



**Monitoring report form for CDM project activity
(Version 06.0)**

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT

| | | |
|---|---|-------------------------------------|
| Title of the project activity | Itezhi Tezhi Hydro Power | |
| UNFCCC reference number of the project activity | 10188 | |
| Version number of the PDD applicable to this monitoring report | 9.0 | |
| Version number of this monitoring report | 34.0 | |
| Completion date of this monitoring report | 0827/068 /2018 | |
| Monitoring period number | First monitoring period | |
| Duration of this monitoring period | 24/05/2016 to 31/05/2017 inclusive of both dates | |
| Monitoring report number for this monitoring report | Not applicable | |
| Project participants | Itezhi Tezhi Power Corporation (ITPC) | |
| Host Party | Zambia | |
| Sectoral scopes | Energy industries (renewable-/non renewable sources) | |
| Applied methodologies and standardized baselines | Methodology : ACM0002, version 16.0 Standardized baseline: Grid emission factor for the Southern African power pool (version 01.0) | |
| Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period | Amount achieved before 1 January 2013 | Amount achieved from 1 January 2013 |
| | 0 | 660,733 |
| Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD | 602,163 | |

SECTION A. Description of project activity

A.1. General description of project activity

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The project activity consists of constructing and operating a 120 MW hydropower plant at the existing Itezhi Tezhi dam on Kafue river in Zambia, with associated ancillary equipment and structures and a transmission line to evacuate the generated electricity. The dam regulates the flow of the Kafue river for hydroelectric power generation and other water uses downstream. The reservoir is located approximately 295 km upstream of the confluence of the Kafue River and the Zambezi river and approximately 230 km upstream from the existing upper Kafue gorge hydro power plant (990 MW). The dam is a conventional rockfill dam with a central impervious core and shell zone meant for the control of seepage and prevention of any degradation of the embankment material properties. The reservoir has a total storage capacity of about 6,000 million cubic metres at elevation of 1,030.5 metres above mean sea level. It is impounded by an earth fill dam with a maximum height of about 51 metres and a crest length of about 1,400 metres. Power is generated using the head available at the existing dam and flow released¹, and therefore there was no need for construction of any new dam, or any change in the surface area of the existing reservoir or volume of water impounded. The average generation output is estimated at 611 GWh per year.

Surface power house and ancillary structures are incorporated into the existing rock filled dam on Kafue river. The project activity entails modifications of the existing intake, construction of a surface Power House to house two Kaplan turbines connected to synchronous generators with capacity of 120 MW. It also involves the placement of a switchyard about 100m from the Power House. The current height of the dam is maintained.

The project activity also includes construction of a transmission line of about 300 km in length to evacuate power from the plant, via Mumbwa, to Lusaka West. The Itezhi Tezhi – Mumbwa 220 kV single circuit transmission line originates from a 220 kV substation on the South bank of the Kafue River at the Itezhi Tezhi dam, located about 100m from the power house, to Mumbwa substation, a distance of approximately 146 km. From Mumbwa substation, a single circuit line of 330 kV (stepped up from 220 KV) to Lusaka West will be constructed with a length of 145 km. The electricity is connected to the Southern African Power Pool (SAPP) grid that is dominated by thermal power plants, resulting in a high grid emission factor (combined margin grid emission factor 0.9644 tCO₂/MWh)².

In addition electricity is exported to the neighbouring Kataba town via a dedicated 33kV transmission line. In order to be conservative, however, these exports to Kataba town are not included in the calculation of emission reductions and exports of electricity via the dedicated 33kV line are not included in the monitoring plan.

Relevant milestone dates for the project activity are summarised below:

| Date | Activities |
|------------|--|
| 08/04/2011 | Power Purchase Agreement approved by Energy Regulatory Board. |
| 16/11/2011 | Civil and hydro mechanical and electromechanical works contract with Sinohydro becomes effective, and works commenced. |
| 17/01/2013 | LoA for project activity issued by Zambia DNA |
| 08/09/2015 | Project registration |
| 04/03/2016 | Official opening of power plant by President of Zambia Edgar Lungu |
| 24/05/2016 | Commissioning/start of operation, start of first crediting period and first monitoring period |

¹ ITPC Ltd, Feasibility report for Itezhi Tezhi Hydro Electric Project (2 x 60 MW) by TEC Consulting Engineers Ltd.

² Standardized baseline for “Grid emission factor for the Southern African power pool”, Version 01.0, EB 73. Annex 3

| | |
|------------|--------------------------------|
| 31/05/2017 | End of first monitoring period |
|------------|--------------------------------|

This monitoring period covers the first monitoring period, 24/05/2016 to 31/05/2017 inclusive of both dates, during which total GHG emission reductions amounted to 660,733 tCO₂.

A.2. Location of project activity

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The project is located in Itezhi Tezhi District, Central Province, Zambia.

The coordinates of the new hydro power plant are given below :

15°46'09"S, 26°01'21"E



Figure 1: Location of Central Province in Zambia and existing Itezhi Tezhi dam

The transmission line passes through four districts namely Itezhi Tezhi, Mumbwa, Chibombo and Kafue. It originates from the south bank of Itezhi – Tezhi dam then traverses the Kafue Flats, crossing the river into Chief Shimbizi's area, then into chiefdoms of Chilyabufu, Muwezwa, Chibuluma, Moono, Senior Chief Shakumbila and part of Nkomensha in Lusaka West.

A.3. Parties and project participants

| Parties involved | Project participants | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|-----------------------------|---|--|
| Party A (host Party) Zambia | Private entity A: Itezhi Tezhi Power Corporation (ITPC) | No |

A.4. Reference to applied methodologies and standardized baselines

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The proposed project activity uses the approved consolidated baseline and monitoring methodology "ACM0002: Grid-connected electricity generation from renewable sources", version 16.0, sectoral scope 01 (<http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN>).

