78 MW AKOCAK HYDROELECTRIC POWER PLANT MONITORING REPORT

Document Prepared By Global Tan Energy

Ehlibeyt Mahallesi 1259. Sokak No: 7/2

Balgat / Çankaya /Ankara

Phone: +90 312 472 3500 Fax: +90 312 472 3366

www.gte.uk.com

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Prepared By	GTE
Contact	Address: Ehlibeyt Mah. 1259.Sok. No:7/2 Balgat/Çankaya/Ankara-Turkey Phone: +90 312 472 3500 Fax: +90 312 472 3366 www.gte.uk.com

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1 PROJECT DETAILS

1.1 Summary Description of Project

AKOCAK is a run of river type hydroelectric power plant (HEPP) project located on Karadere River, in Trabzon province, in East Black Sea Region of Turkey. The purpose of the project is to generate energy from the running waters of Karadere River. The electricity generation license has been awarded to AKENERJI Elektrik Uretimi ve Ticaret A.Ş. for a period of 49 years by the Turkish licensing authority named as Energy Market Regulatory Authority (EMRA).

The project includes two weirs. The first weir called Erikli weir is built on Alcak Brook, a branch of Karadere, on 1,339 meters riverbed elevation. A sediment pool of 41 meters long and 2.3 meters wide is built along the riverbed. The other weir called Akocak weir is built on Karadere branch of the river, on 1,328 meter riverbed elevation. The sediment pool of Akocak weir is 41 meters long and 4.3 meters wide. The powerhouse is located on Karadere River, at 570 meters riverbed elevation.

The water collected at the Erikli weir is connected with a 3 meter diameter, circular section, derivation tunnel of 3,250 meters long to the upstream of Akocak weir. The Akocak weir shall transmit the collected waters to a surge tank through a 6,150 meters long transmission tunnel of 3 meters cross section. The penstock extending from the surge tank to the powerhouse is 1,842 meters long, with an average diameter of 1.82 meters.

The power house includes two turbines of vertical pelton type, each 39 MW. The design flow rate is 12.30 m^3/sec. Net head is 744 meters. There are two generators, each 48.75 MVA. The installed capacity of Akocak HEPP is 81 MWe. The generated electrical energy is connected to Arsin TM grid substation through a double circuit 2 x 477 MCM, 32 km long 154 kV transmission line. The annual estimated electrical energy generation is 257.440 GWh. Corresponding emission reduction is about 168,108 tCO_2 per year.

Milestones of the Project

Milestone	Date
License Issuance	23/11/2005
EIA Approval	17/10/2006
Equipment Purchase Agreement	05/10/2006*
Start of Construction	01/12/2006
License Amendment	17/05/2007
Carbon Agreement	10/06/2008
LSC Meeting	27/10/2008
Provisional Acceptance & Commissioning for Unit 1	29/07/2010
Provisional Acceptance & Commissioning for Unit 2	30/06/2010

Expected Monitoring Frequency	Annual
End of Licensing Period	22/11/2054

Table 1. Akocak HEPP Project Milestones (*Investment Decision Date)

The main goals of the Akocak HEPP project include;

- Using Turkey's hydroelectric potential to meet the increasing demand for electricity and contributing toward the guarantee of Turkey's energy security.
- Increase the share of run of river type HEPPs in the mix of electricity generation in Turkey, reduce dependency on imported fossil fuel and as a consequence provide a tangible reduction in GHG emissions.
- Contribute to economic development by creating direct and indirect job opportunities during the construction and operation phases.

The project contributes to the sustainable development in the region through creating new job opportunities during the construction and operational phases. Approximately 200 people were employed during construction phase. After the commissioning of the plant, the project employs 30 local employees. In addition to direct and indirect job opportunities the project contributes to sustainable development through activities conducted within the framework of corporate social responsibility. In addition to contribution to local economy, project also contributed to the use of local and renewable resources to meet the increasing energy demand of Turkey and reduce dependency on fossil fuels.

