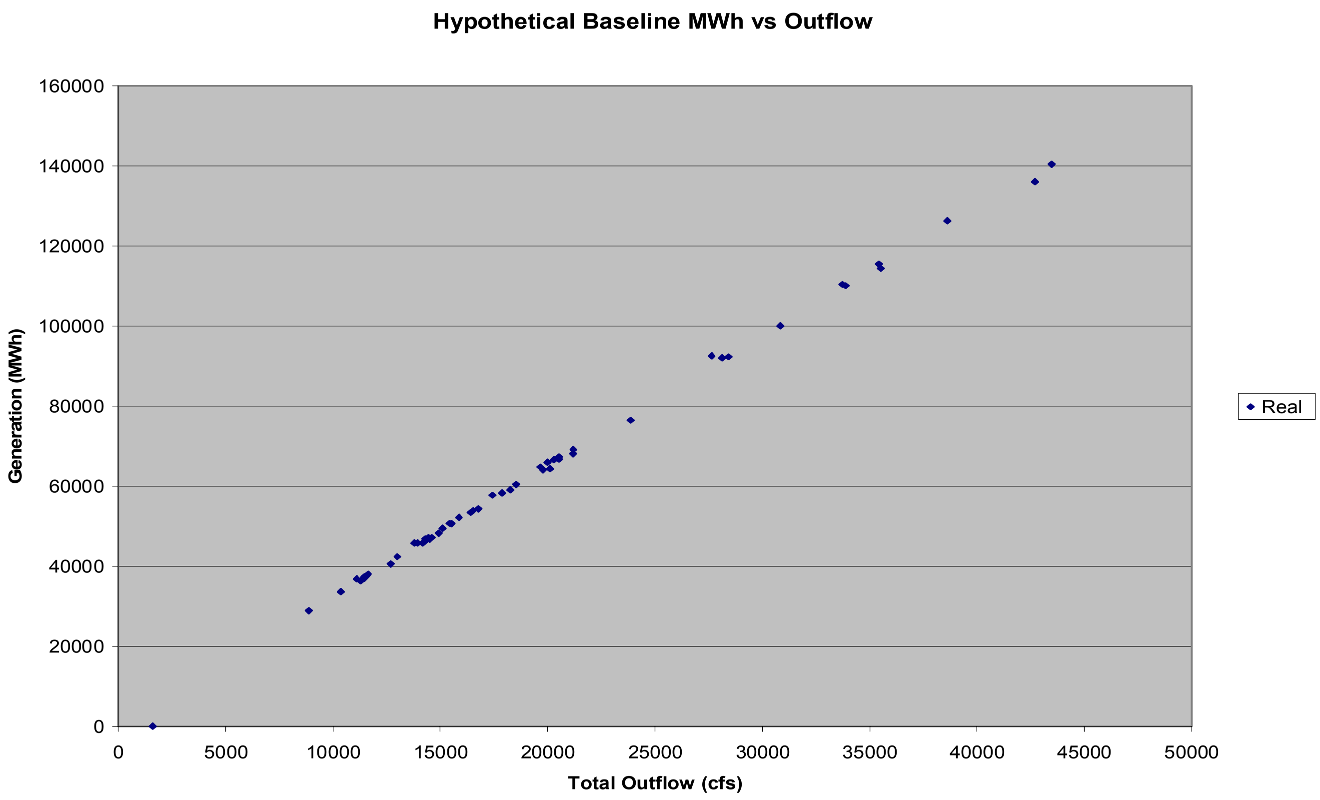
The form of the flow-generation curve (power vs flow and head) is very well represented by a third order, 12-coefficient polynomial, the derivation and discussion of which is included in the attached document. This corresponds directly to the mentioned 'Trend' function on Excel.

