BETHLEHEM
HYDRO

CDM Monitoring Report

Bethlehem hydroelectric project

UNFCCC REFERENCE NUMBER: 2692

MONITORING PERIOD: 08/10/2009 to 31/12/2009

Report Version 3.5

Report date 11 May 2010

Prepared by:

PG Needham

NuPlanet (Pty) Ltd, South Africa

www.nuplanet.co.za

pg@nuplanet.co.za

NuPlanet Project Development (Pty) Ltd.

Director: A Olivier (Managing)

Reg No 2006/016654/07

P O Box 35630, Menlopark 0102, South Africa

Tel: +27 (012) 349 2944, Fax: +27 (012) 349 2944

www.nuplanet.co.za

1. EXECUTIVE SUMMARY

Project Description

The project involves operation of 7.0MW of hydro generation capacity near the Dihlabeng Local Municipality in the Free State Province, South Africa. The project will generate 37 GWH per annum and comprises two generation facilities:

- The Merino Power Plant: A run of river site located on the As River (4 MW), midway between Bethlehem and Clarens; and,
- The Sol Plaatje Power Plant: Facility located at the existing concrete wall of the Sol Plaatje Dam (3 MW), just outside the town of Bethlehem. The Sol Plaatje Dam supplies water to the town and has not been used for hydropower generation before.

Status and Scope

This monitoring report describes the calculations of the emission reductions achieved by the Bethlehem hydroelectric project. The monitoring report for the year 2009, covers power production at the Sol Plaatje unit of Bethlehem Hydro from the 8th October 2009 to the 31st December 2009. Actual power production however only started on the 11th of November 2009. The Merino unit had not been commissioned during this monitoring period and has therefore not produced any power during this period.

This monitoring report is based on the monitoring plan contained in the Project Design Document (PDD) of the project as validated and approved by the CDM Executive Board on the 8th October 2009(PDD Version 7 Revision 4). The project is registered under the approved methodology AMS 1.D version 13.

Electricity production

The metered electricity production for the monitoring period is

EP_{2009} = 1 497.188 MWh

Baseline

The baseline emission factor was calculated using the Combined Margin methodology, fixed ex-ante during the first crediting period and is set at:

$EF_{CM\ 2009}$ = 1.02 tCO_2/MWh

Emission Reductions

The emission reduction for this monitoring period is: 1 527.13 ton CO_2 eq

2. CONTENTS

3. INTRODUCTION

This monitoring report includes data and the calculations of the emission reductions achieved by the Bethlehem hydroelectric project. The monitoring period run from the 8th of October 2009 to the 31st December 2009.Actual power production only started on the 11th of November 2009.

This monitoring report is based on the monitoring plan contained in the Project Design Document (PDD) of the project as validated by SGS and approved by the CDM Executive Board on the 8th October 2009. The project is registered under the approved methodology AMS 1.D Version 13:

AMS 1.D

Reference: Simplified Modalities and Procedures for Small-Scale CDM project activities, category I.D Version 13 Scope 01.

The specific technology for the CDM project is hydropower that displaces electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit. The project involves a grid connected renewable energy plant with the sale of electricity into the national grid, which is the only option open to the project developer and corresponds with category I.D.

4. DESCRIPTION OF THE PROJECT

The purpose of the project activity is to generate hydroelectricity, which is distributed into the South African grid.

The project involves the operation of 7.0MW of hydro generation capacity within the boundaries of the Dihlabeng Local Municipality in the Free State Province, South Africa. The project will generate 37 GWH per annum and is comprised of two generation facilities i.e.

- The Merino Power Plant: A run of river site located on the As River (4 MW), midway between Bethlehem and Clarens; and,
- The Sol Plaatje Power Plant: Facility located at the existing concrete wall of the Sol Plaatje Dam (3 MW), in the town of Bethlehem. The Sol Plaatje Dam is also fed by the As river and supplies water to the town and has not been used for hydropower generation before.

The water resource in the As River is artificially fed from the Lesotho Highlands Water Project (LHWP).

