REHABILITATION OF THE DOLNA ARDA HYDROPOWER CASCADE

JOINT IMPLEMENTATION PROJECT

MONITORING PLAN

PREPARED BY:
VERBUNDPLAN GMBH, VIENNA – AUSTRIA
JULY 2005

Table of Contents

1 THE MONITORING PLAN - INTRODUCTION 4

1.1 PURPOSE OF THE MONITORING PLAN 4
1.2 USE OF THE MONITORING PLAN BY THE PROJECT OPERATOR 4
1.3 STRUCTURE OF THE MONITORING PLAN 5

2 PRINCIPLE ASSUMPTIONS 6

2.1 EMISSION REDUCTION FROM THE DOLNA ARDA PROJECT 6
2.2 MONITORING BOUNDARIES AND POTENTIAL LEAKAGE 6
2.3 CALCULATING EMISSION REDUCTION 7
2.4 CONSERVATIVE APPROACH OF THE MONITORING PLAN 8

3 OPERATIONAL AND MONITORING OBLIGATIONS 9

3.1 DATA COLLECTION AND REPORTING 9
3.2 ALTERNATIVE MONITORING METHODS AND REVISIONS TO THE MONITORING PLAN 9

4 THE DOLNA ARDA JI PROJECT WORKBOOK 10

4.1 GENERAL EXPLANATIONS 10
4.2 EFFICIENCY COEFFICIENT WORKSHEET 11
4.3 THE DOLNA ARDA JI PROJECT GENERATION WORKSHEETS 12
4.3.1 Studen Kladenets New Unit 5 Generation 12
4.3.2 Studen Kladenets (Units 1-4), Kardjali (Units 1-4) and Ivailovgrad (Units 1-3) Rehabilitation Generation 12
4.3.3 Total Dolna Arda Cascade Generation Worksheet 13
4.4 EMISSION FACTOR WORKSHEET 13
4.5 MARGINAL AND NEXT MARGINAL PLANT WORKSHEET 14
4.6 DISPATCH WITHOUT THE DOLNA ARDA JI PROJECT AND THE EMISSION REDUCTION CALCULATION WORKSHEET 15
4.7 CUMULATIVE CO_2 EMISSION REDUCTION WORKSHEET 16
4.8 DATA TRANSFER AND STORAGE 17

5 MANAGEMENT AND OPERATIONAL SYSTEMS MONITORING PLAN 18

5.1 PROJECT MANAGEMENT RESPONSIBILITIES 18
5.2 MANAGEMENT AND OPERATIONAL SYSTEMS 18

6 AUDITING AND VERIFICATION PROCEDURES 21

6.1 AUDIT AND VERIFICATION OBJECTIVES 21
6.2 THE AUDIT AND VERIFICATION REGIME 21
6.3 AUDITING CRITERIA AND NEEDS 22
6.4 AUDIT AND VERIFICATION PROCESS 23
6.5 ROLES AND RESPONSIBILITIES 24

List of Tables

TABLE 1: WORKSHEET 1 - EFFICIENCY COEFFICIENT 11
TABLE 2: WORKSHEET 2 – STUDEN KLADENETS NEW UNIT 5 GENERATION 12
TABLE 3: WORKSHEET 3 – STUDEN KLADENETS UNIT 1 GENERATION 12
TABLE 4: WORKSHEET 14 – DOLNA ARDA CASCADE GENERATION 13
TABLE 5: WORKSHEET 15 – EMISSION FACTORS 14
TABLE 6: WORKSHEET 16 – MARGINAL PLANT 14
TABLE 7: WORKSHEET 18 – EMISSION REDUCTION CALCULATION 15
TABLE 8: WORKSHEET 19 - CUMULATIVE CO_2 EMISSION REDUCTIONS 16
TABLE 9: MONITORING PLAN: MANAGEMENT AND OPERATIONAL RESPONSIBILITIES 20

List of Figures

FIGURE 1: FLOW-CHART EMISSION REDUCTION CALCULATION 7

Abbreviations

CDM	Clean Development Mechanism
CMP	Capacity Marginal Plant
CNMP	Capacity Next Marginal Plant
CO_2	Carbon Dioxide
EC1	Efficiency Coefficient before rehabilitation
EC2	Efficiency Coefficient after rehabilitation
EF	Emission Factor
EFMP	Emission Factor Marginal Plant
EFNMP	Emission Factor Next Marginal Plant
EPS	Electric Power System
ER	Emission Reduction
ERU	Emission Reduction Units
GHG	Greenhouse Gas
GMP	Generation Marginal Plant
GWh	Gigawatt hours
GDAC	Total Generation Dolna Arda Cascade JI Project
HPP	Hydro Power Plant
JI	Joint Implementation
MP	Monitoring Plan
NDC	National Dispatch Center
NEK EAD	Natsionalna Elektricheska Kompania EAD
PC	Plant Code
PDD	Project Design Document
PSHPP	Pump Storage Hydro Power Plant
UCTE	Union for the Co-ordination of Transmission of Electricity

1 The Monitoring Plan - Introduction

1.1 Purpose of the Monitoring Plan

The Monitoring Plan (MP) for the Dolna Arda Hydropower Cascade Rehabilitation Joint Implementation Project (hereafter Dolna Arda JI Project) describes the key characteristics of the project related to greenhouse gases (GHG) that will be monitored to provide evidence that the project is performing according to expectations. The MP is part of the Project Design Documents (PDD) and is based on the methodologies and results of the Baseline Study.

The MP also provides a practical framework for the collection and management of project performance data which will be used for the verification of actual emission reductions generated. Verification is the periodic auditing of monitoring results by a third party, the assessment of achieved emission reductions. This MP does not contain specific guidelines on ER auditing and verification, but it provides sufficient detail on the project structure, the proposed data monitoring methodologies and relevant operational issues, to allow an independent verifier to develop suitable auditing and verification procedures for the Dolna Arda JI Project.

After its validation, the MP will be an integral part of the contractual agreement between the Austrian JI/CDM Programme and the Natsionalna Elektricheska Kompania EAD (NEK) Sofia, the operator of the Dolna Arda JI Project.