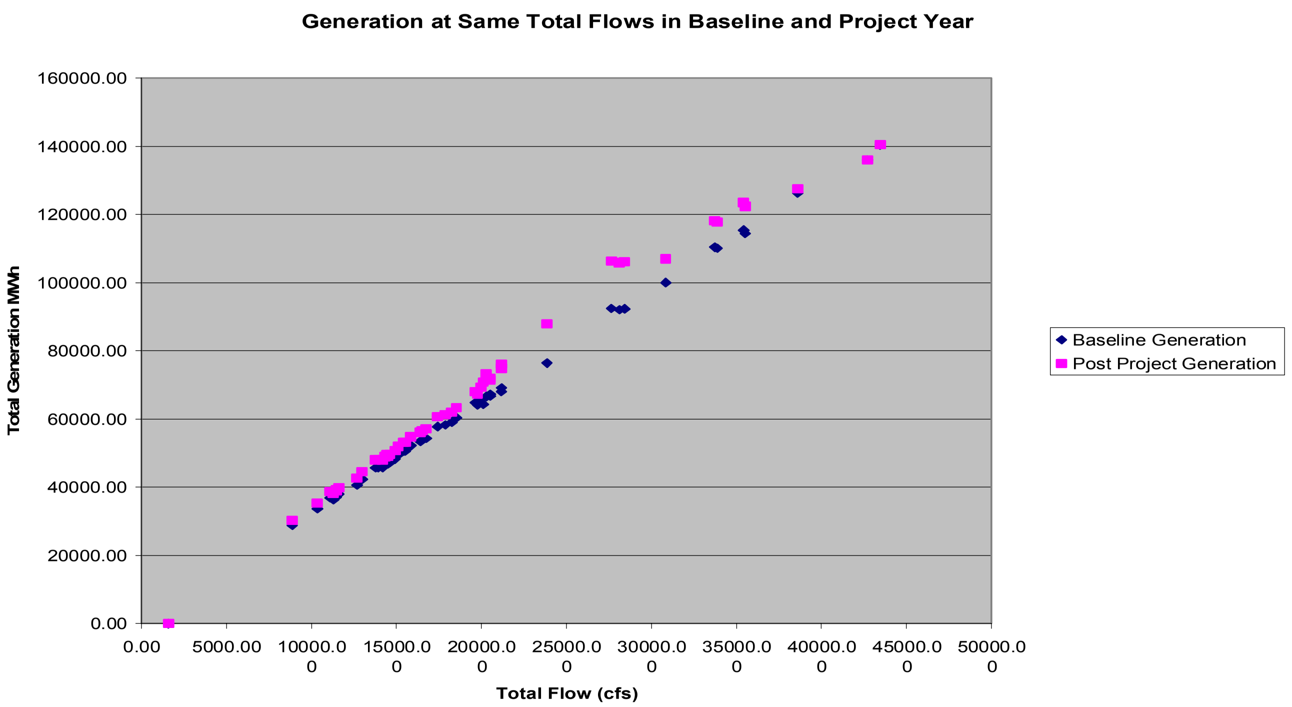
The accuracy of the power determination is usually within a fraction of one percent, and is verifiable by the comparison of the measured relationship versus the values determined with the best-fit relationship.

A Data Book will be prepared prior to DSS implementation, which will contain all functional relationships utilized, including flow-generation functions. These will be reviewed by the DOE to assure their appropriateness, accuracy, and transparency.

Each project year, the baseline generation and the actual generation will be calculated by determining the actual weekly flow index and using the measured electricity production for that flow index in the baseline period to determine what the generation of electricity would have been for that week if the hydro system had not been optimized. The total baseline electricity generation will simply be a sum of all the weekly calculations, and the total actual generation will be the sum of all the actual weekly figures. These two values will then be compared, to determine the additional electricity generated through optimization.

In order to be conservative, the project developer will not seek to claim credit for any weekly project year results in which the flow index falls outside the recorded boundaries of the baseline data. This means that if the baseline data does not extend to extremely high or low flow weeks found in the project year, the project developer will not look to claim carbon credits for that week. This gives the project developer incentives use as many years of baseline data as possible. It also allows the baseline to conservatively and accurately normalize data in changing climates and in different withdrawal regimes.


Hypothetical Baseline MWh vs Outflow
Generation (MWh)
160000
140000
120000
100000
80000
60000
40000
20000
0
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Total Outflow (cfs)
Real



For example, in the baseline *period* the measured outflow in week 18 of 20,000 cubic feet per second (566 m3 per second) produced 60,000 MWh from the hydro generating units in the project boundary. If in the project year after optimization, the same measured outflow produced 62,000 MWh the project developer could claim credit for an additional 2000 MWh produced for that particular week.

Once the total additional electricity generation is determined by subtracting the baseline generation from the actual generation, it will be multiplied by a carbon emissions factor for the entire electricity grid determined using the combined margin approach approved in ACM002.

