Monitoring Protocol (MP)

for

UkrHydroEnergo (UHE) hydropower rehabilitation project in Ukraine

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1.0 INTRODUCTION

Monitoring of a JI project activity can be defined as "the collection and archiving of all relevant data necessary for determining the baseline, measuring anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary of a JI project activity and leakage, as applicable." Verification is defined as "the periodic independent review and *ex post* determination by a designated operational entity (DOE) of monitored reductions in anthropogenic emissions by sources of greenhouse GHG that have occurred as a result of a registered JI project activity during the verification period."

The purpose of this MP is to provide a standard by which UHE is to conduct monitoring and verification. The MP shall be in accordance with all relevant rules and regulations of JI, once they are established. After the project is validated, this MP will become an integral part of the contractual agreement between the World Bank Carbon Finance Business (CFB) and UHE.

The MP is consistent with the project design document (PDD) prepared for the UHE hydropower rehabilitation project in Ukraine (hereafter referred to as the Project). Both the MP and PDD can be utilized by UHE to facilitate accurate and consistent monitoring of the Project's emission reduction units (ERUs).

UHE is required to use the MP for the duration of the Project activity. It is necessary to strictly follow the MP in order to measure and track the project impacts and prepare for the periodic verification process required to confirm the amount of ERUs achieved.

Specifically, the MP facilitates the following;

- Establishing and maintaining a suitable monitoring system
- Easy calculation of ERUs using the attached spreadsheets
- A cross-checking system to allow UHE to determine whether sustainable development indicators (SDI) have been met
- Guide for the implementation of necessary measurement and management operations
- Guide for meeting requirements in regards to verification and auditing by the DOE (based on requirements similar to those applicable to CDM projects)

At some stage in the project's life the MP may need to be modified to meet changes in operational requirements. Furthermore, modification to the MP may be necessary as the rules and regulations for JI projects are developed.

2.0 CONCEPTS, PRINCIPLE ASSUMPTIONS AND CALCULATIONS

The MP is an extension of the baseline study. It provides an outline of the project boundary and provides the tools for determining ERUs in an accurate and transparent manner. Baseline emissions are determined following the general framework of ACM0002 with some minor modifications to make it more applicable to the conditions found in annex 1 countries.

2.1 Baseline emissions for the UHE Project

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. It 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 end of 2012.

The operating margin (OM) is deemed to best represent what would occur in the absence of the Project. The baseline scenario is the amount (and type) of electricity that would have otherwise been generated by the operation of (Ukraine) grid-connected thermal power plants during peak times. Emissions reductions will be claimed based on total CO_2 emission mitigated by the Project.

The operating margin for the Project is the generation-weighted average of all generating sources, excluding hydropower and nuclear power plants, updated yearly. *Ex post* data is used to update the OM upon being released by the Ukraine Ministry of Fuel and Energy (MFE).

Baseline emissions due to displaced thermal electricity are determined by multiplying the simple OM factor by the increased amount of electricity generated by the Project's rehabilitated hydrounits.

The Project will not be responsible for any project emissions or leakage.

2.2 Geographic and system boundaries for the MP

The spatial extent of the project boundary includes the Project sites (listed below) and all power plants connected physically to the Ukraine gird.

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)

The only gas included in the emission reduction calculation is CO_2.

2.3 Time boundary and baseline review protocol

The Project will be eligible to receive ERU's for a period beginning after Project implementation and continuing to at least the end of 2012.

2.4 Workbook - calculating emission reductions

The following steps must be completed each year in order to calculate ERUs (tCO_2e/yr) for the Project using *ex post* grid data provided by MFE and monitored data for electricity generated by the Project;

1. Calculate the simple OM emission factor for the Ukraine grid
2. Determine the total amount of increased electricity generation due to the Project
3. Calculate the ERs for the Project due to increased electricity generation

2.4.1 Calculate the simple OM emission factor for the Ukraine grid

The following table will be provided in electronic form so that the project participant will only be required to enter in the new fuel consumption data (million tce) and the new electricity generation data (MWh). The OM emission factor is recalculated automatically, after the new data is inputted.