1.2 Use of the Monitoring Plan by the Project Operator

The Dolna Arda JI Project Monitoring Plan is a working document that identifies the key project performance indicators and sets out the procedures for tracking, monitoring and calculating the impacts of the project, in particular with respect to the project's emission reductions.

This MP must be used by the Operator of the Dolna Arda JI Project (Natsionalna Elektricheska Kompania EAD) when planning and implementing the project as well as during the project's operation. Adherence to the instructions in the MP is necessary for the project operator to successfully measure and track the project impacts and prepare for the periodic audit and verification process that must be undertaken to confirm the achieved emission reductions. The MP is thus the basis for the production and delivery of Emission Reduction Units (ERUs) to the Austrian JI/CDM Programme.

The MP assists the operator in establishing a credible, transparent, and adequate data measurement, collection, recording and management system to successfully develop and maintain the proper information required for an audit of the collected information and for the verification and certification of the achieved emission reductions. Specifically, the Dolna Arda JI Project Monitoring Plan provides the requirements and instructions for establishing and maintaining the appropriate monitoring system including Worksheets for the calculation of emission reductions and the implementation of the necessary measurement and management operations. Furthermore, instructions for the requirements of independent, third party verification and audits are prepared.

The MP ensures environmental integrity and accuracy of crediting ERs by only allowing actual ERs to be accounted for after they have been achieved. The MP must therefore be used throughout the crediting period of the project by being adopted as a key input into the detailed planning of the project and included into the operational manuals of the Dolna Arda JI Project.

The Monitoring Plan can be updated and adjusted to meet operational requirements, provided such modifications are approved by the verifier during the process of initial or periodic verification. In particular, any shifts in the applicable baseline that are identified by following this MP may lead to such amendments, which may be mandated by the verifier.

1.3 Structure of the Monitoring Plan

The Dolna Arda JI Project Monitoring Plan consists of the following parts:

- Chapter 2 describes the assumptions for monitoring the performance of the project in terms of CO_2 mitigation and calculating the emission reductions. The chapter defines the system boundaries and states the assumptions for calculating the emission reductions.
- Chapter 3 defines the operational and monitoring obligations for the project operator.
- Chapter 4 contains the description of the electronic Dolna Arda JI Project Workbook. This workbook is based on Excel and automatically calculates the emission reductions achieved in the project based on the input data provided by the project operator.
- Chapter 5 describes the Management and Operational System, which has to be established.
- Chapter 6 details the auditing and verification procedures for the project.

2 Principle assumptions

2.1 Emission reduction from the Dolna Arda project

The Dolna Arda JI Project consists of four main parts: the refurbishment of HPP Kardjali, HPP Ivailovgrad, HPP Studen Kladenets, and the installation of an additional generating unit in HPP Studen Kladenets. All hydropower plants are in the Dolna Arda Cascade. The project is developed and owned by Natsionalna Elektricheska Kompania EAD (NEK), a sole-owner joint-stock company which is held 100% by the Bulgarian State and has its headquarters in Sofia.

The Dolna Arda hydropower cascade is situated in the middle and lower part of the Arda River in south-eastern Bulgaria. The Arda River springs from the middle part of the Rhodopi Mountains, collects the waters coming from several smaller rivers and flows into Maritsa River at the town of Odrin in Turkey.

The rehabilitation of the three existing hydropower plants within the cascade – HPP Kardjali, HPP Ivailovgrad and HPP Studen Kladenets – will generate an additional **20,9 GWh/a** due to the increased efficiency coefficients as a result of rehabilitation. The installation of an additional generating unit in HPP Studen Kladenets will increase the annual power generation by approx. **42,7 GWh/a**. As a result of this project, the total increase in power generation by renewable energy sources in the Dolna Arda Cascade will be **63,6 GWh/a**. Hence, the additional electricity generated by the Dolna Arda Cascade project will replace electricity generated by other power plants in the Bulgarian electric power system. As stated in the Baseline Study, whenever a Dolna Arda Cascade project is dispatched, it will move other dispatchable power units upwards the dispatch order.

As indicated in the Baseline Study, the actual emission reductions to be credited to the Dolna Arda JI Project will be based on the actual dispatch of the Bulgarian Electric Power System. The methodology for establishing the emission reductions is provided in the Baseline Study.

2.2 Monitoring Boundaries and Potential Leakage

The electricity generated by the Dolna Arda JI Project will be delivered to the Bulgarian Electric Power System (EPS). The National Dispatch Center (NDC), in its capacity as the system operator, performs the function of real time dispatching in the EPS of the Republic of Bulgaria. Its main assignment is to guarantee reliable and economic operation of the Bulgarian EPS and its synchronous operation with the partners within the Second Synchronous Zone of UCTE.

As described in the Baseline Study, the relevant system boundaries of the project are congruent with the EPS including exports and imports. Therefore the geographical boundaries are congruent with the territory of the Republic of Bulgaria.

Indirect emission effects are changes in emission levels that are caused by the project but occur outside of the baseline and project boundaries. Indirect effects can be positive or negative. If indirect effects are significant, calculated emission reductions within the project

boundaries must be corrected for leakage. In the case of the Dolna Arda JI Project, no identifiable leakage will occur, and thus there is no need to correct the calculated emission reductions in the Monitoring Plan.

2.3 Calculating Emission Reduction

The emission reductions from the Dolna Arda JI Project are based on the installation of an additional generating unit in HPP Studen Kladenets (Unit 5) as well as the additional power generation of the existing hydropower stations in the Dolna Arda Cascade as a result of their increased efficiency coefficients. The power generation from the Dolna Arda Cascade Project displaces power generated by other dispatchable units in the Bulgarian EPS.

The following flow-chart illustrates the applied method for calculating emission reductions.