Related tools applied:

- Tool for the demonstration and assessment of additionality (version 07.0.0., <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf>)
- Combined tool to identify the baseline scenario and demonstrate additionality (version 05.0.0, <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.0.pdf>)
- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion (version 02, <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf>)

The methodology chosen also references the following tools, but these have not been used for this CDM project for the following reasons:

- Tool to calculate the emission factor for an electricity system (<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v6.pdf>): not relevant as emission factor used is referenced from the Standardized baseline entitled “Grid emission factor for the Southern African power pool” (version 01.0)
- “Tool to determine the remaining lifetime of equipment” (<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf>): this tool is used for project activities which involve the replacement of existing equipment with new equipment or which retrofit existing equipment as part of energy efficiency improvement activities, which is not the case for this proposed CDM project.
- “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf>): this tool is relevant at the renewal of a crediting period, which is not the case for this proposed CDM project.

A.5. Crediting period type and duration

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Type of crediting period: Fixed

Start date of crediting period: 24 May 2016 (date of Commissioning/start of operation)

Length of crediting period: 10 years (24 May 2016 to 23 May 2026)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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Description of the installed technology(ies), technical process and equipment

The project has been fully operational since the date of commissioning and start of operation on 24 May 2016. A view of the completed hydropower station is included in Figure 2.



Figure 2: View of the completed hydropower station

Figure 3 shows a schematic of the layout of the hydropower plant including the powerhouse, switchyard, channels, tunnels and access roads.

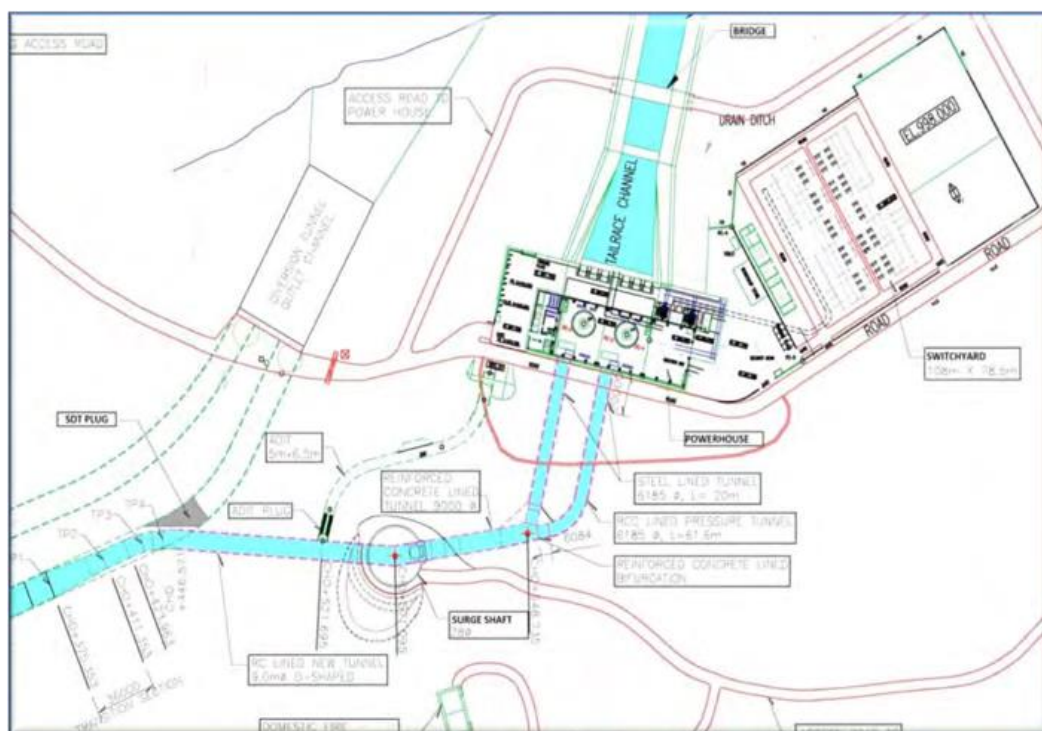


Figure 3: Schematic of the layout of the hydropower plant

The technology involves hydro generation of power and construction of transmission line to evacuate power. The technology deployed has the following components:

Electrical equipment

This involves two generators designed for an output of 66.236 MVA at a power factor of 0.85 with a maximum of 90°C winding temperature rise. The generators operate at a speed of 157.9 rpm with a rated voltage of 11 kV. Each generator has its own excitation and accessories such as static exciter and voltage regulator. Generated voltage (11 kV) is stepped up using three-phase transformer to 220 kV for transmission. Each is connected to an individual unit transformer with a continuous rating of 70 MVA and a rated voltage of 220/11 kV.

The 220 kV switchyard is located about 500 m away from the existing outlet channel. The 220 kV equipment including circuit breakers, isolators and instrument transformers is located in the switchyard. The high voltage windings of the main transformer are connected to SF₆ switchgear in the switchyard by 220 kV overhead line. The switchyard also contains the following:

- A fire detection system
- A DC system with rectifiers and battery to provide a secure supply of power
- AC auxiliary system
- Communication systems
- Grounding
- Emergency diesel generator set (750 kVA)
- Transformers (generator set up, unit auxiliary and station transformers)
- Earthing and lightning protection

Mechanical equipment

This involves turbines with two units of conventional vertical shaft Kaplan each rated at 57.344 MW with a maximum capacity of 61.1 MW. The rated speed is 157.9 rpm with discharge rated at 156 m³/s at a net head of 40 m. The centre of turbine distributor is at El. 977 m about ten metres below tail water. Each turbine has a digital microprocessor-controlled electric-hydraulic governing system with speed and acceleration sensing, speed regulation, stabilizing and diagnostic functions. Each turbine is protected by a butterfly shutoff valve located in the machine hall. The component also contains the following:

- Water level monitoring and sensing systems
- Turbine flow meters and taps
- A cooling and service water system that will be supplied from the draft tubes
- A treated water system that will include a self-contained water treatment plant.
- A governor and turbine inlet valve compressed air system to provide pressure for the oil pressure tanks
- A station service compressed air supply system.
- A unit unwatering and filling system to unwater the area between the draft tube gate and the inlet valve.
- An oil purification and recovery system
- A forced, reticulating air conditioning and ventilation system; and
- Emergency generating equipment to supply emergency power to essential station services in the event of station power loss.

