

FEKE II 69.58 MW HYDROELECTRIC POWER PLANT MONITORING REPORT



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1 PROJECT DETAILS

1.1 Summary Description of Project

Feke II Hydroelectric power plant project is located at the south of Turkey, in the Mediterranean Region, on the Goksu Creek, a main branch of Seyhan River, within the province of Adana, about 9 km southwest of Feke I district.

Feke I and Feke II projects were first developed by General Directorate of DSI (State Hydraulic Works) as a single project, to generate energy by utilizing the water potential of Goksu Branch in Seyhan Basin. However it was seen during the feasibility studies that the project would cause whole of Feke district to be covered with water, therefore the project was divided into Feke I and Feke II projects which are developed as individual projects.

Akkur Enerji Uretim Sanayi ve Ticaret A.S. has been awarded the project after bidding by the Turkish Energy Market Regulatory Authority (EMRA) and won the rights of the license for a period of 49 years.

The project consists of compressed concrete dam with a crest length of 256 meters and a height of 60 meters from the riverbed; 317 meters long derivation tunnel, upstream and downstream cofferdams, spillway, 171 meters long penstock, a powerhouse of 44 by 32 meters dimensions and 2 vertical axis Francis turbines with a gross head of 63 meters. The maximum capacity of the dam surface is 2.47 km².

Feke II HEPP project have an installed capacity of 69.35 MW and is expected to have an annual generation of about 223.410 GWh of electricity. Electricity generated by the power plant will be delivered to the grid by a 7 km long 154 kV, 795 MCM overhead transmission line.

Main goals of the proposed project include;

- Utilize the hydroelectric potential of Turkey in the southern part of Turkey, in order to meet increasing electricity demand and guarantee the energy security. The increasing electricity demand is 8.1 % in 2007 (<http://www.teias.gov.tr/apkuretimplani/veriler>). If reserve energy capacity is below 2% (3,814 GWh) the energy security is endangered.
- Increase share of HEPPs in electricity generation mix of Turkey and reduce GHG emissions.
- Contribute to economic development by creating direct and indirect job opportunities during construction and operation phases.
- Reduce import dependency on fossil fuel weighed electricity sector and diversify generation mix through use of local resources.
- Project does not include irrigation of lands; however DSI (State Hydro Works) has the priority to use the dam waters for irrigation.

Project contributes to sustainable development in the region through creating new job opportunities during construction and operational phase. Project also creates employment opportunities for about 20 people during operation stage. In addition to direct and indirect job opportunities, project was also expected to increase income of fishermen in the region, increase the agricultural income of the local community and support the development Adana region.

Considering the contribution of the project on local and national economy, environment and local community, project has positive influences on sustainable development in the region and in Turkey. The Feke District ranks as 797th among 872 districts in Turkey in terms of socio-economic

development index and classified in group 6 which shows the least developed districts. The population centers are wide apart in this region. Population intensity is about 17 persons/km², one of the low population density Districts of Adana. As a result of transmigration, the population drops continuously and with the effect of poorness in investments to the city, the population of people at working age decreases. Average population increase has been 7.7% from the Feke District according to study of State Planning Organization¹. Main economic activity in the region is agriculture and main agricultural products are fruits and nuts. About 89% of the population works in agriculture and 9% works in service sector whereas ratio of population working in industrial sector is less than 2%.

Major milestones of project activity is given below:

Activity	Date
Issuance of Generation License	17/05/2007
Establishment of Plant Facilities	01/05/2008
Access Road Construction	01/06/2008
Start of Tunnel Construction	01/07/2008
Start of Dam Construction	01/12/2008
Start of Powerhouse Construction	01/12/2008
Start of EM Installation	01/01/2009
Start of Energy Transmission Line Construction	01/05/2009
Validation report date	26/07/2010
Provisional Acceptance& Commissioning	24/12/2010
Expected Monitoring Period	Annual

* Investment Decision Date

Table 1. Main project activities

The 326,111.446 MWh electricity generations for 21months of monitoring period avoids 178,376. ton CO₂. The detailed calculations are shown in FEKE II Calculation sheet

¹ Socioeconomical Development Index of Districts', State Planning Organization, 2004 (page 135)

1.2 Sectoral Scope and Project Type

Proposed project activity is a large-scale 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 definition².