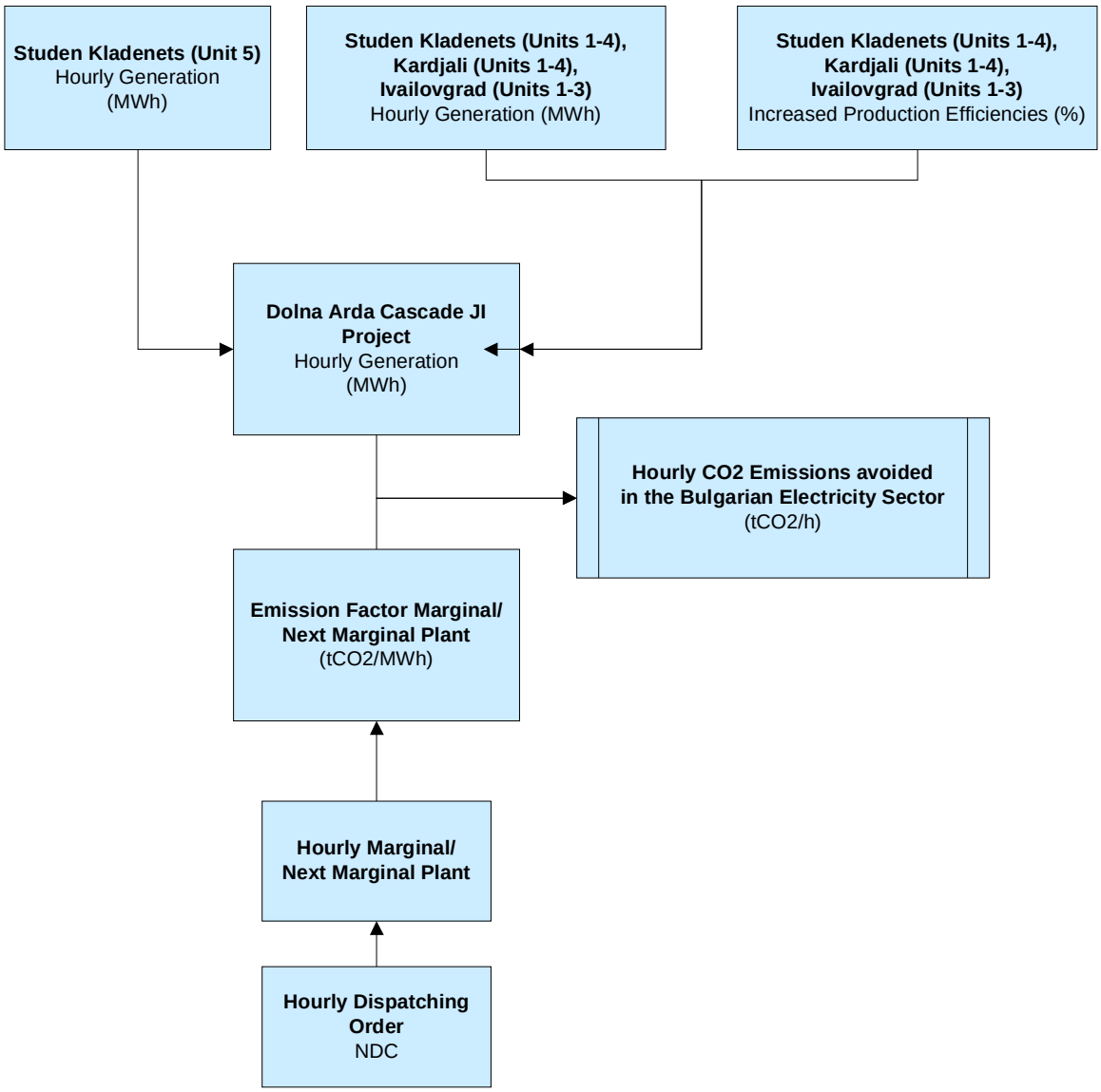

Figure 1: Flow-Chart Emission Reduction Calculation

The project operator (NEK EAD) has received the official confirmation from the National Dispatch Center (NDC) that hourly monitoring of all required parameters will be provided.

Based on the hourly dispatch order, NDC prepares reports on the Bulgarian EPS, in particular on the marginal and the next marginal plant and the actual generation and specific emission factors. The information required to perform the monitoring in the project is thus made available by NDC to the project operator NEK EAD.

2.4 Conservative Approach of the Monitoring Plan

The methodology for the monitoring and the calculation of the emission reductions is based on metered parameters and real time dispatch data for the Bulgarian EPS. This reduces the likelihood that the monitoring will lead to an overestimation of the emission reductions. In addition, the project does not claim emission reductions from emissions associated with the production and transportation of the fossil fuels used in the marginal plants. Also, the lifetime of the project will significantly exceed the crediting period.

For these reasons, the calculated emission reductions are seen as conservative figures with no tendency to overestimate the emission reduction generated by the Dolna Arda Cascade JI Project throughout the crediting period.

3 Operational and monitoring obligations

The Project Operator (NEK EAD) of the Dolna Arda JI Project must fulfil certain operational and data collection obligations in order to ensure that sufficient information is available to calculate emission reductions in a transparent manner and to allow for a successful verification of these emission reductions. The operational obligations of the Project Operator are to ensure that all reasonable steps to maximize the generation from the Dolna Arda Cascade facilities are taken.

3.1 Data Collection and Reporting

To perform the monitoring requirements (see Figure 1: Flow-Chart Emission Reduction Calculation), the Project Operator has to collect the following data from the sources listed below:

1. NEK EAD:
   - Hourly generation of Unit 5 in HPP Studen Kladenets
   - Hourly generation of each individual generating unit in HPP Studen Kladenets (Units 1-4), HPP Kardjali (Units 1-4) and HPP Ivailovgrad (Units 1-3)
   - Efficiency coefficients of each individual generating unit in HPP Studen Kladenets (Units 1-4), HPP Kardjali (Units 1-4), and HPP Ivailovgrad (Units 1-3) **before** the rehabilitation project
   - Efficiency coefficients of each individual generating unit in HPP Studen Kladenets (Units 1-4), HPP Kardjali (Units 1-4), and HPP Ivailovgrad (Units 1-3) **after** rehabilitation

2. National Dispatch Center (NDC):
   - Actual hourly marginal and next marginal plant in the Bulgarian EPS
   - Actual generation and available capacity of the marginal and next marginal plants
   - Emission factors of the marginal and next marginal plants

The Project Operator will transfer all required data into the Workbook provided for this purpose as described in section 4.