According to the research conducted by State Planning Organization(SPO) on socio-economic level of Districts in Turkey, Arakli District is ranked as 475th among 872 Districts in Turkey in terms of development level and classified in third (out of six) group. Unemployment rate of Araklı District has been determined as 6.56% whereas population increase rate is about 11.44%. About 77.7% of the population works on agriculture and 18.1% works on service sector whereas only 4.2% works on industry. In that respect, direct and indirect contribution of project activities to local economy through employment and supply of needs from the region has a significant effect on development in the region.[1] Industrial plants and agricultural lands are limited in the region (only 25% of land within the province can be used for agriculture) and main products are tea plant, hazelnut, corn and grains. [2]

The project has generated 301,812 GWh for 25 months between July 2010-July 2012 which has avoided 169,619 tonnes of CO_2. The detailed calculations are shown Monitoring spead sheet

[1] Socioeconomical Development Index of Districts in Turkey, State Planning Organization, 2004 (page 206)

[2] EIA Report, Section IV.3, page 126

1.2 Sectoral Scope and Project Type

Proposed project activity involves electricity generation from renewable sources therefore it is categorized in the sectoral scope 1 “Energy Industry – Renewable -/Non-renewable Sources” according to the UNFCCC definition.

Project consists of two weirs and a powerhouse. Project is not a part of grouped project.

1.3 Project Proponent

Project Participants	Role/Responsibilities	Contact Information
AKENERJI Elektrik Uretim AS	Owner of the VER rights of the project. Construction and Operation of the power plant in line with regulations. Implementation of monitoring plan and collecting and archiving monitoring data	Özlem Sefer Palabıyık Miralay Sefik Cad. No:15 Zip Code:34437 Taksim/Istanbul Phone: +90 212 249 8282 Fax: +90 212 249 7355 E-Mail: info@akenerji.com.tr
Global Tan energy Ltd.	Development of project documents. Managing validation and verification processes for the project.	M.Kemal Demirkol-Director Ehlibeyt Mahallesi 1259 sk 7/2 Balgat Cankaya Ankara TURKEY Tel:90 312 472 35 00 Fax: 90 312 472 33 66 E-mail: kemal@gte.uk.com

Table 2. Project participants

1.4 Other Entities Involved in the Project

N/A

1.5 Project Start Date

The project has started to feed energy to the grid as of 30/06/2010 after its preliminary acceptance had been realized.

1.6 Project Crediting Period

Crediting period of the project is 10 years between 01/07/2010 and 31/07/2020. Moreover, crediting period will be renewed twice.

1.7 Project Location

The Akocak HEPP project is located within the boundaries of Arakli District of Trabzon Province. The nearest settlements to the project site are Kayaici and Gelber Villages. The GPS coordinates of the project is given following table:

	LONGITUDE	LATITUDE
Erikli Weir	E 39° 57′ 5.4″	N 40° 36′ 23.8″
Akocak Weir	E 39° 54′ 54.9″	N 40° 36′ 47.5″
Powerhouse	E 39° 54′ 12.9″	N 40° 40′ 13″

Table 3. Project coordinates

Also the project location represented on the Map of Turkey is shown below.

Figure 1. Project Location

1.8 Title and Reference of Methodology

The United Nations approved consolidated baseline methodology applicable to this project is ACM0002 "Consolidated methodology for grid-connected electricity generation from renewable sources", Version 10[3].

ACM0002 refers to the following tools:

- "Tool for the demonstration and assessment of additionality", Version 05.2, [4]and
- ''Tool to calculate the emission factor for an electricity system'', Version 02[5].

[3] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_YOYKBRCBIK7TSPSB7MQT75SPX75PE8

[4] http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The project has been in operation since 30/06/2010. The crediting period for the project is 10 years between 01/07/2010 and 30/06/2020 and will be renewable for 2 times. The project activities consist of only one site.

No event or situation that may prevent applicability of methodology has occurred during the monitoring period.

2.2 Project Description Deviations

In the PDD, only the reservoir area of the Erikli weir has been taken into consideration. Although, the area of the reservoirs both of Erikli and Akocak weirs are small, the calculation of power density for both weirs is provided below. As the power density still remains higher than 10 W/m^2, project emissions from the reservoirs have been ignored.

Based on the regulation of Electricity Market Balancing and Conciliation dated 01/01/2012, Electricity generation is measured and recorded by remote system and records are sent to PYS (Market Management System). Therefore, Generated electricity is shown only TEIAS-PMUM web site. Moreover, OSF forms for May, June, July 2012 could not been provided. PMUM data for these months has been used.