It is an independent project with its own dam and its own powerhouse. It is not part of a grouped project.

1.3 Project Proponent

Project Participants	Role/Responsibilities	Contact Information
Akkur Enerji Elektrik Üretim A.Ş. (subsidiary of Akenerji)	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

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 24/12/2010.

1.6 Project Crediting Period

Crediting period of the project is 10 years between 01/01/2011 and 31/12/2020. Moreover, crediting period will be renewed twice and total period will be 30 years.

² <http://cdm.unfccc.int/DOE/scopes.html>

1.7 Project Location

The project site lies between 35° 51' 41.7" - 35 ° 52' 2.2" E longitudes and 37° 44' 35.9" - 37° 44' 52.6"N latitudes. The closest settlement is the Feke Village, about 10 km north of the project site, within the province of Adana. The project lies on the Goksu creek basin, which is a branch of Seyhan River.

The location of project is shown below:

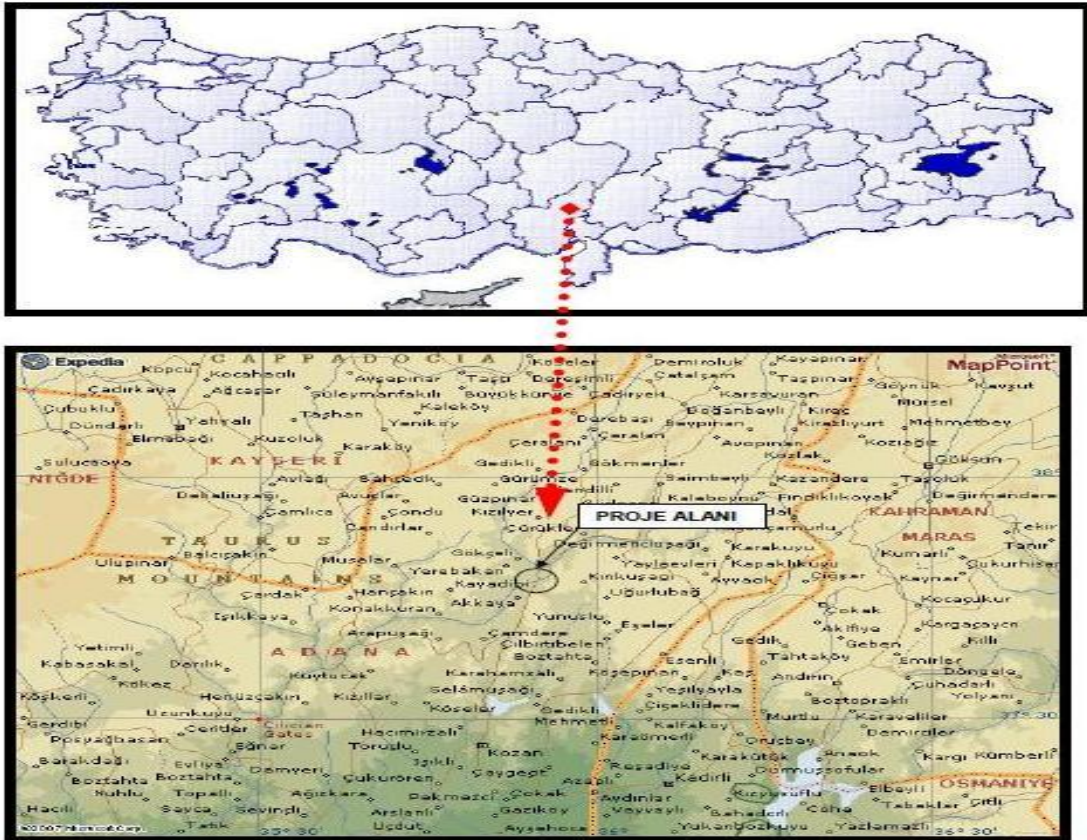


Figure 1. Location of the project site

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 10³.