Water from the project is currently transferred from the Katse Dam in Lesotho to South Africa via the transfer tunnel and the delivery tunnel. During the transfer it is used to generate electricity for Lesotho in the Muela hydropower plant situated between the two tunnels. After driving the turbines the water flows to South Africa via the delivery tunnel, the outfall of which is located in the upper reaches of the As River (a tributary of the Liebenbergsvlei River). The flow rate in the river is therefore not seasonally dependent and remains almost constant throughout the year and over time.

The project contributes to sustainable development in South Africa through supporting the development of renewable energy in the country and assisting South Africa in the achievement of its renewable energy target of 10000 GWH renewable energy contribution to final energy consumption by 2013 (White Paper on Renewable Energy, Republic of South Africa, November 2003).

At a local level the project has lead to increased economic activity in the area. In terms of job creation the project will create 40 skilled and 100 to 160 unskilled job opportunities during the construction phase, which will last approximately 12 months. Three full-time permanent jobs will be created once the project goes into implementation.

Sol Plaatje power station showing plant and transmission line

5. CURRENT STATUS OF THE PROJECT

- The start date of the project as defined in the PDD is the start of construction on 15 December 2006.
- The project was registered by the CDM Executive Board on the 8th of October 2009.
- The Sol Plaatje Power Plant has been fully operational from the 11 November 2009. Generation of electricity and the export of power to the grid had commenced on the same date and time.
- The Merino power plant is scheduled for commissioning in April 2010.The Merino plant didnot produce any power during this monitoring period
- During this monitoring period only the Sol Plaatje unit of Bethlehem Hydro was producing electricity. All data and monitoring procedures in this report therefore refer only to the Sol Plaatje Unit.

6. SCOPE OF MONITORING REPORT

This monitoring report covers the period 8 October 2009 to 31 December 2009 and falls into the first crediting period as defined in the PDD (2009 to 2016)

The monitoring report only includes the data for the Sol Plaatje unit as the Merino unit has not been commissioned and was not operational during this monitoring period.

7. DATA MONITORING

7.1 DATA MONITORED

The PDD lists the sets of data that are monitored for the calculation of the baseline and the emission reductions.

The baseline emission factor is calculated using the Combined Margin methodology as prescribed in the "Tool to calculate the emission factor for an electricity system". The baseline was fixed ex-ante for the first crediting period (2009- 2016) using data with the reference year 2005.

The monitoring methodology for Type 1.D, renewable energy generation for a grid, as described in Appendix B of the simplified M&P for CDM Small Scale Projects is as follows:

"Monitoring shall consists of metering the electricity generated by the renewable energy technology"

The data and parameters monitored according to Section B.7.1 of the PDD is:

B.7.1 Data and parameters monitored:	
Data / Parameter:	
Data unit:	kWh
Description:	Total annual power generated at each generating unit
Source of data to be used:	Electricity meters installed at each generating unit
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Total annual electricity produced (kWh) will be used to calculate annual emission reductions
Description of measurement methods and procedures to be applied:	Remote monitored meters will be used which records each Wh produced. Data will be downloaded daily via a wireless GPRS (cell phone) system.
QA/QC procedures to be applied:	Meters to be calibrated by accredited calibration authority. Real

	time digital data recording.

The only data to be monitored during the monitoring period is therefore:

- Metered electricity production delivered to the national grid as measured at the point of supply.

7.2 ELECTRICITY METERS

7.2.1 SOL PLAATJE ELECTRICITY METERS

The electricity production of the Sol Plaatje unit is measured by two meters, a main and a check meter. Both these meters are installed at the Panorama substation. The meters are located in a small closed building constructed specifically to house the Bethlehem Hydroelectric project switchgear and meters located at the point of supply (POS) into the grid. Both meters are "bi-directional" meters. They measure and record both the power produced by the power plant as well as power consumed by the power plant. The plant is a net consumer of electricity in periods when the plant is not producing power, eg. for lighting and machine tools during maintenance periods when the plant is shut down.

Power produced by the Sol Plaatje unit is transmitted to the Panorama substation by a dedicated 11kV power line. This line which consists of a combination of overhead conductors (3km length) and buried cable (2km length) is used exclusively for the supply of power by the Sol Plaatje unit to the grid.

