CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Bugoye 13.0 MW Run-of-River Hydropower Project
Document version: 04
Date of completion: 06 May 2010

A.2. Description of the small-scale project activity:

Tronder Power Ltd plans to initiate the Bugoye hydropower project, a run-of-river plant with an installed capacity of 14.28 MW and an annual production of 82,000 MWh. The project is located at the foot of the Rwenzori Mountains in the Kasese District, Western Uganda. The project will divert water from the river Isya and run it via a five kilometer-long canal into a 950 meter-long penstock with a head of 160 meters. After passing through two 7.228 MW Francis turbines, the water will be discharged to the Mubuku River. The project will utilize the remaining head between two existing hydropower plants; Mubuku 1, upstream of the project site, and Mubuku 3, downstream of the project site. The hydro power plant will be connected to the national grid via a 6 km long transmission line routed to the Nkenda substation.

Implementation of the project will consist of construction of the following main items:

- A main intake and sedimentation basin where water from the river Mubuku is diverted through a 1,0 km canal to the river Isya
- A second intake and sedimentation basin at the river Isya, where tailrace water from the Mubuku 1 power station is added to the system
- An open concrete headrace canal with total length of 4.0 km.
- A spillway of approximately 1 km, a forebay and 950 m penstock.
- Power house with two horizontal 7.228 MW Francis turbines
- Tailrace canal back to the Mubuku River.
- Switch station and a 33 kV transmission line of 6.5 km

The primary objective of the project is to supply affordable electricity and contribute to environmental and economical sustainability for the population of Uganda. The electricity grid in Uganda supplies only a small fraction of the population and relies partly on fossil fuels. Increased production of electricity from renewable resources will lead to a reduction of the global emissions of greenhouse gases. The project will furthermore help Uganda to stimulate and commercialize the use of grid connected renewable energy technologies. The project will demonstrate the viability of small scale grid connected hydropower which can support improved energy security, improved air quality, improved local livelihoods and sustainable renewable energy industry development.

It is estimated that the project will lead to an annual emission reduction of 51,074 tonnes CO_2 annually.

The project will:

- Produce renewable energy and thus reduce global greenhouse gas emissions;
- Help to stimulate the hydro power industry in Uganda;
- Create local employment during the construction and operation of the hydropower station;
- Reduce other pollutants such as SO_2 and NOx resulting from fossil fuel power generation industry in Uganda;

- Reduce Uganda's increasing energy deficit; and
- Reduce import dependency.
- Diversify Uganda's energy mix which comprises of biomass, petroleum and electricity. According to the energy balance 2006, final energy consumption is 92.1% biomass, 7.0% petroleum products and only 0.9% electricity[1];

The project contributes to sustainable development in Uganda in the following ways:

- Hydro power presents various environmental benefits compared to other primary energy sources: hydro power does not result in emissions of pollutants into the atmosphere nor does it emit residuals that can have a negative impact on soil, vegetation, drinking water etc. As a renewable energy source hydro power can be used without putting the supply of primary energy sources into danger for future generations. The proposed project will also contribute to a reduction in other emissions than GHG emissions related to conventional electricity generation, like emissions of sulphur dioxide, nitrogen oxides and particulates;
- The project will result in additional employment opportunities, especially during the construction phase. Construction materials for the foundations, cables and access roads will be sourced locally;
- Project developer will build a fence along the vulnerable parts of the canals and 12 footbridges as well as one motor vehicle bridge. Adjacent to the footbridges, there will be water collection points. The project developer will further leave the road from Ibanda to Nkenda will be in the same or better standards as before constructions and Support to establishment of gravity fed water supply system for affected villages both sides.
- The project complies with national and local laws and regulations. The project has been granted a permit to develop hydro power plant at Bugoye from the Ministry of Energy and Mineral Development (MEMD) and the Environmental and Social Impact Assessment (ESIA) has been approved by the National Environment Management Agency (NEMA);
- The project supports the main policy goal of the Ministry of Energy and Mineral Development; namely "To establish, promote the development, strategically manage and safeguard the rational and sustainable exploitation and utilization of energy and mineral resources for social and economic development"[2].
- The project is expected to involve some transfer of technology. First, the project developer will use modern technology which will be of a higher standard than other power plants currently existing in Uganda. Further, project developer will train both skilled and unskilled local workers.

A.3. Project participants:

The project participants are:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)
Republic of Uganda (host)	• Tronder Power Ltd.	No
Switzerland	• Climate Cent Foundation	No

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the

[1] Annual report 2006, Ministry of Energy and Mineral Development (MEMD), page 32
[2] Annual report 2006, Ministry of Energy and Mineral Development (MEMD), page iii

time of requesting registration, the approval by the Party(ies) involved is required.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Republic of Uganda

A.4.1.2. Region/State/Province etc.:

Kasese District in the Western region of Uganda, 400 km drive from Kampala.

A.4.1.3. City/Town/Community etc:

The project is in Bugoye Sub County which is situated around 15 km north of Kasese town and comprises of 5 parishes and 35 villages.

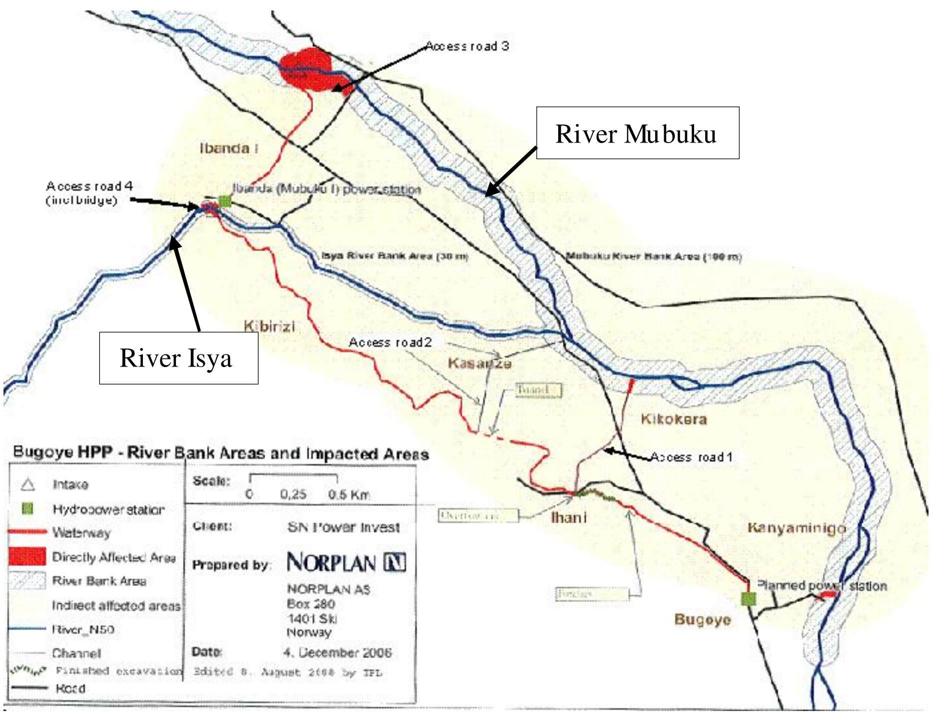
A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

The Bugoye Hydropower Plant is located on the river Mubuku, in the Kasese District in the Western region of Uganda, 400 km drive from Kampala.

Project coordinates

Diversion intake:	0 20’02.30’’N	30 04’27.76’’E
Intake:	0 19’46.58’’N	30 04’16.27’’E
Forebay:	0 18’51.93’’N	30 05’43.25’’E
Power station:	0 18’25.80’’N	30 05’57.57’’E
Tailrace outlet:	0 18’27.94’’N	30 06’07.20’’E

The Mubuku River originates on the central parts of the Rwenzori Mountains. It passes the Ibanda village, which is the main entrance gate to the Rwenzori National Park and the starting point for trekking in the mountains. The river runs south east, crossing the Kasese – Fort Portal road before it “disappears” in the wetlands north of Lake George. There are already two hydro power plants in the river, Mubuku I[3] upstream and Mubuku 3[4] downstream of the proposed site.The proposed project utilizes the remaining head between the two existing hydropower plants and has to be constructed in close regard to the existing plants. An overview of the Mubuku valley with the rivers and the power plants is shown in figure to the left. The project makes use of the tailrace water from the Mubuku 1 power plant, discharging water into river Isya, a stream that joins river Mubuku some 500 m further down. As the Mubuku 1 power station only divert 4 m^3/s from the Mubuku river to its power station, and also has frequent shut downs, the project needs to have its own intake at Mubuku river, diverting water from Mubuku to the tailrace where the Mubuku 1 tailrace stream is also utilized. The water is then channeled to the proposed power station and let back to the Mubuku river



[3] Mubuku 1 is also referred to as Ibanda HHP which is owed by Kilembe Mines (in operation since 1954)

[4] Mubuku 3 is also referred to as Kasese Cobalt Company Limited (KCCL) HHP (in operation since 1993)

upstream of the Mubuku 3 intake.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The project comes under AMS Type I – Renewable Energy Project and Category I.D.- Grid connected renewable electricity generation (version 15).

The proposed project activity generates electricity from run-of-river hydro power and supplies it to the national electricity grid, replacing generation from fossil fuels. Hydro power being renewable energy, type I category has been chosen and the generated electricity is supplied to grid meeting the applicability conditions for AMS I.D (detailed in section B.2). The installed capacity of the project is 14.28 MW which is below the 15 MW limit, so it therefore qualifies as a small scale project. The project capacity will not exceed 15MW within the crediting period.

Project Concept

The Bugoye Hydropower Project is a run-of-river project making optimum use of the available water resources.

Implementation of the project will consist of construction of the following main items:

- A main intake and sedimentation basin where water from the river Mubuku is diverted through a 1,0 km canal to the river Isya
- A second intake and sedimentation basin at the river Isya, where tailrace water from the Mubuku 1 power station is added to the system
- An open concrete headrace canal with total length of 4.0 km.
- A spillway of approximately 1 km, a forebay and 950 m penstock.
- Power house with two horizontal 7.228 MW Francis turbines and two 7.140 MW generators
- Tailrace canal back to the Mubuku river.
- Switch station and a 33 kV transmission line of 6.5 km
- An emergency diesel generator

In the power house, two horizontal axis turbines will be installed, each with a capacity of 7.228 MW, giving a total capacity of 14.456 MW. The two 7.140 MW generators are horizontal axis, three-phase, synchronous salient-pole, with sleeve bearings and brushless excitation systems. The generators have a power factor of 0.85, a frequency of 50 Hz and an output of 8.4 MVA.[5] The power output for supply to the grid has to include losses in the generator (n~0.97) and transformer (n~0.985). The rated output to the grid for combined operation of the two turbines at discharge 10m^3/s, taking into account losses in the generator and transformer, is 13MW. Annual production is based on 6,308 annual operating hours and therefore estimated to be 82,000 MWh.

The project will also include installation of a small switch field at the power house. Two transformers shall amplify the production energy of 6.3 kV to a potential of 33 kV. The 33kV line shall be connected to the indoor switchgear in the existing spare 33kV panel at Nkenda Substation by an underground cable. The relevant metering devices for measuring electricity supply to the distribution grid will be located at

[5] Information differs from feasibility study from 2006 and is provided by Tronder Power Ltd.

the outlet of the power house switch field. The energy produced at the outlet of the switch field shall be sold to UETCL[6].

During maintenance periods, power will be drawn from the grid. Normally however, it will be possible to operate one turbine while the other is under maintenance, so there should be little need to import power from the grid. A 80 kVA emergency diesel generator will be installed to cover non-operation of the turbines. This on-site diesel generator will only be used in exception periods, for example when the grid is down and on-site loads cannot be self-supplied. It is expected that the use of the diesel generator will be less than 100 hours per year, however, the hours of usage will be monitored.

The key project data for the Bugoye Hydropower Project is given below:

Catchment area	207 km^2
Mean annual run-off	10.2 m^3/s
Intake pond storage	1000 m^3
Canal length	4.0 km
Penstock length	950 m
Penstock diameter	1.8/2.0/2.2 m
Rated head	160 m
Turbine type	Francis
Turbine capacity	2 x 7.228 (14.456) MW
Generator type	Horizontal synchronous
Generator capacity	2 x 7.140 (14.28) MW
Mean annual production	82,000 MWh
Plant load factor	65.55%

All equipment and parts related to the supply of turbine and generator and auxiliary mechanical works will conform to internationally accepted standards (e.g. DIN, ISO, EN). The most relevant standard is for the turbine, where IEC standard 61362, 60193 and 41, in addition to CCH 70-3, have been set. All materials used are to have a quality equal to or better than the relevant international standards specified in the contract documents prepared by the project engineer (annex 5). This will ensure that the technology transferred to the host country will meet the modern internationally accepted standards on quality, environmental performance and safety.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

The estimated amount of emission reductions over the chosen 10 year crediting period is 510,740 tonnes CO_2.

[6] Uganda Electricity Transmission Company Limited (UETCL) is a public limited liability company incorporated under the Companies Act. It was established and commenced operations on 26th March 2001 as a result of the power sector reform and liberation policy of the government of Uganda that unbundled Uganda Electricity Board (UEB) into a number of successor companies.