The Operator must integrate the monitoring requirements and the calculation of the emission reductions into the operational procedures for the Dolna Arda JI Project. In particular, the Operator has to install the electronic workbook. In order to avoid errors based on data transfer, maximum automation of the workbook is desired. The implementation of the monitoring system and the calculation of the emission reductions are subject to review and approval at the verification.

3.2 Alternative Monitoring Methods and Revisions to the Monitoring Plan

The Monitoring Plan can be adjusted as is necessary and in response to changing circumstances in order to maintain a high quality monitoring and emission reductions calculation system. All adjustments must be approved by the verifier.

4 The Dolna Arda JI Project Workbook

The following section explains and illustrates the procedure to calculate the emission reductions achieved through the implementation of the Dolna Arda JI Project on a monthly basis using the Workbook. Each individual Worksheet is described and the use is illustrated.

4.1 General Explanations

The Dolna Arda JI Project Workbook consists of the following nineteen separate Worksheets:

1. Efficiency Coefficients
2. Studen Kladenets New Unit 5 Generation
3. Studen Kladenets Unit 1 Generation
4. Studen Kladenets Unit 2 Generation
5. Studen Kladenets Unit 3 Generation
6. Studen Kladenets Unit 4 Generation
7. Kardjali Unit 1 Generation
8. Kardjali Unit 2 Generation
9. Kardjali Unit 3 Generation
10. Kardjali Unit 4 Generation
11. Ivailovgrad Unit 1 Generation
12. Ivailovgrad Unit 2 Generation
13. Ivailovgrad Unit 3 Generation
14. Total Project Generation
15. Emission Factors
16. Marginal Plants
17. Next Marginal Plants
18. Emission Reductions
19. Cumulative Emission Reductions

The following color keys are used in the Dolna Arda Workbook:

- **Title Field:** Gray fields describe data and are the headings for the Worksheet sections.
- **Input Field:** Yellow fields indicate cells in which the Project Operator is required to supply data input needed to run the Worksheet.
- **Input Field – from cell within workbook:** Light Yellow fields indicate cells where the Project Operator is required to transfer data from another cell in the workbook.
- **Calculation Field**: Blue fields include formulas that automatically calculate a parameter once the Project Operator has entered the input data in the yellow fields.

The Project Operator must complete one workbook per month starting with January 2008. Each month's workbook must be saved with a unique name reflecting the month for which monitoring has been carried out (e.g. 01/2008). Furthermore, the Project Operator has to retain a hard copy of every month's workbook. The monthly workbooks will be a transparent record of electricity generation and emission reductions. On an annual basis cumulative emission reductions are determined.

4.2 Efficiency Coefficient Worksheet

The additional electricity expected to be generated by the Studen Kladenets (Units 1-4), Kardjali (Units 1-4) and Ivailovgrad (Units 1-3) hydropower plants will be the result of the increased efficiency coefficients achieved by the Dolna Arda Cascade rehabilitation project.

The efficiency coefficients are determined by the thermo-dynamic method according to IEC Standard 41 – 'Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines'. A detailed description of the applied method is shown in Annex **Fehler! Verweisquelle konnte nicht gefunden werden.**. All tests will be prepared by an independent team of experts (Technical University of Sofia).

The efficiency coefficient data have to be derived from measurements made for each hydropower plant at different operation modes. Efficiency coefficients for each individual generating unit before rehabilitation (EC1) have to be entered in *cells D3-N3*. Final figures after rehabilitation have to be entered in cells *D4-N4*. Based on these results, the increase in the efficiency coefficients is calculated in cells *D5-N5*.

	A	B	C	D	E	...	N
1	**Efficiency Coefficient Worksheet**						
2				**HPP Studen Kladenets Unit 1**	**HPP Studen Kladenets Unit 2**		**HPP Ivailovgrad Unit 3**
3	**Measured efficiency coefficient before Rehabilitation**	Average	%	EC1 Studen Kladenets Unit 1	EC1 Studen Kladenets Unit 2		EC1 Ivailovgrad Unit 3
4	**Measured efficiency coefficient after Rehabilitation**	Average	%	EC2 Studen Kladenets Unit 1	EC2 Studen Kladenets Unit 2		EC2 Ivailovgrad Unit 3
5	**Increase in Efficiency Coefficient**			**1-(D3/D4)**	**1-(E3/E4)**		**1-(N3/N4)**

Table 1: Worksheet 1 - Efficiency Coefficient

- EC1: Efficiency Coefficient before rehabilitation
- EC2: Efficiency Coefficient after rehabilitation

The Project Operator provides measurement reports of all executed measurements. The efficiency coefficients have to be determined once for each unit before rehabilitation, and once for each unit as soon as rehabilitation works on that particular unit have been completed. Once a unit is rehabilitated, the efficiency coefficients should not change significantly anymore. The Dolna Arda JI Project is expected to be completed according to the time schedule in the Baseline Study. The first unit in each HPP is expected to be rehabilitated by fall of 2007, thus the new efficiency coefficients should be included in the first Worksheet in January 2008. The rehabilitation works on the remaining units will be carried out during the spring and summer months of 2008-2010, and the efficiency coefficients of the rehabilitated units must be measured and determined by the end of each year so that the new efficiencies can be included in the monitoring report by the beginning of the following year.

The measurement reports will be attached to the monitoring report until completion of rehabilitation works (end of 2010).

4.3 The Dolna Arda JI Project Generation Worksheets

The calculation of the Dolna Arda electricity generation is based on Worksheets 2-14.

4.3.1 Studen Kladenets New Unit 5 Generation

NEK EAD, the Project Operator, reports the net generation due to the new generating unit in HPP Studen Kladenets (Unit 5) on an hourly basis. The data is obtained from the metering system at the power station and will be stored automatically in a database (SAT 250 SCADA). To transfer data from the database to the Worksheets, data will be transformed in the corresponding formats and will be transferred by email from the power station to the person responsible for the Workbook. Table 2 shows the Excel spreadsheet used for generation data acquisition.