Access to the substation is restricted to authorized employees of the Dihalbeng Municipality's electricity department. Access to the Bethlehem Hydroelectric project switchgear is restricted to Bethlehem Hydro and NuPlanet operational personnel.

The electricity meters used are the following:

- **Main Meter:** *Iscraemeco MT 860*. (Serial No A22R36S33-EI-M3K03-). This meter is fitted with a GPRS modem to allow for remote accessing of data
- **Check Meter:** *Iscraemeco MT 831* (Serial No 35597712)Specification sheets for both the meters and the GPRS modem are enclosed in Annex A

Location of Sol Plaatje electricity meters at the point of supply (Panorama substation)

Main (left) and check electricity meters at point of supply (Panorama substation)

7.2.1 METERING PROTOCOL

Where duplicate meters have been installed and the meter readings at any time differ by more than 2.5% (two comma five per centum) from the average of the two readings, then for the purposes of rendering accounts, if Bethlehem Hydro's records show that the discrepancy is attributable to one meter only, the reading of the other meter shall be taken but if the discrepancy may be due to the inaccuracy of both meters a reasonable estimate shall be made by Bethlehem Hydro of the correct quantity but such meters shall as soon as possible be tested to correct faulty readings.

7.2.2 ELECTRICITY METER CALIBRATION

Both the main and check meter have been calibrated at

Calibration certificates for the meters as well as the accreditation of the calibration authority are attached in Annex C

7.3 DATA CAPTURE AND PROCESSING

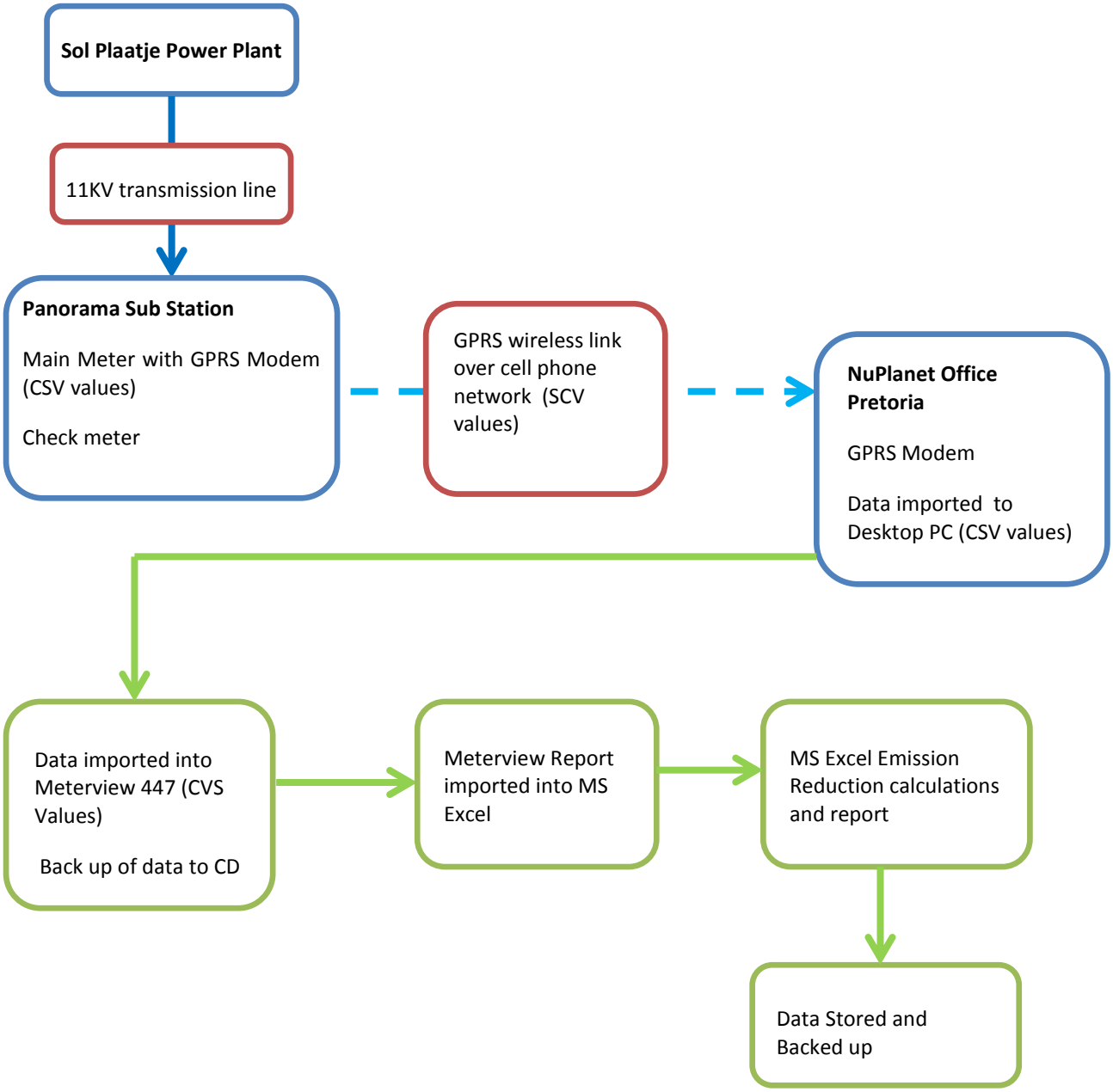
1. Data is recorded by both the electricity meters mentioned in the previous section.
2. Data is then downloaded via a GPRS (cell phone) modem connection to an off-site personal computer located at NuPlanet offices in Pretoria.
3. The data is downloaded on a software platform, *Meterview 4.4.7*, which is a proprietary software program for use with the meters supplied by the meter manufacturer
4. Data is then exported from this software program into *Microsoft Excel* for analysis and calculations.