In the VCS PD, regarding electricity generation, it has been stated that *"Generation data were recorded by four metering devices continuously. These records provided the data for the monthly invoicing to TEIAS. Each month, an officer from TEIAŞ and the plant manager/electricity technician of the plant recorded the reading. The internal consumption of the facility was subtracted from the gross generation. The internal consumption was also taken from the facility's records and cross-checked with the PMUM data"*

However, as of 01/02/2012, Electricity Market Balancing and Conciliation body has declared that all readings would be carried out remotely based on an amendment in the Bylaw on Electricity Market Balancing and Conciliation (Clause 81)[6]. However, the facility has settled the remote reading system on 20/12/2011 with TEIAS (slightly earlier than the change was enforced). Thus, for electricity generation calculations after December 2011, PMUM readings will be deployed as there is no meter readings signed by TEIAS. The main and cross-check values are indicated below which accommodates this deviation:

- July 2010-November 2011 electricity generation calculations are based on the meter readings (OSF) signed by TEIAS and the PMUM records are used for cross-check.

- January-July 2012 electricity generation calculations are based on the PMUM records. As cross-check Monthly Facility Reports will be used.

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[5] See: http://cdm.unfccc.int/methodologies/Tools/EB35_repan12_Tool_grid_emission.pdf

[6] http://www.epdk.gov.tr/documents/elektrik/mevzuat/yonetmelik/elektrik/dengeleme_uzlastirma/DUYson.doc

Project installed capacity has been increased from 78 MWe to 81 MWe[7]. However, annual generation which is 257.440 GWh has remained same. So, There is no need to change additionality of the project.

Furthermore, in the VCS PD, regarding the project emissions from diesel generators, bills would be used for quantification. For conservativeness, working hours, obtained from weekly generator maintenance reports, have been deployed.

2.3 Grouped Project

Project is not a part of grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter:	**$EG_{y,\ Total}$**
Data unit:	GWh
Description:	Net Electricity delivered to the grid by power plants in Turkey in years 2005, 2006 and 2007
Source of data used:	TEIAS web page - http://www.teias.gov.tr/ist2007/30(84-07).xls
Value applied:	155,469.1 GWh; 169,543.1 GWh; 183,339.7 GWh
Purpose of the data	Data used for emission reduction calculation(for calculation of OM, Net-to-Gross electricity ratio and share of low-cost must-run sources)
Any comment:	

Data / Parameter:	**$EF_{CO2,\ i,\ y\ i}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type “i” in year “y”
Source of data used:	-For EF of fossil fuels, IPCC values at the lower limit have been used.
Value applied:	

[7] Akocak HEPP Generation licence.

	Fuel Source / **EF(tCO2/Tj)** Coal 89.5 Lignite 90.9 Fuel Oil 75.5 Diesel 72.6 LPG 61.6 Naphta 69.3 Natural Gas 54.3
Purpose of the data	According to ACM0002, IPCC default values at lower limit of 95% confidence interval can be used. Although, the actual emission reduction is expected to be higher due to high EF of fuels consumed in existing power plants, IPCC values have been used for conservativeness as requested by the methodology.
Any comment:	

Data / Parameter:	**$FC_{i,y}$**
Data unit:	Tons or $1000m^3$ for gases
Description:	Amount of fuels consumed by thermal power plants for electricity generation in terms of fossil fuel type "i" in year "y"
Source of data used:	TEIAS web page (http://www.teias.gov.tr/ist2007/43.xls)
Value applied:	See Annex 3
Purpose of the data	Data used for OM calculation
Any comment:	

Data / Parameter:	**GE**
Data unit:	%
Description:	Generation efficiency of thermal power plants

Source of data used:	Annex I- Tool to calculate the emission factor for an electricity system
Value applied:	See Annex 3
Purpose of the data	Data used for BM calculation
Any comment:	

Data / Parameter:	**NCV**
Data unit:	Tj/kt
Description:	Net Calorific Values of Fuel combusted in power plants.
Source of data used:	TEIAS web page (http://www.teias.gov.tr/ist2007/45.xls)
Value applied:	See Annex 3
Purpose of the data	Data used for OM and BM calculation
Any comment:	