Table 1 – simple OM calculation[1]

Plant type	Fuel consumption (million tce)	Electricity generated (MWh)	Energy content (TJ)	CEF (tC/TJ)	Oxid'n factor	CO_2 emission (tCO_2)	OM
Data Source	MFE	MFE		IPCC	IPCC		
Coal	A	B	A x 1000 x 29.308 = C	D	E	C x D x E x (44/12) = F	F / B
Oil based	G	H	G x 1000 x 29.308 = I	J	K	I x J x K x (44/12) = L	L / H
Gas	M	N	M x 1000 x 29.308 = O	P	Q	O x P x Q x (44/12) = R	R / N
Total for OM cal.		B + H + N = S				F + L + R = T	**T / S**

For the purpose of demonstration only, basic calculations for the simple OM are included below;

The net calorific value for tonnes of coal equivalents in the Ukraine is 29.308 TJ/kt.

Energy content (TJ) = 000's tce x Net calorific vale (29.308)

Next CO_2 emissions for each of the fuel types is calculated:

[1] Data for low-cost/must run resources (hydropower and nuclear) have been excluded from calculations.

CO_2 emission for coal (tCO_2/yr)	=	Fuel consumption (TJ/yr)	x	C emission factor (tC/TJ)	x	Fraction of C oxidised	x	Mass conversion factor (tCO_2/tC) 44/12

The above calculation is repeated to obtain the CO_2 emissions (tCO_2/yr) for natural gas and oil-based. The amount of electricity imported from imports (Russia) is assumed to be zero.

The emission values for coal, natural gas and oil-based are tallied to get the total amount of CO_2 emissions for the Ukraine grid.

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

2.4.2 Determine the total amount of increased electricity generation due to the Project

The following table will be provided in electronic form and simply requires the Project participant to enter in the amount of actual generation by each hydropower plant (MWh/yr) and the water flow (m^3/yr). The table for generation by the Project is shown below:

Table 2 – Table for determination of increased generation due to the Project

Hydropower plant	B.E. factor (m^3/kwh)	Water flow (m^3/yr)	Baseline electricity (MWh/yr)	After rehab gen. (MWh/yr)	Final project gen. (MWh/yr)
Kyiv HPP	39.9	A	A / 39.9 = B	C	C - B = D
Kaniv HPP	40.95	E	E / 40.95 = F	G	G - F = H
Krem HPP	28.26	I	I / 28.26 = J	K	K - J = L
DndzHPP	35.08	M	M / 35.08 = N	O	O - N = O
DniproHPP	11.52	P	P / 11.52 = Q	R	R – Q = S
Kakh HPP	26.79	T	T / 26.79 = U	V	V – U = W
Dnist HPP	8.60	X	X / 8.60 = Y	Z	Z – Y = a
TOTAL	-				

Please see the electronic worksheet ‘ER calculations’ for the tables for each year from 2006 to 2012.

The amount of electricity generation per (Project) plant is determined using the following formula:

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 (after being rehabilitated) as calculated above.

Data for baseline efficiency factor was determined *ex ante* from actual data (2002-2003).

2.4.3 Calculate the ERs for the Project due to increased electricity generation

The baseline emission reductions (tCO_2e) for each year will be generated automatically once all the monitored data has been inserted for a particular year.

Table 3 – Table for determination of Project ERUs

Year	Increased generation due to Project (MWh)	ERs due to increased generation (tCO_2e)
2006	$Total_{gen(2006)}$	$Total_{gen(2006)}$ x OM = $ER_{gen(2006)}$
2007	$Total_{gen(2007)}$	$Total_{gen(2007)}$ x OM = $ER_{gen(2007)}$
2008	$Total_{gen(2008)}$	$Total_{gen(2008)}$ x OM = $ER_{gen(2008)}$
2009	$Total_{gen(2009)}$	$Total_{gen(2009)}$ x OM = $ER_{gen(2009)}$
2010	$Total_{gen(2010)}$	$Total_{gen(2010)}$ x OM = $ER_{gen(2010)}$
2011	$Total_{gen(2011)}$	$Total_{gen(2011)}$ x OM = $ER_{gen(2011)}$
2012	$Total_{gen(2012)}$	$Total_{gen(2012)}$ x OM = $ER_{gen(2012)}$
Total	$Total_{gen(2006-2012)}$	$ER_{gen(2006-2012)}$

2.5 Conservative and transparent approach to ERU calculations

The formulas proposed for this PDD are transparent and reproducible. Data sources and factor used are clearly referenced and official national data has been used where possible.