In developing the data set for both the baseline and the project year, the project developer must identify and eliminate outlying data points that represent atypical circumstances such as blackouts, major equipment malfunction and repair. For the baseline, this will simply mean eliminating these data points from the data set. In the project year, the project developer will not be able to claim any emission reductions in weeks where these types of major abnormalities occur since it would be too hard to calculate the baseline generation in those same abnormal conditions.

Additionally, the project developer will measure electricity generation at each generating unit and total the output for the week. This is needed since any major post-project upgrades to existing generating units or any new units added will need to be factored out of the calculations since the optimization project will not be directly responsible for the increase in generation. This means that if two years after the optimization project a 50MW generating unit is overhauled and upgraded to a more efficient 75MW, from that point on the generation output of this unit will be factored out both in the baseline calculation and in the post project calculation.

Baseline Electricity Generation in year x equals or BEgen
(note two caveats listed above which may change slightly the actual formula (i.e. only 51 weeks are tabulated since a major blackout occurred during one week)

$$\sum_{week_x=1}^{52} \left(\sum_{HPU=1}^{\Psi g} kWh_{hpu} \text{ produced in } year_0 \text{ at } Q(index)week_x \right)$$

Where
Year x= given project year being compared to baseline
HPU= Hydro power unit
ψg= total number of hydro power generation units that existed in the baseline *period*
Q(index)= total of all generation flows and spill flows during the week (as calculated below)
$Week_x$ = week in the year x (1-52)
Year 0= baseline period

The Weekly flow index which is used to identify the corresponding total electricity generation figure from the *baseline period*, Q(index), is calculated by cumulating all project releases (generation flow and spill flow) during the week, as follows.

$$Q(index) = \sum_{hour_x=1}^{168} \left(\sum_{HPU=1}^{\Psi g} m3_{hpu} \right) + \sum_{hour_x=1}^{168} \left(\sum_{s/w=1}^{\Psi s} Qspill \right)$$

Where
HPU= Hydro power unit index in m3
S/w = spillway
ψg= total number of hydro power generation units that existed in the baseline period
ψs= total number of spillways that existed in the baseline period
Qspill= total m3 of spillage for given time period and spillway

Note: The flow index will not include water consumption and irrigation/other return flows.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E). Option Not Selected

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
	NA							

Option Not Selected

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Option Not Selected

D.2.3. Treatment of leakage in the monitoring plan

There is no anticipated leakage from this project. The hydro-optimization installation is not a large, capital-intensive project with substantial environmental impacts (like power plant construction). In terms of generation efficiency, the environmental gains should only be positive. In other words it is not expected that generation output increases in the hydro facility would lead to greater fossil fuel use or inefficiencies in any other part of the grid.

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	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)	Comment

NA – No Anticipated Leakage From This Project

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

NA

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The CO2 emissions reductions for year x is the difference between actual electricity generation for year x and the baseline electricity generation for year x which is then multiplied by the carbon emissions factor for the electricity in year x being displaced by the extra generation.

(Actual Electricity Generation$_x$ - Baseline Electricity Generation$_x$) * CEF $_{yearx}$ = Emission Reductions$_x$

CEF= kgCO2/kWh=Carbon emissions factor determined either by using the combined margin approach outlined in ACM002.

To determine the actual electricity

Total actual generation energy, Egen is the sum of the generation in all the weeks in year x

$$Egen = \sum_{week_x=1}^{52} E(x)$$

To determine the actual electricity generation in week x or, E(x) equals[4]

$$E(x) = \sum_{hour_x=1}^{168} \left(\sum_{HPU=1}^{\Psi g} kWh_{hpu} \right)$$

[4] Note the following two caveats which may affect the implementation of the formula either reducing the number of weeks or reducing the number of HPUs-