3.2 Data and Parameters Monitored

Data Unit / Parameter:	$EG_{facility, y}$
Data unit:	GWh
Description:	Net Electricity generated and delivered to the grid by 78MW Akocak HEPP in year "y"
Source of data:	As explained in Section 2.2, as of January 2012, the energy generation data will be obtained remotely by TEIAS and there will be no signed meter readings. Thus, for the period July 2010-December 2011, meter readings (signed by TEİAS) are used for calculations where PMUM records are used for cross-check. For calculations after January 2012, PMUM records are used for main calculation where "Monlthly Facility Reports" (signed by the project owner) are used for cross-check.
Description of measurement	Generation data were recorded by four metering devices

methods and procedures to be applied:	continuously. These records provided the data for the monthly invoicing to TEIAS. Until January 2012,each month, an officer from TEIAŞ and the plant manager/electricity technician of the plant recorded the reading. After January 2012, TEIAS started reading the generation data remotely. The internal consumption of the facility was subtracted from the gross generation. The internal consumption was also taken from the facility's records and cross-checked with the PMUM data.
Frequency of monitoring/recording:	Continuous measurement at the site and daily and monthly recording were applied. The plant manager and the staff extracted the records regularly every day. The monthly records gathered by TEİAŞ remotely.
Value applied:	301.812 GWh during monitoring period.
Monitoring equipment:	Four calibrated ammeters (two of them are spare). Meters used are in compliance with the regulation[8] on meters issued by relevant government agencies and have 0.5S accuracy class[9].
QA/QC procedures to be applied:	Maintenance and calibration of the metering devices will be made by TEIAS periodically. If there is a significant difference between the readings of two devices, maintenance and tests of the metering devices and the associated equipment will be done before waiting for the periodical maintenance.
Calculation method:	*N/A*
Any comment:	

Data Unit / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data:	Project site.
Description of measurement	The parameter were determined from the labels on the

[8] http://www.epdk.gov.tr/web/elektrik-piyasasi-dairesi/44

[9] http://www.aktifenerji.com.tr/pdf/sl7000_brosur.pdf

methods and procedures to be applied:	equipment and letter for approval of commissioning issued by Ministry of energy and Natural Resources
Frequency of monitoring/recording:	Yearly
Value applied:	81 MWe [10]
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	-

Data Unit / Parameter:	A_{PJ}
Data unit:	m^2
Description:	Area of the reservoir measured on the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data:	Project site
Description of measurement methods and procedures to be applied:	Measured from topographical surveys or maps
Frequency of monitoring/recording:	Yearly
Value applied:	38,543.722 (Akocak Weir) and 33,877.016 (Erikli Weir)m^2 [11]
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	Maximum area is given in Reservoir Map and considered in calculations. Annual measurements are not higher than baseline value.

Data Unit / Parameter:	$FC_{i,j,y}$
Data unit:	Mass or Volume unit per year (e.g. ton/yr or m^3/yr)
Description:	Quantity of fuel type i combusted in Diesel power

[10] Project Generation License

[11] Akocak HEPP Reservoir map

	generator during the year y
Source of data:	Project site
Description of measurement methods and procedures to be applied:	Fuel Invoices
Frequency of monitoring/recording:	Continuous monitoring, annual recording.
Value applied:	32,788.45 liters of diesel oil
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	The calculation for the project emissions has been carried out through the total working hours of the generators. To be conservative, maximum fuel consumption rate (l/hr) is obtained from the generators' manual. The working hours are obtained from the meekly maintenance reports dated in September.

3.3 Description of the Monitoring Plan

Monitoring is a key procedure to verify the real and measurable emission reductions from the proposed project. To guarantee the proposed project's real, measurable and long-term GHG emission reductions, the monitoring plan is established.

In order to demonstrate the emission reduction, only the required data is the net electricity delivered to the grid by the project activity.

Net electricity generation is measured and recorded by both TEIAS and project owners for billing purposes therefore no new additional protocol is needed monitoring emission reduction. Power Plant Manager, is responsible for the electricity generated, gathering all relevant data and keeping the records. He is informed about VER concepts and mechanisms and how to monitor and collect the data which is used for emission reduction calculations.

Generation data collected during crediting period is submitted to Global Tan Energy who is responsible for calculating the emission reduction subject to verification: Generation data is used to prepare monitoring reports which is used to determine the vintage from the project activity. These reports are submitted to the duly authorized and appointed Designated Operational Entity 'DOE' before each verification period.

The monitoring system organization chart is shown in Figure 2 below, in which the authority and responsibility of project management are defined.