3.0 OPERATIONAL AND MONITORING OBLIGATIONS

In order to facilitate successful ERU verification, the project participant must fulfill a number of operational and data collection obligations. This will ensure that ERUs are calculated in a transparent manner and monitoring is carried as stipulated in the Monitoring Plan.

3.1 Operational obligations

UHE is obligated to maximize electricity production in order to generate as many ERUs as possible. The net amount of electricity generated by each hydrounit shall be constantly monitored via a meter and the amount double checked by receipt of sales.

3.2 Data requirements and project database

In addition to monitoring electricity produced by the project, the following data shall be collected:

- Names of plants and hydrounit number for those hydrounits which have recommenced operation after undergoing rehabilitation as part of the Project[2].
- 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

In order to calculate the simple OM *ex post*, the following data shall be acquired from MFE after each year and the calculations in the spreadsheet completed;

- 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 (IPCC factors to be used if national data not available).
- Aggregated electricity generation data (MWh/yr) for all generation sources attached to the Ukraine grid.

The complete list of data that needs to be monitored by UHE is included in Annex 1. If the above data cannot be acquired from MFE, the default *ex ante* CEF (see electronic spreadsheet for calculation) will be used.

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

4.0 MANAGEMENT AND OPERATIONAL SYSTEMS MP

In order to ensure a successful operation of the Project and the credibility and verifiability of the ERs achieved, the project must have a well defined management and operational system. It is the obligation of the operator to put such a system in place for the Project. It must include the operation and management of the monitoring and record keeping system that is described in this MP. The proper functioning of the UHE management and operational system must be monitored by the operator and may be subject to third party verification as far as the ability of the project to generate credible ERUs is concerned. Therefore, the project management responsibilities that concern this MP are outlined in this section.

4.1 Allocation of Project management responsibilities

The management and operation of the project is the responsibility of UHE, the project operator. Ensuring the environmental credibility of the project through accurate and systematic monitoring of the project's implementation and operation for the purpose of achieving trustworthy ERUs is the key responsibility and accountability of the operator as far as this MP is concerned. For calculating the ERs, the operator, UHE, shall rely on data published yearly by the MFE.

Independent verifiers may periodically audit the operator and their management systems to ensure credibility and transparency of the reported ERUs and other performance indicators of the UHE project.

For the time the CFB has an interest in the project, it has the responsibility to ensure the credibility of the generated ERUs, arrange for periodic verification (if required) in line with the Kyoto Protocol requirements and modalities as well as other relevant rules, to receive the verified and certified ERUs and to pay the operator as agreed.

4.2 Management and operational systems

It is the responsibility of the operator to develop and implement a management and operational system that meets the requirements of the Project and of this MP. The MP can only offer general guidance in this regard. This includes:

4.2.1 Data handling

- The establishment of a transparent systems for the collection, computation and storage of data, including adequate record keeping and data monitoring systems. The operator must develop and implement a protocol that provides for these critical functions and processes, which must be fit for independent auditing.
- For electronic and paper based data entry and record keeping system, there must be clarity in terms of the procedures and protocols for collection and entry of data, use of workbooks and spreadsheets and any assumptions made, so that compliance with requirements can be assessed by a third party. Stand-by processes and systems, e.g. paper based systems, must outlined and used in the event of and to provide for the possibility of system failures. The record keeping system must provide the paper train that can be audited.

