JOINT IMPLEMENTATION (JI)
PROJECT DESIGN DOCUMENT FORM[1]

CONTENTS

Annexes

[1] In the absence of UNFCCC formats for JI project, the CDM PDD is applied here

SECTION A. General description of project activity

A.1 Title of the project activity:

UkrHydroEnergo (UHE) hydropower rehabilitation project in Ukraine (hereafter referred to as the "Project" or "Project Activity")

A.2. Description of the project activity:

The Project involves the rehabilitation of 46 hydrounits which are located at nine different sites on the Dnipro river and one site on the Dnister river. This will entail the replacement of hydrolic power, electro-technical and hydro-mechanical equipment such as gates, turbines, generators, excitation and governor systems, control, protection and automation systems, switchyard equipment and auxiliary equipment.

Some of the oldest hydrounits (to be rehabilitated under the Project) were commissioned 70 years ago and although they will not be obsolete for many years to come, continue to run at increasingly lower efficiency levels. Hydropower generation in the Ukraine is limited by reservoir level. It is desirable to have turbines running at high efficiency to produce the maximum amount of power from the available water resources.

The Project will increase the electricity generation capacity and efficiency of the rehabilitated hydropower plants. Additional power generated by the hydrounits during peak periods will displace that generated by thermal plants. It is estimated that emission reductions due to displaced thermal electricity generation will be just over 1.4 million tCO_2e between 2006 and the end of 2012.

The Project will be implemented in stages and as more hydrounits are rehabilitated, the Project's hydropower plants will generate an increased amount of electricity. By the year 2012 it is expected that increased generation will be approximately 470 GWh/yr.

At present in Ukraine, nuclear power plants supply the majority of baseload power. Since hydropower plants, dispatched in peak times, are fully utilized, thermal plants must supply incremental demand. Most of the grid connected thermal plants were built before the 1980's, with the oldest plants built in the 1950's. These plants typically have very low efficiencies and require high maintenance.

The Project will bring a number of benefits to the local community and Ukraine as a whole. It will help increase the reliability of power supply by enhancing the ability of the rehabilitated hydropower plants to provide critical electricity supply during peak times and frequency control. It also includes additional technical assistance to improve reservoir management and plant operation. Additionally, as part of the Project, a dam safety monitoring system will be installed along with other related components.

In terms of environmental benefits, the Project will help reduce air pollution caused by the emission of SO_2, NO_X and CO_2 by outdated thermal plants. Water pollution will also be reduced at some of the reservoirs through the installation of environmentally safe runners to the hydrounits, which eliminate oil leakage.

A.3. Project participants:

Project participants:

- UkrHydroEnergo (UHE)[2]
- International Bank for Reconstruction and Development (IRBD) as Trustee for the Netherlands European Carbon Facility

IRBD is the contact for the Project Activity.

Parties Involved:

- Ukraine, host Party
- The Netherlands

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Ukraine

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

Seven locations and nine plant sites on the Dnipro and Dnister rivers

A.4.1.3. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Project will be located at nine sites on the Dnipro river and one site on the Dnister river (Novo-Dnistrovsk area). Dnipro river runs through central Ukraine where as Dnister river is located in western Ukraine. The sites on the Dnipro river (and plant names) are as follows:

Kiev (Kiev Pump Storage Power Plant and Hydropower Plant)
Kaniv (Kaniv Hydropower Plant)
Svetlovodsk (Kreminchug Hydropower Plant)
Dniprodzerzhinsk (Dniprodzerzhinsk Hydropower Plant)
Zaporizhya (DniproGES Hydropower Plant-1 and DniproGES Hydropower Plany-2)
Nova Kakhovka (Kakhovka Hydropower Plant)

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

The category applicable to the project is “grid connected electricity generation from renewable sources”

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

[2] UHE is a fully state owned joint stock company which is involved in the generation of electricity using hydropower plants. The company owns and operates plants that generate approximately 99% of all hydropower generated electricity in the Ukraine. It sells electricity to the grid at a tariff rate predetermined by the National Energy Regulatory Commission (NERC).