Table 1: Estimated amount of emission reductions

Years	Estimation of annual emission reductions in tonnes of CO2e
2011	51,074
2012	51,074
2013	51,074
2014	51,074
2015	51,074
2016	51,074
2017	51,074
2018 2019	51,074 51,074
2020	51,074
Total estimated reductions (tonnes of CO_2e)	**510,740**
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tonnes of CO_2e)	**51,074**

A.4.4. public funding of the small-scale project activity:

The Ministry of Finance in Norway has provided a grant of 60 million NOK to the project. However, the project activity will be managed by Tronder Power Ltd and supported by the company's shareholders.

The public funding from the Government of Norway will not be used to acquire GHG emission reductions from the project. Instead, Tronder Power Ltd will seek other buyers. The financial resources given to the project will not lead to any diversion of ODA government resources, as confirmed by the Norwegian Ministry of Foreign Affairs in Annex 2.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

In *Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project Activities,* it is stated the following results in debundling of a large CDM project:

"A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- with the same project participants;
- in the same project category and technology/measure; and
- registered within the previous 2 years; and
- whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point"

For the proposed project activity, the project participant does not own any more hydro power projects registered within the previous 2 years whose project boundary is within 1 km of the project boundary of the proposed activity. Neither Mubuku 1 HPP (owned by Kilembe Mines, in operation since 1954) or Mubuku 3 HPP (owned by Kasese Cobalt Company Limited, in operation since 1993) are owned or operated by the project participant, and neither has been, or ever will be, registered as a CDM project. Thus the proposed small-scale project is a stand-alone project and is not a debundled component of a larger project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The approved baseline and monitoring methodology of the project activity are described as:

AMS Type I – Renewable Energy Project
Category I.D.- Grid connected renewable electricity generation (Version 15)

The "Tool to calculate the emission factor for an electricity system" (Version 02), has been used to calculate the emission factor.

The "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02) is used to calculate the project emissions from potential use of diesel for the plant back-up generator.

B.2 Justification of the choice of the project category:

The choice of methodology AMS I.D., Version 15, is justified as the proposed project activity meets its applicability criteria:

- Bugoye Run-of-River Hydropower project is a grid-connected renewable power generation project without reservoir that adds electricity capacity from hydro power sources, and which will supply electricity to and displaces electricity from an electricity distribution system that is supplied by at least one fossil fuel fired generating unit.
- The unit added has only renewable components of total maximum production capacity of 14.28 MW, which does not exceed the eligibility limit (15 MW). Tronder Power Ltd does not plan to upgrade plant capacity during the crediting period.
- The project involves construction of new units in a new plant, and does not involve the addition of renewable energy generation units at an existing renewable power generation facility, nor does it seek to retrofit or modify an existing facility for renewable energy generation.

- Project owner does not own any more hydro power plants registered within the previous 2 years whose project boundary is within 1 km of the project boundary of the project.

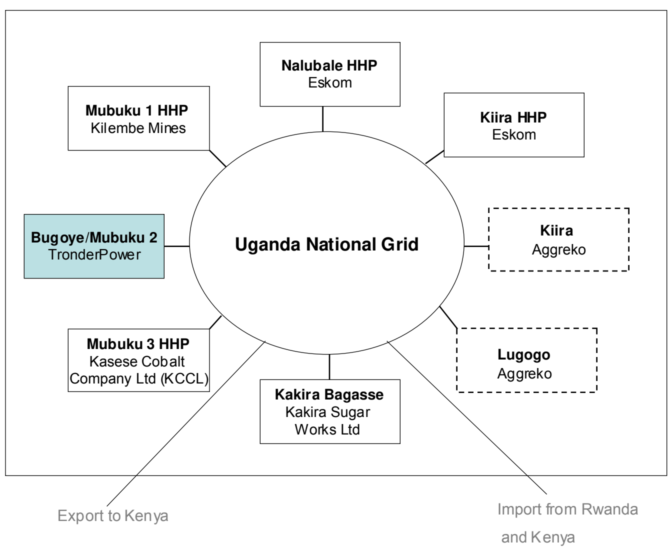
B.3. Description of the project boundary:

According to AMS 1.D, the project boundary encompasses the physical, geographical site of the renewable generation source.

However, for the purpose of determining the electricity emission factors, a **project electricity system** is in the "Tool to calculate the emission factor for an electricity system" (Version 02), defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

The spatial extent of the project boundary therefore includes the project power plant and all power plants connected physically to the project electricity system. The project boundary is limited to the Ugandan national grid as depicted in Figure 1.

Figure 1: Schematic of project showing project boundary



For this project activity, the project electricity system is the Ugandan national grid. But there is both import and export of electricity to and from the Uganda grid. Due to the power shortage, the government has suspended electricity export to Kenya and instead negotiated for import up to 20 MW when available. Total import from Rwanda and Kenya has increased over the last years and represented 3 % of total electricity supply in 2007.

Figure 2 provides a summary of the greenhouse gases included within the project boundary.

Figure 2: Schematic of the gases included in project boundary

Source	Gas	Included?	Justification / Explanation

Baseline	CO2 emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity.	CO2	Yes	Main emission source. According to AMS.I.D.(Version 15)
		CH4	No	According to AMS.I.D.(Version 15)
		N2O	No	According to AMS.I.D.(Version 15)
Project activity	For hydro power plants, emissions of CH4 from the reservoir. Project is a run-of-river.	CO2	No	According to AMS.I.D.(Version 15)
		CH4	No	According to AMS.I.D.(Version 15)
		N2O	No	According to AMS.I.D.(Version 15)

B.4. Description of baseline and its development:

The project activity is generating electricity from a new hydropower plant, which will be fed into the Uganda grid, displacing electricity generated from the Uganda source mix.

Two possible baseline scenarios of the project activity have been identified as:

Alternative 1: The proposed project activity without CDM i.e. the construction of a new hydropower plant with an installed capacity of 14.28 MW connected to the regional grid, implemented without CDM status. The barrier analysis in Section B.5 shows that the proposed project faces barriers that would prevent its implementation without the CDM.

Alternative 2: Continuation of the current situation i.e. electricity will continue to be generated by the existing generation mix operating in the grid.

This represents a plausible baseline scenario and it does not face any barriers.
From the above analysis, alternative 2 is considered to be the baseline scenario, and baseline emissions will be calculated for the scenario where electricity will continue to be generated by the existing generation mix operating in the grid. The baseline is calculated according to the methodology AMS I.D.-Grid connected Renewable Electricity generation (version 15).

According to methodology AMS I.D., the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor:

$$BE_y = EG_{BL,y} * EF_{CO2}$$

Where:

BE_y Baseline Emissions in year y; t CO_2

$EG_{BL,y}$ Energy baseline in year y; kWh

EF_{CO2} CO_2 Emission Factor in year y; t CO_2e/kWh

The Emission Factor can be calculated in a transparent and conservative manner as:

a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the “Tool to calculate the emission factor for an electricity system” (version 02); OR

b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

For this project, option a) above is chosen as this will give a more accurate emission factor for the entire crediting period. All the procedures, including the characteristics of electricity generation and the accordant emissions in the baseline scenario, are based on the 7-step approach described in the “Tool to calculate the emission factor for an electricity system” (version 02).

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

According to the general guidance for SSC project activities, project participants shall demonstrate to a designated operational entity that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities and annex 34 “Non-binding best practice examples to demonstrate additionality for SSC project activities”. Reference is also made to “Guidelines for objective demonstration and assessment of barriers” (annex 13 of EB50), and specifically guideline 7 regarding Least Developed Countries (LDCs). In this respect, Uganda is on the UN list of LDCs[7]. In addition, Uganda is also on the UN list of Landlocked Developing countries (LLDCs) where “lack of territorial access to the sea, remoteness and isolation from world markets and high transit costs continue to impose serious constraints on the overall socio-economic development”.

With respect to Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities and annex 34 “Non-binding best practice examples to demonstrate additionality for SSC project activities”, project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) **Investment barrier**: a financially more viable alternative to the project activity would have led to higher emissions;

(b) **Access-to-finance barrier**: the project activity could not access appropriate capital without consideration of the CDM revenues;

(c) **Technological barrier:** a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(d) **Barrier due to prevailing practice**: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(e) **Other barriers** such as institutional barriers or limited information, managerial resources, organizational capacity, or capacity to absorb new technologies.

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[7] http://www.un.org/special-rep/ohrlls/ldc/list.htm

The project has identified "(b) Access-to-finance barrier" as the most relevant barrier, as described below. However other barriers have also relevant been identified as relevant barriers, and these are also outlined.

(b) Access-to-finance barrier

Uganda is one of few countries in Sub-Saharan Africa that has recorded rapid economic growth[8] and effective poverty reduction[9]. Nonetheless, Uganda is still one of the poorest countries in the world (and an LDC).

In Uganda, borrowing takes place in informal networks (mainly families) with limited ties to formal credit or finance risk. Uganda's global ranking in the World Bank *Doing Business* indicators fell from 107th to 118th (out of 178 countries) from 2006 to 2008[10]. Uganda ranks as number 159 out of 178 countries on "getting credit"[11]. The lack of financial markets is a strong barrier to private participation in long-term investments, such as hydro power plants, and Uganda still relies largely on foreign aid rather than private sector investors. According to the recent report from the OECD, commercial banks' average lending rate remained very high at 19 per cent in 2007, compared to the time deposit interest rate of 11 per cent[12]. The high spread indicates a lack of competition in the banking sector and high operational inefficiency.

A private investor, such as Tronder Power Ltd, therefore needs to raise capital from outside Uganda, and has to assure its creditors that all investment risks have been minimized. The potential revenue from the sale of CERs has been integral to Tronder Power Ltd's investment in this project. Tronder Power Ltd has signed a contract with the Uganda government which contains an expression of mutual interest and acknowledgement of the environmental benefits of the project (termed the "Support Agreement", appendix 4). This contract acknowledges explicitly the commercial value of the emission reductions and that this will have an impact on the price to be paid for power by UETCL. In this contract it is agreed that GoU will get 60% of the revenue stream from CERs and Tronder Power Ltd will get 40%, after cost of CDM project development is deducted[13]. The revenues from the sale of CERs is therefore intrinsic to the ability of UETCL to enter into a long-term power purchase agreement and pay an appropriate tariff to Tronder Power Ltd for the electricity generated.

The agreement on the sharing of the revenue stream from CERs has also been a pre-requisite for the "buy-out" option which is included in the contract, and which stipulates that the Government of Uganda has to pay off all outstanding debt and equity in case of purchasing default. This "buy-out" clause is of crucial importance for Tronder Power Ltd and its lenders, who would not otherwise take on the investment risks associated with this project were it not for the "buy-out" clause.

It is also noted that the "Emerging Africa Infrastructure Fund" (EAIF), who have an agreement to provide a loan of between US$ 30 Million and US$ 35 Million and to the project developers and who are the only lender for the project, took into consideration revenues accruing from the sale of CERs in their assessment of the viability of the project, and the project's ability to service the debt, and this revenue was considered a significant contributor to the project's viability (appendix 5). The importance of the GoU receiving a share of the revenues from the sale of the CERs in ensuring a guarantee to repay lenders on default is also highlighted the letter from EAIF.

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[8] Averaging over 6% per annum for the past decade (World Bank)

[9] Down from 56% to 38% between 1992 and 2003 (World Bank)

[10] World Bank *Doing* Business ranking http://www.doingbusiness.org/economyrankings/

[11] http://www.doingbusiness.org/documents/DoingBusiness2007_FullReport.pdf

[12] African Economic Outlook 2008 http://www.oecd.org/dataoecd/13/3/40578334.pdf

[13] Relevant sections of the Support Agreement is included as **Error! Reference source not found.** in Annex 6

(d) **Barrier due to prevailing practice**: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions.

The Ugandan Government and Ministry of Energy and Mineral Development aim to promote private investments in energy projects[14]. Over the last years, 50 sites has been identified as being potentially viable for private investors and about ten hydro projects with a total capacity of 210 MW have been studied for exclusive permits[15]. However, so far there have been no privately financed hydropower projects in Uganda, neither large nor small scale (see table 2). The Bugoye project has been the subject of studies since the late 1950s[16], but investors have not been able to overcome the barriers to implement the project. This is a clear indication of the difficulties facing private investors.

Hydro is the main source of energy for generation of electricity in Uganda, but this is primarily due to the two large scale plants (Nalubaale and Kiira HPPs), financed by GoU and donor funds. Use of own diesel generator sets and back-up diesel generators are also common (Ministry of Energy and Development, Uganda) Diesel generators can be installed with comparable short lead time and is currently the main activity to cover the power shortage in Uganda. In 2005-2006, the GoU introduced the reduction of the diesel tax[17] and acquired two large scale Aggreko power plants, consisting of up to 60 units. Plants were installed in several steps during 2005 and 2006, increasing the thermal share of total supply mix from 8 to 28 per cent over 2005-2007. Due to the large supply deficit and the tax reduction on diesel, it is also likely that there have been increased production of electricity from non-connected privately owned diesel generators.[18]

It can therefore be concluded that Government supported construction of large hydro and diesel plants represents common practice in Uganda, whereas private owned small scale hydropower does not. Table 2 shows all the grid connected power plants in Uganda. The two large hydro power plants and the two Aggreko plants, represented together more than 98,3 % of domestic grid connected generation in 2007. The government owned Mubuku 1, which was built in 1954 and primarily serves the needs of the Kilembe mines complex, represented 1,51 % of total generation.