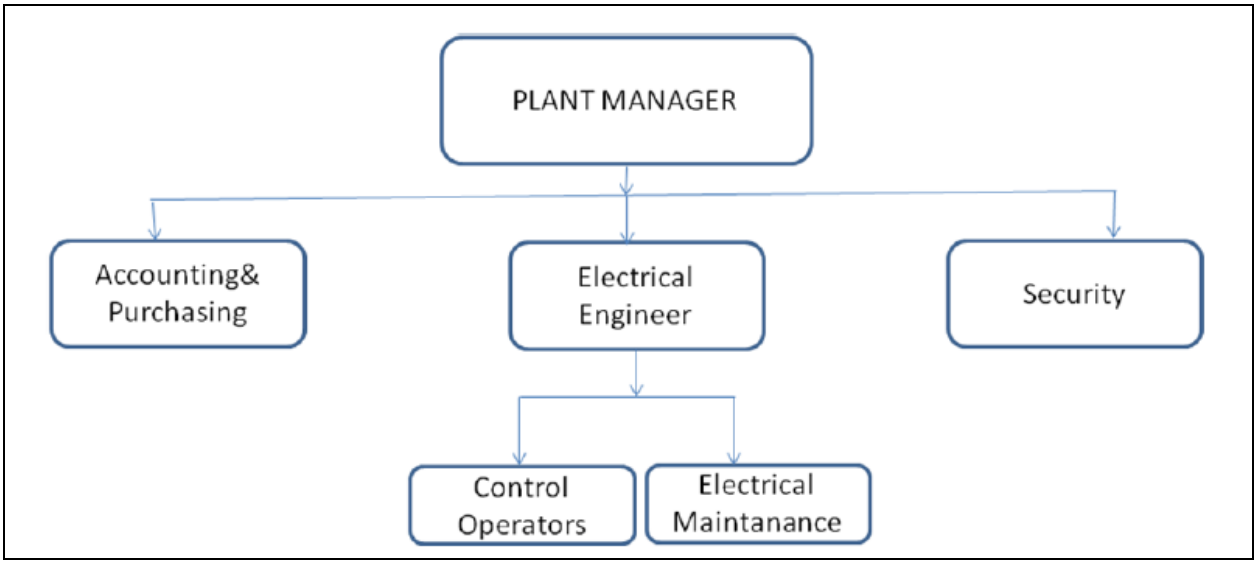

Figure 2. Operational structure of 78MW Akocak HEPP

VER Team Members are;

Plant Manager: Overall responsibility of compliance with VER monitoring plan
Electrical Engineer: Responsible for day to day running of plant, recording and monitoring of relevant data and periodic reporting
Accounting Manager: Responsible for keeping data about power sales, invoicing and purchasing.
Control Operators &Electrical Maintenance: Staff is responsible for day to day operation and maintenance of the plant and equipments. All staffs were trained and had certificate for working with high voltage equipments.
Global Tan Energy: Responsible for emission reduction calculations, preparing monitoring report and periodical verification process.

Installation of meter and data monitoring are carried out according to the regulations by TEIAS. Two metering devices (one of them used as spare) are used for monitoring the electricity generated by the power plant. Readings are done using main metering devices and spare metering device is used for comparison only. Data from metering devices is recorded by TEIAS monthly and form the basis for invoicing using the template formed by TEIAS[12]. In addition to the two metering devices, generation of the Akocak HEPP can be cross checked from TEIAS – PMUM web site(http://pmum.teias.gov.tr) which is accessible using a password provided to electricity generation companies. Both the PMUM data and the facility/TEAIS records are taken into account for comparison and to identify any anomalities.

Technical information of the meters is tabulated below:

Brand	Type	Serial Number
Actarıs	SL761A071	53064405 (main- unit 1)
Actarıs	SL761A071	53064406 (spare- unit 1)

[12] http://www.teias.gov.tr/mali/GDUY/PRO_FORM/OLCUM/K01.xls

Actarıs	SL761A071	53064407 (main- unit 2)
Actarıs	SL761A071	53064408 (spare- unit 1)

No change or calibration of the metering devices has been necessary during the monitoring period.

In case of a major failure at both metering at the same time, electricity generation by the plant since the last measurement is able to be monitored by another metering device at the inlet of the main substation operated by TEIAS where the electricity is fed to the grid. Electricity generated by the power plant is also available at the SCADA (supervisory control and data acquisition system) of the grid operator TEIAS, through the RTU (remote terminal unit) installed at the power plant and supervised by the Load Dispatch Centre of TEIAS.