The Project involves the rehabilitation of a total of 46 hydrounits. This will entail the replacement of hydrolic power, electro-technical and hydro-mechanical equipment such as gates, turbines, generators, excitation and governor systems, control, protection and automation systems, switchyard equipment and auxiliary equipment.

Most of the mechanical equipment will be produced locally while control and regulation systems, circuit breakers and other electrical equipment will be imported from overseas.

The Project will also include civil works on hydraulic structures and installation of computer-aided dam safety monitoring systems.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed JI 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:

Since the Project will not result in an increase in the reservoir area, the rehabilitated hydropower plants will generate additional electricity without emitting GHG. It will reduce anthropogenic GHG emissions by displacing electricity produced by fossil fuel fired power plants. Over the 2006 to end of 2012 period, the Project is projected to generate emission reductions totalling 1,402,712 tCO_2e.

The Project is not BAU, as demonstrated by the investment analysis (see section B.2. – Step 2). Additionally, the supporting arguments for additionality further demonstrate that the Project is additional due to the fact that it faces significant barriers.

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

The Project is projected to generate a total of 1,402,712 tCO_2e over the duration of the 2006 to 2012 period.

A.4.5. Public funding of the project activity:

The World Bank is likely to provide the Project with a US$127 million loan as part of the World Bank Energy Sector Reform and Development Program Adjustable Program Loan. However, at the time of PDD production, the loan was yet to be finalized.

This loan is not related to official development assistance (ODA) of any particular country.

SECTION B. Baseline study for the project

B.1. Baseline methodology applied to the project activity:

This PDD follows ACM0002 in its general framework with some minor modifications to make it more applicable to the conditions found in Ukraine.

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

The Project is a grid-connected zero-emission renewable power generation activity and has the following characteristics relevant to baseline emission determination:

- The Project supplies electricity capacity addition from the rehabilitation of a hydropower source, and the volume of the existing reservoirs is not increased;
- The Project is not an activity that involves switching from fossil fuels to renewable energy at the project site;
- The electricity grid is clearly identified (as Ukraine grid) and information is available on the characteristics of the grid;

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

The operating margin (OM) is deemed to best represent what would occur in the absence of the Project. The Project will not affect the build margin due to the large excess installed capacity of the Ukraine grid. The current excess capacity is over 32%; peak demand is approximately 27,000 MW compared to a total installed capacity of 40,000 MW (Ministry of Fuel and Energy (MFE) data). Capacity additions have been very few in the past and, given the large excess capacity in the system, little are planned for the future: last year two 1 GW nuclear power plants, which were previously partially completed projects left over from the former USSR, commenced operations; these two plants are the only major capacity additions to the Ukraine grid since the 1970's.

The baseline scenario is the amount and type of electricity that would have otherwise been generated by the operation of grid-connected power plants. The Project will displace electricity produced by thermal plants during peak periods. Emissions reductions will be claimed based on total CO_2 emission mitigated by the Project.

The Simple OM Method[3] will be used to determine the CO_2 emission factor (CEF) of the Ukraine grid[4]. Demand for power in the Ukraine is forecast to increase in future years. This increased demand will be mainly met by thermal power plants, resulting in the portion of low-cost/must-run resources on the Ukraine grid decreasing continuously and to constitute less than 50% of total generation. Low cost/must-run resources (excluding combined heat and power (CHP) plants)[5] constituted 50.2% of total grid generation in 2003. Therefore, the Project will not displace low-cost/must-run resources (at any point in time) now or in the foreseeable future.

[3] Based on the calculation method suggested in ACM0002.

[4] Imports from the Russia grid to the Ukraine grid will be treated as neutral (0) since a power swapping agreement exists between the two countries.

[5] Data was not available for generation by low cost/must run CHP plants but it is most likely to be under 2% of total grid generation.

Aggregated data for generation and fuel consumption obtained from MFE is used in OM calculations[6]. For net calorific values and carbon emission factors for fossil fuels, IPCC figures are used in the absence of official national values.

The operating margin for the Project is the generation-weighted average of all generating sources, excluding least-cost/must-run resources[7], determined *ex post*.[8] Generation by the Project is claimed for the proportion of increased electricity exported to the grid due to rehabilitation (increased efficiency) of the hydrounits (identified in the Project boundary)[9]. Baseline emissions are determined by multiplying the simple OM emission factor by the amount of generation by the Project. Estimated emission reductions for each year of the Project up until 2012 are displayed in section E.6. The Project is additional in terms of emission reductions, and an additionality test is completed in the section below to demonstrate that the Project is not BAU due to a number of insurmountable barriers.