Transmission lines

This involves 146 km 220 kV of single circuit of the line from Itezhi tezhi power plant to Mumbwa substation and further extension of 145 km 330 kV line with twin bison single circuit to Lusaka West substation.

Substation

Two 125 MVA, 330/220/33 kV substations have been constructed at Mumbwa. Also the existing Lusaka West 330 kV substation has been extended to accommodate a new 330 kV line bay and two transformers (1 No. 330 / 132kV and 1 No. 132 / 33kV). All insulators have a minimum creepage distance of 20 mm/kV.

Information on the implementation and actual operation of the project activity

The table below provides a summary of the relevant dates for construction, commissioning, start of operation and other milestone dates.

| Date | Activities |
|-------------|--|
| 08/04/2011 | Power Purchase Agreement approved by Energy Regulatory Board. |
| 18/04/2011 | Contract for the infrastructure works became effective |
| 16/11/2011 | Civil and hydro mechanical and electromechanical works contract with Sinohydro becomes effective, and works commenced. |
| 04/03/2016 | Power plant was officially opened by the President of Zambia |
| 24/05/2016 | Plant commissioned and start of operation |
| 24/05/2016 | Start of first monitoring period |
| 31/05/2017 | End of first monitoring period |

Itezhi Tezhi Hydro Power Plant was registered as a CDM project by UNFCCC on 8 September 2015. The power plant was officially opened by the President of Zambia, Edgar Lungu, on the 4th March 2016, and the plant was commissioned on 24 May 2016, which is also the date for start of operation. The first monitoring period thus started on 24 May 2016. In general, during the first monitoring period ending on 31/05/2017, Itezhi Tezhi Hydro Power Plant has been in safe and stable operation state, no emergency cases have occurred.

B.2. Post-registration changes**B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines**

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Not applicable

B.2.2. Corrections

>>

Not applicable

B.2.3. Changes to the start date of the crediting period

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Change in start date for crediting period to 24 May 2016.

B.2.4. Inclusion of monitoring plan

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Not applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

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Not applicable

B.2.6. Changes to project design

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The following main change has been made in project design:

1. Change in project description to include description of 33kV transmission line to Kataba town (section A.1.)

SECTION C. Description of monitoring system

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The generation of electricity is done by the ITPC while transmission is done by ZESCO Ltd therefore the two companies monitor electricity generation. ITPC records the electricity generated and sold to ZESCO Ltd on a monthly and an annual basis. ZESCO Ltd records the electricity at the point of connection to SAPP grid system on a monthly and an annual basis. Emission reductions are calculated by multiplying electricity supplied to the SAPP grid system with the ex-ante fixed combined margin grid emission factor.

Electricity supplied to the SAPP grid system is measured by the Nambala Line Meter, which is the main meter to the 220kV Nambala line, as shown in figure 4. In addition electricity is also exported to Kataba town. In order to be conservative, however, these exports to Kataba town are not included in the calculation of emission reductions.

Monitoring equipment:

The diagram in figure 4 presents all power meter locations, and Table 1 provides a description of each meter, including location, function, recording frequency and frequency of meter checks.