ACM0002 refers to the following tools:

- "Tool for the demonstration and assessment of additionality", Version 05.2, ⁴and
- "Tool to calculate the emission factor for an electricity system", Version 02⁵.

³ http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_YOYKBRCBIK77SPSB7MQT75SPX75PE8

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 24/12/2010. Crediting period for the project will be 10 years between 01/01/2011-31/12/2020. and will be renewable for 2 times. The project activities consist of only one site.

There isn't any event or any situation that occurred during the monitoring period, which can change the applicability of the methodology.

2.2 Project Description Deviations

Electricity generation is measured and recorded by remote system and records are sent to PYS (Market Management System). Therefore, Generated electricity is shown TEIAS-PMUM web site.

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 TEIAS 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, the facility has settled the remote reading system. Thus, for electricity generation calculations, PMUM readings are deployed as there is no meter readings signed by TEIAS. The main and cross-check values are indicated below which accommodates this deviation:

- Electricity generation calculations are based on the PMUM records. As cross-check Monthly Facility Reports will be used.

Project installed capacity has been decreased from 69.58 MWe to 69.35 MWe⁶. However, annual generation which is 223.410 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, have been deployed.

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

⁶ FEKE II HEPP Generation licence.

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 Unit / Parameter:	EG_{y, Total}
Data unit:	MWh
Description:	Net Electricity generated by power plants in Turkey
Source of data:	TEIAS web page http://www.teias.gov.tr/istatistik2008/30(84-08).xls
Value applied:	169,543.1 GWh for 2006, 183,339.7 GWh for 2007, 189,761.9 GWh for 2008
Purpose of 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 Unit / 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:	For EF of fossil fuels, IPCC values at the lower limit has been used.												
Value applied:	<table> <tr> <th>Fuel Source</th><th>EF(tCO₂/Tj)</th></tr> <tr> <td>Coal</td><td>89.50</td></tr> <tr> <td>Lignite</td><td>90.9</td></tr> <tr> <td>Fuel Oil</td><td>75.5</td></tr> <tr> <td>Diesel</td><td>72.6</td></tr> <tr> <td>LPG</td><td>61.6</td></tr> </table>	Fuel Source	EF(tCO ₂ /Tj)	Coal	89.50	Lignite	90.9	Fuel Oil	75.5	Diesel	72.6	LPG	61.6
Fuel Source	EF(tCO ₂ /Tj)												
Coal	89.50												
Lignite	90.9												
Fuel Oil	75.5												
Diesel	72.6												
LPG	61.6												

	Naphta69.3 Natural Gas54.3
Purpose of 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 Unit / Parameter:	FC _{i, y}
Data unit:	Tons or 1000 m 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:	TEIAS web page (http://www.teias.gov.tr/istatistik2008/44.xls)
Value applied:	Given in table in Annex 3 in PD
Purpose of data:	Data used for OM calculation
Any Comment:	-

Data Unit / Parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit m in year y
Source of data:	Annex I of “Tool To Calculate Emission Factor For An Electricity System”
Value applied:	Given in table in Annex 3 in PD
Purpose of data:	Data used for BM calculation
Any Comment:	-

Data Unit / Parameter:	NCV
------------------------	------------

Data unit:	Tj/kt
Description:	Net Calorific Values of Fuel combusted in power plants.
Source of data:	TEIAS web page (http://www.teias.gov.tr/istatistik2008/46.xls and http://www.teias.gov.tr/istatistik2008/44.xls)
Value applied:	Given in table in Annex 3 of the VCS PD
Purpose of data:	Data used for OM and BM calculation
Any Comment:	-

Data Unit / Parameter:	Cap _{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero
Source of data:	Project site
Value applied:	0 MWe
Purpose of data:	To calculate the power density of the project activity
Any Comment:	-