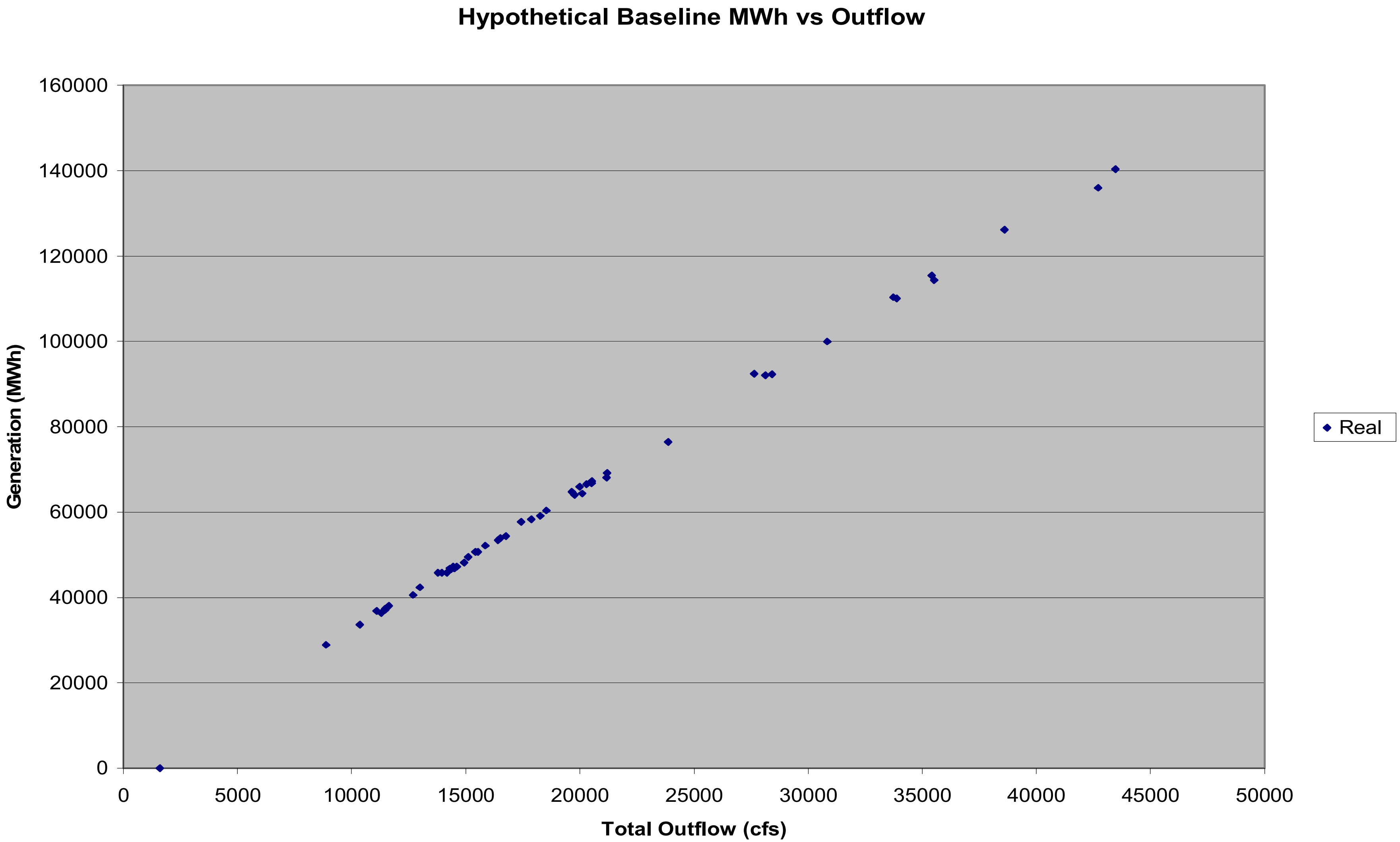
1. In developing the data set for both the baseline and the project year, the project developer must identify and eliminate outlying data points that represent atypical circumstances such as blackouts, major equipment malfunction and repair. For the baseline, this will simply mean eliminating these data points from the data set. In the project year, the project developer will not be able to claim any emission reductions in weeks where these types of major abnormalities occur since it would be too hard to calculate the baseline generation in those same abnormal conditions. This may mean the actual data calculations for the year involves fewer than 52 weeks.

2. Additionally, the project developer will measure electricity generation at each generating unit and total the output for the week. This is needed since any major post-project upgrades to existing generating units or any new units added will need to be factored out of the calculations since the optimization project will not be directly responsible for the increase in generation. This means that if two years after the optimization project a 50MW generating unit is overhauled and upgraded to a more efficient 75MW, from that point on the generation output of this unit will be factored out both in the baseline calculation and in the post project calculation.

where
$E(x)$ = total electricity generated in week x
$hours_x$ =total hours in week x
HPU= Hydro power unit
ψg= total number of hydro power generation units that existed in the baseline period
KWh_{hpu} =total kWh generated by the given hydropower unit (HPU) for a given time frame

Note: The flow index as determined in the project year for calculating the baseline will not include water consumption and irrigation/other return flows.