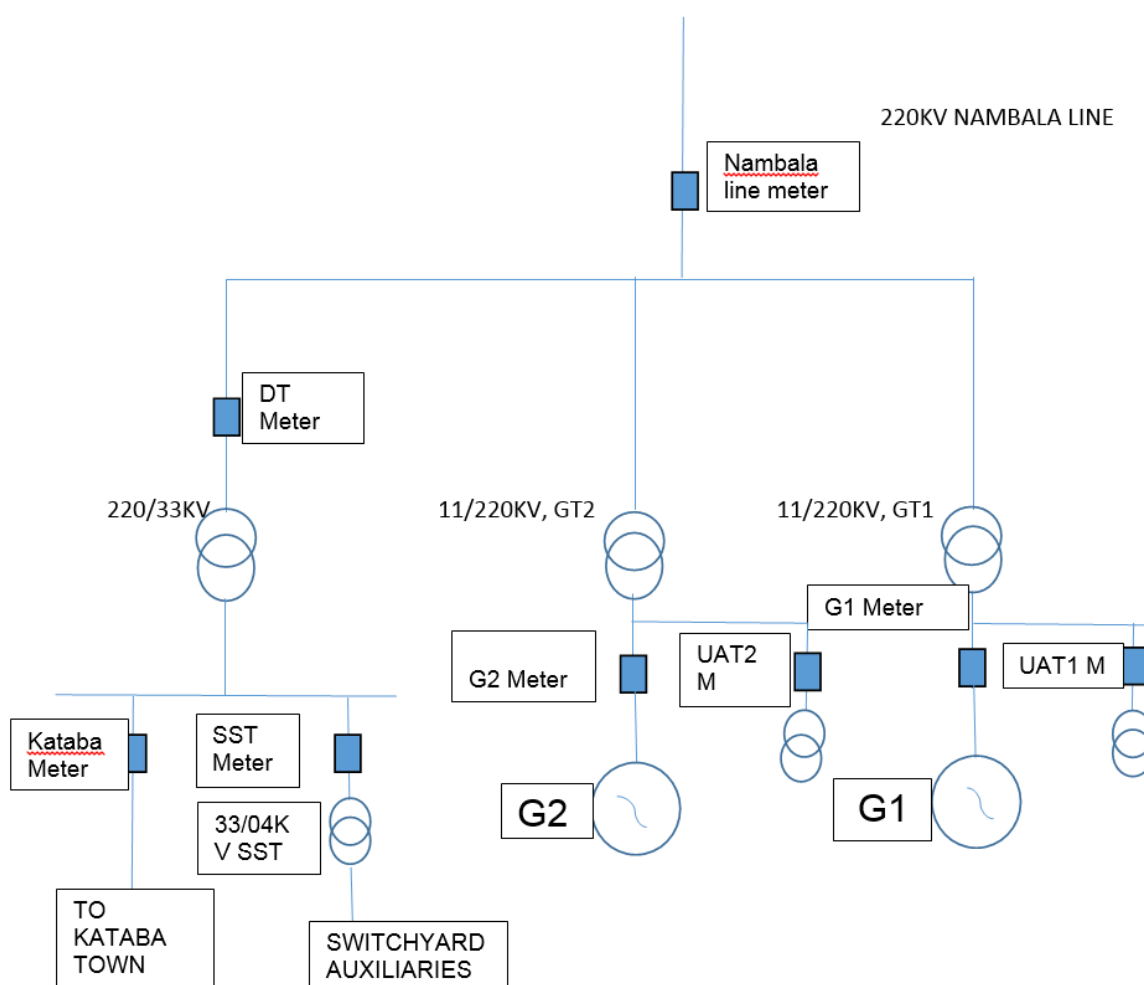


Figure 4: Schematic diagram of ITT power station metering points

Table 1: Description of power meters

| Power meter | Location | Function | Recording frequency | Frequency of checking meter |
|--------------------|---------------------------------|--|---------------------|--------------------------------|
| Nambala Line Meter | 220kV Nambala line | Metering main exports into the grid | Once monthly | 3 rd Party annually |
| G1 Meter | Generator terminals Unit 1 | Gross generated energy from unit 1 | Daily | 3 rd Party annually |
| G2 Meter | Generator terminals Unit 2 | Gross generated energy from unit 2 | Daily | 3 rd Party annually |
| UAT1 M | UAT1 feeder | Auxiliary consumption | Daily | - |
| UAT2 M | UAT2 feeder | Auxiliary consumption | Daily | - |
| DT Meter | Distribution Transformer feeder | Gross export & imports through 33kV feeder | Daily | - |
| SST Meter | SST feeder | Switchyard auxiliary consumption | Daily | - |
| Kataba Meter | Kataba feeder | Exports to ZESCO | Daily | 3 rd Party annually |

| | | | | |
|--|--|---------------------|--|--|
| | | through Kataba Line | | |
|--|--|---------------------|--|--|

Monitoring organisation

The monitoring organization for the CDM project and roles of relevant parties follows the structure provided in the validated PDD, which is summarized in Figure 5.