	A	B	C	D	E	F	G	H	I	J	K	…	Z	AA
1	**Studen Kladenets New Unit 5 Generation Worksheet**						**Year:**		**Month:**					
2			**Hour**											
3	**Day**		**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**…**	**23:00**	**Total**
4	**1**	MWh												SUM(C4:Z4)
5	**2**	MWh												SUM(C5:Z5)
6	**3**	MWh												SUM(C6:Z6)
…	**…**	MWh												…
34	**31**	MWh												SUM(C34:Z34)
35	**Total Month**	MWh												SUM(AA4:AA34)

Table 2: Worksheet 2 – Studen Kladenets New Unit 5 Generation

4.3.2 Studen Kladenets (Units 1-4), Kardjali (Units 1-4) and Ivailovgrad (Units 1-3) Rehabilitation Generation

The additional electricity generated by the Studen Kladenets (Units 1-4), Kardjali (Units 1-4) and Ivailovgrad (Units 1-3) hydropower plants is the result of (i) total hourly generation of each generating unit multiplied by (ii) the increase in the efficiency coefficient of each generating unit. The first step of calculating the additional electricity generation is shown in the Studen Kladenets Unit 1 Generation Worksheet. Data transfer is organized as described in chapter 4.3.1.

	A	B	C	D	E	F	G	H	I	J	K	…	Z	AA
1	**Studen Kladenets Unit 1 Generation Worksheet**						**Year:**		**Month:**					
2			**Hour**											
3	**Day**		**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**…**	**23:00**	**Total**
4	**1**	MWh												SUM(C4:Z4)
5	**2**	MWh												SUM(C5:Z5)
6	**3**	MWh												SUM(C6:Z6)
…	**…**	MWh												…
34	**31**	MWh												SUM(C34:Z34)
35	**Total**	MWh												SUM(AA4:AA34)

Table 3: Worksheet 3 – Studen Kladenets Unit 1 Generation

Generation data collection for all other units in the Studen Kladenets, Kardjali and Ivailovgrad power stations (Worksheets 4-13) has the same structure as the Studen Kladenets Unit 1 Generation Worksheet.

4.3.3 Total Dolna Arda Cascade Generation Worksheet

The Total Dolna Arda Cascade Generation Worksheet is shown in the following table. Increased efficiency coefficients (Worksheet 1) and generation data (Worksheets 2-13) are used to calculate the hourly Dolna Arda Cascade generation.

	A	B	C	D	E	F	G	H	I	J	K	…	Z	AA
1	**Total Project Generation Worksheet**						**Year:**		**Month:**					
2			**Hour**											
3	**Day**		**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**…**	**23:00**	**Total**
4	**1**	MWh	GDAC											SUM(C4:Z4)
5	**2**	MWh												SUM(C5:Z5)
6	**3**	MWh												SUM(C6:Z6)
…	**…**	MWh												…
34	**31**	MWh												SUM(C34:Z34)
35	**Total**	MWh												SUM(AA4:AA34)

Table 4: Worksheet 14 – Dolna Arda Cascade Generation

- GDAC: Total Generation Dolna Arda Cascade JI Project

The hourly total generation of the Dolna Arda Cascade JI Project (GDAC) is the sum of the power generation due to the new unit in Studen Kladenets plus the power generation of each individual unit in the three power plants – Studen Kladenets (all units except the new one), Kardjali, and Ivailovgrad – multiplied by the increase in efficiency coefficients which must be derived for each unit separately. If a unit has not been rehabilitated yet, then the increase in efficiency coefficient will be zero and thus there will be no additional generation due to that particular unit.

4.4 Emission Factor Worksheet

Each thermal power plant has its own specific emission factor according to its specific energy consumption, efficiency and type of fuel. In order to determine the plant specific emission factors (EF), each power plant in the Bulgarian EPS is given a numerical code. Emission factors are required for all marginal and next marginal plants and are reported on a monthly basis.

The specific heat rates are manually calculated for each month at each TPP. The carbon contents are measured accordingly. Until the 10th of the following month the Project Operator NEK EAD and the NDC will receive the calculated plant specific emission factors for each month. The data is transferred via Email.

	A	B	C
1	**Emission Factors**	**Year:**	
2		**Month:**	
3	**Power Station**	**Code**	**Emission Factor**
4			**tCO2/GWh**
5	TPP Bobov dol	1	EF1
6	TPP Varna	2	EF2
7	TPP Brikel (Maritsa Iztok #1)	3	EF3
8	TPP Maritsa Iztok #2 part (150MW)	4	EF4
9	TPP Maritsa Iztok #2 part (210MW)	5	EF5
10	TPP Maritsa Iztok #3	6	EF6
…	…	…	…
30	New TPP burning imported coal	26	EF26
31	New Combined Cycle PP	27	EF27
32	New TPP burning indigenous lignites	28	EF28
33	New NPP	29	EF29
34	Pump Storage HPP Chaira	30	EF30
35	Other	31	EF31

Table 5: Worksheet 15 – Emission Factors

- EF: Emission Factor

If monthly emission factors are not available, NDC will report annual plant specific emission factors. In the absence of actual emission factors, the most recent emission factors for corresponding types of power plants published by the Intergovernmental Panel on Climate Change will be used.

4.5 Marginal and next Marginal Plant Worksheet

This worksheet records the available capacity and the actual generation of the marginal plant. All required information is provided by the National Dispatch Center (NDC). A similar worksheet is applied for reporting the next marginal plants (Worksheet 17).

All required data will be stored in the SCADA database and can be transferred easily to Microsoft Excel. The data transfer will be arranged via Email.