Data Unit / Parameter:	A _{BL}
Data unit:	m ²
Description:	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.
Source of data:	Project site
Value applied:	0 (m ²)
Purpose of data:	To calculate power density of project activity
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 Feke II HEPP in year y
Source of data:	the energy generation data are obtained remotely by TEIAS and there are no signed meter readings. PMUM records are used for main calculation where "Monthly Facility Reports" (signed by the project owner) are used for cross-check
Description of measurement methods and procedures to be applied:	Generation data were recorded by four metering devices continuously The internal consumption of the facility was subtracted from the gross generation. PMUM records were used for main calculation where "Monthly Facility Reports" (signed by the project owner) were used for cross-check.
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:	For 21 months period, total generation has been 326,111.446 MWh. Average monthly generation corresponds to 15,529 MWh and 12 months generation of the plant corresponds to 186,649.
Monitoring equipment:	Four calibrated ammeters (two of them are spare) Meters used are in compliance with the regulation ⁷ on meters issued by relevant government agencies and have 0.5S accuracy class ⁸
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:	-

⁷ <http://www.epdk.gov.tr/web/elektrik-piyasasi-dairesi/44>

⁸ First index Protocol

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 methods and procedures to be applied:	The parameter were determined from the labels on the equipment and letter for approval of commissioning issued by Ministry of energy and Natural Resources
Frequency of monitoring/recording:	Yearly
Value applied:	69.35 MWe ⁹
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:	2,480,000 (m ²) ¹⁰
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	Maximum area is already calculated in the feasibility report and considered in calculations. Annual

⁹ FEKE II Generation licence

¹⁰ FEKE II Hepp Reservoir Map

	measurements are not expected to be higher than this value.
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Data Unit / Parameter:	$PE_{FF,y}$
Data unit:	tCO ₂ /yr
Description:	Project emissions from fossil fuel consumption in year y
Source of data:	Project site (Diesel generator)
Description of measurement methods and procedures to be applied:	Total working hour of diesel generator and maximum fuel consumption are multiplied and total fossil fuel consumption is calculated. 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
Frequency of monitoring/recording:	Yearly
Value applied:	5.163=6 tCO ₂ during monitoring period
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	-

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 required data is the net electricity delivered to the grid by the project activity and internal combustion for the auxiliary diesel generator.

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.