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 JI project activity:

The following steps are utilized to demonstrate Project additionality:

STEP 1 – Identification of alternatives to the project activity consistent with current laws and regulations
STEP 2 – Investment analysis
STEP 4 – Common practice analysis
STEP 5 - Impact of JI revenue

[6] No data was available on generation as well as fuel consumption of low-cost/must -run CHP plants. Assuming that the average efficiency of these plants is similar to that of thermal plants, the CEF should not be affected if this data is not excluded.

[7] In the case of the Ukraine grid, nuclear power plants, hydropower plants and some CHP plants are classed as least-cost/must-run resources.

[8] If data required for *ex post* determination of the OM cannot be acquired from the Ukraine power authorities, an *ex ante* default OM value will be used. This value is calculated as the 3-year average based on the most recent statistics available at the time of PDD production.

[9] Hydropower plants attached to the Ukraine grid are currently fully utilized.

STEP 1 – Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

The following alternatives are applicable:

1. Additional electricity is supplied by new thermal plant(s) or by the expansion of existing plants

2. The Project participant decides that an electricity generation project is not warranted. Continuation of the current situation means that existing thermal plants continue to supply electricity to the Ukraine grid during peak times.

3. The proposed Project activity is implemented and rehabilitated hydrounits produce an increased amount of electricity for sale to the Ukraine grid during peak times.

Alternative 1 would not be a plausible alternative for the Project participant because, as stated earlier, there is already a large amount of excess thermal capacity. Furthermore, the high cost of building thermal plants, in a sector heavily burdened with debt, makes this alternative implausible.

Considering that alternative 3 is the Project scenario, alternative 2 is the only possible baseline scenario. In the absence of the Project, CO_2 emissions would occur unabated from outdated thermal power plants. Hydropower, which is dispatched before thermal plants in peak periods, is a renewable energy source. Emission free power generated by the Project will displace CO_2 emission intensive grid electricity generated by thermal plants.

The Project requires financial assistance to help alleviate Project barriers (see Steps 2 and 3 below). This prompted UHE to look for alternative ways, including JI, to improve the return on the Project and to reduce risks associated with its implementation.

Sub-step 1b. Enforcement with applicable laws and regulations:

All the alternatives are in compliance with applicable laws and regulations.

STEP 2 – Investment analysis

Sub-step 2a – Determine appropriate analysis method

In order to determine whether the proposed Project is a financially attractive course of action, its IRR is compared to a relevant benchmark for similar projects in the Ukraine. The analysis has been completed below.

Sub-step 2b – Option III – Apply benchmark analysis

IRR is deemed the most suitable financial indicator for the Project. The benchmark value will be derived from Ukraine commercial lending rates, which recently stood at 17.8% p.a.[10]

A risk premium for power projects must be added to the commercial lending rate to arrive at the suitable benchmark for the Project. Experts' opinions vary between 5-10% for this risk premium. For the sake of conservatism of the additionality analysis, the low ends of this range is selected, resulting in 22.8% as the suitable benchmark value for the Project.

Sub-step 2c – Calculation and comparison of financial indicators

The table below represents the main data used in the IRR calculation for the Project.

Item	Value
Financial Details	
Foreign exchange rate	5.28 UAH / 1 US$
Project initial cost (before tax and duties)	296,000,000 US$
Electricity tariff	0.0114 US$/kWh (in 2012)
Electricity sales (470,000,000 kWh)	5,340,909 US$ (in 2012)
Project life	35 years
Expenses	
O&M costs (savings) /yr	- 3,774,671 US$[11] (in 2012)
Project IRR	**4.1%**

Data assumptions

- The costs for the hydrounit equipment, etc. was supplied by the project developer based on quotes, consultation with renewable energy experts and industrial standards.
- Predicted future tariff rates for hydropower generated electricity were supplied by UHE. The predictions factor in the need to significantly increase the tariff rate in order to attempt to recover the project capital invested.
- Electricity sales will peak in 2012 after all the Project's hydrounits have been rehabilitated.
- O&M cost savings were estimated by the Project developer based on the cost of running the Project's hydrounits before rehabilitation compared to the predicted cost of running the same units after rehabilitation.