	A	B	C	D	E	F	G	H	I	…	AA	AB
1	**Marginal Plant Worksheet**				**Year:**		**Month:**					
2					**Hour**							
3	**Day**				**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**…**	**22:00**	**23:00**
4	**1**	**Marginal Plant**	Name (Code)		PC							
5			Capacity	MW	CMP							
6			Generation	MWh	GMP							
7			Emission Factor	tCO2/GWh	SVERWEIS(E4;'7. Emission Factor'!$B$5:$C$35;2;0)							
8	**2**	**Marginal Plant**	Name (Code)									
9			Capacity	MW								
10			Generation	MWh								
11			Emission Factor	tCO2/GWh								
…												
124	**31**	**Marginal Plant**	Name (Code)									
125			Capacity	MW								
126			Generation	MWh								
127			Emission Factor	tCO2/GWh								

Table 6: Worksheet 16 – Marginal Plant

The worksheet includes the name/code of the marginal power plant, the amount of energy generated by the marginal power plant and the available capacity at the marginal power plant on an hourly basis. The emission factors reported in Emission Factor Worksheet[1] will complete this worksheet.

- PC: Plant Code
- CMP: Available Capacity Marginal Plant
- GMP: Generation Marginal Plant

4.6 Dispatch without the Dolna Arda JI Project and the Emission Reduction Calculation Worksheet

Based on the data collected in Worksheets 1-17, the following worksheet will answer the question what would happen without the implementation of the Dolna Arda JI Project and in particular the emission reduction that has occurred due to the implementation of the Dolna Arda JI project.

The methodology described in the Baseline Study (marginal plant only - least cost dispatch analysis) assumes that the plants running at the margin (with the highest cost) will be the first to be replaced. Without the implementation of the Dolna Arda JI Project, the marginal plant (and in some cases the next marginal plant) would increase its generation by the same amount that is being generated by the Dolna Arda Cascade in that hour.

	A	B	C	D	E	F	H	I	…	AB	AC
1	**Dispatch w/o Dolna Arda Cascade Worksheet**				**Year:**		**Month:**				
2					**Hour**						
3	**Day**				**0:00**	**1:00**	**2:00**	**3:00**	**…**	**23:00**	**Total**
4	**1**	**Dolna Arda Cascade**	Generation	MWh	GDAC						
5		**Marginal Plant**	Capacity	MW	CMP						
6			Generation	MWh	GMP						
7			Incremental Generation	MWh	IF(E4<(E5-E6);E4;E5-E6)						
8			Emission Factor	tCO2/MWh	EFMP						
9			Emission Reduction	tCO2.	E7*E8						
10		**Next Marginal Plant**	Capacity	MW	CNMP						
11			Generation	MWh	GNMP						
12			Incremental Generation	MWh	E4-E7						
13			Emission Factor	tCO2/MWh	EFNMP						
14			Emission Reduction	tCO2	E12*E13						
15		**Total**	**Emission Reduction**	**tCO2**	**E9+E14**						SUM(E15:AB15)
…	**…**	**…**									
376		**Total Month**	**Emission Reduction**	**tCO2**							**SUM(AC4:AC375)**

Table 7: Worksheet 18 – Emission Reduction Calculation

Usually the available additional capacity of the marginal plant should be sufficient to cover the Dolna Arda Cascade generation. Therefore the emission reductions will be equal to the electricity generated by the Dolna Arda Cascade Project multiplied by the specific emission factor of the marginal plant. The calculation of the incremental generation of the marginal plant is shown in cell *E7* in the worksheet above. If the marginal plant has insufficient additional available capacity to cover the Dolna Arda Cascade generation, the residual generation *(E4-E7*) will virtually be generated by the next marginal plant. The incremental

[1] section 4.4 Emission Factor Worksheet

generation of the next marginal plant is shown in cell *E12,* which is simply the Dolna Arda Cascade generation minus the incremental generation of the marginal plant. Finally the emission reduction is calculated as a binomial formula. The summation of the incremental generation of the marginal plant *(E7)* times the plant specific emission faction *(E8)* and the incremental generation of the next marginal plant *(E12)* times the specific emission factor *(E13*) will result in the emission reductions achieved through the implementation of the Dolna Arda JI project. The calculation of the emission reductions is done on an hourly basis and results in the daily emission reduction as shown in cell *AC15*. Due to the fact that the Dolna Arda JI project monitoring plan is based on a monthly reporting period, the total monthly emission reduction is calculated in cell *AC376*.

GDAC: Total Generation Dolna Arda Cascade JI Project
CMP: Capacity Marginal Plant
GMP: Generation Marginal Plant
EFMP: Emission Factor Marginal Plant
CNMP: Capacity Next Marginal Plant
GNMP: Generation Next Marginal Plant
EFNMP: Emission Factor Next Marginal Plant

4.7 Cumulative CO_2 Emission Reduction Worksheet

Once work on the monthly Workbook is complete, the Project Operator transfers the total amount of emission reductions to the appropriate cell (according to the month and year) of the Cumulative CO_2 Emission Reduction Worksheet.

	A	B	C	D	E	F	G
1	**Cumulative Emission Reduction Worksheet**						
2		**2008**	**2009**	**2010**	**2011**	**2012**	**Total 2008-2012**
3		GHG Emission Reduction	GHG Emission Reduction	GHG Emission Reduction	GHG Emission Reduction	GHG Emission Reduction	GHG Emission Reduction
4	**Month**	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
5	**January**						
6	**February**						
…							
15	**November**						
16	**December**						
17	**Total**	SUM(B5:B16)	SUM(C5:C16)	SUM(D5:D16)	SUM(E5:E16)	SUM(F5:F16)	SUM(B17:F17)

Table 8: Worksheet 19 - Cumulative CO_2 Emission Reductions

The Cumulative CO_2 Emission Reduction Worksheet adds the monthly CO_2 emission reduction figures up to produce annual GHG emission savings (see Table 8).

4.8 Data Transfer and Storage

As mentioned, once the operator has completed the monthly workbook, the workbook must be saved as the auditable record for any entity wishing to verify the emissions reductions achieved by the project. The operator must do this each month, building up a series of monthly workbooks. In addition, the operator must maintain a paper trail of all relevant documentation and measurements and of the monthly signed off workbooks.

When calculating the next month's figures, the operator takes the previous month's workbook, deletes the input data in the Dolna Arda Cascade Workbook, enters the new month's parameters, transfers the new monthly CO_2 emissions reduction to the Cumulative CO_2 Emission Reduction Worksheet and then saves the new workbook under a new name and date.