7.4 DATA STORAGE

1. Data is firstly stored on the electricity meter, MT 860. This meter can save data up to 15 monitoring periods, after which it starts discarding the oldest data. Each monitoring period includes data being captured every half hour for the duration of one month starting on the 15th day of each month and concluding on the 14th day of the next month.
2. Data is downloaded on a monthly basis, and stored on the computer used for the download.
3. Data is also stored on the Operation Manager's computer which is used for the manipulation of the data.
4. The data is stored on a compact disc each month, and kept at the administration office of Bethlehem Hydro.
5. Data is sent via email to the Managing Director's computer via email.

7.5 DATA PROCESSING

The following flow chart describes the data capturing, transfer and processing:



The metered values for a monitoring period are downloaded remotely from the main meter using a GPRS modem unit at the meter and second GPRS modem at the NuPlanet offices. Data is imported into the software platform, *Meterview 4.4.7*, which is a proprietary electricity metering software provided by the meter suppliers. MeterView 4 was designed to simplify parameterization and testing of electronic electricity meters. Its main features are:

- Parameterization of various devices through unified user interface.
- Different control readings for meter testing.
- Support for different communication protocols and media.

- Downloading of meter data registers

Data is then exported from this software program into *Microsoft Excel* for analysis, calculations, and setting up invoices for electricity production