The following is a demonstration of how the methodology is applied using simplistic hypothetical data.


Hypothetical Baseline MWh vs Outflow
Generation (MWh)
160000
140000
120000
100000
80000
60000
40000
20000
0
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Total Outflow (cfs)
Real

Baseline Data

Total Water Flow Index in Cubic Feet per second (cfs)*	Total Generation per week in MWh (Total from Each Generating Unit)
10,000	30,000
15,000	45,000
20,000	65,000
25,000	75,000
30,000	90,000
35,000	110,000
40,000	130,000
45,000	140,000

* 1 cubic foot = 0.0283168 cubic meter

Week # in Project Year x	Total Water Flow Index (cfs)	Expected Baseline Generation (MWh)	Actual Generation (MWh)	Additional Energy Generation (MWh)
21	35,000	110,000	115,000	5,000
22	40,000	130,000	135,000	5,000
23	25,000	75,000	79,000	4,000
24	30,000	90,000	94,500	4,500
25	25,000	75,000	79,000	4,000

So for weeks 21-25 and additional 22,500 MWh have been produced compared to the same expected outcome for the same Total Water Flow Index in the baseline scenario. If after completing the combined margin analysis it is determined that there is a carbon emission

factor of .8 tonnes of CO_2 per MWh then 18,000 tonnes of CO_2 emission reduction would have been recorded. In a real case, all weeks would have been tabulated together to get the difference.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
A-1	*L*	The data acquisition system used for the Decision Support Tool will provide highly accurate data. Meters will be tested annually and calibrated *as recommended by the manufacturer. Meters are typically accurate to plus or minus a tenth or hundredth of a percent.*
A-2	*L*	The data acquisition system used for the Decision Support Tool will provide highly accurate data. Meters will be tested annually and calibrated *as recommended by the manufacturer.*
A-3	*L*	*The data acquisition system used for the Decision Support Tool will provide highly accurate data. Meters will be tested annually and calibrated as recommended by the manufacturer. . Meters are typically accurate to plus or minus a tenth or hundredth of a percent.*
A-4	*L*	*The data acquisition system used for the Decision Support Tool will provide highly accurate data. Meters will be tested annually and calibrated as recommended by the manufacturer. . Meters are typically accurate to plus or minus a tenth or hundredth of a percent.*
A-5	*L*	*The data acquisition system used for the Decision Support Tool will provide highly accurate data*
A-6	L	If linked to the rest of the grid, the data acquisition system used for the Decision Support Tool will provide highly accurate data.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

The data acquisition system for the Decision Support tool will be designed to monitor the emissions reductions.

D.5 Name of person/entity determining the monitoring methodology:

Kevin James
Quality Tonnes

Lasse Ringius
World Bank

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The project will produce additional renewable energy beyond the baseline scenario with zero additional emissions

E.2. Estimated leakage:

NA

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Zero additional emissions from project activities.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Anticipated Tonnes of CO2 Above Project Level	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624

Estimates for project years using best available data for current years extrapolated over the course of the project. Better quality baseline data from newly installed advanced meters will precede full installation of the Decision Support system by one year.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624
Total Baseline Tonnes of CO2										
Total Estimated Actual TonnesCO2	0	0	0	0	0	0	0	0	0	0
Estimated Emission Reductions	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624	202,624

* Estimates for project years using best available data for current years extrapolated over the course of the project. Better quality baseline data from newly installed advanced meters will precede full installation of the Decision Management Tool by one year.

HYDRO

(MW)	Annual output (thd.kWh)	Thousand m3	Specific consumption of water (kWh/m3) Baseline*	(kwh/m3) Based on 10 % improve ment 2005	Baseline Electricity Generation in 2005 (Thousand kwh)	Estimated Actual Electricity Generation in 2005 (Thousand kwh)	Difference between baseline and Estimated Actual for 2005 (Thousan d kwh)	CEF kgCO2/ MWh	Estimated Total Tonnes CO2 reduced for 2005
			Mingechaur Hydro Power Plant (HPP)						
342	1122897.190	9207755.4	.122	.136	1123346.2	1252255	128908.6	693	89333.64
			Shamkir HPP						
380	1028225.576	8739912.5	.118	.131	1031309.7	1144929	113618.9	693	78737.87
			Varvara HPP						
16.5	64457.406	3989913.43 14	.016	.018	63838.615	71818.44	7979.827	693	5530.02
			Yenikend HPP						
150	305062.905	8023154.40 15	.038	.042	304879.87	336972.5	32092.62	693	22240.18
			Araz HPP						
22	81553.000	1631060	.05	.056	81553	91339.36	9786.36	693	6781.947
					2604927	2897314			
				* CEF of 693	1,805,214	2,007,838	Total		202623.7