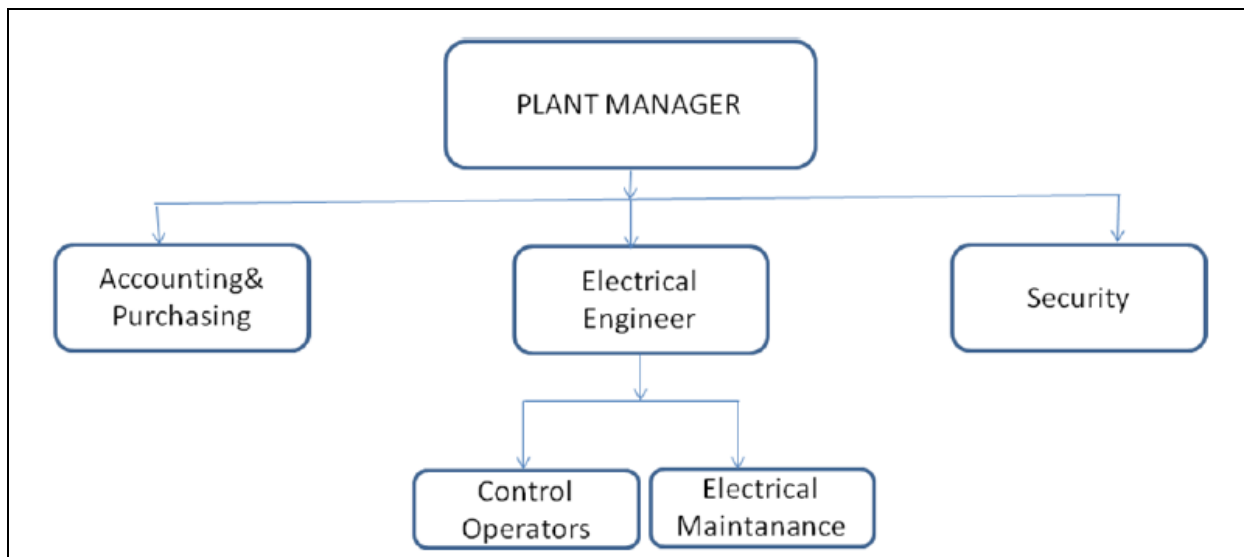


Figure 2. Operational structure of FEKE II HEPP

VER Team Members is expected to include the following staff of the HEPP:

Plant Manager: Responsibility for running the HEPP plant and compliance with VER monitoring plan

Electrical Engineer: Responsible for day electrical operations and recording and monitoring of relevant data and periodic reporting

Accounting Manager: Responsible for keeping data about power sales, invoicing and purchasing.

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. Four metering devices (two 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 remotely.. generation of the FEKE II HEPP are taken from TEIAS – PMUM web site(<http://pmum.teias.gov.tr>) which is accessible using a password provided to electricity generation. The project owner extracted these data and send to GTE. Both the PMUM data and Monthly Facility Reports” (signed by the project owner) were taken into account for comparison and to identify any abnormalities.

Technical information of the meters is tabulated below:

Brand	Type	Serial Number
ELSTER	A1500	00416326 (main- unit 1)

ELSTER	A1500	00416327 (spare- unit 1)
ELSTER	A1500	00416328 (main- unit 2)
ELSTER	A1500	00416329 (spare- unit 2)

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 was measured continuously and recorded monthly by the TEIAS and plant staff. For consistency, recorded data were compared with electricity sale receipts.

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 template¹¹ or upon request by either project owner or TEIAS¹².

The maximum area of the reservoir is provided map of reservoir, 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.

Diesel generator is utilized at the powerhouse which is used as auxiliary power source when there is no electricity generation in the plant or supply by the grid. For the calculation of the project emission from diesel generator, purchasing bill will be used during the monitoring period. For this monitoring period, working hour of diesel generator and maximum fuel consumption were used. 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 (*ER_y*) are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

¹¹ http://www.teias.gov.tr/mali/GDUY/PRO_FORM/OLCUM/DAG02.xls

¹² <http://www.epdk.gov.tr/english/regulations/electric/balancing/balancing.doc>

ER_y = Emission reductions in year y (tCO_2)

BE_y = Baseline emissions in year y (tCO_2)

PE_y = Project Emissions in year y (tCO_2)

LE_y = Leakage emissions in year y (tCO_2)

Baseline emission is calculated according to the formula

$$BE_y = EG_y \times EF_y$$

Where:

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

EF_y = Emission factor calculated according to selected methodology

LE_y	Leakage Emissions	0
EG_y	Net Generation(kWh)	326,111,446
EF_y	Emission Factor (tCO_2/GWh)	547¹³
BE_y	Gross Total Emission Reduction (tCO_2)	178,382
PE_y	Project Emissions(tCO_2)	6
ER_y	Net Emission Reduction (tCO_2)	178,376

Table 4. Baseline emissions

Spread sheet used for calculations have been provided. EF_y has been calculated in FEKE II 69.58 MW HEPP PD EG_y has been calculated from monthly generation records of the plant.

4.2 Project Emissions

The proposed project activity involves the generation of electricity by a hydroelectric power plant which has power density higher than $10W/m^2$ therefore emissions from reservoir is ignored as per the applied methodology.