A number of economic factors prevent the Project from being implemented on a BAU basis. The Project requires high initial capital investment of approximately $296 million. However, due to the low tariff rate in Ukraine, the revenue base is too small to effectively absorb the initial investment costs. The high initial costs combined with the small revenue base result in a low IRR.

The Project's IRR is estimated to be 4.1%, which is well below the benchmark value of 22.8%/yr. An additional revenue stream through the sale of ERUs could help increase profitability of the Project and alleviate other barriers.

[10] The average commercial lending rates as of November 2004, Source: National bank of Ukraine.

[11] This is negative because as a direct result of the Project, O&M cost savings are achieved.

Sub-step 2d –Sensitivity Analysis

The following assumptions are analyzed to demonstrate that the conclusion regarding the financial attractiveness of the Project is robust under different favorable scenarios:

1) The tariff for electricity will be 10% per annum higher than expected. (Project IRR = 7.5%)
2) The initial costs for equipment, etc. will be 15% lower than expected. (Project IRR = 5.0%)
3) O&M cost savings will be 15% higher than expected. (Project IRR =4.6%)

Although cases 1), 2), and 3) were calculated in a very conservative manner, Project IRR would still be expected to be much lower than the benchmark value of 22.8%.

The sensitivity analysis confirms the fact that the Project is unlikely to be financially attractive and is not BAU.

Supporting argument for additionality

The Project faces a number of barriers that impede its implementation on a BAU basis. At present, the economic and political circumstances in the Ukraine are not conductive to new power plant additions or rehabilitation of old power plants. As discussed earlier, the Ukraine grid has an excess capacity so there is no urgent need to implement new power generation projects. The power sector is in heavy debt due to a low rate of cash collection in the past and low tariff rates that are below the cost of power production.[12] Credit rating agencies also view the Ukraine as a high risk country.[13]

Although the Project will receive favourable loan conditions for approximately 43% of the initial investment amount, risk is such that the Project faces significant barriers. This can be confirmed by the fact that although UHE endeavoured to rehabilitate10 hydrounits using company based funds, the project could not be completed due to lack of available funds. A subsequent detailed analysis of the underlying economic feasibility of rehabilitating hydrounits in Ukraine found that project implementation is not possible without a loan with favourable conditions. In addition, JI assistance provides a means of paying the interest on the loan. With the expectation that a new law will be passed this year to force the energy sector to settle over US$7.7 billion[14] in debt in the near future, JI assistance will help to ensure successful implementation of the Project in an environment of high debt risk.

[12] The present tariff for electricity generated by hydropower plants in the Ukraine is approximately 0.56 cents US.

[13] Coface (France's export credit underwriter) has given Ukraine a C rating for country risk.

[14] This includes tax arrears of about $1.7 billion equivalent, but does not include debts to foreign gas suppliers (Russian and Turmenistan) which were about $2 billion in 2003. Approximately 40% of the total debt is from the power sector alone.

STEP 4 – Common practice analysis

Sub-step 4a – Analyse other activities similar to the proposed project

In 2002, UHE finished the rehabilitation of 16 hydrounits funded by a World Bank loan under favourable conditions. Soon after this, UHE started a project to rehabilitate a further 10 units using their own equity. Apart from these activities and two recently completed nuclear power plants, there has been no other new capacity addition to the Ukraine grid in the last 25 years.

Sub-step 4b –Discuss any similar option occurring

The 16 hydrounits completed by UHE under stage 1 were partially funded with a favourable loan from the World Bank at a time when the issue of sectoral debt had not entered the national political spotlight. Since 2002, sector debt has continued to increase steadily and this has prompted the drafting of a new law which will be passed this year to force the energy sector to settle over US$7.7 billion in debt. In a move to stabilize the energy sector and reduce debt, power generation companies will be forced to increase profitability.