Table 2 Grid connected power plants in Uganda before the end of 2007

[14] Ugandan Government and Ministry of Energy and Mineral Development, Annual report 2005

[15] http://www.era.or.ug/Investment.php

[16] Bugoye HPP Final Feasibility Study, Norplan for SN Power AS, March 2006

[17] Tax waiver were given in 2006 to industrial generators and power imports. http://myafrica.wordpress.com/2006/10/01/uganda-electric-power-production-has-dropped/

[18] See PDD for West Nile Project http://cdm.unfccc.int/UserManagement/FileStorage/QQMIYUT47K73D9CVAETZNDT7G5DQZI

Grid connected Power Plant	Capacity	Installed	Ownership	Fuel
Mubuku 1 HHP Kilembe Mines	5 MW	1954	Government	Hydro
Mubuku 3 HHP KCCL	10 MW	1993	Private (Kasese Cobalt company Ltd.)	Hydro
Aggreko Kiira	50 MW (50-60 units)	2006	Government	Diesel
Aggreko Lugogo	50 MW (50-60 units)	2005	Government	Diesel
Nalubaale HPP	180MW	1954	Government	Hydro
Kiira HPP	120 MW	2003	Government	Hydro
Kakira Bagasse	6 MW (upgrade to 19MW)	2007	Private (Kakira Sugar Works Ltd. Madhvani Group)	Sugar waste
West Nile HPP *(Not grid connected)*	5 MW	2007	Private (West Nile Rural electrification Company Limited)	Hydro

Note; * Due to the low water level in Lake Victoria, current total capacity of Nalubaale and Kiira about 135 MW.
Source; Information collected from Electricity regulatory authority, kakira sugar works (webpage), West Nile (PDD).

There are two privately owned power plants based on renewable energy (Mubuku 3 and Kakira), which only generated 0,18 % of domestic production during 2007. However, both of these plants differ significantly from the Bugoye project. The Kakira Bagasse is a power plant utilizing the waste from sugar production. The Kakira sugar plant operated in Uganda long before they started electricity production, meaning lower investment risks than for new entrants in the market, and the attractive economics for bagasse cogeneration are well known. As for Mubuku 3, the Kasese Cobalt Company Ltd. (KCCL) is a mining company, utilizing the hydro power resources form a nearby river. KCCL is working in close cooperation with the Uganda government[19]. Operators of both of these plants have government support, local knowledge and, most significantly, produce electricity primarily for in-house consumption, although any surplus can be sold to the grid[20]. This substantially reduces the risks of purchase default, financing and political instability. Bugoye HPP depends entirely on the revenue from sale of electricity to the grid, and is the first example in Uganda of such an operating model. This model has inherently greater risks than current practices in Uganda, and the project therefore relies on CDM to counter these risks.

The most recently built small-scale hydro power plant is 3.5 MW West Nile HPP. This is a small scale HPP not connected to the national grid, but to a local mini-grid. It is the first and only registered CDM project in Uganda, and is financially supported by the World Bank. Even if it would have been connected to the national grid, 2007 generation would be less than 1% of total grid-connected electricity generation and cannot say to represent common practice. Furthermore, as this project was implemented as a CDM project, it must be excluded from the prevailing practice analysis.

[19] See company profile, http://www.kccl.co.ug/about.htm, accessed June 24th, 2008

[20] See http://www.era.or.ug for a breakdown of energy supplied to the grid compared to total production for both these plants

It can therefore be concluded that although the energy sector has been partly privatized and there are ongoing initiatives (grid extensions scheme, rural electrification programs, capacity building, etc) to facilitate investments in the power sector, these measures have yet to prove effective. So far there are no examples in Uganda of privately financed small-scale hydropower projects relying solely on the sale of electricity to the national grid (the West Nile HPP, as explained above, is financed by the World Bank as opposed to a private investor and is the only supplier connected to its own mini-grid), and this option cannot therefore be considered common practice. Prevailing practice, in the short to medium term, would be to increase production of electricity from large scale grid connected diesel plants and non-connected privately owned diesel generators, both of which would lead to higher emissions, and in the longer term for the Uganda government to invest in large scale hydropower projects.

(e) Other barriers;

Institutional barriers
Political stability is essential to ensure a predictable and stable investment climate. The leadership of Idi Amin and civil wars has severely damaged the infrastructure and investor confidence in Uganda. The Presidency of Yoweri Museveni since 1986 has brought increased economic growth to Uganda, but political instability still remains. Uganda has been subject to armed fighting among hostile ethnic groups, rebels, armed gangs, militias, and various forces at its borders toward Congo, Rwanda and Sudan[21], including armed conflict in Northern Uganda between the Government and the Lord's Resistance Army (LRA) for more than twenty years. The project is situated less than 50 km from the border with the Democratic Republic of Congo (DRC), where the rebel group African Democratic Front (ADF) destabilized the region up to 2002. There are ongoing peace negotiations, but the long-term outcome of these remains unclear. The situation has stabilized, but tension is still present and the company has, on certain occasions, experienced restricted access to the site due to Ugandan military activities in the area. These factors create risks for the project.

In addition to the conflicts mentioned above, Uganda suffers from lack of rule of law, lack of transparency and corruption. These are barriers to economic development, particularly to long-term investment with large upfront costs such as hydro power plants. On the Global Competitiveness Index 2007-2008[22] Uganda is ranked as the 127 out of 130 economies on basic requirements such as institutions, macroeconomic stability, infrastructure and health. Transparency International has developed the Corruption Perception Index (CPI) where 10 is "highly clean" and 0 is "highly corrupt". Based on the perceptions of the degree of corruption as seen by business people and country analysts, Uganda scores only 2.8[23]. The project developer faces corruption as well as unpredictable interference from local politicians both before and after implementation of the project. In July 2000, the President launched the Government Strategy and Plan for Action to fight Corruption and Build Ethics and Integrity in Public Office and created the institutions to implement the plan, but according to the European Commission the program was still lacking adequate resources in 2007 and the political commitment to pursue this plan has been questioned[24].

The Heritage Fund analysis on economic freedom argues that in addition to corruption, bureaucratic apathy and ignorance of rules within public organizations make commercial licensing burdensome and regulations inconsistently enforced. The Ministry of Energy and Mineral Development (MEMD) also acknowledge problems of protracted procurement processes for power generation projects[25]. The project

[21] CIA The world fact book 2008
[22] World Economic Forum's Global Competitiveness Report for 2007-08
[23] Transparency International 2007
[24] European Commission - Uganda Country Strategy Paper (2002-2007)
[25] Annual report 2006 from Ministy of energy and mineral development

developer has also experienced problems of getting access to data that should be publicly available, creating unnecessary delays. The process of acquiring a license to the project site was protracted and burdensome, and there have also been delays in purchasing land required for the project from the Government owned company, Kilembe Mines, in the area (Communication with project developer).

As discussed above, there are many barriers to the project and the project does not represent common practice. Several project developers have considered developing the project since the 1950's but have not been able to overcome the barriers. Political instability due to conflicts, weak institutions and corruption also represents a major barrier and the project developers are dependent upon revenue from CDM to secure government support and the buy-out clause in case of purchase default. Tronder Power Ltd did not undertake any major investments until the signing of the support agreement January 24th 2008 (see project milestones, *Table 3*). The project is therefore additional.

Table 3: Summary of project milestones

Date	***Milestone***	***Comment***
Jan 2006	Site permit	Awarded by ERA to SN Power AS
Mar 2006	Feasibility Study & EIA completed	Undertaken by Norplan for SN Power AS
May 2006 Aug 2006	Project company registered in Uganda First tender for supply of equipment	As a subsidiary of SN Power AS Issued by SN Power AS
July 2007	Transfer of project from SN Power AS to TrønderEnergi	Agreement between SN Power AS & TronderEnergi for 1 MUSD
Sept 2007	Updated supply and service contact price offers from contractors	Submitted to TrønderEnergi
Sept 2007	TrønderEnergi (co-owner of Tronder Power Ltd) investment decision	Conditional on Norfund participating
Dec 2007	Norfund (co-owner of Tronder Power Ltd) investment decision	Final investment decision Norfund Board
Jan 2008	Signing of support agreement	Signed between Govt. of RoU and Tronder Power Ltd
15 January 2008 7 March 2008	Mobilization for construction Contract for civil works signed (project start date)	Based on letter of intent with Noremco for early start-up prior to contract signature With Noremco
Mar 2008	Contracts with suppliers signed	With ABB, Mavel, Norplan
May 2008	Loans signed	With EAIF
22 August 2008	Submission of PDD to validator	--
2 September 2008 22 October 2008	PDD uploaded for GSP Site visit by validator	-- --
12 May 2009	First LoA provided by DNA in Uganda	--
Feb 2010	ERPA signed	--

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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- The **AMS I.D.- methodology** (Grid connected renewable electricity generation, version 15) is to be used. This methodology is applicable to renewable energy generation units, including hydro, which displaces electricity from an electricity distribution system supplied by at least one fossil fuel fired generating unit.

- **The "Tool to calculate the emission factor from an electricity system" Version 02** is used to calculate the baseline emission factor. The baseline emission factor (tCO_2/MWh) is calculated as the combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the tool. All the procedures, including the characteristics of electricity generation and the accordant emissions in the baseline scenario, are based on the 7-step approach described in the "Tool", and are outlined below.

- The "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version 02 is used to calculate the project emissions from potential use of diesel for the plant back-up generator. The CO_2 emissions from fossil fuel combustion will be calculated based on the quantity of fuels combusted and the CO_2 emission coefficient ($COEF_{i,y}$) of the fuel type. Due to the availability of data from the fuel supplier, $COEF_{i,y}$ will be determined according to Option B (i.e. based on the net calorific value and CO_2 emission factor of the fuel type).

Step 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints. The DNA of Uganda has not published any delineation of the grid and we assume that the project electricity system is the Ugandan national grid.

The national grids of Kenya and Rwanda are considered connected electricity systems. Electricity transfers from connected electricity systems to the project electricity system are defined as electricity imports and electricity transfers to connected electricity systems are defined as electricity exports.

As per "Tool to calculate the emission factor for an electricity system" (version 02);
- For the purpose of calculating operating margin, the emission factor of 0 tons CO_2 per MWh is applied to net import from Rwanda.
- Electricity exports to Kenya are <u>not</u> subtracted from electricity generation data used for calculating and monitoring the electricity emission factors,
- For the purpose of determining the build margin emission factor, the spatial extent is limited to the project electricity system.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants may choose between the following two options to calculate the OM and BM emission factor:

Option I: Only grid power plants are included in the calculation

Option II: Both grid power plants and off-grid power plants are included in the calculation

For this project, Option I is chosen, and only grid power plants will be included in the calculation.

Step 3. Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) should be based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

OM will be calculated according to (b)

For the simple adjusted OM, the emissions factor can be calculated using either of the two following data vintages:

- *Ex ante option* is chosen for this project. Ex ante option is a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period. The period 2005-2007 is used to calculate the OM and year 2007 is used for the BM.

- *Ex post option:* The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

The ex-ante option is used to calculate the emission factor for this project activity.

The emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation

The emissions factor may be calculated based on two different data sources:

- Based on data on fuel consumption and net electricity generation of each power plant / unit (Option A), or

- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit (Option B)

Option A is used because plant specific fuel consumption data is available from the national utility.

Power plants registered as CDM project activities should be included in the sample group that is used to calculate the operating margin if the criteria for including the power source in the sample group apply.

There is only one CDM project in Uganda and this plant is not connected to the national grid and is therefore not included in the sample.

Step 4. Calculate the operating margin emission factor according to the selected method

(b) Simple adjusted OM

The simple adjusted OM emission factor ($EF_{grid,OM-adj,y}$) is a variation of the simple OM, where the power plants / units are separated into low-cost/must-run power sources (k) and other power sources (m). OM is calculated:

- Based on data on fuel consumption and net electricity generation of each power plant / unit (Option A), as follows:

$$EF_{grid,OM-adj,y} = (1-\lambda_y) \times \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \cdot \frac{\sum_m EG_{k,y} \times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

The indices m and k are subsets of all power sources m supplying electricity to the grid in year y, where k refers to power plants / units which are either low-cost or are must-run and m refers to the remaining power plants / units.

Where:

$EF_{grid,OM-adj,y}$	=	Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh)
λ_y	=	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EG_{k,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit k in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{EL,k,y}$	=	CO_2 emission factor of power unit *k* in year *y* (tCO_2/MWh)
m	=	All grid power units serving the grid in year *y* except low-cost/must-run power units
k	=	All low-cost/must run grid power units serving the grid in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3 (the three most recent years for which data is available at the time of submission, 2005-2007)

According to "tool for calculating the emission factor of a electricity system" typical low operating cost and must run resources include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Net electricity imports must also be considered low-cost / must-run plants, (k), and the remaining plants are in set (m). For Uganda, (k) consists of hydro power plants, a biomass plant and imports, whereas (m) consists of diesel generators.

λ_y is defined as follows:

$$\lambda_y (\%) = \frac{\text{Number of hours low - cost / must - run sources are on the margin in year y}}{\text{8760 hours per year}}$$

Step 5. Identify the group of power units to be included in the build margin

The sample group of power units m used to calculate the build margin consists of either;

(a) The set of five power units that have been built most recently, or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.