5 Management and Operational Systems Monitoring Plan

In order to ensure a successful operation of the Dolna Arda JI Project and to maintain the credibility and verifiability of the emission reductions generated, a well defined management and operational system has to be established. It is the responsibility of the project operator (NEK EAD) that a system is implemented, which clearly assigns project management responsibilities and defines procedures to establish credible emission reductions. The proper function of the management and operational system must be monitored by NEK EAD.

5.1 Project Management Responsibilities

The responsibility for management and operation of the Dolna Arda JI Project rests with the project operator, NEK EAD. Ensuring the credibility of the project through accurate and systematic monitoring of the project's implementation and operation for the purpose of achieving trustworthy emission reductions is the key responsibility and accountability of the project operator as far as this monitoring plan is concerned. However, the project operator will need to work in close co-operation with the National Dispatch Center (NDC), which will report the marginal and the next marginal plants on an hourly basis.

5.2 Management and Operational Systems

It is the responsibility of NEK EAD to develop and implement a management and operational system that meets the requirements of this Monitoring Plan. This Monitoring Plan establishes the framework for these requirements.

Data handling:
A transparent system for the collection, computation and storage of data, including adequate record keeping and data monitoring systems, must be established.

There must be clarity in terms of the procedures and protocols for the collection and entry of data, use of workbooks and Worksheets 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 be used to provide for the possibility of system failures. The record keeping system must provide a paper trail that can be easily audited.

Quality assurance:
The Project Operator must designate a competent manager (the Manager) who will be in charge of, and accountable for, the generation of data, monitoring, record keeping, and computation of ERs, and of audits and verification. He/she shall officially sign all worksheets.

The Manager shall establish well-defined protocols and routine procedures, with professional data entry, extraction and reporting procedures, aimed at facilitating the auditor and verifier work. The more organized and transparent the organization the easier will be to track, monitor, verify and audit.

Proper management processes and systems records must be kept by the Project Operator, 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.

Reporting:
The Project Operator will prepare reports, as needed, for audit and verification purposes.

The Project Operator should prepare a brief Annual Emission Reduction Report including information on overall project performance, emission reductions generated and information on adjustment of key Monitoring Plan assumptions, calculation methods and other amendments of the MP and the monitoring system.

Training:
It is the responsibility of the Project Operator to ensure that the required capacity is available and that his operational staff participates in internal training to enable them to undertake the tasks required by this MP. Initial training must be provided to the staff before the Project starts operating and generating ERs.

The following Table describes the management system of the Dolna Arda Cascade JI Project.

	NEK EAD - Project Operator	Worksheet
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	
Data collection	Establish and maintain data measurement and collection systems for all MP indicators Check data quality and collection procedures regularly Measure plant efficiencies after rehabilitation Dolna Arda Cascade Generation Emission Factors Bulgarian Power Stations Marginal and Next Marginal Plant Enter and control data in MP workbooks	Worksheet 1 Worksheets 2-14 Worksheet 15 Worksheet 16-17 Worksheets 1-17
Data computation	Use MP workbooks to calculate emission reductions on a monthly basis Enter data in annual worksheet	Worksheet 18 Worksheet 19
Data storage systems	Implement record maintenance system Store and maintain records (paper trail) Implement sign off system for completed worksheets	
Performance monitoring and reporting	Analyze data and compare project performance with project targets Analyze system problems and recommend improvements (performance management) Prepare and forward periodic reports	
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	
Quality assurance, audit and verification	Establish and maintain quality assurance system with a view to ensuring transparency and allowing for verification Prepare for, facilitate and coordinate verification process Arrange for periodic verification	

Table 9: Monitoring Plan: Management and Operational Responsibilities

6 Auditing and Verification Procedures

6.1 Audit and Verification Objectives

Periodic auditing and verification of project results is a mandatory component for all JI projects. The chief objective of the audit is to independently verify that the project has achieved the emission reductions reported by the operator. Audits are an integral part of the verification process and are undertaken in conjunction with verification and by the same firm.

This section of the MP outlines the auditing and verification procedures and prerequisites. It provides instructions on how the monitoring work undertaken by the project operator in line with this MP as well as project performance and compliance with JI requirements will be verified.

6.2 The Audit and Verification Regime

The verification system for JI projects consists of three activities:

Validation of project design:
JI projects undergo validation of the Project Design Document, including the Baseline Study and the Monitoring Plan, against JI requirements and modalities. Validation is a JI requirement. This MP has been (will be) validated for use with the Dolna Arda JI Project and must be followed by the project operator. This MP can be adjusted or amended, if necessary, in order to improve consistency with its objectives, general concepts and project circumstances, subject to approval by the project verifier.

Periodic verification of emission reductions:
All JI projects must undergo periodic audits and verification of emission reductions. This is a JI requirement and the basis for setting aside Assigned Amount Units (one to one for emission reductions prior to 2008) and issuance of Emission Reduction Units (ERUs) and for their value in the market place. Verification is arranged by the Project Operator and conducted at annual intervals.

The purpose of periodic audits and verification is to confirm that:
- the project has achieved the ERs claim for the verification period in compliance with the methodology laid down in this MP.
- the claimed ERs are real and additional to any that would have occurred in the baseline scenario as interpreted and developed in the Dolna Arda Cascade Baseline Study and this MP.
- the operation of the project continues to be in compliance with the Kyoto Protocol.
- the project maintains a high quality monitoring system consistent with the MP.

As part of the periodic audit and verification process, auditors are expected to:
- review and audit relevant monitoring records and reports,
- verify that the required measurements and observations have been made for all monitorable indicators in this MP,

- check whether the MP methodology has been applied correctly and consistently
- check whether achieved ERs have been computed correctly using the provided spreadsheets, and, if necessary, recalculate achieved ERs,
- verify that all relevant MP and baseline assumptions are still valid,
- verify that the management and monitoring system, including data handling, record keeping and reporting, is in place and remains adequate,
- consult with the operator on the continued adequacy of the monitoring system and approve any modifications that need to be made to ensure a high quality monitoring operation.
- undertake any other activities required by this MP, by the Kyoto Protocol requirements and modalities for JI.