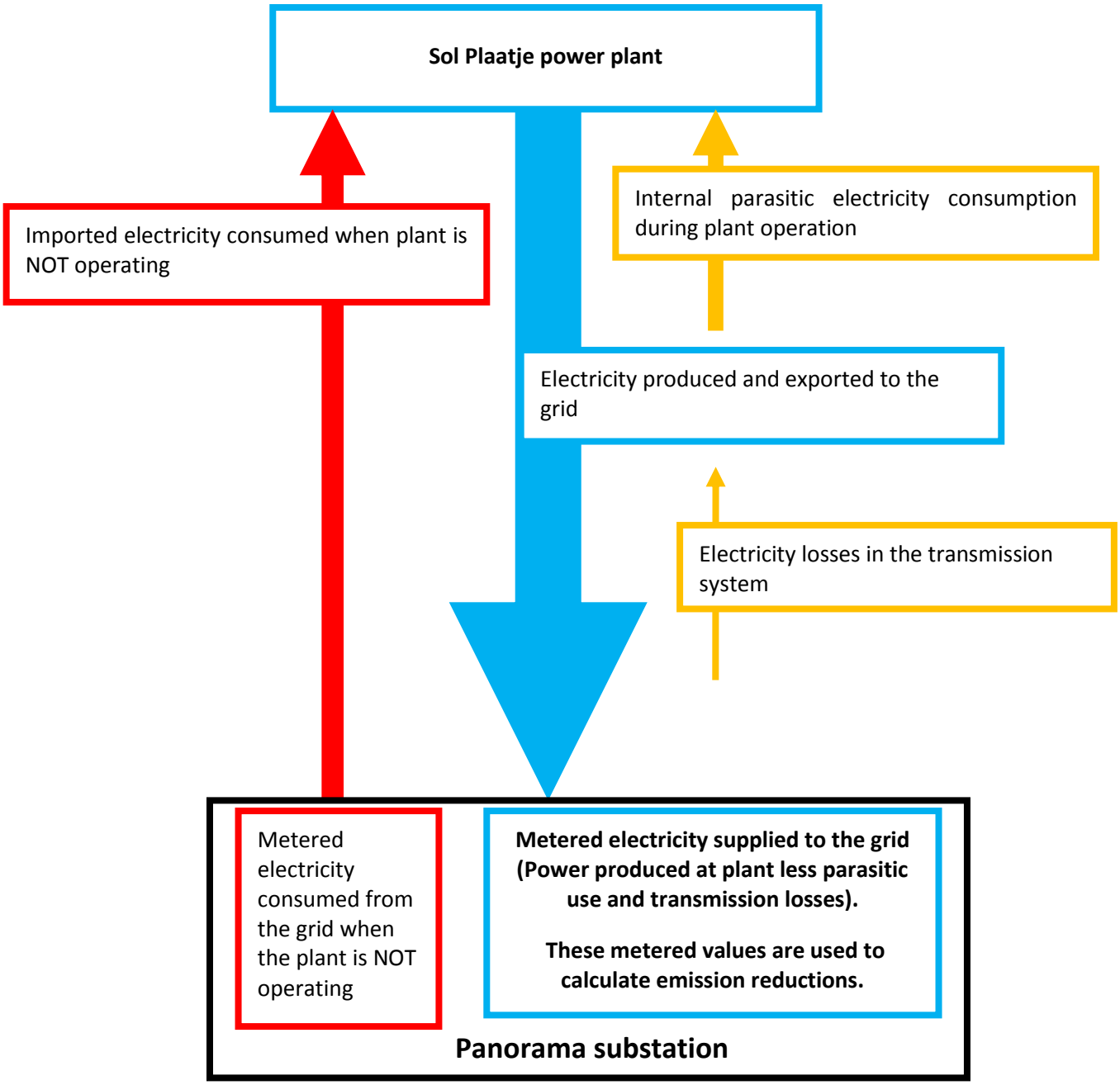
Calculations

The emission reduction calculations are done in MS Excel.

8. ELECTRICITY PRODUCTION: METERED VALUES

8.1 ELECTRICITY PRODUCTION AND CONSUMPTION

The flow chart below describes the different electricity production, consumption and losses in the Sol Plaatje electricity generation and supply system.



8.2 OWN USAGE

The power plant is both a user and a producer of electricity. The plant is a net consumer of grid electricity in periods when the plant is not producing power, eg. for lighting and machine tools during maintenance periods when the plant is shut down.

The Sol Plaatje electricity meters are “bi directional”. The meters record both power produced and consumed by the plant. The consumption of grid power during periods when the plant is not operational is distinct from the internal parasitic electricity consumption during periods when the plant is operational and producing electricity.

It is important to note that “metered electricity production” will be used to calculate the emission reductions. Metered electricity production is net of internal parasitic use of electricity, which is consumed during plant operation. While the plant is operating and exporting power to the grid, it uses some of the power produced internally for lighting, ventilation and pumps.

Gross metered power production as measured at the point of supply is used in calculation the emission reductions since all power produced by the plant and exported to the grid at the point of supply (Panorama substation) will offset emissions as per the baseline irrespective of any grid electricity consumed in the Sol Plaatje plant itself. The emission reductions are calculated on gross metered power production at the point of supply and not power production net of metered own use.

8.3 TRANSMISSION LOSSES

The metered electricity production as metered at the Panorama substation point of supply is net of transmission losses which occur in the transmission network between the Sol Plaatje power plant and the point of supply. The metered electricity production used to calculate the emission reductions is therefore net of transmission losses.