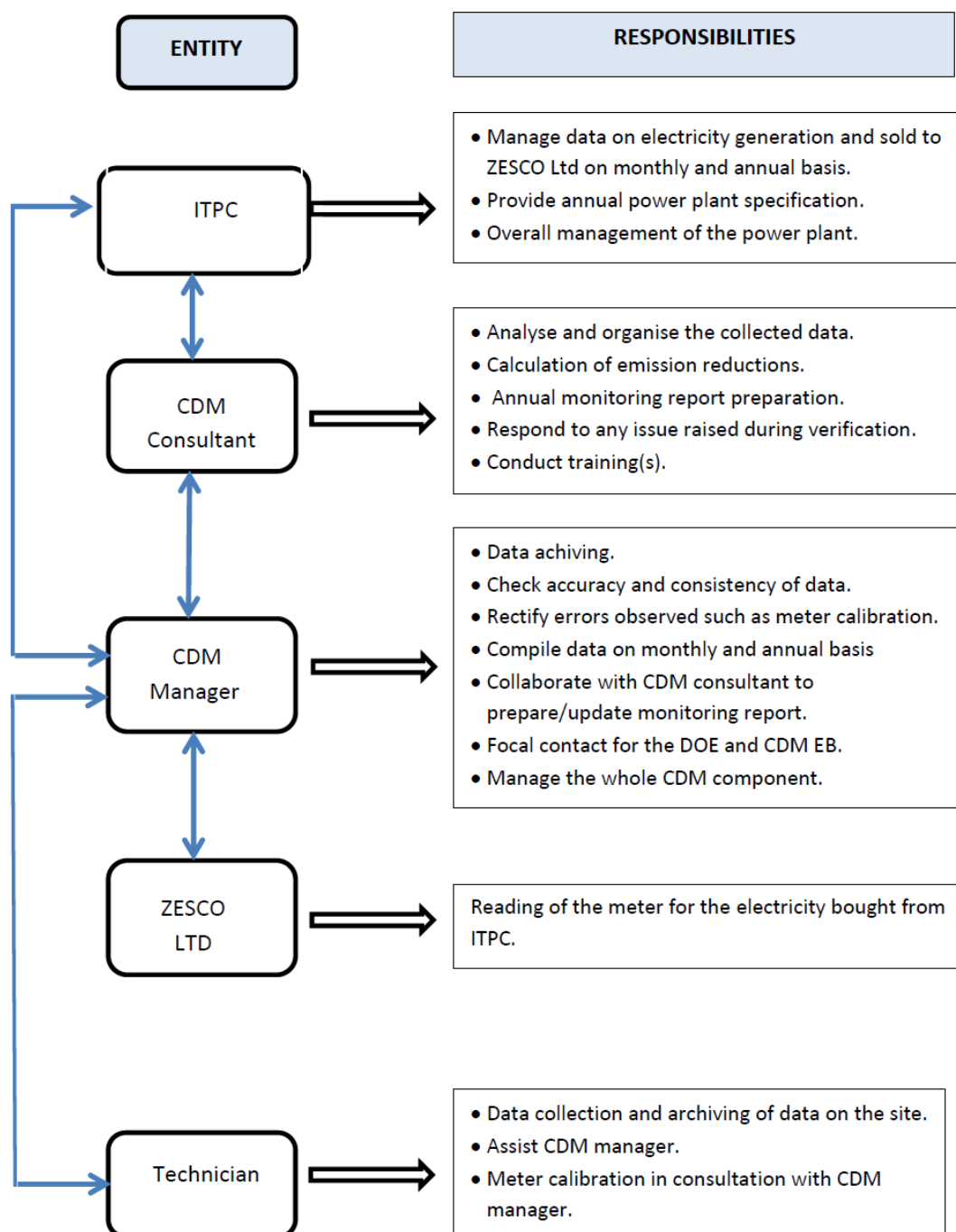


Figure 5: Responsibilities of relevant parties for monitoring

Specific descriptions of the roles of the CDM manager and the CDM consultant are provided below.

CDM manager

The CDM manager is responsible for data processing and archiving. All data recorded is stored in electronic format. The role of the CDM manager is to check accuracy, consistency and relevance of the manual readings with electronic data sets. The CDM manager and his /her assistants carry out monthly/annual reading of meters. The monthly and annual data has two types of information: electricity generated in the site and electricity dispatched to the SAPP grid system. To ensure consistency and as a way of back up the manager crosschecks monthly readings against respective sales receipts and the readings at the point of connecting to the SAPP grid.

The CDM manager is the Operations Engineer with position corresponding to one of the titles shown in the plant organization diagram presented in Figure 6. Selected staff support the CDM manager, and the following collect relevant data for the purposes of the CDM project:

- Electricity generation ($EG_{\text{facility},y}$): Shift Leaders position from Figure 6 (i.e. Shift leaders – technologists)
- Fuel consumption ($FC_{i,j,y}$): Shift Leaders position from Figure 6 (i.e. Shift leaders – technologists)
- Density of diesel ($\rho_{i,y}$): CDM Manager position from Figure 6 (i.e. Operations Engineer)

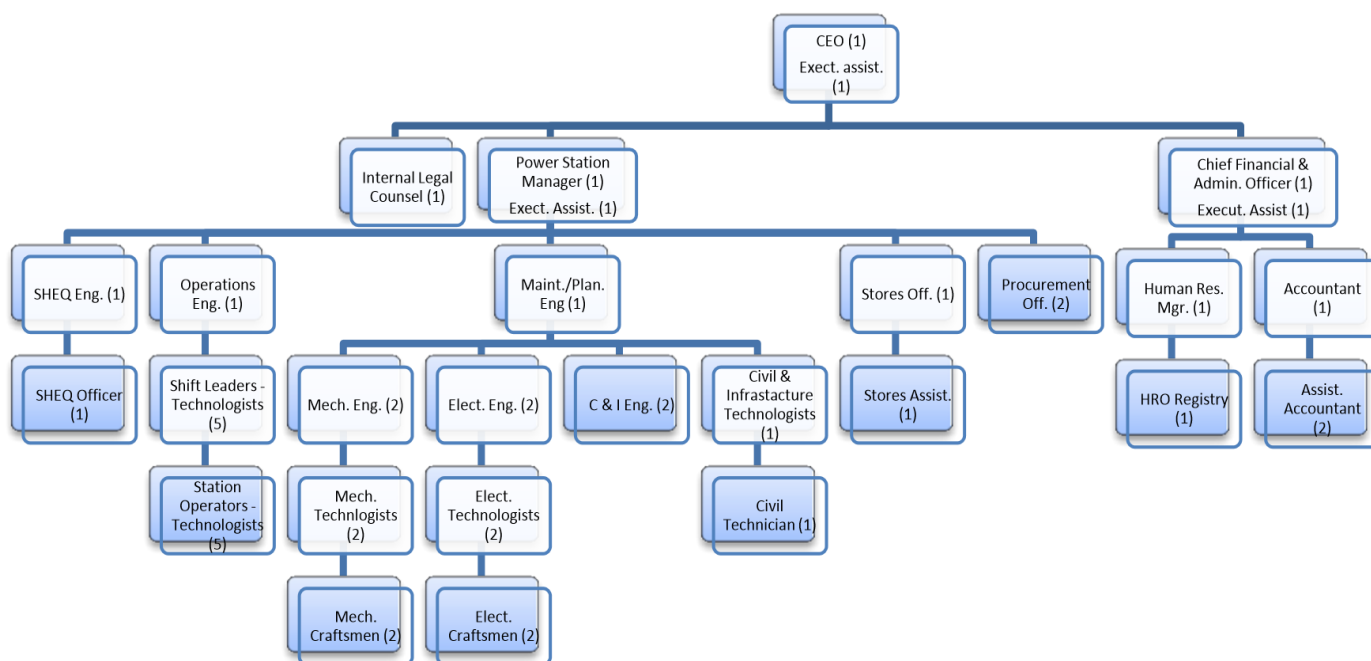


Figure 6: Plant organization diagram

CDM consultant

A consultant, Carbon Limits AS, has been hired to organise the data and to prepare monitoring reports as well as respond to any CDM related technical concerns raised during verification.