Lack of capital due to low tariffs was cited as the main reason why the UHE rehabilitation project started in 2002 (to rehabilitate 10 hydrountis) has not been completed[15]. This supports the above argument and reflects the high risk in the Ukraine energy sector at present.

STEP 5 – Impact of JI Registration

Expected revenue from JI was taken into account when planning project finance and will help to increase project profitability. The addition source of income will also help to alleviate other barriers.

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

In order to retain a conservative approach, the only gas included in the baseline emission calculation is CO_2.

The spatial extent of the Project boundary includes the Project sites (as listed in section A.4.1.3.) and all power plants connected physically to the Ukraine grid.

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:

The baseline study was completed in May 2005 by:

Clean Energy Finance Committee
Mitsubishi Securities Company Ltd.
Tokyo, Japan
Tel: (81-3) 6213-6860
E-mail: hatano-junji@mitsubishi-sec.co.jp

The Clean Energy Finance Committee, Mitsubishi Securities Co. Ltd. developed the Project's baseline under the guidance of the CFB.

[15] Up-to-date the Project is only half finished and the funds necessary to complete the project are not available.

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:

01/01/2006

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

35 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:

01/01/2006

The expected date of commissioning is given as the starting date of the first crediting period. Should the plant construction/commissioning be delayed, the starting date of the crediting period will be delayed accordingly.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

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C.2.2.2. Length:

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SECTION D. Monitoring plan

D.1. Items to be monitored:

The following items will be monitored in order to determine baseline emissions in a conservative and transparent manner[16]:

- Names of plants and hydrounit number for those hydrounits which have recommenced operation after undergoing rehabilitation as part of the Project[17].
- Amount of net generation (MWh/yr) supplied to the grid by each project hydropower plant.
- Total water flow (m^3/yr) for each project hydropower plant
- The Simple OM factor (tCO_2/MWh) calculated *ex post*.
- Aggregated fuel consumption data (kt/yr) for all thermal generation sources attached to the Ukraine grid based
- CO_2 emission coefficient of each fuel type.
- Aggregated electricity generation data (MWh/yr) for all generation sources attached to the Ukraine grid

The baseline efficiency factors for the plants were determined ex ante based on actual data from 2002 and 2003.

[16] The Project is located on existing reservoirs which are not increased in size as a result of project implementation. Therefore, methane emissions will not be monitored/determined.

[17] Project hydropower plants will be included in emission reduction calculations from the year that the first hydrounit is rehabilitated.

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

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 are no Project emissions.

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 *(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?[18] (electronic/ paper)	Comment
1	Name of rehabilitated plant and hydrounit number		text	m	daily	100%	electronic	Project hydropower plants will be included in emission reduction calculations from the year that the first hydrounit is rehabilitated.
2	Net generation by each rehabilitated hydrounit		MWh/yr	m	continuous	100%	electronic	Recorded by electricity meter and data is aggregated yearly for each hydrounit. The total for each hydropower plant is double checked by receipt of sale.
3	Total water flow (m^3/yr) for each HHP		m^3/yr	m, c	daily	100%	electronic	Used to determine baseline generation by hydropower plants (which are included in the Project) before undergoing rehabilitation
4	CO_2 emission factor of the grid		tCO_2/MWh	c	yearly	100%	electronic	Determined *ex post* at the end of each year.

[18] Data shall be archived for 2 years following the end of the crediting period.

5	Amount of each fossil fuel consumed by each power source		Various	m	yearly	100%	electronic	Obtained from MFE.
6	CO_2 emission coefficient of each fuel type		tCO_2/TJ	m	yearly	100%	electronic	IPCC default values used in the absence of official national values.
7	Electricity generation of each power source		MWh/yr	m	yearly	100%	electronic	Obtained from MFE (latest local statistics).

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

See Section E.4 for baseline emission calculations.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable

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

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

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D.2.3. Treatment of leakage in the monitoring plan

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

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

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.)

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.

1.	Low	These data will be directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure consistency.
Others	Low	Default data (for emission factors) and IEA statistics (for energy data) are used to check the local 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

All monitoring equipment will be installed by experts and regularly calibrated to the highest standards by Project staff. Staff will be trained in the operation of all monitoring equipment and all reading will be taken under the supervision of management. UHE will appoint an executive to be responsible for all data monitoring / acquisition and recording for JI purposes.