* This is an annual average based on best available data in 2004. Weekly data including kwh/m3 at the various discharge rates will be measured for the baseline. The data also is based on the expected outcome if the project was implemented in 2005. Better data will be provided closer to the actual project implementation date and the PDD will be revised.

E.6. Table providing values obtained when applying formulae above:

Year	Estimation of project activity emission reductions (tonnes of CO2 e)	Estimation of baseline emission reductions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of emission reductions (tonnes of CO2 e)
Year 1	**1,805,214**	**2,007,838**	**0**	**202,624**
Year 2	**1,805,214**	**2,007,838**	**0**	**202,624**
Year 3	**1,805,214**	**2,007,838**	**0**	**202,624**

Year 4	**1,805,214**	**2,007,838**	**0**	**202,624**
Year 5	**1,805,214**	**2,007,838**	**0**	**202,624**
Year 6	**1,805,214**	**2,007,838**	**0**	**202,624**
Year 7	**1,805,214**	**2,007,838**	**0**	**202,624**
Total (tonnes of CO2 e) For 1st Crediting Period	**12,636,498**	**14,054,866**	**0**	**1,418,368**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The environmental impacts of this project are likely to be only positive. The installation of the Decision Management System is benign in terms of environmental impacts. The additional hydro generation and the resulting reduced fuel consumption will only have a positive environmental impact by reducing CO_2 emissions and other criteria air pollutants such as NOx, SOx, and particulate. Any negative environmental impacts of the hydro installation itself will already have occurred and will in no way be caused by this project.

F.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:

NA

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

Azerenerji and the Ministry of Industry and Energy have both been involved in the development of this project. An initial stakeholders meeting was held and the World Bank has required additional meetings before the implementation of the project. There are not likely to be any groups negatively affected by the installation of a Decision Support System.

G.2. Summary of the comments received:

All parties were supportive of the proposed project.

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

NA

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Azerenerji ASC	World Bank Carbon Funds
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Country:	Azerbaijan Republic	USA
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FAX:	(+994 12) 4984117	202-522-7432
E-Mail:	abdulkhalik@azerenerji.com	lringius@worldbank.org
URL:	http://www.azerenerji.com/	www.carbonfinance.org
Represented by:	Abdulhalik Heydarov	Lasse Ringius
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Salutation:	Mr.	Mr.
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Middle Name:		
First Name:	Abdulhalik	Lasse
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Mobile:		
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Direct tel:	(+994 12) 4984184	202-473-6381
Personal E-Mail:	abdulkhalik@azerenerji.com	lringius@worldbank.org

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No Annex 1 public funding is being used for this project.

ANNEX 3
BASELINE INFORMATION

Key Variables/Parameters	**Data Source**
Number of Hydro power units	Based on observed data and company records
total number of hydro power generation units that existed in the baseline year	Based on observed data and company records
total of all generation flows and spill flows during the week	Based on measured and logged data
kgCO2/kcal	Measured through logged data of fuel consumption by type in project year.

Baseline Electricity Generation in year x equals or BEgen
(note two caveats listed above which may change slightly the actual formula (i.e. only 51 weeks are tabulated since a major blackout occurred during one week)

$$\sum_{week_x=1}^{52} \left(\sum_{HPU=1}^{\Psi g} kWh_{hpu} \text{ produced in year}_0 \text{ at } Q(\text{index})week_x \right)$$

Where
Year x= given project year being compared to baseline
HPU= Hydro power unit
ψg= total number of hydro power generation units that existed in the baseline year
Q(index)= total of all generation flows and spill flows during the week (as calculated below)
$Week_x$ = week in the year x (1-52)
Year 0= baseline year

The Weekly flow index which is used to identify the corresponding total electricity generation figure from the baseline year , Q(index), is calculated by cumulating all project releases (generation flow and spill flow) during the week, as follows.

$$Q(index) = \sum_{hour_x=1}^{168} \left(\sum_{HPU=1}^{\Psi g} m3_{hpu} \right) + \sum_{hour_x=1}^{168} \left(\sum_{s/w=1}^{\Psi s} Qspill \right)$$

Where
HPU= Hydro power unit index in m3
S/w = spillway
ψg= total number of hydro power generation units that existed in the baseline year
ψs= total number of spillways that existed in the baseline year
Qspill= total m3 of spillage for given time period and spillway

The first step of this project once approved will be to install appropriate meters and gather the data required to accurately establish the baseline.