Monitoring equipment and calibration

The main monitoring equipment of the purposes of the CDM project is the Nambala Line Meter located on the 220kV Nambala line which meters main exports of electricity into the SAPP grid. Two trivector energy meters are installed on the 220 kV outgoing line (main meter and check meter) just before it leaves the switchyard. The same meters measure both import & export (i.e. the energy taken from the grid & supplied to the grid). The accuracy class of both meters is specified as 0.2 s.

The meters are tested on an annual basis in accordance with the PPA.

Meter readings are taken on a daily basis by ITPC staff, while readings are also taken by ZESCO staff once a month. These meter readings are also available online through the SCADA system.

Quality assurance and quality control of data

Quality assurance and quality control for measurement reading, recording/documentation and archiving is emphasised and improved from time to time to ensure high quality monitoring is achieved and the emission reductions achieved is credible. Meters are checked on annual basis or any other time when discrepancy is observed by professional technicians and take any necessary calibration/adjustment.

Data management, archiving and retrieval

The collected data on electricity generation is archived electronically and stored in electronic file entitled "Weekly Statistics", and also documented in hard copy at the hydropower plant as a back-up.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

| | |
|--|---|
| Data/Parameter | EF _{grid,CM,y} |
| Unit | tCO ₂ /MWh |
| Description | "Combined margin CO ₂ emission factor for the project electricity system applicable to all project activities other than wind and solar for the first crediting period" specified in the standardized baseline entitled "Grid emission factor for the Southern African power pool" version 01.0. |
| Source of data | "Grid emission factor for the Southern African power pool" version 01.0. |
| Value(s) applied | 0.9644 |
| Choice of data or measurement methods and procedures | The Combined Margin (CM) grid emission factor is calculated ex-ante for the duration of the crediting period |
| Purpose of data/parameter | Calculation of baseline emissions |
| Additional comments | None |

D.2. Data and parameters monitored

| | |
|---------------------------------|---|
| Data/Parameter | EG _{facility,y} |
| Unit | MWh |
| Description | Quantity of net electricity generation supplied by the project plant/unit to the grid in year y |
| Measured/calculated/default | Measured |
| Source of data | Project activity site, energy meters |
| Value(s) of monitored parameter | 686,525 MWh (conservatively adjusted to 685,152 MWh for calibration delays) |

| | |
|---------------------------------------|--|
| Monitoring equipment | <p>Bulk electricity meters which measure both:</p> <p>(i) The quantity of electricity supplied by the project plant/unit to the grid; and</p> <p>(ii) The quantity of electricity delivered to the project plant/unit from the grid</p> <p>Main meter (Figure 7): Make: Wasion Group limited Model: DSSD331/DTSD341-9D Three Phase High Accuracy Gateway Meter (see http://www.wasion.com/EN/pro/628.html for technical data) Serial no: 1408241739000005 Accuracy class: 0.2s Calibration frequency: At least once every ten (10) years as per PPA Meter accuracy tests: Annual Date of last test: 31/07/2017 Validity: 30/07/2018</p> <p>Check meter (Figure 7): Make: Wasion Group limited Model: DSSD331/DTSD341-9D Three Phase High Accuracy Gateway Meter (see http://www.wasion.com/EN/pro/628.html for technical data) Serial no: 1408241739000001 Accuracy class: 0.2s Calibration frequency: At least once every ten (10) years as per PPA Meter accuracy tests: Annual Date of last test: 31/07/2017 Validity: 30/07/2018</p> |
| Measuring/reading/recording frequency | Continuous measurement and at least monthly recording |
| Calculation method (if applicable) | NA |
| QA/QC procedures | Cross check measurement results with records for sold electricity. Meters periodically checked according to the relevant national electric standards and regulations. |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comments | <p><u>The energy meters were installed prior to the date of commissioning/start of operation (24/05/2016), and were calibrated by the manufacturer before installation. However, the initial calibration test reports of the energy meters could not be provided. Furthermore, the first accuracy test was delayed and carried out on 31/07/2017 (i.e. more than one year after commissioning and outside the monitoring period). In accordance with paragraph 369 of the CDM VVS for project activities (version 01.0), therefore, the electricity export and import data have been adjusted by applying maximum permissible error of 0.2% (as provided by the equipment supplier) to calculate the net exported electricity and the emission reductions accrued by the project activity. This correction was applied for the entire monitoring period. The maximum permissible error of 0.2% was applied as the error identified in the delayed calibration was lower than the maximum permissible error. The meter check carried out on 31 July 2017 found the error to be 0.033% (below the error limit of 0.2%).--</u></p> |

| | |
|---------------------------------|---|
| Data/Parameter | $FC_{i,j,y}$ |
| Unit | ton/yr or m ³ /yr |
| Description | Quantity of fuel type <i>i</i> combusted in process <i>j</i> during the year <i>y</i> |
| Measured/calculated/default | Calculated from purchase invoices |
| Source of data | Purchase invoices |
| Value(s) of monitored parameter | 9.87 m ³ |

| | |
|---------------------------------------|---|
| Monitoring equipment | Not applicable, calculation based on purchase invoices |
| Measuring/reading/recording frequency | Continuous (as and when purchased). |
| Calculation method (if applicable) | NA |
| QA/QC procedures | Cross check measurements with buying receipts/invoices. |
| Purpose of data/parameter | Calculation of project emission |
| Additional comments | See xl file entitled "Copy of fuel GENSET March 2017" |

| | |
|---------------------------------------|---|
| Data/Parameter | $NCV_{i,y}$ |
| Unit | TJ/Gg |
| Description | Net calorific value of diesel |
| Measured/calculated/default | Default |
| Source of data | IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories |
| Value(s) of monitored parameter | 43.3 TJ/Gg (IPCC default value) |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency | NA |
| Calculation method (if applicable) | NA |
| QA/QC procedures | Any future revision of the IPCC Guidelines should be taken into account |
| Purpose of data/parameter | Calculation of project emission |
| Additional comments | Option b) used: IPCC default value |