Step 6. Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available (2007), calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available, 2007

According to the "Tool to calculate the emission factor for an electricity system" (Version 02) individual power units at one site comprise one power plant, whereby a power unit characterizes that it can be operated independently of the other power units at the same site. Both the Aggreko power plants are 50 MW installations that are made up of numerous power units, each with a nominal rating of 1250 kVA, giving 1,000 kW peak capacity and 850 kW in baseload. A 50 MW plant is normally made up of 55-60 units, to provide steady generation during maintenance etc. The power units can be installed, operated and dispatched independently. Each control unit covers 6-10 power units, however, each of the power units can be operated independently.[26]

The units were commissioned at different dates:

Aggreko Lugogo:		
	20 MW	09/05/05
	10 MW	20/05/05
	20 MW	28/05/05
Aggreko Kiira	35 MW	07/10/06
	15 MW	12/12/06

[26] See annex 3 Figure 8 Confirmation on Aggreko units for confirmation

We can also see from the tables in Annex 3 that the generation of electricity from Kiira and Lugogu increased from the given dates. In the calculations, we have assumed that the plant consists of 50 units in operation at the same time.

Step 7. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	=	Weighting of operating margin emissions factor (%)
w_{BM}	=	Weighting of build margin emissions factor (%)

The Baseline emission factor is the weighted average of the Operating Margin emission factor and the Build Margin emission factor, 50:50 accordingly.

B.6.2. Data and parameters that are available at validation:

Parameters for the "Tool to calculate the emissions factor for an electrical system"

Data / Parameter:	**$FC_{i,m,y}$**
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power plant *m* in year *y* (for calculation of $EF_{EL,m,y}$)
Source of data used:	Utility official publications, collected from UETCL, See Annex 3
Value applied:	For operating margin: (see table below)

		$FC_{i,m,y}$, 1000 litres
2005	LGGO Aggreko 1	37,724
	Kiira Agrekko 2	-
2006	LGGO Aggreko 1	83,970
	Kiira Agrekko 2	13,203
2007	LGGO Aggreko 1	73,989
	Kiira Agrekko 2	70,445

For build margin:

Power plants	Start of operation	$FC_{i,m,y}$, 1000 litres
Kakira Sugar Works KSW)	2007	-
50*KIIRA Aggreko	2006	70,445
20*LGGO Aggreko	2005	29,596
Total		100,051

Justification of the choice of data or description of measurement methods and procedures actually used:	• OM: Most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (2005-2007) • BM: For the first crediting period, once *ex-ante*, following the guidance included in step 6. Sample group of power units according to option (b) representing 20.44% of system generation
Any comment:	Calculation of the simple adjusted OM in cases where fuel consumption data is available for all power plants / units

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ / mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y* (for calculation of $EF_{EL,m,y}$)
Source of data used:	The following data sources may be used if the relevant conditions apply:

Data source	**Conditions for using the data source**
Values provided by the fuel supplier of the power plants in invoices	If data is collected from power plant operators (e.g. utilities)
Regional or national average default values	If values are reliable and documented in regional or national energy statistics / energy balances
IPCC default values at the lower 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	

Neither values from fuel supplier nor regional / national values are available and the IPCC default values are used.

Value applied:	41.4 TJ/Gg
Justification of the choice of data or description of measurement methods and procedures actually used:	IPCC standard for diesel (lower limit of uncertainty at 95%) used as values are not available by fuel supplier and no reliable national default values are available
Any comment:	Applicable in the following cases: • Calculation of the simple OM, the simple adjusted OM and the average OM in cases where fuel consumption data is available for all power plants / units.

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Data unit:</td><td>tCO_2/TJ</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor of fossil fuel type i in year y</td></tr>
<tr><td>Source of data used:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g. utilities)</td></tr>
<tr><td>Regional or national average default values</td><td>If values are reliable and documented in regional or national energy statistics / energy balances</td></tr>
<tr><td>IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table>
Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.</td></tr>
<tr><td>Value applied:</td><td>72.6 tCO_2/TJ</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually used:</td><td>IPCC standard for diesel (lower limit of uncertainty at 95%) used as values are not available by fuel supplier and no reliable national default values are available</td></tr>
<tr><td>Any comment:</td><td>--</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>$EG_{m,y}$, $EG_{k,y}$</td></tr>
<tr><td>Data unit:</td><td>MWh</td></tr>
<tr><td>Description:</td><td>Net electricity generated and delivered to the grid by power plant / unit m or k in year y</td></tr>
<tr><td>Source of data used:</td><td>Most recent 3 years data (2005-2007) collected from Electricity Regulatory Authority (ERA) and Uganda Electricity Transmission Company Limited (UETCL), see Annex 3.</td></tr>
<tr><td>Value applied:</td><td>For operating margin:
<table>
<tr><th></th><th></th><th>Gen ($EG_{m,y}$), MWh</th></tr>
<tr><td>2005</td><td>LGGO Aggreko 1</td><td>140,911</td></tr>
<tr><td></td><td>Kiira Agrekko 2</td><td>-</td></tr>
<tr><td>2006</td><td>LGGO Aggreko 1</td><td>319,320</td></tr>
<tr><td></td><td>Kiira Agrekko 2</td><td>50,137</td></tr>
<tr><td>2007</td><td>LGGO Aggreko 1</td><td>272,995</td></tr>
<tr><td></td><td>Kiira Agrekko 2</td><td>266,437</td></tr>
</table>
For build margin:
<table>
<tr><th>Power plants</th><th>Start of operation</th><th>Gen ($EG_{m,y}$), MWh</th></tr>
<tr><td>Kakira Sugar Works KSW)</td><td>2007</td><td>1,828</td></tr>
<tr><td>50*KIIRA Aggreko</td><td>2006</td><td>266,437</td></tr>
<tr><td>20*LGGO Aggreko</td><td>2005</td><td>109,198</td></tr>
<tr><td>Total</td><td></td><td>377,463</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually used:</td><td>• OM: Most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (2005-2007)
• BM: For the first crediting period, once ex-ante, following the guidance included in step 6. Sample group of power units according to option (b) representing 20.44% of system generation</td></tr>
<tr><td>Any comment:</td><td>--</td></tr>
</table>

B.6.3 Ex-ante calculation of emission reductions:

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Baseline

Step 1. Identify the relevant electric power system

The power plants connected to the Ugandan grid as well as imports are the relevant electric power system. This includes all the plants accounting for total generation listed in *Table 4*. The West Nile HHP is not included as this power plant is connected to a mini-grid.

Table 4: Generation from grid connected power plants in Uganda 2005-2007

Year	Generation MWh								
	Uganda generation	Thermal	Hydro	Nuclear	Biomass	Import	Total supply (inc. imports)	Low cost / must run Abs	Low cost / must run as share total production
2005	1,908,173	140,911	1,767,262	-	-	24,177	1,932,350	1,791,439	94 %
2006	1,577,455	369,434	1,208,021	-	-	49,027	1,626,482	1,257,048	80 %
2007	1,846,761	539,431	1,307,330	-	-	60,299	1,907,060	1,367,629	74 %

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

For this project, Option I is chosen, and only grid power plants will be included in the calculation.

Step 3. Select a method to determine the operating margin (OM)

b) Simple adjusted OM with ex-ante data

The operating margin is calculated according to the "simple adjusted OM" and based on fuel consumption and net electricity generation of each power plant (Option A) according to formulas given in B.4. Data is provided in Annex 3.

Step 4. Calculate the operating margin emission factor according to the selected method

In accordance with the use of "simple adjusted OM" method, the load duration curves for years 2005 – 2007 have been plotted and are presented below.

Figure 3: Load duration curve 2005

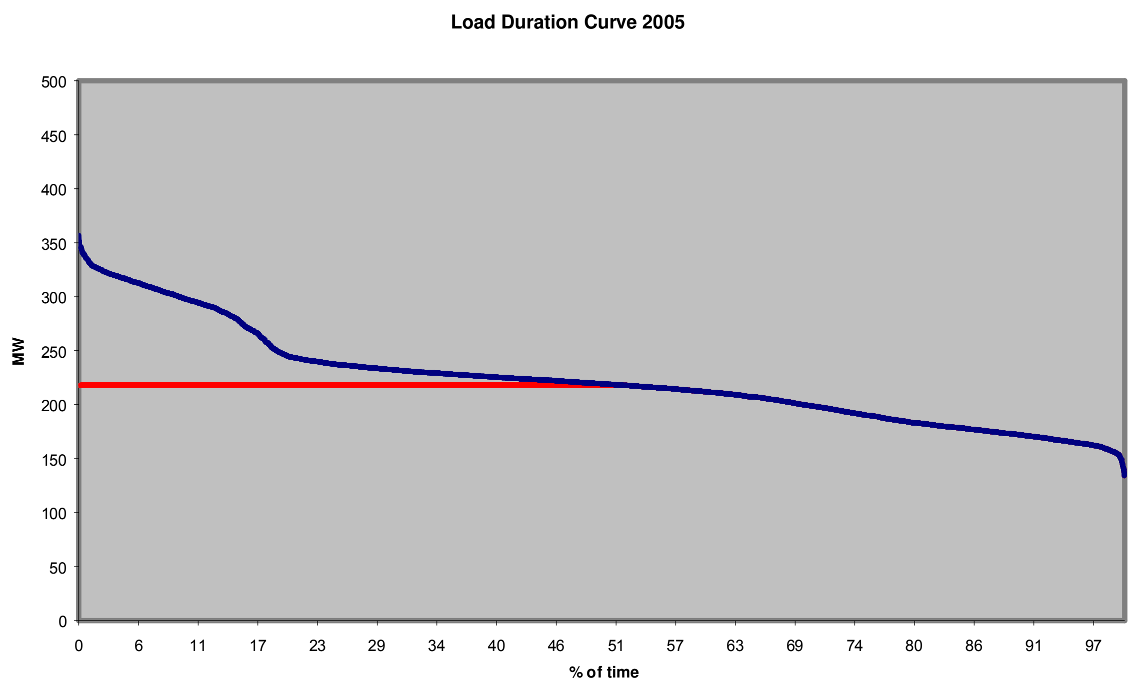


Figure 4: Load duration curve 2006

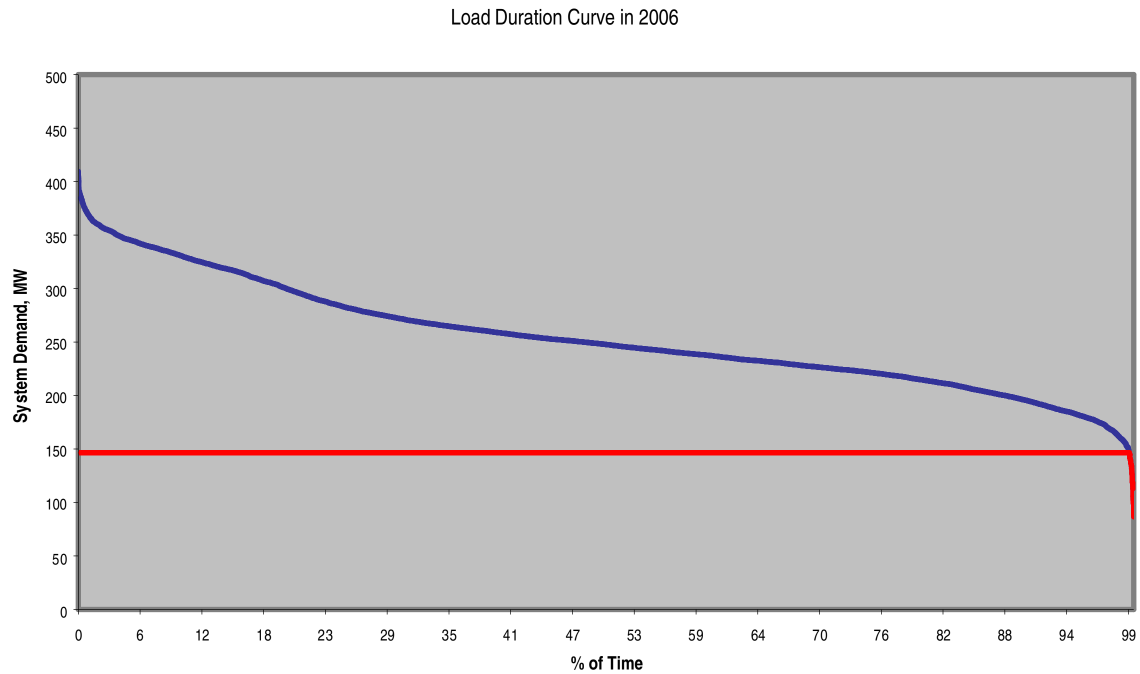
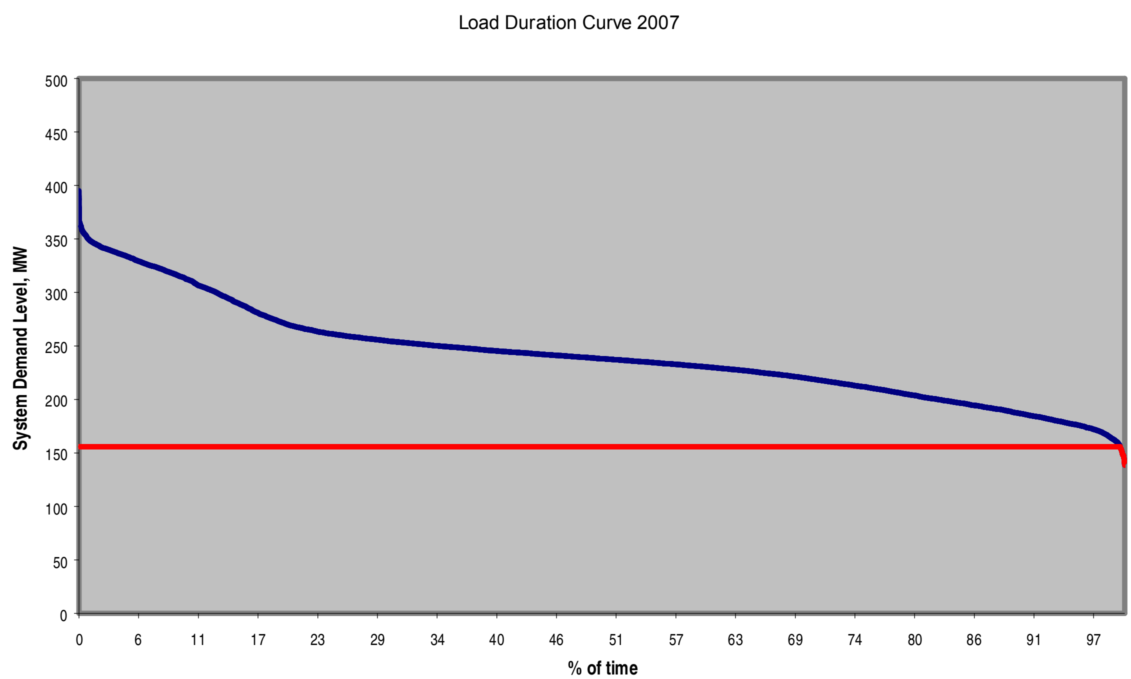


Figure 5: Load duration curve 2007



Note: In year 2006, the load duration data only covers 8455 hours due to installation of a new monitoring system. UETCL assures that there was no seasonal variation that would affect the curve [27]. Low cost/must-run sources are in any case not on the margin.