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

The baseline study was completed in May 2005 by:

Clean Energy Finance Committee
Mitsubishi Securities Company Ltd.
Tokyo, Japan
Tel: (81-3) 6213-6860
E-mail: hatano-junji@mitsubishi-sec.co.jp

The Clean Energy Finance Committee, Mitsubishi Securities Co. Ltd. developed the Project's monitoring methodology under the guidance of the CFB.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The Project shall be responsible for zero GHG emissions. Hydropower plants which do not require the construction of a new dam or result in an increase in the area of an existing reservoir, are classed as zero emission projects.

E.2. Estimated leakage:

The Project is not responsible for any leakage.

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

The Project is not responsible for any project activity emissions. Project activity emissions are zero (0) due to the fact that there are no anthropogenic emissions or leakage.

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

Baseline emission reductions are to be determined for the following:

- Baseline emission reductions due to increased generation by rehabilitated hydrounits

Baseline emission reductions due to increased generation by rehabilitated hydrounits

Baseline emission reductions are to be determined using the following three steps:

1) Determine the Simple OM factor (tCO_2/MWh)
2) Determine the total amount of electricity generation (MWh/yr) by the Project
3) Determine the amount of baseline emission reductions (tCO_2e/yr)

Step 1 - Calculate the Simple OM factor

The Simple OM is defined as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost/ must-run power plants. It is determined *ex post* at the start of each year after the Project is implemented.

Actual data is sourced from MFE for aggregate fuel consumption / electricity generation for each generation type on the Ukraine grid. Default IPCC figures are to be used for calorific values and carbon emission factors, for the different fuel types if national values are not available. In the case that sufficient data cannot be accessed from MFE to calculate the simple OM *ex post*, the Project will revert to a default *ex ante* simple OM factor which has been calculated based on the most recent 3 years of Ukraine grid data available at the time of PDD production (see Appendix 1 for data and calculations).

To demonstrate simple OM calculations, Ukraine grid data from 2001 is used:

Type of Fuel	Fuel consumption (million tce[19])	Electricity generated (GWh)	Fuel consumption (TJ)	Carbon emission factor (tC/TJ)	Oxidation factor	Grid emission (tCO_2)	CEF (tCO_2e/MWh)
Hydroelectric	-	12,100	-	-	-	-	-
Coal	18.1	50,749	530,475	25.8	0.98	49,179,258	0.97
Natural gas	11.5	32,211	337,042	15.3	0.995	18,813,516	0.58
Oil	0.31	923	9,085	21.1	0.99	695,884	0.75
Nuclear	-	76,169	-	-	-	-	-
Total (less least cost/must run)		83,883	876,602			68,688,658	
Grand Total		172,152					0.82

The calculation for CO_2 emission for natural gas (tCO_2) appears below. The calculated value represents the grid CO_2 emission from natural gas for the 2001 Ukraine grid.

CO_2 emission for natural gas (tCO_2/yr)	=	Fuel consumption (thousands tce/yr)	x	Net calorific value (TJ/thousands tce)	x	C emission factor (tC/TJ)	x	Fraction of C oxidised	x	Mass conversion factor (tCO_2/tC)
	=	11,500 (tce/yr)	x	29.308 (TJ/kt)	x	15.3 (tC/TJ)	x	0.995	x	3.6666667 (tCO_2/tC) 44/12

CO_2 emission for natural gas	=	18,813,516	tCO_2/yr

The above calculation is repeated to obtain the CO_2 emissions (tCO_2/yr) for coal and oil.

[19] The net calorific value for coal in the Ukraine is 29.308 (MFE data).

The emission values for all the above types of thermal power plants are tallied to get the total amount of CO_2 emissions for the Ukraine grid in 2001. The total amount of CO_2 emission is divided by the total electricity generated from fossil fuelled plants to calculate the Simple OM emission factor.