| | |
|---------------------------------------|---|
| Data/Parameter | $EF_{CO_2,i,y}$ |
| Unit | tCO ₂ /TJ |
| Description | Emission factor for diesel in year y |
| Measured/calculated/default | Default |
| Source of data | IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories |
| Value(s) of monitored parameter | 74.8 TCO ₂ /TJ |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency | NA |
| Calculation method (if applicable) | NA |
| QA/QC procedures | Any future revision of the IPCC Guidelines should be taken into account |
| Purpose of data/parameter | Calculation of project emission |
| Additional comments | Option b) used: IPCC default value |

| | |
|-----------------------|-----------------------------|
| Data/Parameter | $\rho_{i,y}$ |
| Unit | t/L |
| Description | Density of diesel in year y |

| | |
|---------------------------------------|---|
| Measured/calculated/default | Default |
| Source of data | Worldwide Winter Diesel Fuel Quality Survey 2014 (https://www.infineum.com/media/80722/wdfs-2014-full-screen.pdf) |
| Value(s) of monitored parameter | 0.000842 t/L |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency | NA |
| Calculation method (if applicable) | NA |
| QA/QC procedures | Any future revision of the value should be taken into account |
| Purpose of data/parameter | Calculation of project emission |
| Additional comments | Option c) used: Regional or National default values |



Figure 7: Main and check meter, Itezhi Tezhi 120 MW hydro power plant

D.3. Implementation of sampling plan

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No data and parameters monitored were determined by a sampling approach therefore sampling plan is not relevant to the proposed project activity.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

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Baseline emissions include only CO₂ emissions from electricity generation by fossil fuel fired power plants that are displaced due to the project activity. Baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid, CM,y}$$

Where:

- BE_y = Baseline emissions in year *y* (tCO₂)
 EG_{PJ,y} = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
 EF_{grid, CM,y} = Combined margin CO₂ emission factor for grid connected power generation in year *y* calculated using the “Tool to calculate the emission factor for an electricity system” (tCO₂/MWh) = **0.9644 tCO₂/MWh**

In the first monitoring period (24/05/2016 to 31/05/2017), the Itezhi Tezhi hydropower plant has supplied to the grid a total net electricity of 685,152 MWh.

The baseline emission (BE_y) can therefore be calculated as follow:

$$BE_y = 685,152 \text{ MWh} \cdot 0.9644 \text{ tCO}_2/\text{MWh} = 660,760 \text{ tCO}_2$$

Baseline emission are **660,760 tCO₂**.

The detailed calculation of baseline emissions for each month is shown in table 2.

Table 2: Baseline emission calculation for each month (or part thereof) in the first monitoring period.

| Period | Electricity exported, corrected (MWh) | Electricity imported, corrected (MWh) | Net electricity (MWh) | Emission factor (tCO ₂ /MWh) | Baseline emissions (tCO ₂) |
|--------------------------|---------------------------------------|---------------------------------------|-----------------------|---|--|
| 24/05/2016 to 31/05/2016 | 20,742 | 109,43 | 20,633 | 0.9644 | 19,898 |
| 01/06/2016 to 30/06/2016 | 75,593 | 0,00 | 75,593 | 0.9644 | 72,901 |
| 01/07/2016 to 31/07/2016 | 59,446 | 2,80 | 59,443 | 0.9644 | 57,327 |
| 01/08/2016 to 31/08/2016 | 64,607 | 0,00 | 64,607 | 0.9644 | 62,307 |
| 01/09/2016 to 30/09/2016 | 40,766 | 0,00 | 40,766 | 0.9644 | 39,315 |
| 01/10/2016 to 31/10/2016 | 53,589 | 0,00 | 53,589 | 0.9644 | 51,681 |
| 01/11/2016 to 30/11/2016 | 48,064 | 0,00 | 48,064 | 0.9644 | 46,353 |
| 01/12/2016 to 31/12/2016 | 40,511 | 0,00 | 40,511 | 0.9644 | 39,069 |
| 01/01/2017 to 31/01/2017 | 32,255 | 0,00 | 32,255 | 0.9644 | 31,107 |
| 01/02/2017 to 28/02/2017 | 32,894 | 0,00 | 32,894 | 0.9644 | 31,723 |
| 01/03/2017 to 31/03/2017 | 64,878 | 0,00 | 64,878 | 0.9644 | 62,568 |
| 01/04/2017 to 30/04/2017 | 75,640 | 0,00 | 75,640 | 0.9644 | 72,948 |
| 01/05/2017 to | 76,279 | 0,00 | 76,279 | 0.9644 | 73,564 |

| | | | | | |
|--------------|----------------|------------|----------------|---------------|----------------|
| 31/05/2017 | | | | | |
| TOTAL | 685,264 | 112 | 685,152 | 0.9644 | 660,760 |

E.2. Calculation of project emissions or actual net removals

>>

As the tool proposes the quantity of fuel type used in a year y to be used, emissions from back up diesel generator are calculated ex-post. Sample calculation for all formulae used to calculate project GHG emissions applying actual values is provided below:

Project GHG emissions = Volume * density * NCV * emission factor

Where:

Volume = 9 870 L

Density = 0.000842 t/L

NCV = 43.3 TJ/Gg (which is the same as 43,3 GJ/t)

Emission factor = 0.0748 tCO₂/GJ

Therefore:

Project GHG emissions = 9 870 * 0.000842 * 43.3 * 0.0748 = **26.92 tCO₂**

Total emissions from back up diesel generator during the reporting period = 26.92 tCO₂ (see xl file entitled "Copy of fuel GENSET March 2017").

E.3. Calculation of leakage emissions

>>

According to the methodology leakage was not considered.