Table 5 presents the calculation of emission factors based on the information presented in the above steps.

Table 5: Emission factor simple adjusted OM

		Fuel ($FC_{i,m,y}$)			$NCV_{i,y}$	EF_{CO2}	Gen ($EG_{m,y}$)	FC*NCV*EF_{CO2}	$EF_{EL,m,y}$
		$FC_{i.m.v}$ 1000 Litres	Density kg/litre	$FC_{i.m.v}$ 1000 Kg	NCVi,y TJ/Gg	Conversion tCO_2/TJ	MWh	tCO_2	tCO_2/MWh
2005	LGGO Aggreko 1	37,724	0.85	32,065	41.4	72.6	140,911	96,377	0.68
	Kiira Aggreko 2	-			41.4	72.6	-	-	-
2006	LGGO Aggreko 1	83,970	0.85	71,375	41.4	72.6	319,297	214,527	0.67
	Kiira Aggreko 2	13,203	0.85	11,223	41.4	72.6	50,137	33,731	0.67
2007	LGGO Aggreko 1	73,989	0.85	62,891	41.4	72.6	272,994	189,028	0.69
	Kiira Aggreko 2	70,455	0.85	59,887	41.4	72.6	266,437	179,999	0.68

From the load duration curve	2005	2006	2007
Total hours in a year	8,760	8,544	8,760
Intersection point (MW)	218	147	156
Hours that low cost is on the margin	4,205	37	41
λ (%) = Hr low cost on margin/8760	48.0 %	0.4 %	0.5 %

EF Operation margin	2005	2006	2007
$EF_{EL,m,y}$	0.6840	0.6720	0.6841
$EF_{EL,k,y}$	-	-	-
$EF_{grid.OM-adj.y}$ ((1-λ) m + λ *k*)	0.3556	0.6691	0.6809

EF OM	0.5685426	tCO_2/MWh

As the table shows, low cost must run are on the margin 48 % of the time in 2005, and 0.4% and 0.5% of the time in 2006 and 2007 respectively due to the installation of the two large diesel generator stations. The average operating margin emission factor over the most recent 3 years is 0.56854 tCO_2/MWh.

Step 5. Identify the group of power units to be included in the build margin

The sample group of power units m used to calculate the build margin consists of either;

(a) The set of five power units that have been built most recently, or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

As explained in section B.6.1 it is assumed that both of the Aggreko plants consist of 50 units each, since each of the units can be operated independently. Electricity production and fuel consumption is considered to be 1/50 for the respective plants.

[27] For confirmation, see annex 3 Figure 6

Table 6: Sample group of power units to include in build margin

Total Generation		MWh	1,846,761
a) 5 latest built (KSW and 4 units from Kiira Aggreko)	Generation	MWh	21,315
	Proportion	%	1.15 %
b) 20% latest built (KSW, 50 units from Aggreko Kiira and 20 from units Aggreko LGGO)	Generation	MWh	377,462
	Proportion	%	20.44 %

Note; KSW is the 6MW Kakira Sugar Work bagasse plant.

Build margin have to be calculated based on the sample group for which the 2007 generation is the largest. Built margin will be calculated based on b) the sample group consisting of the 20 % most recent built power units.

Step 6. Calculate the build margin emission factor

EF Built Margin	tCO_2/MWh
$EF_{grid,BM,y}$	0.67718

The build margin emission factor is 0,67718 tCO_2/MWh.

Step 7. Calculate the combined margin emissions factor

When utilizing an 50:50 weighting of operating margin and built margin, the combined margin is 0.62286 tCO_2/MWh.

	Weigth	Emission factor	
EF OM	0.50	0.56854	tCO_2/MWh
EF BM	0.50	0.67718	tCO_2/MWh
EF combined	1	0.62286	tCO_2/MWh

Project emissions

For most renewable energy project activities, $PEy = 0$. However, for the following categories of project activities, project emissions have to be considered:

- Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity/fossil fuel consumption)
- Emissions from water reservoirs of hydro power plants

As neither of the above two points apply to the project activity, it is concluded that $PEy = 0$.

It should be noted, however, that a diesel generator will be installed in the plant to provide emergency power in the event of any grid blackouts. The generator will be of type FG Wilson supplied by Reservekraft AS and have a capacity of 80 kVA. Emissions from this diesel generator are considered to be negligible, as the generator is expected to be operating for less than 100 hours a year. Based on a conservative assumption that the generator operates for 100 hrs/yr, it has been calculated that the emissions from this source will amount to 19.37 tCO_2/yr, which accounts for less than 0.05% of baseline emissions (see annex 6). Nevertheless, fuel consumption of the diesel generator will be monitored, and is included in the monitoring plan. If running hours, and therefore fuel consumption, will increase to a level where emissions from this source will be equal to or exceed 1% of baseline emissions, the electricity generation metered will be adjusted by deducting the electricity generation from fossil fuels using the specific fuel consumption and the quantity of fossil fuel used, as prescribed in AMS I.D. v 15.

Leakage

If the energy generating equipment is transferred from another activity, leakage (LEy) is to be considered. As all generating equipment installed for the project activity is new and not transferred from another activity, it is concluded that *LEy* = 0.

Emission reductions

Emission reductions are calculated as follows:

$ER_y = BE_y - PE_y - LE_y$

Where:

ER_y Emission reductions in year y (t CO_2e/y)

BE_y Baseline Emissions in year y (t CO_2e/y)

PE_y Project emissions in year y (t CO_2/y)

LE_y Leakage emissions in year y (t CO_2/y)

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2011	0	51,074	0	51,074
2012	0	51,074	0	51,074
2013	0	51,074	0	51,074
2014	0	51,074	0	51,074
2015	0	51,074	0	51,074
2016	0	51,074	0	51,074
2017	0	51,074	0	51,074
2018	0	51,074	0	51,074
2019	0	51,074	0	51,074
2020	0	51,074	0	25,537
Total (tonnes of CO_2e)	**0**	**510,740**	**0**	**510,740**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Parameter:	*EGy*
Unit:	MWh

Description:	Net electricity supplied by the project to the grid
Source of data:	Measurement of energy output meter at the 33 kV side of the transformer that connects to the 33 kV line that evacuates the power to the main grid.
Value of data	82,000 MWh
Brief description of measurement methods and procedures to be applied:	Hourly measurements and monthly recordings of net electricity supplied by the project activity to the grid will be taken.
QA/QC procedures to be applied (if any):	Measurement results shall be cross-checked with records for sold electricity (to UETCL).
Any comment:	

Parameter:	$FC_{i,j,y}$
Unit:	tonne/year
Description:	Quantity of diesel fuel used by site diesel generator during year y
Source of data:	Onsite measurement
Value of data	5.79 tonnes/year
Brief description of measurement methods and procedures to be applied:	Fuel counter on control panel (volume meter) monitoring continuously
QA/QC procedures to be applied (if any):	The consistency of metered fuel consumption quantities will be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Verified against annual diesel fuel purchase invoices from the financial records.
Any comment:	Will only be estimated if emissions from the diesel generator equal or exceed 1% of baseline emissions.

Parameter:	$NCV_{i,y}$
Unit:	GJ per tonne
Description:	Weighted average net calorific value of diesel fuel in year *y*
Source of data:	(see table below)

Data source	**Conditions for using the data source**
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources.
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC	If a) is not available

	Guidelines on National GHG Inventories Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.
Value of data	43.3 TJ/Gg
Brief description of measurement methods and procedures to be applied:	Measurement method not required as d) chosen
QA/QC procedures to be applied (if any):	Any future revision of the IPCC Guidelines will be taken into account
Any comment:	--

Parameter:	$EF_{CO2,i,y}$
Unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of diesel fuel in year *y*
Source of data:	see table below Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.
Value of data	7.48 tCO_2/GJ
Brief description of measurement methods and procedures to be applied:	Measurement method not required as d) chosen
QA/QC procedures to be applied (if any):	Any future revision of the IPCC Guidelines will be taken into account
Any comment:	--

Data source	**Conditions for using the data source**
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources.
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

B.7.2 Description of the monitoring plan:

>>
Monitoring shall consist of metering the electricity generated by the renewable technology inline with "I.D. Grid connected renewable electricity generation" and the "Tool to calculate the emission factor for an electricity system".

The monitoring plan should ensure that the true, maintainable and measurable GHGs of CDM project can be monitored, recorded and reported. This is the key procedure to determine the CERs. According to monitoring plan, monitoring system should be reliable, conservative and comprehensive; this system should have the function of data evaluation, measurement, and collection and monitoring.

CDM Manager

The overall responsibility for monitoring and reporting issues will lie with Tronder Power Ltd and Jon Einar Værnes, hereby referred to as the Project Manager.

The Project Manager will assign an Operational Manager who will be responsible for the monthly meeting of electricity generation.

Operational Manager

The Project Manager will appoint an Operational Manager who will monitor electricity generation as part a of the operational and management structures of both the project developer and the purchaser of the electricity, UETCL. Electricity generation is the main input variable for the calculation of emission reductions. Operational Manager will monitor the hours run of diesel generators.

Operational Manager should report to the Manager and UETCL on a monthly basis, and the figures will be used for reporting emission reductions. At the end of each 12 month monitoring period, the data from the monthly meter reading records will be added up to the yearly net electricity generation and multiplied with the combined margin emission factor in a Microsoft Excel spreadsheet. Thus, the complete baseline calculations are always transparent and traceable. The Manager will approve and quality assures the calculations.

Tronder Power Ltd (TPL) is responsible provide the necessary labor, material and instruments to meter according to the requirements described in Annex 4.

Meter

There will be one main meter and one check meter system installed. The main and check meter, physically installed in the control room at the power house, measure the power flow at the 33 kV side of the transformer (i.e. the output of the transformer) that connects to the 33 kV line that evacuates the power to the main grid.

There will only be one line and the meter will be a two-way hourly meter, so each meter reading will be a net reading of power exported/imported to the power station. The main meter and the check meter system to be installed, owned and maintained by TPL shall be designed such that the overall error of the installation, (including instrument transformers, wiring, and metering instruments) shall be no greater than 0.2% over the equivalent road range (see special requirements from UECTL, annex 4).

All instruments shall be the flush mounting type and shall be fitted with nonreflecting glass according to the relevant international standards. The metering system shall be described clearly in appropriate drawings to be provided by TPL to both UETCL (Uganda Electricity Transmission Company) and Umeme[28] for approval.

[28] Umeme is the leading electricity distributor in Uganda, see http://www.umeme.co.ug/index.php

As the main meter, TPL will use a Cewe Prometer R supplied by Cewe Instrument AB. The Cewe Prometer R is a Precision meter in class 0.2S[29].

Testing/calibration

All testing should be carried out by qualified personnel using test equipment with a rated error of ±0.1% or better according to national standards and IEC standards 60521 within 48 months. Main and Check meter shall be calibrated annually.

Recording

Main and Check meter shall be read at 12:00 on the last day of each successive month (or other days if agreed upon). UETCL shall be given a 48 hours notice before reading, giving them the opportunity to be present at readings. All data collected as part of monitoring should be archived both as hard copy and electronically (when practical) and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

Reporting

All reading shall be reported to UETCL and reading from main meter shall be used for preparing the invoice. All data required for verification and issuance will be kept for at least two years after the end of the crediting period or the last issuance of CERs of this project, whichever occurs later. The invoice documentation can be used to quality assure report.

Emergency

If the meter is found to be inaccurate for more than two-tenths of a percent (±0,2%) or otherwise function improperly, the Tronderpower and UETCL shall jointly prepare an estimate for correct reading.