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

¹³ FEKE II Hepp, Project Description Document, page 29

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

$$A_{PJ} - A_{BL}$$

Where:

PD = Power density of the project activity (W/m²)

Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W)

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

A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m²)

A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m²). For new reservoirs, this value is zero

For proposed project HEPP,

Cap_{PJ} = 69,350,000 W

Cap_{BL} = 0.0 W

A_{PJ} = 2,480,000 (m²)¹⁴

A_{BL} = 0.0 (m²)

Therefore PD is calculated as ;

$$PD = \frac{69,350,000 - 0}{2,480,000 - 0}$$

$$2,480,000 - 0$$

$$PD = 27,96 \text{ W/m}^2$$

Emissions from Diesel Generator

Diesel generators is utilized at the powerhouse which is used as auxiliary power source when there is no electricity generation in the plant or supply by the grid. For the proposed project, 750 lt diesel oil was purchased during the monitoring period. To be conservative, working time of the diesel oil and maximum fuel consumption has been used to calculate project emission from the diesel oil. According to the "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" CO₂ emissions from fossil fuel combustion for process are calculated based on the quantity of fuels combusted and the CO₂ emission coefficient of those fuels, as follows:

¹⁴ FEKE II Reservoir Area Map

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

Where:

- $PE_{FC,j,y}$ = Are the CO₂ emissions from fossil fuel combustion in process j during the year y (tCO₂/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 CO₂ emission coefficient of fuel type i in year y (tCO₂/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;

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i,y} \quad (4)$$

Where:

- $COEF_{i,y}$ = Is the CO₂ emission coefficient of fuel type i in year y (tCO₂/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)
- $EF_{CO_2,i,y}$ = Is the weighted average CO₂ emission factor of fuel type i in year y (tCO₂/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.

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.

NCV and EF¹⁵ values which have been calculated and updated based on 2010 data have been used for COEF calculation. All references has been indicated in the excel sheet.

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

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

$$PE_{FC,j,y} = 5.163 \approx 6 \text{ tonnes CO}_2$$

¹⁵ UNFCCC 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.

Parameter	Value	Unit
Total working hours	34	hour
Hourly Consumption at Max Load	57	lt/hour
Density of Diesel oil	0.845	g/cm ³ or kg/Liter
$\sum FC_{i,j,y}$	1.638	tonnes
$EF_{i,y}$	0.07333	tCO ₂ /GJ
$NCV_{i,y}$	42,991.117	GJ/kt
COEF	3,152.682	tCO ₂ /kt
Project Emissions from diesel Generator	5.163=6	tCO ₂

4.3 Leakage

The energy generating equipment is not transferred from or to another activity. Therefore leakage is also considered as “0”.¹⁶

$$LE_y = 0$$

4.4 Summary of GHG Emission Reductions and Removals

Total Emission Reduction has been determined as;

$$ER_y = BE_y - PE_y - LE_y$$

Where;

ER_y = Emission reductions in year y (tCO₂)

BE_y = Baseline emissions in year y (tCO₂)

PE_y = Project Emissions in year y (tCO₂)

LE_y = Leakage emissions in year y (tCO₂)

¹⁶

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, E_{Ry} = B_{Ey}

Baseline Emissions

$$B_{E_y} = E_{G_{BL,y}} \times EF_{CO_2}$$

Where:

B_{Ey} : Baseline emissions in year y (tCO₂/year)

E_{G_{BL,y}} : Energy baseline in year (kWh)

EF_{CO₂} : Combined Margin CO₂ emission factor (tCO₂/MWh), which is 0.547 tCO₂/MWh in the validated PD.

Thus, the emission reduction(in tonnes CO₂) for January 2011 – September 2012 is calculated as given in table below.

Total Generation From January-2011 to September- 2012	326,111.446 MWh
Total Emission Reduction (From January-2011 to September- 2012)	178,382 tCO₂
Project Emissions	6tCO₂
Net Emission Reduction	178,376 tCO₂

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)

2011	122,205	95,027
2012 (01/01/2012-30/09/2012)	91,654	83,355
Total Emissions excluding project emissions from diesel generator	178,382	
Project Emissions	6	
Total net emission reductions (20 Months)	213,859	178,376

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