The net electricity fed to the grid is measured continuously and recorded monthly by the TEIAS and plant staff. For consistency, recorded data are compared with electricity sale receipts.

All data collected are recorded daily and archived both as electronically and as hard copy for at least two years.

Calibration of the metering devices was made by TEIAS and sealed during first operation of the plant. The meters were calibrated by TEIAS when exists significant inconsistency between two devices using a fixed template[13] or upon request by either project owner or TEIAS[14.]

The maximum area of the reservoir is provided in Akocak, Reservoir Map , the level of water was also checked from topographical surveys and maps and didn't exceed the limit value.

A_{BL} value was takes as zero as the project is a new project and there was no reservoir area before the project is released, thus, as per the methodology.

All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The ex-ante emission reductions (ERy) are calculated as follows:

$$ERy = BEy - PEy - LEy$$

Where:

ERy = Emission reductions in year y (tCO_2)

[13] http://www.teias.gov.tr/mali/GDUY/PRO_FORM/OLCUM/DAG02.xls

[14] http://www.epdk.gov.tr/english/regulations/electric/balancing/balancing.doc

BEy = Baseline emissions in year y (tCO_2)

PEy = Project Emissions in year y (tCO_2)

LEy = Leakage emissions in year y (tCO_2)

Baseline emission is calculated according to the formula

BEy = EGy x EFy

Where:

EGy = Net electricity delivered to the grid by the project activity in year y excluding transmission losses of the grid.

EFy = Emission factor calculated according to selected methodology

LEy	**Leakage Emissions**	**0**
EGy	**Net Generation(MWh)**	**301,812**
EFy	**Emission Factor (tCO_2/GWh)**	**562**[15]
BEy	**Gross Total Emission Reduction (tCO_2)**	**169,619**
PEy	**Project Emissions(tCO_2)**	**87.217**
ERy	**Net Emission Reduction (tCO_2)**	**169,531**

Table 4. Baseline emissions

4.2 Project Emissions

The proposed project activity involves two small reservoirs which are Akocak Weir and Erikli Weir. The power density is higher than 10 MW/m^2, so, the project emissions of the project is ignored.

The power density of the project activity (PD) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

[15] Akocak Hepp, Project Description Document, page 29

PD = Power density of the project activity (W/m^2)

CapPJ = Installed capacity of the hydro power plant after the implementation of the project activity (W)

CapBL = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero

APJ = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)

ABL = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

For proposed project HEPP,

CapPJ = 81.000 000 W

CapBL = 0.0 W

APJ = 38,543.722 + 33,877.016 (m^2)[16]

ABL = 0.0 (m^2)

Therefore PD is calculated as ;

$$PD = \frac{81000000 - 0}{72420.738 - 0}$$

PD = 1,118.46 W/m^2

As the calculation per the methodology also indicates, the project emissions from the reservoir is higher than 4W/m^2 and thus the emissions from water reservoir is ignored in the calculations.

Emissions from Diesel Generator

Diesel generators are utilized at the powerhouse and the regulators as auxiliary power source when there is no electricity generation in the plant or supply by the grid. For the proposed project, there are 4 diesel generators that are used as auxiliary power source when there is no electricity generation in the plant or supply by the grid. The locations of these generators and type, their fuel consumption at maximum load and their working hours are provided in the table below:

[16] Akocak, Reservoir Map

Generator Type	Location	Fuel consumption at maximum load[17] (L/H)	Total working hours during the monitoring period
AJD 275, 275 KVA	Power house	41	75.57
APD 70YT, 70 KVA	Erikli Regulator	10.3	1249.6
APD 70YT, 70 KVA	Akocak Regulator	10.3	922.4
APD 33CF, 33 KVA	Valve room	5.2	1407.4

For the proposed project, to be conservative the calculation of the project emissions is based on the working hours of the diesel generators. The working hours of the generators are obtained from the maintenance reports recorded by the project owner. The maximum fuel consumption at ¾ load are obtained from the generator manuals. Accordingly, 32,788.45 litres of diesel oil is calculated to be consumed by all of the generators.