Training

The project is utilizing modern technology and expected to be of a higher standard than other power plants currently existing in Uganda, as demonstrated by the specification of standards included in annex 5. Project will utilize the same maintenance standards as currently used in other TronderEnergi power plants. In general, Norwegian experts will be present in the beginning of the operation, but the plan is to train Ugandan staff to operate the power plant and perform all necessary operation, monitoring and maintenance tasks.

Key staff will be trained in Norway at the facilities of one of the investors (TronderEnergi). Before the project is put into operation, the staffs have received a training program on operation and metering, both on generally on operation of hydro power plant and specifically on CDM. All staff undergoes training programs aiming at upgrading unskilled labor to semiskilled and skilled labor.

The project developer operates with a zero tolerance for serious accidents and deaths, and will act in accordance to Norwegian construction regulations. The project developers cover insurance for all workers and 3rd party damage, including CAR (Construction All Risk) insurance. The project developer shall meet all the technical requirements to ensure safety, including a setting up 2.4 meter fence along the canal to protect workers and non-workers. On mitigation of risk related safety, health, employment and other issues related sustainable development see section D.

See annex 4 for more specification on monitoring.

B.8 Date of completion of the application of the baseline and monitoring methodology and the

[29] For more information, see http://www.ceweinstrument.se/

name of the responsible person(s)/entity(ies)

>>

30/01/08

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Person/entity is not a project participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

07/03/2008 when project developer signed the contract for civil works with Noremco.

C.1.2. Expected operational lifetime of the project activity:

The expected lifetime of the project is 25 years and 0 months.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

Not applicable

C.2.1.2. Length of the first crediting period:

>>

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Start 01/01/2011 or on the date of registration of the CDM project activity, whichever is later.

C.2.2.2. Length:

>>

10 years

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The regulatory bodies in Uganda require an Environmental and Social Impact Assessment (ESIA) to be undertaken for this type of project. The project had an Environmental Impact Assessment (EIA) and a Resettlement Action Plan (RAP) done in 2006. The EIA was approved by the National Environmental Management Authority (NEMA) 4th of October 2006 and the approval was transferred to Tronderpower 17th of July 2008. A consolidated social and environmental action plan and management system including a site visit was undertaken in 2008. Reports and copy of permits have been made available during validation.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Full Environmental and Social Impact Assessment (ESIA) studies according to World Bank standards have been conducted for the project. The report will be available for validator upon request. The project has received the approval of the National Environment Management Authority, NEMA (see appendix 3)

The ESIA Report deals with the potential environmental and social impacts of Bugoye Small hydropower Project and aims to fulfill the legal requirement for an Environmental Impact Statement for the Bugoye Small-Hydropower Project. Consultations and fieldwork for the ESIA was carried out in the period January – August 2005.

<u>The identified positive social impacts of the projects include;</u>

1) The project will supply electric power to the grid and provide power stability. Constant power supply disruptions and rising oil prices have caused worsening in power crisis and economic development in Uganda since 2006. From a population of about 26.8 million people only 4% (1% in rural areas) have access to grid supplied electricity. The supply deficit has had serious negative economic implications on the industrial sector. The electricity generated from the project will feed to the national grid.

2) The Project will generate electricity from renewable resources which would lead to lower emissions of greenhouse gases compared to the existing generation mix. It is also likely that reduce load-shedding would lead to reduced usage of privately owned diesel generators.

3) The project creates opportunities for economic development in Bugoye, beside power generation. This include employment of the local population during the construction period, a foreseen growth of the local economy in terms of improved market opportunities for local produce and increased trade and an upgrading of the road infrastructure in the project area. In terms of employment opportunities it is estimated that the Project during its construction period will require 150-200 workers, out of whom around 30% will be skilled workers.

4) The project company has committed itself in the loan agreements to undertaking an agreed social and environmental action plan. Key elements of this action plan includes 1) Financial and physical in-kind support to local health centre, upgrading of health centre, including operation atrium and two new buildings, 2) Road from Ibanda to Nkenda will be in the same or better standards as before constructions, in addition there will be constructed two access roads to the canal as well as the canal maintenance road.

These will be prominent and serve as transport roads for the community in the hills which previously had no or very low standard roads.3) support to establishment of gravity fed water supply system for affected villages both sides of the river, 4) Build a fence along the canals and 9 footbridges as well as one motor vehicle bridge. Adjacent to the footbridges, there will be water collection points.

In addition, the project pays royalties to the local authority which will improve the local authority's ability to fund social services in its mandate. Discussions with the local authority have included earmarking a portion of royalties for improvements to health services.

The identified potential negative social impacts of the project include;

1) The project will require resettlement. In the original ESIA this included relocation of 30 households in the project area, and occupation of 30 acres of land affecting 252 households. However, the implementation of the Bugoye HPP will necessitate the successful resettlement of 21 households, or some 150 people. Of these, only 7 households will actually be resettled to new lands, the rest will only have to move their house within their original land. These numbers are lower than anticipated in the original ESIA, because the project corridor has been adjusted in order to minimize negative impact on the local communities and to reduce the number of households affected. The total number of affected people in the project area is approximately 1800. Close cooperation with local communities and the central government and UNDP has been initiated in order to ensure a transparent, socially responsible and orderly process of compensation and mitigation. UNDP has developed a baseline study documenting the present situation in the valley.

2) The Project will also entail a reduced flow in a 4.6 km stretch of the Mubuku river and in a 2.2 km of Isya river. This will potentially affect water quality, riverbank vegetation, birds, fish populations and other aquatic life.

3) There will also be loss of income due to the partial loss of land and loss of economic activities.

4) Other potential impacts are health risk related to influx of construction workers and increased traffic during construction.

5) In addition, the water supply for parts of the population in 12 villages along the affected stretch of the Mubuku and Isya rivers might be affected by the project.

The environmental and social impacts of the project have been determined to be manageable provided reasonable mitigation measures are put into place. The intention is not only to mitigate the potential negative impacts of the power project, but also to leave the community better off than they were before the project implementation and the Ministry of Energy and Mineral Development have approved the ESIA.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

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The Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) are required in accordance with the National Environment Act and the Environmental Impact Assessment Regulations. As a part of the ESIA study, a public consultation process was carried out involving the main stakeholders and in particular the indirectly and directly affected population in Bugoye Sub-County.

The main stakeholders that will be affected and who have an interest in the project include:

- The Project Affected Population (PAP) in Bugoye Sub County (252 households – app 1764 people)
- Kasese Cobalt company Limited
- Kilembe Mines Limited
- Rwenzori Mountaineering Services
- Kasese District Local Government
- District Land Board,
- Bugoye Sub County

A number of community meetings were conducted in villages that will be affected by the Project, where approximately 500 local villagers were consulted, including 84 women. The consultations aimed to inform the public about the potential impacts of the project and the process of compensation and resettlement. The meetings also acted as a forum where the public could express their concerns, expectations and communicate with the project team. Special attention was given to potentially vulnerable groups such as households affected by the AIDS epidemic and female headed households. *Table 7* gives an overview of the consultations held January – August 2005. The consultations were arranged and conducted by the Consultant and the local authorities in close cooperation.

Table 7 Stakeholder Consultation Process

Consultation Event	Location	Attendants / Stakeholders	Contents and Issues
Public Community meetings 21-22 January 2005	Ibanda I, Ibanda II, Kanyaminigo & Kikokera; Ihani, Kasanze and Kibirizi, Nyakabogha and Nyakaringijo	416 males 84 females (majority could not write so they did not register)	Provided briefings to APs on project proposed activities and components; solicited comments and concerns from PAP
Household visits July 2005	All affected households along the diversion, headrace and tailraces canals and other project components such as penstock and powerhouse	Around 200 households visited by local authorities and NORPLAN staff	Distribution of brochures in English and Lukonjo on resettlement and compensation entitlements for PAP. Illiterate households were read the contents of the brochures
Focus Group Discussion July 2005	Sub county officials including Local Council members and administrators		Provided briefing on land acquisition process and discussed relocation issues with sub county officials
Public Community Meetings July 2005	Affected community members- the meeting dates and location were announced over the radio (appendix 3)	6 meetings	Conducted community meetings to review and discuss information in the brochures, resettlement and compensation
Household Interviews / socioeconomic		315 household heads visited, informed and interviewed during the	Information dissemination collection of detailed information on assets and

Consultation Event	Location	Attendants / Stakeholders	Contents and Issues
survey July 2005		socio economic survey (231 males, 84 females)	other household information

E.2. Summary of the comments received:

>>
The concerns raised in the consultation meetings are presented in *Table 8*. As almost identical concerns and issues were raised in all meetings, no reference as to where the concerns were raised is given. However, concerns that exclusively apply to one specific site or community are mentioned with a site reference.

Table 8: Concerns and Issues Raised in Consultation Meetings

Concern / Issue	Comments by PAP / Stakeholders
Compensation	Will lost or affected property and crops be compensated for promptly and fairly?
Valuation of assets	It was requested that affected people are allowed to participate and negotiate with regard to the valuing of their assets.
Employment	Especially youths and young men expressed concern about employment and the possibilities for paid work during construction.
Water Supply	Fears of water scarcity: communities were relying on the Mubuku river as their sole source of water expressed their concern.
Dam and canal safety	The participants raised concerns about canal safety. They cite a canal breakage at Mubuku I that had been experienced earlier.
Health service facilities	The participants suggested that the developer improves the existing health centre
Loss of land / land for resettlement	It was asked whether the Project had enough land for relocation of those who will be affected by the Project. A wish to see and be informed about potential relocation sites well in advance was expressed. People also enquired about the consequences of refusing to surrender land for Project purposes.
Infrastructure	As a social benefit, the community members requested the project to construct a bridge connecting the people of Ibanda and Bikuni, rehabilitate the road from Ibanda to Nkenda, construct permanent access roads and upgrade existing murram (laterite) roads.
Land slides and accidents	Community members expressed a fear of increased land slides and accidents due to construction in steep areas.

Affected graves	Moving of graves was discussed but was not seen as a problem as long as necessary ceremonies and material costs are properly compensated.

Women did not participate in the consultations to the same extent as men. Further as some of the women who did participate were illiterate this may have limited their involvement in the consultations. As the proportion of women headed households is large in the project area, further consultations with women and vulnerable groups such as orphans, people living with HIV/AIDS and disabled will be undertaken in the next phases of the project. Different methods for consultations and involvement will be used to maximize the involvement such as Participatory Rural Appraisal (PRA). This issue is mentioned and covered in the RAP which accompanies the ESIA.

E.3. Report on how due account was taken of any comments received:

>>

Due accounts from the project developer are summarized in *Table 9*.

Table 9: *Summary of how due account was taken of stakeholder comments*

Concern / Issue	Project developers measures
Compensation	Affected property and crops are compensated promptly and fairly. Compensation is an ongoing process during construction and will be given for loss of land, crops, trees, buildings and infrastructure, and carried out based on both Ugandan and World Bank guidelines. The Kasese District Boards approved compensation rates. Preliminary compensation values for 2005/2006 are given in appendix 3.
Valuation of assets	All affected people are allowed to participate and negotiate with regard to the valuing of their assets.
Employment	It is estimated that the Project during its construction period will require 150-200 workers, of whom around 20% will be unskilled workers from Bugoye district. The project developer prioritizes labor from the Bugoye district and the surrounding districts.
Water Supply	A water supply scheme is being planned in order to compensate the affected villages and to support the establishment of gravity fed water supply system for affected villages both sides of the river. The license allows the project to divert up to 10 m^3/s, but shall at all times leave a minimum water flow of 1 m^3/s . The project will not affect the existing power plants negatively. It is expected that the downstream Mubuku 3 will experience less silt in the intake as a result of the project.
Land slides, accidents and canal safety	The project developer operates with a zero tolerance for accidents and deaths, and will act in accordance to Norwegian construction regulations. The project developers cover insurance for all workers and 3rd party damage, including CAR (Construction All Risk) insurance. The project developer shall meet all the technical requirements to ensure safety, including a setting up 2.4 meter fence along the vulnerable parts of the canal.