4.2.2 Quality assurance

- The operator, UHE, must designate a competent manager who will be in charge of and accountable for the generation of ERs including monitoring, record keeping, computation of ERs, audits and verification. The person will officially sign-off on all GHG Emission worksheets.
- Well-defined protocols and routine procedures, with good, professional data entry, extraction and reporting procedures will ease time and costs, while making it considerably easier for the auditor and verifier to do their work - the more organised and transparent the organization, the easier to track, monitor, verify and audit.
- Proper management processes and systems records must be kept by the operator, UHE, as the auditors will request copies of such records to judge compliance with the required management systems. Auditors will accept only one set of official information, and any discrepancies between the official, signed records and on-site records will be questioned.

4.2.3 Reporting

- The operator will report regularly to the CFB as well as to Ukraine authorities as required.
- The operator must transmit copies of completed worksheets to the CFB on a regular basis (at least quarterly) while maintaining originals on file.
- The operator, UHE, will prepare reports as needed for audit and verification purposes.
- The project should prepare an brief annul or biannual report which should include: information on overall project performance, emission reductions generated and verified and comparison with targets, observations regarding MP baseline scenario indicators, compliance with sustainable development targets, information on adjustment of key MP assumptions concepts, calculation methods and other amendments of the MP and the monitoring system. The report can be combined with the periodic verification report.

4.2.4 Training

It is the responsibility of the operator to ensure that the required capacity and internal training is made available to its operational staff to enable them to undertake the tasks required by this MP. Initial staff training must be provided before the project starts operating and generating ERUs.

4.2.5 Verification and commissioning

- The management and operational system and the capacity to implement this MP must be put in place before the project can start generating ERUs.
- This will be verified before the project is commissioned by the CFB to generate ERUs that the CFB will accept.

The following Table summarizes the roles and responsibilities of the various project partners with regard to the monitoring system.

Table 4 – MP Management and Operation System: Roles of Project Partners

	UHE	CFB
Monitoring system	• Review MP and suggest adjustments if necessary • Develop and establish management and operations system • Establish and maintain monitoring system and implement MP • Establish or confirm sustainable development indicators and performance targets • Prepare for initial verification and project commissioning	• Review monitoring and management system • Ensure project meets CFB requirements and safeguards • Arrange for initial verification
Data Collection	• Establish and maintain data measurement and collection systems for all MP indicators • Check data quality and collection procedures regularly	• Review data collection systems
Data computation	• Enter date in MP workbooks • Use MP workbooks to calculate emission reductions	• Review completed worksheets
Data storage systems	• Implement record maintenance system • Store and maintain records (paper trail) • Implement sign off system for completed worksheets • Forward monthly and annual worksheet outputs	• Receive copies of key records and reports • Maintain CFB records
Performance monitoring and reporting	• Analyse data and compare project performance with project targets • Analyse system problems and recommend improvements (performance management) • Prepare and forward periodic (monthly) reports	• Review reports • Evaluate performance and assist with performance management
MP Training and Capacity Building	• Develop and establish MP training, and skills review and feedback system • Ensure that operational staff is trained and enabled to meet the needs of this MP	• Assist with MP training and capacity building
Quality assurance, audit and verification	• Establish and maintain quality assurance system with a view to ensuring transparency and allowing for audits and verification • Prepare for, facilitate and co-ordinate audits and verification process	• Supervise projects • Arrange for periodic verification

5.0 AUDITING AND VERIFICATION PROCEDURES[3]

The validation, auditing and verification process for the project shall follow the procedures and requirements laid down in the latest version of the Validation and Verification Manual (VVM) available at the time of the validation or verification activity. The DOE for the project shall follow the VVM in conducting all validation and verification activities for the project, and the project operator shall consult the VVM in order to properly prepare for validation, audits and verification activities. The VVM is available online at http://www.VVManual.info or http://www.ieta.org/VVM/VVM.htm. It can also be obtained from the World Bank Carbon Finance Business or from the DOE validating or verifying the project.

[3] This section is based on CDM requirements since there is presently no guidance on the rules and regulations for JI projects.

ANNEX 1

Table 5 – Data to be monitored

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?[4] (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.
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.

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

7	Electricity generation of each power source		MWh/yr	m	yearly	100%	electronic	Obtained from MFE (latest local statistics).