Simple OM emission factor (2001) (tCO_2/yr)	=	Total CO_2 emissions tCO_2/yr	/	Total electricity generated from fossil fuel-based plants MWh
	=	68,688,658 tCO_2/yr	/	83,883,000 MWh
Simple OM emission factor (2001)	=	0.82 tCO_2/MWh		

Step 2 - Determine the total amount of electricity generation (MWh/yr) by the Project

The amount of electricity generation per (Project) plant is determined as follows:

Project electricity generation (MWh/yr)	=	Total electricity generation by HHP after project implementation (MWh/yr)	-	Total baseline electricity generation by HPP (MWh/yr)

Where;

Total baseline electricity generation by HPP (MWh/yr)	=	Total water flow for HHP after project implementation (m^3/yr)	/	Average baseline efficiency for HHP m^3/kWh

Total electricity generation (MWh/yr) is equal to the sum of generation by all the rehabilitated plants identified in the Project boundary as calculated above.

For the purpose of ERU estimation in the PDD increased power generation due to the Project is assumed as follows:

Year	Generation (MWh)
2006	0
2007	78,000
2008	156,000
2009	251,000
2010	338,000
2011	420,000
2012	470,000

This Project generation data will be replaced with data measured *ex post* as directed in the monitoring plan

Step 3 - Determine the amount of baseline emission reductions due to increased electricity generation (tCO_2e/yr)

Lastly, the baseline emission (the CO_2 displaced by the project) is calculated.

CO_2 emission in 2012 (tCO_2/yr)	=	Total increased electricity due to the Project (MWh/yr)	x	Simple OM emission factor (tCO_2/MWh)
	=	470,000 (MWh/yr)	x	0.82 (tCO_2/MWh)
	=	**385,400**		**tCO_2/yr**

The total amount of predicted baseline emission reductions for the Project are shown in the below table:

Year	Increased generation due to Project(MWh)	ERs due to increased generation (tCO_2e)
2006	0	0
2007	78,000	63,871
2008	156,000	127,743
2009	251,000	205,535
2010	338,000	276,776
2011	420,000	343,922
2012	470,000	384,865
Total	1,713,000	1,402,712

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

The emission reduction of the Project is equal to baseline emissions because the Project itself does not produce any emissions.

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

Year	Total baseline emissions (tCO_2e)	Total Project emissions (tCO_2e)	Emission reductions (tCO_2e)
2006	0	0	0
2007	63,871	0	63,871
2008	127,743	0	127,743
2009	205,535	0	205,535
2010	276,776	0	276,776
2011	343,922	0	343,922
2012	384,865	0	384,865
TOTAL	1,402,712		1,402,712

SECTION F. Environmental impacts

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

The Hydropower Rehabilitation Project is in full compliance with all environmental requirements of the Government of the Ukraine and the World Bank. In accordance with the World Bank Environmental Assessment safeguard policy and procedures (OP/BP/GP 4.01) the project has been assigned Category B and an Environmental Management Plan (EMP) is required.

The Project will not adversely affect the quality or quantity of water flows to the other riparians; and the Project will not be adversely affected by other riparians' water use.

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:

UHE's capacity for implementing the requirements of the EMP was reviewed by the Bank and found to be highly adequate, having benefited from the experience gained in the first hydropower project.

All environmental issues for both the project implementation and operation phases are minor, of limited duration and extent and readily managed.

As part of the Project, UHE will implement dam safety measures agreed with the World Bank.

SECTION G. Stakeholders' comments

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

UHE (the project implementation agency) provided an English language version of the EMP acceptable to the World Bank on March 9, 2005 and disclosed Ukrainian language versions of the EMP at each of the nine subproject sites from March 4 to 9, 2005. The World Bank provided the English language version to the World Bank Infoshop on March 9, 2005. Prior to disclosure, public consultations were held at each of the nine subproject sites. Project approval by the Ukrainian environmental authorities (State Ecological Expertise) is also presented in the EMP.

G.2. Summary of the comments received:

>>

No negative comments were received on the Project

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

>>

No negative comments were received on the Project

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The World Bank is likely to provide the Project with a US$127 million loan as part of the World Bank Energy Sector Reform and Development Program Adjustable Program Loan. However, at the time of PDD production, the loan was yet to be finalized.

This loan is not related to official development assistance (ODA) of any particular country.

Annex 3

BASELINE INFORMATION

See Monitoring Plan as well as appendix 2.