According to the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" CO_2 emissions from fossil fuel combustion for process are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y}$$

Where:

$PE_{FC,j,y}$ = Are the CO_2 emissions from fossil fuel combustion in process j during the year *y* (tCO_2/yr);

$FC_{i,j,y}$ = Is the quantity of fuel type *i* combusted in process *j* during the year *y* (mass or volume unit/yr);

$COEF_{i,y}$ = Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)

i = Are the fuel types combusted in process *j* during the year *y*

For calculating the $COEF_{i,y}$ option B has been used which is given as;

[17] From the manual of the generators

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad (4)$$

Where:

$COEF_{i,y}$	=	Is the CO_2 emission coefficient of fuel type i in year *y* (tCO_2/mass or volume unit)
$NCV_{i,y}$	=	Is the weighted average net calorific value of the fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Is the weighted average CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
i	=	Are the fuel types combusted in process *j* during the year *y*

COEF for diesel fuel has been calculated and based on these parameters, PE due to diesel generator has been calculated for the monitoring period. Calculations and references are indicated in excel sheet.

The NCV (0.043 GJ/tonne) is obtained from the IPCC 2006 Guidelines.[18] The density of diesel is obtained from TUPRAS website.[19]

The EF is calculated based on the carbon conversion unit (20 t C/TJ) given in the Turkey's National Inventory Report. [20]

$COEF_{i,y}$= [0.043 * (20* (44/12))*1000)] / ((1/845)*1,000,000))

$COEF_{i,y}$ = 2.66 kg CO2/lt

Thus, the project emission from the diesel generator is calculated as:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

$PE_{FC,j,y}$= 32,788.45 (litres)* 0.00266 (t CO2)=87.217 tonnes CO2

4.3 Leakage

The energy generating equipment is not transferred from or to another activity. Therefore leakage is also considered as "0".[21]

[18] IPCC 2006. Vol.2, Ch.1, pg.1.18-1.19

[19] http://www.tupras.com.tr/detailpage.tr.php?strProductKey=403&lRedirectPageID=145

[20] UNFCC Turkey National Inventory Report 2010 (Table 1A(b)). Value given in t C per TJ. Converted to kg CO2e per kWh. Then converted to kg CO2e per L using NCV.

[21] PDD page 30

LEy = 0

4.4 Summary of GHG Emission Reductions and Removals

Total Emission Reduction has been determined as;

ERy = BEy –Pey - LEy

Where;

ERy = Emission reductions in year y (tCO_2)

BEy = Baseline emissions in year y (tCO_2)

PEy = Project Emissions in year y (tCO_2)

Ley = Leakage emissions in year y (tCO_2)

The proposed project activity involves a small reservoir area. Project's power density is above 4 W/m2, project emissions are ignored as per the methodology.

The energy generating equipment is not transferred from or to another activity. Therefore leakage is also considered as "0".

Thus, ERy = BEy- PEy

Baseline Emissions

BEy = EGBL,y x $EFCO_2$

Where:

BEy : Baseline emissions in year y (tCO_2/year)

EGBL,y : Energy baseline in year (kWh)

$EFCO_2$: Combined Margin CO2 emission factor (tCO_2/MWh), which is 0.562 tCO_2/MWh in the validated PD.

Thus, the emission reduction for July 2010 – July 2012 is calculated as given in table below

Total Generation (July2010 - July 2012)	**301,812**
Total Emission Reduction (July2010 - July 2012)	**169,619**
Project Emissions	**87.217**
Net Emission Reduction	**169,531**

Table 5. Summary of Emission Reductions

5 ADDITIONAL INFORMATION

Table below shows the comparison of estimated net GHG emission reductions and actual values reached as yearly bases.

Item	**Estimated net GHG emission reductions or removals (tCO2e)**	**Net emission reductions during monitoring period(tCO2e)** **(Gross Generation-internal consumption)**
2010 (01/07/2010-31/12/2010)	84,054	**10,331**
2011	168,108	**89,097**
2012 (01/01/2012-31/07/2012)	98,063	**70,104**
Total Emissions excluding project emissions from diesel generator	**169,619**	
Project Emissions	**87.217**	
Total net emission reductions (25 months)	**350,225**	**169,531**

Table 6. Comparison of actual emission reductions with estimated net GHG emission reductions

During the monitoring period, project has generated less electricity than expected due to low rate of flow and downtimes which are expected in first years of operation. No event or situation that may prevent applicability of methodology has occurred during the monitoring period.