E.4. Calculation of emission reductions or net anthropogenic removals

| | Baseline GHG emissions or baseline net GHG removals (t CO ₂ e) | Project GHG emissions or actual net GHG removals (t CO ₂ e) | Leakage GHG emissions (t CO ₂ e) | GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e) | | |
|--------------|---|--|---|---|-----------------|--------------|
| | | | | Before 01/01/2013 | From 01/01/2013 | Total amount |
| Total | 660,760 | 27 | -- | -- | 660,733 | 660,733 |

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

| Amount achieved during this monitoring period (t CO ₂ e) | Amount estimated ex ante (t CO ₂ e) |
|---|--|
| 660,733 | 602,163 |

E.6. Remarks on increase in achieved emission reductions

>>

The actual GHG emission reductions achieved is greater than the amount based on the ex-ante estimation in the registered PDD. The actual GHG emission reductions is 9.94% above the amount based on the ex-ante estimation in the registered PDD.

The increase in GHG emission reductions achieved compared to the amount based on the ex-ante estimation in the registered PDD is due to favourable hydrological conditions during the monitoring period compared to the projected hydrological conditions used for the feasibility study. [Figure 8 shows the -Itezhi Tezhi reservoir daily water level hydrographs for the periods 1st October 2015 to 30th September 2016 and 1st October 2016 to 30th September 2017, which includes the monitoring](#)

period (24/05/2016 to 31/05/2017 inclusive of both dates). These graphs clearly show that the inflow during the monitoring period was much higher than that during the Average Year (1987-88), in particular during the first half of 2017, where inflow figures were 50% above those of the Average Year for significant periods of time. The energy forecasts in the feasibility studies are based on inflows during Average Year i.e. 1987-88. Further evidence of the favourable hydrological conditions includes local press reports³ which also refer to considerable improvement in the water inflows at Itezhi Tezhi reservoir. This clearly shows that the hydrological conditions were better than expected.

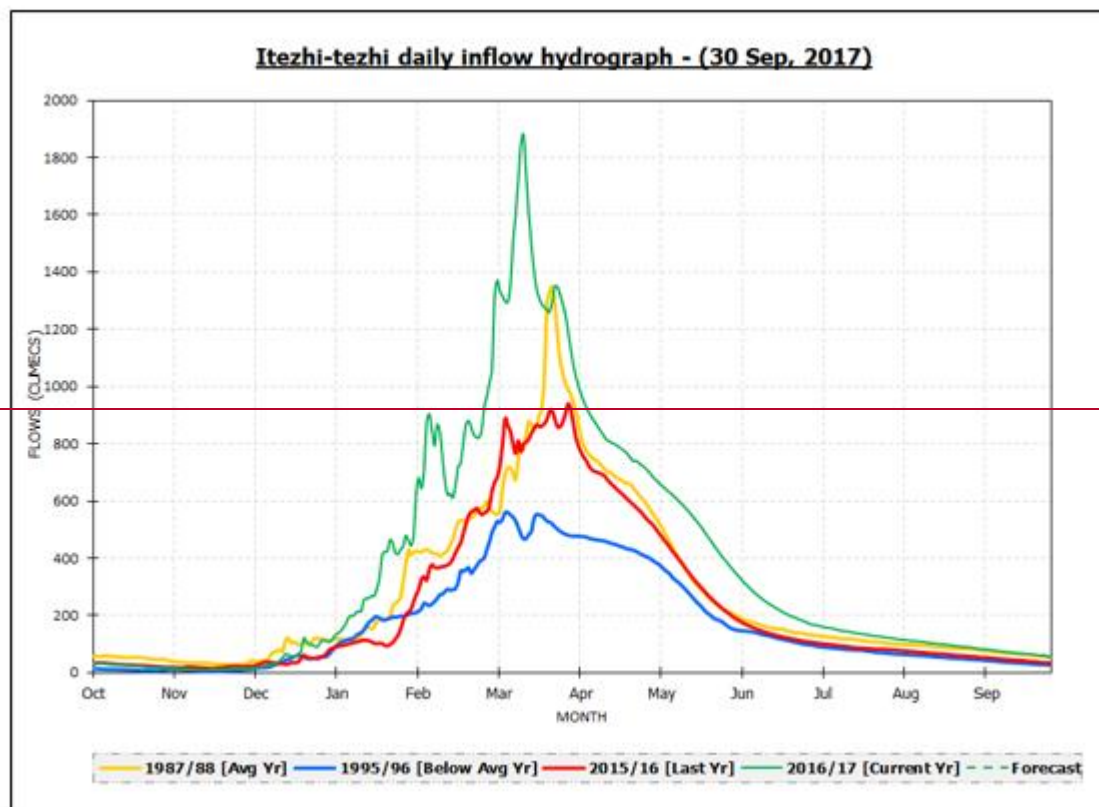


Figure 8: Itezhi Tezhi Daily Inflow Hydrograph

There has been no increase in installed capacity of the plant during the monitoring period.

³ <https://www.lusakatimes.com/2016/05/13/water-kariba-dam-itezhi-tezhi-reservoirs-improves-zesco/>

Document information

| <i>Version</i> | <i>Date</i> | <i>Description</i> |
|---|-----------------|--|
| 06.0 | 7 June 2017 | Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements. |
| 05.1 | 4 May 2015 | Editorial revision to correct version numbering. |
| 05.0 | 1 April 2015 | Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement. |
| 04.0 | 25 June 2014 | Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement. |
| 03.2 | 5 November 2013 | Editorial revision to correct table in page 1. |
| 03.1 | 2 January 2013 | Editorial revision to correct table in section E.5. |
| 03.0 | 3 December 2012 | Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11). |
| 02.0 | 13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20). |
| 01.0 | 28 May 2010 | EB 54, Annex 34. Initial adoption. |
| Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report | | |