8.4 METERED ELECTRICITY PRODUCTION

Monitored data includes the data collected on the metered production electricity by the Bethlehem Hydroelectric project only. The amount of electricity delivered to the grid at the points of supply for the crediting period has been measured by the metering equipment.

Metered electricity production at point of supply

= production by plant – parasitic loads – transmission losses

The metered electricity at the point of supply for the monitoring period is given below:

Measuring interval	Register Reading at Beginning of interval (kWh)	Register reading at end of interval (kWh)	kWh generated per interval
8 October 2009 – 10 November 2009	0	0	0
11-30 November 2009	0	483 538	483 538
1-15Dec 2009	483 538	977 099	493 561
15 - 31 December 2009	977 099	1 497 188	520 089
Total power generated for the Monitoring Period			1 497 188

The primary data for the electricity production for the monitoring period is presented in **Annex B.**

9. THE CALCULATION OF THE BASELINE EMISSION FACTOR

The baseline emission factor was calculated using the Combined Margin methodology, fixed ex-ante during the first crediting period and is set at:

$EF_{CM\ 2009}$ = 1.02 tCO_2/MWh

10. EMISSION REDUCTION CALCULATION

The emission reductions for the monitoring period are obtained from the electricity generation data and the calculated emission factor.

A total of 1 497 188 kWh has been generated for the period 8 October 2009 to 31st December 2009, (Refer to Section 8.4)

The baseline grid emission factor for emission reduction in this case is ***1.02 tCO_2/MWh*** (Refer to Section 9)

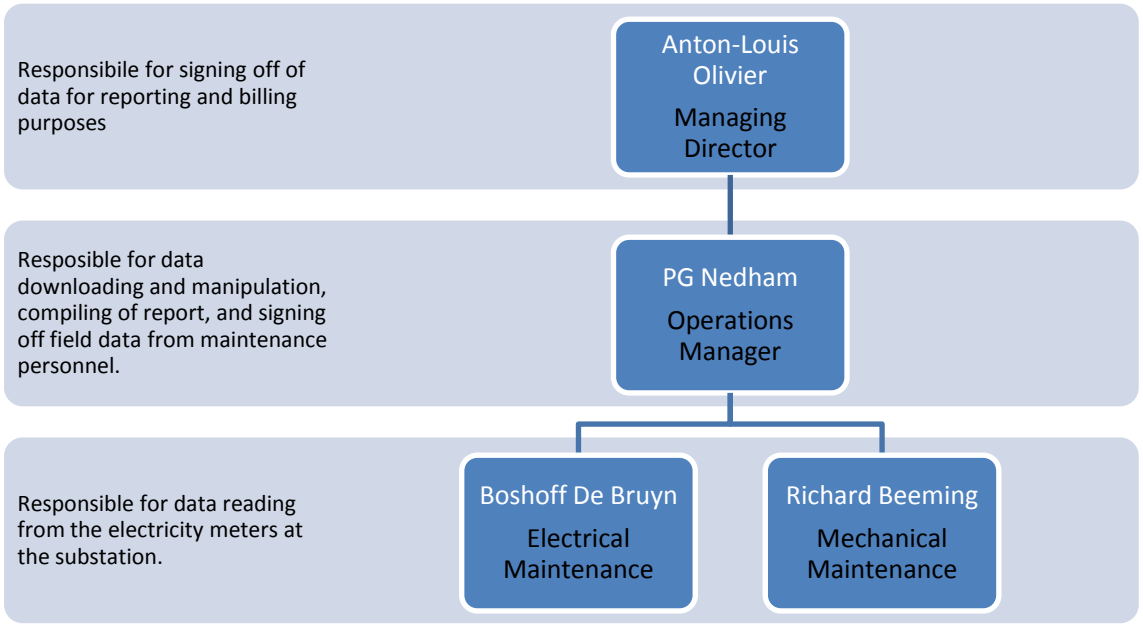
The emission reduction for the period can therefore be calculated as:

1497.188 x 1.02 = 1 527.13 ton CO_2 eq

11. QUALITY CONTROL AND QUALITY ASSURANCE

11.1 QUALITY CONTROL FLOW CHART

The personnel involved in the handling and quality assurance of the data are as followed:



11.2 METER READING

All electricity production is measured by the MT860 main meter and by the MT 831 check.