Annex 4

MONITORING PLAN
- - - - -

Each project year, the baseline generation and the actual generation will be calculated by determining the actual weekly flow index and using the measured electricity production for that flow index in the baseline year to determine what the generation of electricity would have been for that week if the hydro system had not been optimized. The total baseline electricity generation will simply be a sum of all the weekly figures, and the total actual generation will be the sum of all the weekly figures. These two values will then be compared, to determine the additional electricity generated through optimization.

The first step of this project once approved will be to install appropriate meters and gather the data required to accurately monitor the project results.

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estim	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

				ated (e),				
A-1	*Generation for each generation unit*	*Measured at each hydro generation unit*	*Kwh*	*m*	*Hourly, cumulated Weekly*	*100%*	*electronic*	*The monitoring system used to inform the Decision Support System will gather and archive this data*
A-2	*Total water flow index*	*Measured as a flow rate, a total flow volume across all generating units including spillage, or total volume at a representative point such as the most downstream plant*	*m3 or m3/second*	*m*	*Weekly (measured both in the baseline year and in the project years)*	*100%*	*electronic*	*The monitoring system used to inform the Decision Support System will gather and archive this data*
A-3	*Carbon emissions factor*	*Calculated using the combined margin approach outlined in ACM002*	*KgCO2/kwh*	*m and c*	*Annually (in project years)*	*100%*	*electronic*	*IPCC data may be used to determine carbon content for fuels.*

The flow index is determined using the industry standard method as follows:

- *MW output is measured at each unit and plant on a continuous basis*
- *Headwater level is also measured as above*
- *Tailwater level is measured*
- *Gross head is the difference between the last two bullets*
- *Flow through each generating unit is determined for each hour, based on the unit performance "hill diagram" provided by turbine manufacturer and/or commissioning test, which defines the three dimensional relationship between power output, head and flow (and associated efficiency). Flows are aggregated at all units and all plants in the cascade to yield the flow index.*

The meters associated with measuring MW output and water levels are extremely accurate. River flow gauges will not be used since their accuracy is not high enough. Using the QA/QC

measures outlined in calibrating the meters, there should be little inaccuracy in any of these measurements. However, it should be noted that for the methodology to reach accurate and conservative results, the measurement of the flow index does not have to be accurate, as long as it is 100% consistent in the before and after cases. To demonstrate this point, assume that a particular unit performance curve before DSS implementation is in error by x%, which implies that the calculated flow will also be in error. It should be noted that after DSS implementation, for the same flow, the error will be exactly the same, since the unit performance curve is the same. Therefore, the flow index will be 100% consistent between the before- and after-DSS cases providing an accurate and conservative flow measurement. This measurement approach is a internationally recognized as the industry standard.

Annex 5
HYDRO CHARACTERIZATION CHART

Performance Characteristics of The Existing Hydroelectric Plants

Name	River	Purpose	Year of Commissi on	Installed Capacity (MW)	Available Capacity (MW)	Number of Units	Fixed O&M ($/kW-yr)	Variable O&M ($/MWh)
Shamkhir	Kura	Power, Irrigation, Fishing, Water Supply	1981/1982	380.0	380	2	5.0	0.22
Mingechau r	Kura	Power, Irrigation, Fishing, Water Supply	1953/1955 (1)	409	409	6	6.0	0.3
Yenikend	Kura	Power, Irrigation, Fishing, Water Supply	2000/2002	150	150	4	5.0	0.15
Varvara	Kura	Power	1956/1957	16.5	6.3	3	14.3	0.07

(1) Units 5 and 6 were reconstructed in 1999, Unit 2 in 2000 and Unit 4 in 2001.

*taken from a Burns and Roe Enterprises report Prepared for Azerenerji and the EBRD.