Health service facilities	The project developer will improve the existing health centre and institute HIV/Aids and malaria programs for its workers and surrounding community. Financial and physical in-kind support to local health centre, upgrading of health centre, including operation atrium and two new buildings.
Loss of land / land for resettlement	The Resettlement plan and compensation program based on a "cash for land" or "land for land" basis were explained. If more than 20% of the total land of a person is affected, such a person is eligible for resettlement. The resettlement plan will follow Ugandan and World Bank guidelines and has been approved by the MEMD.
Infrastructure	Road from Ibanda to Nkenda will be in the same or better standards as before constructions, in addition there will be constructed two access roads to the canal as well as the canal maintenance road. These will be prominent and serve as transport roads for the community in the hills which previously had no or very low standard roads.
Affected graves	Graves will be relocated. The project developer does not anticipate finding anything of archeological significance.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

See appendix 1

Annex 3

BASELINE INFORMATION

Table 10: Grid connected electricity Uganda 2005-2007 (source; Electricity Regulatory Authority and UETCL)

		AGGREKO LUGOGO	AGGREKO KIIRA	Nalubale HPP	Kiira HPP	KCCL (Mubuku 3)	KML (Mubuku 1)	KSW	Total domestic	Import	Total + import
YEAR	**QUARTER**	**(GWhrs)**	**(GWhrs)**			**(GWhrs)**	**(GWhrs)**	**(GWhrs)**			
2	Q1		-	219 000	233 000	108	3 230	-	455 338	6 738	462 076
0	Q2	24 445	-	203 000	235 000	154	5 693	-	468 292	6 144	474 436
0	Q3	54 478	-	161 000	266 000	451	3 441	-	485 370	5 419	490 789
5	Q4	61 988	-	189 000	240 000	343	7 842	-	499 173	5 876	505 049
	TOTALS	**140 911**	**-**	**772 000**	**974 000**	**1 056**	**20 206**	**-**	**1 908 173**	**24 177**	**1 932 350**
2	Q1	62 093	-	115 000	210 000	401	6 588	-	394 082	6 506	400 588
0	Q2	73 983	-	134 000	167 000	428	7 137	-	382 548	6 963	389 511
0	Q3	91 815	-	159 000	126 000	629	6 675	-	384 119	17 647	401 766
6	Q4	91 406	50 137	165 000	102 000	164	7 999	-	416 706	17 911	434 617
	TOTALS	**319 297**	**50 137**	**573 000**	**605 000**	**1 622**	**28 399**	**-**	**1 577 455**	**49 027**	**1 626 482**
2	Q1	78 515	78 154	168 000	111 000	104	7 142	-	442 915	18 919	461 834
0	Q2	51 868	66 876	189 637	116 882	78	8 013	-	433 354	21 347	454 701
0	Q3	75 067	63 066	190 537	135 463	454	8 267	-	472 853	11 888	484 741
7	Q4	67 544	58 340	178 575	186 851	108	6 221	-	497 638	8 145	505 783
	TOTALS	**272 994**	**266 437**	**726 748**	**550 195**	**744**	**29 643**	**-**	**1 846 761**	**60 299**	**1 907 060**

Comment: "Werenco" is referring to the West Nile HPP and is not connected to the grid. It is therefore excluded from the total.

Table 11: Data on generation and fuel usage from Aggreko 1 and 2 (source:ERA)

ANALYSIS OF AGGREKO -KIIRA FUEL CONSUMPTION (OCTOBER -DECEMBER 2007)

Month	Gross Units Delivered	Fuel Csption	Csption Rate	Agreed Csption Rate	Expected cons	Variance
	kWh	Litres(main)	Litres/MWh	Litres/MWh	Litres	Litres
Oct' 06	8 937 079	2 387 911	267	270	2 411 224	(23 313)
Nov' 06	18 415 548	4 849 740	263	270	4 968 515	(118 775)
Dec' 06	22 784 607	5 965 539	262	270	6 147 287	(181 748)
Jan' 07	27 616 162	7 270 693	263	270	7 450 841	(180 148)
Feb' 07	24 688 944	6 510 272	264	270	6 661 077	(150 805)
Mar' 07	25 849 158	6 878 936	266	270	6 974 103	(95 167)
Apr' 07	18 542 167	4 887 599	264	270	5 002 677	(115 078)
May'07	24 964 875	6 598 166	264	270	6 735 523	(137 357)
June'07	23 369 379	6 196 512	265	270	6 305 058	(108 546)
July'07	23 033 782	6 084 516	264	270	6 214 514	(129 998)
Aug'07	20 866 213	5 506 077	264	270	5 629 704	(123 627)
Sept'07	19 165 644	5 053 732	264	270	5 170 891	(117 159)
Oct'07	20 437 659	5 429 011	266	270	5 514 080	(85 069)
Nov'07	17 954 495	4 752 703	265	270	4 844 123	(91 420)
Dec'07	19 948 041	5 286 977	265	270	5 381 981	(95 004)
Total	**316 573 753**	**83 658 384**	**264**	**270**	**85 411 599**	**(116 881)**

ANALYSIS OF AGGREKO 1(LUGOGO) FUEL CONSUMPTION (2005-2006)

Month	Gross Units Delivered	Fuel Consumption	Consumption Rate	Agreed Consumption Rate	Expected cons	Variance
	kWh	Litres(main)	Litres/MWh	Litres/MWh	Litres	Litres
May' 05	8 528 494	2 269 078	266	278	2 387 978	(118 900)
June' 05	15 916 799	3 969 153	249	278	4 456 704	(487 551)
Jul' 05	15 650 101	4 221 457	270	278	4 382 028	(160 571)
Aug' 05	18 394 479	4 986 812	271	278	5 150 454	(163 642)
Sept' 05	20 433 062	5 530 707	271	278	5 721 257	(190 550)
Oct' 05	19 890 273	5 351 800	269	278	5 569 276	(217 476)
Nov' 05	19 852 958	5 377 630	271	278	5 558 828	(181 198)
Dec' 05	22 245 205	6 017 307	270	278	6 228 657	(211 350)
Jan '06	24 958 423	5 554 684	223	278	6 988 358	(1 433 674)
Feb'06	16 725 966	4 556 546	272	278	4 683 270	(126 724)
Mar' 06	20 408 428	5 070 955	248	278	5 714 360	(643 405)
Apr' 06	23 150 862	6 154 629	266	278	6 482 241	(327 612)
May' 06	25 567 438	6 839 284	267	278	7 158 883	(319 599)
June' 06	25 264 602	6 705 342	265	278	7 074 089	(368 747)
July' 06	27 046 235	7 216 109	267	278	7 572 946	(356 837)
Aug' 06	32 960 407	8 769 121	266	278	9 228 914	(459 793)
Sept' 06	31 808 820	8 553 588	269	278	8 906 470	(352 882)
Oct' 06	31 748 730	8 542 034	269	278	8 889 644	(347 610)
Nov' 06	30 182 702	8 082 582	268	278	8 451 157	(368 575)
Dec' 06	29 474 597	7 925 547	269	278	8 252 887	(327 340)
Total	**460 208 581**	**121 694 365**	**264**	278	**128 858 403**	**(7 164 038)**

ANALYSIS OF AGGREKO 1(LUGOGO) FUEL CONSUMPTION (2007)

Month	Gross Units Delivered	Fuel Consumption	Consumption Rate	Agreed Consumption Rate	Expected cons	Variance
	kWh	Litres(main)	Litres/MWh	Litres/MWh	Litres	Litres
Jan '07	28 946 023	7 801 538	270	278	8 104 886	(303 348)
Feb'07	23 324 105	6 308 778	270	278	6 530 749	(221 971)
Mar' 07	26 244 992	7 139 100	272	278	7 348 598	(209 498)
Apr' 07	15 853 739	4 341 043	274	278	4 439 047	(98 004)
May'07	18 517 224	5 085 289	275	278	5 184 823	(99 534)
June'07	17 497 086	4 859 564	278	278	4 899 184	(39 620)
July'07	24 331 818	6 479 852	266	278	6 812 909	(333 057)
Aug'07	28 011 942	7 565 916	270	278	7 843 344	(277 428)
Sept'07	22 723 430	6 106 631	269	278	6 362 560	(255 929)
Oct'07	27 405 576	7 381 158	269	278	7 673 561	(292 403)
Nov'07	16 098 534	4 407 643	274	278	4 507 590	(99 947)
Dec'07	24 039 691	6 512 905	271	278	6 731 113	(218 208)
Total	**272 994 160**	**73 989 417**	**271**	**278**	**76 438 365**	**(204 079)**

Figure 6 Confirmation on the load duration curve 2006

Econ Pöyry questioned the UETCL as the load duration curve only covered 8455 hours. UETCL assures that this is caused by upgrading of the control centre and that there was no seasonal variation that would affect the curve.

RE: load duration curve
Valentine Katabira to Knut Ødegaard 20.05 2008 16.24
Cc: "Lawrence Omuler", maja tofteng, maja tofteng, "Mohamed Sebugenyi" Show Details

Dear Knut,

The reason is that during part of the year 2006 our Control Centre was being upgraded and as such data could not be captured until after the migration to the new system. But I believe the data you have is representative as there are no serious seasonal variations in loading across the year.

Valentine
Valentine K. Katabira
Manager Operations & Maintenance
Uganda Electricity Transmission Company Limited
P.O. Box 7625, Kampala. Uganda
Office Phone: +256 414 233433/4
Office Fax: +256 414 341243
Cell: +256 (0) 772 845356
email: valentine.katabira@uetcl.com

Figure 7 Confirmation of generation data

Econ Pöyry questioned the generation data for UETCL KCCL and KML 2005 to 2007 as the figures are identical. ERA state that these are the accurate figures provided them. Generation from the plants are less than 1,5 % of total generation, so any inaccuracies would not change the outcome of the baseline calculations.

From: J P K Sembeguya [mailto:j.p.k.sembeguya@era.or.ug]
Sent: 7. april 2008 10:37
To: Mark Davis
Cc: 'Charles Baker'; 'Benon Mutambi'
Subject: RE: Aggreko data

Good morning Mark – please pardon my late reply.

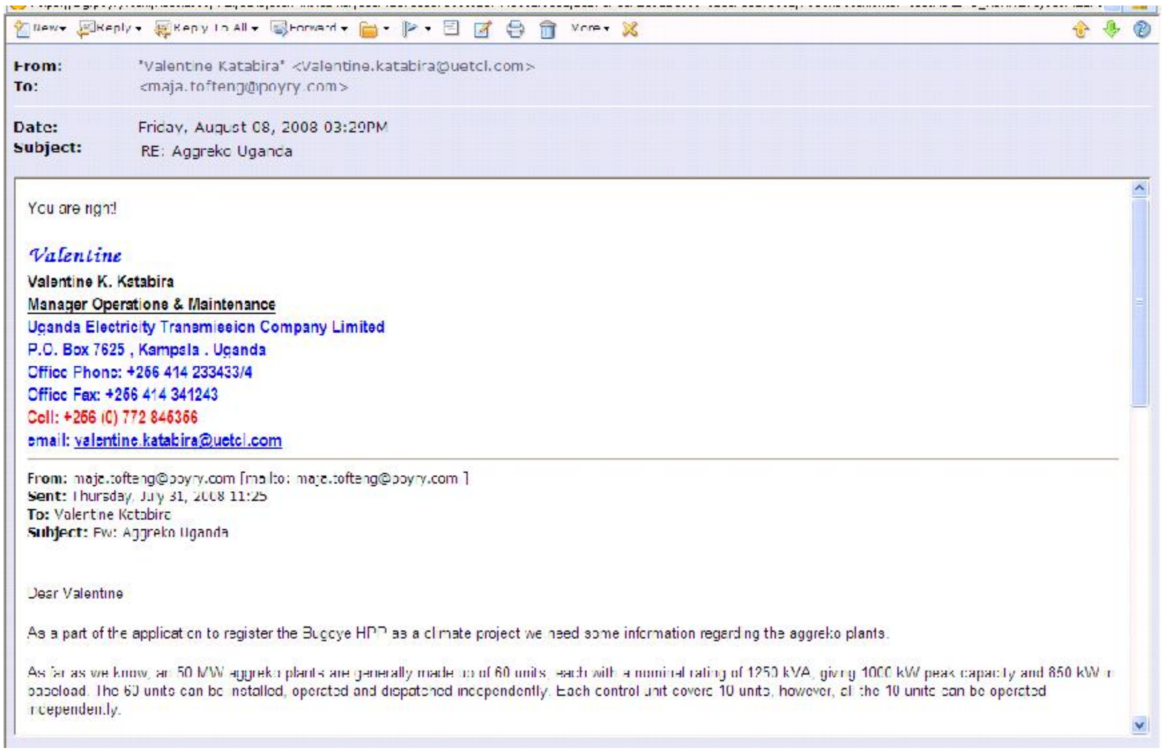
ERA has got load duration curves for all the generation sources. It is not limited to Aggreko only.
KCCL and KML data that I sent you reflect what the two (2) companies send ERA.

Thank you

James Philip K Sembeguya
STATISTICIAN / IT OFFICER
ELECTRICITY REGULATORY AUTHORITY
Plot 15 - Shimoni Road
P.O. Box 10332
Kampala - Uganda
Email: j.p.k.sembeguya@era.or.ug

Figure 8 Confirmation on Aggreko units

Both UETCL and Aggreko International confirm that the Aggreko plants consist of several units which were commissioned at various dates and that they can be operated independently.



From: "Valentine Katabira" <Valentine.katabira@uetcl.com>
To: <maja.tofteng@poyry.com>

Date: Friday, August 08, 2008 03:20PM
Subject: RE: Aggreko Uganda

You are right!