The meters contain a history for 15 monitoring periods of one month each. Each monitoring period covers data being captured every half hour for the duration of one month starting on the 15th of each month and concluding on the 14th of the next month. Each of these periods can be seen from the meter interface and downloaded for analysis and storage.

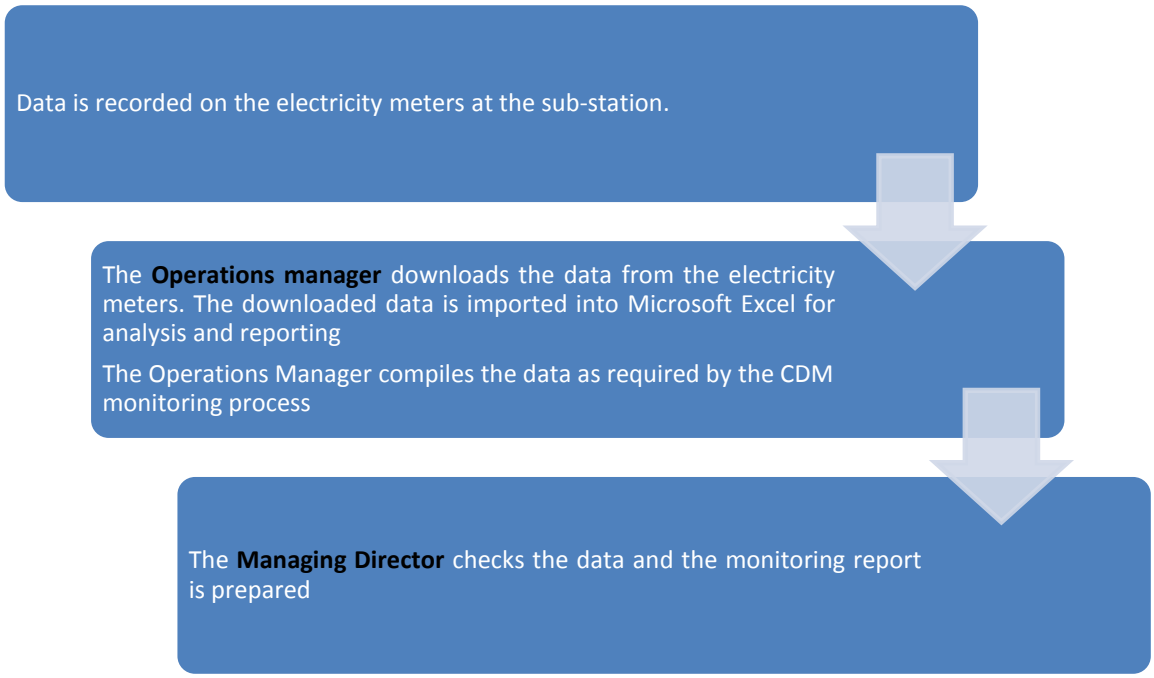
11.1 RECORDS FOR SOLD ELECTRICITY

The metered electricity values can be checked against the invoices for electricity sold to Dihlabeng municipality.

The relevant invoices for the monitoring period are attached in Annex D

11.2 DATA HANDLING

The process for the handling of the data is described in the following diagram



ANNEX A

SPECIFICATION SHEETS FOR ELECTRICITY METERS

ANNEX B

PRIMARAY POWER PRODUCTION DATA

ANNEX C

CALIBRATION CERTIFICATES FOR ELECTRICITY METERS.

Refer to the attached MS Excel files:

1) In the first file 300 915 -1SP.xls there is a single meter (MT860) (See attached file: 300 915-1SP.xls)

2) In the second file 300 628 -1SP.xls there are test results for 100 pcs of MT831, including testing result of MT 831 with serial number 35597712 (item 24) (See attached file: 300 628-1SP.xls)

ANNEX D

COPIES OF INVOICES FOR ELELCTRICITY SOLD IN MONITORING PERIOD