Annex 4

MONITORING PLAN

The Monitoring Plan is presented in a separate document

Appendix 1

To demonstrate *ex ante* default simple OM calculations, Ukraine grid data from 2004 is used:

Type of Fuel	Fuel consumption (million tce)	Net calorific value (TJ/kt)	Electricity generated (GWh)	Fuel consumption (TJ)	Carbon emission factor (tC/TJ)	Oxidation factor	Grid emission (tCO_2)	CEF
Hydroelectric			11,700,000					
Coal	19.2	29.308		562,714	25.8	0.98	52,168,052	
Natural gas	10.9	29.308		319,457	15.3	0.995	17,831,941	
Oil	0.3	29.308		8,792	21.1	0.99	673,436	
Nuclear			87,000,000					
Total (less least cost/must run)			82,500,000	890,963			70,673,430	
Grand Total			181,200,000					0.86

The calculation for CO_2 emission for natural gas (tCO_2) appears below. The calculated value represents the grid CO_2 emission from natural gas for the 2004 Ukraine grid.

CO_2 emission for natural gas (tCO_2/yr)	=	Fuel consumption (kt/yr)	x	Net calorific value (TJ/kt)	x	C emission factor (tC/TJ)	x	Fraction of C oxidised	x	Mass conversion factor (tCO_2/tC) 44/12
	=	10,900 (kt/yr)	x	29.308 (TJ/kt)	x	15.3 (tC/TJ)	x	0.995	x	3.6666667 (tCO_2/tC) 44/12

CO_2 emission for natural gas = 17,831,941 tCO_2/yr

The above calculation is repeated to obtain the CO_2 emissions (tCO_2/yr) for coal and oil.

The emission values for all the above types of thermal power plants are tallied to get the total amount of CO_2 emissions for the Ukraine grid for 2004.

The total amount of CO_2 emission is divided by the total electricity generated from fossil fuelled plants to calculate the Simple OM emission factor.

Simple OM emission (tCO_2/yr)	=	Total CO_2 emissions tCO_2/yr	/	Total electricity generated from fossil fuel-based plants MWh
	=	70,673,430 tCO_2/yr	/	82,500,000 MWh
Simple OM emission factor (2004)	=	0.86 tCO_2/MWh		

The final OM emission factor is calculated as the average OM emission factor based on 2004, 2003 and 2002 data:

Simple OM emission factor (2003)	=	0.80	tCO_2/MWh
Simple OM emission factor (2002)	=	0.82	tCO_2/MWh

The Final OM emission factor is 0.83 tCO_2/MWh.

Appendix 2

The original commissioning year and rehabilitation schedule for hydrounits (number of hydrounits to be rehabilitated per plant)

Years	Comm. date	2006	2007	2008	2009	2010	2011	2012
Plant names								
Kyiv HPP	1971-1972	2	2	2	2	0	0	0
Kyiv PSPP	1964-1968	0	0	1	1	1	0	0
Kaniv HPP	1972-1975	2	1	2	2	2	2	2
Kremenchuk HPP	1959-1960	1	1	1	1	1	1	1
Dniprodzerzhynsk HPP	1963-1964	1	1	1	1	1	1	0
Dnipro HHP	1932-1950	1	1	1	1	1	1	1
Kakhovka HHP	1955-1956	1	1	0	0	0	0	0
Dnistro HHP	1981-1983	0	0	0	0	0	0	0
Total		8	7	8	8	6	5	4

Predicted increased generation by the Project (GWh)

Years	2006	2007	2008	2009	2010	2011	2012
Plant names							
Kyiv HPP	0	0	0	15	17	18	18
Kyiv PSPP	0	5	10	14	18	19	19
Kaniv HPP	0	8	14	20	29	36	43
Kremenchuk HPP	0	11	22	32	42	54	63
Dniprodzerzhynsk HPP	0	13	25	38	51	64	77
Dnipro-1 HHP	0	0	0	27	54	81	81
Dnipro-2 HHP	0	21	42	63	84	105	125
Kakhovka HHP	0	20	43	42	43	43	44
Dnistro HHP	0	0	0	0	0	0	0
Total	0	78	156	251	338	420	470

Appendix 3

Load curves for the Ukraine grid