Valentine
Valentine K. Katabira
Manager Operations & Maintenance
Uganda Electricity Transmission Company Limited
P.O. Box 7625 , Kampala . Uganda
Office Phone: +256 414 233433/4
Office Fax: +256 414 341243
Cell: +256 (0) 772 846366
email: valentine.katabira@uetcl.com

From: maja.tofteng@poyry.com [mailto: maja.tofteng@poyry.com]
Sent: Thursday, July 31, 2008 11:25
To: Valentine Katabira
Subject: Fw: Aggreko Uganda

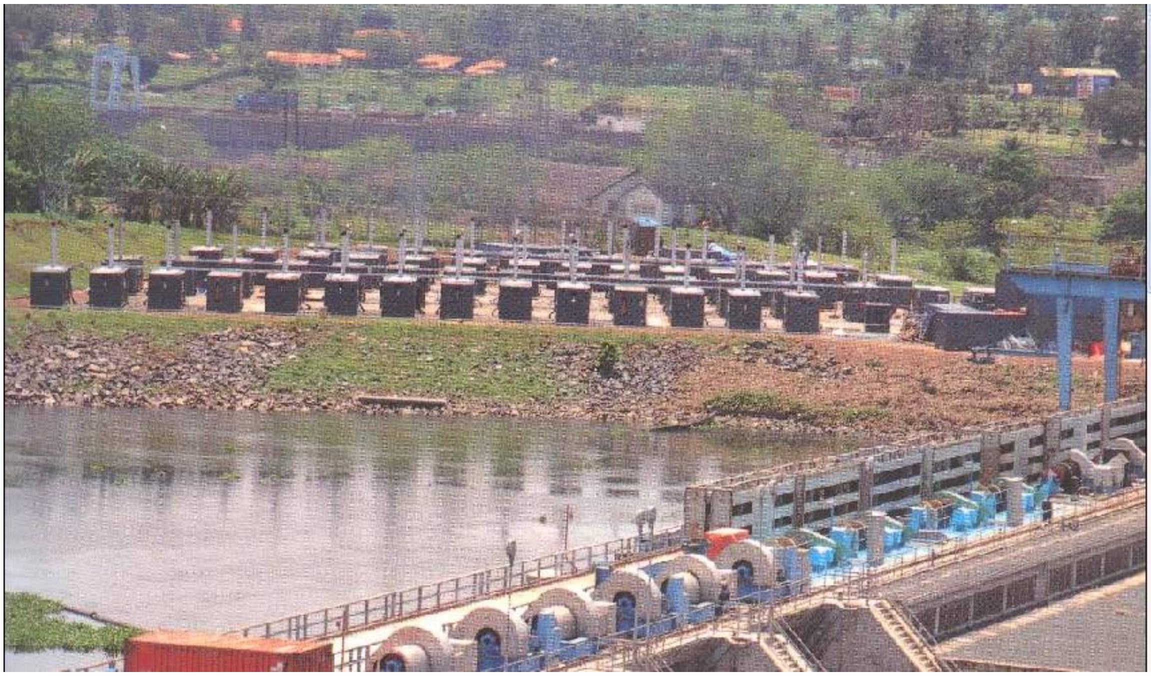
Dear Valentine

As a part of the application to register the Bugoye HPP as a climate project we need some information regarding the aggreko plants.

As far as we know, an 50 MW aggreko plants are generally made up of 60 units, each with a nominal rating of 1250 kVA, giving 1000 kW peak capacity and 850 kW in baseload. The 60 units can be installed, operated and dispatched independently. Each control unit covers 10 units, however, all the 10 units can be operated independently.

Frank Alloghe (meeting Africa Energy Forum in Nice 2.-4. July 2008) and Maria Hales (phone conversation 11 august 2008) from Aggreko International have also confirmed that Aggreko offers generators providing their customers with great flexibility. This means that their generators consist of 1 MW units (1250 kVA) and the units can be operated independently. The units are typically installed at different time and can be up- / downgraded to support the clients need.

Figure 9 The 50 MW Aggreko Plant at Kiira consisting of multiple units.



Source; Aggreko International

Annex 4

MONITORING INFORMATION

See appendix 2

Annex 5

STANDARDS FOR EQUIPMENT AND PARTS

The types or makes to be used shall be decided later by the Employer.

All instrument indicator scales shall be written in the official language of the country of the Employer and in the SI system of units.

7-2.3 Standards

7-2.3.1 General

All equipment and parts related to this section and concerning choice of materials, main dimensions and function shall conform to the appropriate standards the manufacturer specifies. For this purpose, he will submit in his Tender the relevant standards for the main items on which his Tender is based and clearly identify the parts, phases, operations, etc. to which each particular standard shall be applied. For example, he must indicate the standards to be applied for design, calculations, materials, and fabrication of the supply.

The Contractor shall supply copies of other standards at the Engineer's request, clearly identifying or marking the particular chapters or sections that are being applied. The following standards, or equivalent standards, are preferred:

- ASTM American Society for Testing of Materials
- AWS American Welding Society
- ASME American Society of Mechanical Engineers
- DIN German Standards, (Deutsche Industrie-Normen)
- EN European Standards
- ISO International Organisation for Standardisation
- IEC International Electrotechnical Commission
- JIS Japanese Standards Association
- NFPA National Fire Protection Association, USA
- NS-EN Norwegian Standards
- SS-EN Swedish Standards

Whichever standard is chosen, it shall be made available in the English language. The latest revision or edition in effect at the time of the Invitation of Tenders shall apply.

The equipment and materials furnished under this contract shall conform to the requirements of the Specifications and to the designated standards. In case of discrepancy between the designated standards and the Specifications, the latter shall rule.

7-2.3.2 Turbines with Governors

IEC Standard 61362, 60193 and 41, in addition CCH 70-3.

7-2.4 Materials

All materials incorporated in the equipment supplied shall be of quality, grades and conditions as set forth in the approved Standards.

Materials not specifically designated herein shall be subject to the Employer's approval, shall be suitable for their purpose and shall as far as practicable comply with the latest issue or revision of the following standards or their approved equivalent. The use of alternative materials having corresponding or higher quality and properties will be subject to the approval of the Engineer.

Materials for general purposes shall have a quality equal to or better than the following (it shall be clearly stated in the Tenders which standard is applied):

Steel Castings	DIN 1681, GS-45, W1.0466 (Stahlguss) DIN 17245, GS-C25 (Warmfester Stahlguss)
Grey Iron Castings,	ASTM A48, Class 35 DIN 1691, GG-25, W0.6025 (Gusseisen mit Lamellengraphit (Grauguss))
Ductile Iron Castings	ASTM A536 -84 DIN 1693, GGG-40.3, W0.7043 (Gusseisen mit Kugelgraphit)
Vacuum-Treated Steel Forgings for Generator Rotors	ASTM A469 -94a, Class 1
Steel Forgings, Carbon and Alloy, for Pinions, Gears and shafts for Reduction Gears	ASTM A291 -03, Class 1
Carbon Steel Forgings for Piping Applications (For pressures above 20 bars)	ASTM A105/A105M -02
Seamless Carbon Steel Pipe for High-Temperature Service	ASTM A106 -02a
Carbon Steel forgings, for General-Purpose Piping (for pressures below 20 bars)	ASTM A 181/A181M -01
Forged or Rolled Alloy-Steel Pipe Flanges, Forged fittings, and Valves and Parts for High-Temperature Service	ASTM A182/A182M -02
Steel plates	DIN 17100, W1.0038 (RSt37-2) EN 10025 -90, Fe 360 BFN EN 10027-1 -92: S235J2G2 EN 10027-2 -92: 1.0038
Steel plates, fine grained	EN 10025 -90: Fe 510D1 EN 10027-1 -92: S355J2G3 EN 10027-2 -92: 1.0570 EN 10028-1,2,3,4,5,6: -92 > -97 EN 10113-1,2,3: -93 DIN 17102
Carbon and Alloy Steel Nuts and Bolts for High Pressure or High Temperature Service, or Both	ASTM A194/A194M -03a
Carbon Steel Bolts and Studs	ASTM A307 -02, Grade B DIN 17240
Copper Alloy Sand Castings for General Applications. Bronze castings	ASTM B584 00, Alloy 2B DIN 1705, G-CuSn7ZnPb, W2.1090
Bronze for bearings, bushings thrust discs, etc.	ASTM B584 -00, Alloy 3A DIN 1716, GZ-CuPb10Sn, W2.1176.03 GC-CuPb10Sn, W2.1176.04
Brass pipe	ASTM B43, DIN 1755
Copper pipe	ASTM B42, DIN 1754, DIN 17660

Welded and seamless steel piping	ASTM A53, Grade A, DIN 1629 DIN 1630
Stainless steel pipes	AISI 304 DIN 17440, W 1.4301
Stainless steel plates	AISI 304 DIN 17440, W 1.4301
Stainless steel castings	ASTM A487 DIN 17445
Babbitt metal for bearings	ISO 4381: 2000
Turbine shaft steel	DIN 17243, W1.1133, NS-EN 10083, Impact strength (at 0°C) > 22 J.

For plates exposed to high loads in the transversal direction Z-plates shall be used.

Special requirements are provided in the detail specifications of the individual section of work, or under Construction Elements in these General Technical Specifications where necessary.

Works certificates which contain chemical analysis and mechanical properties (yield point, breaking point, elongation at break and impact tests at 0 °C) shall be delivered for materials used in constructions exposed to pressure and fatigue.

The Employer reserves the right to execute tests he considers necessary to control the quality of the material.

7-2.5 Design Calculations

7-2.5.1 Considerations for Design

At the design work the Contractor must consider the environmental conditions at the site when choosing materials and components in the equipment.

7-2.5.2 Working Stresses

Ample factors of safety shall be used throughout the design of the equipment, especially in the design of parts and components subject to alternating stresses, vibration, impact or shock.

Under maximum design conditions and hydrostatic pressure test conditions respectively, the stress levels in the material shall not exceed the following values unless otherwise stated by the manufacturer and approved by the Engineer.

Cast steel: general maximum static stress level	35 % of the yield strength
Cast steel: maximum static stress at points with local stress concentrations, calculated according to methods approved by the Employer.	45 % of the yield strength, provided that the quality of material can be controlled by approved methods at the points with stress concentrations

Annex 6

ESTIMATION OF EMISSIONS FROM DIESEL GENERATOR

Typical fuel consumption for a 80 kVA diesel generator: (Conservative estimate based on stand by power is provided by the producer FG Wilson, see next page)	18 USg /hr (68.12 l/hr)
Running time per year:	100 hrs
Total fuel use = 89.2 * 100 =	6812 l/yr (6.81 m^3/yr)
IPCC emission factor for diesel:	74.8 tCO_2/TJ
IPCC net calorific value diesel:	43.3 TJ/Gg
COEF for diesel[30]:	3.24 tCO_2/tonne diesel
Density of diesel[31]:	842 kg/m^3 (0.85 T/m^3)
Total tonnes of diesel used/yr = 6.81 * 0.842 =	5.734 T
Total CO_2 emissions per year from diesel use =	5.734 * 3.379 = 19.37 TCO_2/yr
Baseline emissions	51,075 tCO2 annually
% of baseline emissions	0.037%

[30] Based on IPCC values for NCV and EF (see tables section B.7.1)

[31] Energy and carbon conversions, Carbon Trust, www.carbontrust.co.uk

FG WILSON

Output Ratings		
Generating Set Model	P80P1	P88E1
380 – 415V, 50 Hz	80.0 kVA 64.0 kW	88.0 kVA 70.4 kW
480V, 60 Hz	90.0 kVA 72.0 kW	100.0 kVA 80.0 kW

Ratings at 0.8 pf

Ratings Definitions

Prime Power – Model P80P1

These ratings are applicable for supplying continuous electrical power (at variable load) in lieu of commercially purchased power. This model can supply 10% overload power for 1 hour in 12 hours.

Standby Power – Model P88E1

These ratings are applicable for supplying continuous electrical power (at variable load) in the event of a utility power failure. No overload is permitted on these ratings. The alternator model is peak continuous rated (as defined in ISO 8528-3).

Technical Data		
Engine Model:	Perkins 1104A-44TG2	
Alternator Model:	LL2014L	
Number of Cylinders:	4 in line	
Displacement: Litres (cu.in)	4.4 (268.5)	
Bore/Stroke: mm (in)	105.0 (4.1) / 127.0 (5.0)	
Compression ratio:	17.25:1	
Induction:	Turbocharged	
Frequency:	50 Hz	60 Hz
Engine Speed:	1500 RPM	1800 RPM
Gross Engine Power: kW (hp)	80.7 (108.0)	92.6 (124.0)
BMEP: kPA (psi)	1468.0 (212.9)	1403.0 (203.5)
Piston Speed: m/sec (ft/sec)	6.4 (20.8)	7.6 (25.0)
Fuel Tank Capacity: Litres (US Gal)	175 (46.2)	175 (46.2)
Fuel Consump, P80P1: 1/hr (USg/hr)	18.0 (4.8)	21.3 (5.6)
Fuel Consump, P88E1: 1/hr (USg/hr)	19.9 (5.3)	23.7 (6.3)
Heat Rejected to Exhaust System: kW (Btu/min)	58.3 (3315)	70.1 (3987)
Heat Rejected to Water & Lube Oil: kW (Btu/min)	50.4 (2866)	55.8 (3173)
Heat Radiated to Room: kW (Btu/min)	20.8 (1183)	22.7 (1291)
Exhaust Gas Temperature: °C (°F)	580 (1076)	560 (1040)
Radiator Cooling Air Flow: m³/min (cfm)	121.2 (4280)	140.4 (4958)
Combustion Air Flow: m³/min (cfm)	5.1 (180)	6.4 (226)
Exhaust Gas Flow: m³/min (cfm)	13.3 (470)	15.9 (560)

Note: Standard reference conditions 27°C (80°F) Air Inlet Temp, 152.4m (500ft) A.S.L. 60% relative humidity. All engine performance data based on the above mentioned maximum continuous ratings. Fuel consumption data at full load with diesel fuel with specific gravity of 0.85 and conforming to BS2869: 1998, Class A2.

Dimensions and Weights				
Length: mm (in)	**Width:** mm (in)	**Height:** mm (in)	**Dry:** kg (lb)	**Wet:** kg (lb)
2149 (84.6)	752 (29.6)	1366 (53.8)	990 (2183)	1010 (2227)

Dry = With Lube Oil Wet = With Lube Oil and Coolant

Generating set pictured may include optional accessories

P80P1 – P88E1

FG Wilson (Engineering) Ltd
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Northern Ireland, United Kingdom
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www.FGWilson.com