Verification concludes with a formal verification report.

Certification of emission reductions: A successfully completed verification process and the related verification report provide the basis for the issuance by the verifier of an emission reduction certificate. The certificate is a legally binding statement which confirms the (successful) verification report's conclusion that has project has achieved the stated quantity of ERs in compliance with all relevant criteria and requirements.

The certificate is issued by the verifier for the project only and it does not automatically constitute or create Emission Reduction Units (ERUs) as defined by Article 6 of the Kyoto Protocol. However, the verifier's certificate may be used by the Project Operator in the process of setting aside AAUs and issuance of ERUs by the Republic of Bulgaria in line with applicable JI and Kyoto Protocol modalities and procedures.

6.3 Auditing Criteria and Needs

Verification includes an audit of the project's output information and data and management systems on the basis of the following established criteria:

- Completeness
- Accuracy
- Coverage
- Risk Management Controls

Auditors / verifiers will request information (in the form of records and documentation) from the operator to determine if key performance indicators meet the objectives of the Dolna Arda Cascade Project as set out in this document. The operator is required to record all such indicators, and provide satisfactory documentation and an audit trail for verification purposes.

The information that will be needed includes:

- **Records on reported GHG emission reductions** including the electronic spreadsheets / workbooks and supporting documentation (assumptions, data estimations, measurement methods, sampling techniques etc)
- **Records on project management,** including monitoring, data collection and management systems

The audit process followed, as with other management systems, is interactive, iterative and participatory. The auditors will determine the credibility and accuracy of the reported performance through spot checks of data measurement and collection systems and interviews with the key project participants. It is necessary for all involved in an audit to understand the audit process and verification requirements.

6.4 Audit and Verification Process

Audits procedures used to verify JI projects are similar to audits of other environmental management systems (ISO 14000, EMAS) and should complement these established processes. Principle audit tools are spot checks of documents and interviews with participating organizations and individuals. Auditors/verifiers are generally free to apply any method that represents good auditing practice and internationally accepted standards. Auditors typically conduct risk-based spot checks, which are checks of the key parameters and systems with the highest risks for data measurement and collection problems. The planning and scheduling of audits and the verification process is covered in this section.

Audit preparation and requests for information:
The auditor will familiarize him/herself with the Dolna Arda Cascade documentation, project reports, project requirements and expected project performance. The auditor will use this MP to prepare the audit process. He will make telephone contact with the project operator (NEK EAD), and if necessary, will request additional information from the project operator, and other project partners (e.g. NDC).

Development and delivery of an audit checklist:
The auditor will develop a checklist to guide the audit process. The checklist will cover the key points of the audit. The checklist will be sent to the project operator accompanied by explanatory materials prior to a site visit.

The audit:
The auditing procedure may include, if necessary, visits to the project site to undertake the audit. The length of the audit visit depends on the complexity of the project and its monitoring system and on previous performance of an experience with the project and the project operator. The audit time will be spent checking records and undertaking interviews with staff and other individuals, which will allow the auditor to complete the audit checklist. These activities are the basis for completing the verification process and for preparing the verification report.

Audit and draft verification reports:
The auditor will produce an audit report and a draft verification report, which summarizes the audit findings. The draft verification report will state the number of ERs achieved by the project and will point to areas of possible non-compliance if warranted. The report will also include conclusions on data quality, the project's monitoring and management and operational system, and other areas where corrective action may be required in order to come into compliance, improve performance or mitigate risks. The draft report will be sent to the operator. Relevant parties will be given opportunity to comment on the report. The operator will also have the opportunity to come into compliance, if necessary, by submitting the appropriate evidence or by taking corrective action.

Final verification report:
The auditor will revise the draft report taking into consideration reviewers' comments and further findings and issue the final verification report. If justified, the final verification report will conclude and explain that, within the verification period, the project has generated the stated quantity of ERs in compliance with all applicable JI and other requirements. The final verification report is the basis for the issuance of a certificate by the verifier, which will state and confirm the conclusions of the report.

Non-compliance and dispute settlement:
In the event of non-compliance findings, the project operator will be given sufficient time to demonstrate compliance. It is the responsibility of the verifier to ensure that dispute over any non-compliance issue is communicated clearly and that any attempt is made to resolve it. The verifier will have the final decision over the process. The verifier will also provide guidance as appropriate on how identified deficiencies can be met so that the operator can come into compliance in the following period.

Audit and verification schedule:
Audits and verification of the Dolna Arda Cascade JI project will be conducted annually.

6.5 Roles and Responsibilities

Audit responsibilities are allocated between the project's participants as follows:

Dolna Arda Cascade Project Operator: NEK EAD:
- The operator will prepare for the audit and verification process to the best of his/her abilities.
- The operator will facilitate the audit through providing auditors with all the required information, before, during and, in the event of queries, after the audit.
- The operator will select a third party auditor/verifier in accordance with UNFCCC requirements and selection criteria
- The operator will make arrangements for and organize the auditing and verification process
- The operator will fully cooperate with the auditors and instruct his/her staff and management to be available for interviews and respond honestly to all audit questions.
- It is the operator's contractual obligation and in his/her best interest to fully cooperate with auditors and verifier, since only successful verification will enable him/her to deliver Emission Reduction Units to the Austrian JI/CDM Programme in fulfilment of the contract with the Austrian JI/CDM Programme.

Auditor / verifier:
- The auditor must be a professional organization with a proven track record in environmental auditing and verification, experience with JI projects and work in economies in transition. Only accredited independent entities will be used once accreditation as an independent entity under the UNFCCC/Kyoto Protocol becomes available. The audit firm must guarantee professional work and assure the quality of the audit and verification team.

- The auditor / verifier must undertake the audit to the best of their professional ability. The auditor's responsibilities include to (I) provide the checklists and request for information in good time, (II) allow adequate time for sufficient review and preparation, (I) provide publishable reports in the agreed format, (IV) work with the project operator as appropriate, (V) report on Lessons Learnt during the course of the project.