**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Bethlehem Hydroelectric project
Version number of the PDD	8
Completion date of the PDD	1 August 2013
Project participant(s)	Bethlehem Hydro (Pty) Ltd Statkraft Markets BV
Host Party(ies)	South Africa
Sectoral scope(s) and selected methodology(ies)	Type 1 – Renewable Energy Projects 1.D Grid connected renewable electricity generation
Estimated amount of annual average GHG emission reductions	32 688 tons of CO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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

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

- A run of river site located on the As River (4 MW), midway between Bethlehem and Clarens; and,
- Facility to be located at the existing concrete wall of the Sol Plaatje Dam (3 MW), in the town of Bethlehem. The Sol Plaatje Dam supplies water to the town and is not used for hydropower generation so far.

The project will involve the construction of these facilities as well as a 5km transmission line at 11KV on wood poles to deliver 7 MW to the Panorama substation to link the project to the national grid. A step-up transformer will be required at the power station in order to deliver power at 11kVA. Existing access roads to the site will also be upgraded.

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 will contribute 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 will 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.

A.2. Location of project activity

A.2.1. Host Party(ies)

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South Africa

A.2.2. Region/State/Province etc.

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Free State

A.2.3. City/Town/Community etc.

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Bethlehem (Dihlabeng Municipality)

A.2.4. Physical/ Geographical location

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The 3 MW facility will be located at the Sol Plaatje dam which is 5km from the centre of Bethlehem. The actual location is at the existing concrete dam wall adjacent to a pumping station, which supplies the town of Bethlehem with water.

The 4MW As River site is located on farmland on the As River on the farms 'Merino' and 'De Burg Susan', some 15 km outside Bethlehem in the direction of the town of Clarens.

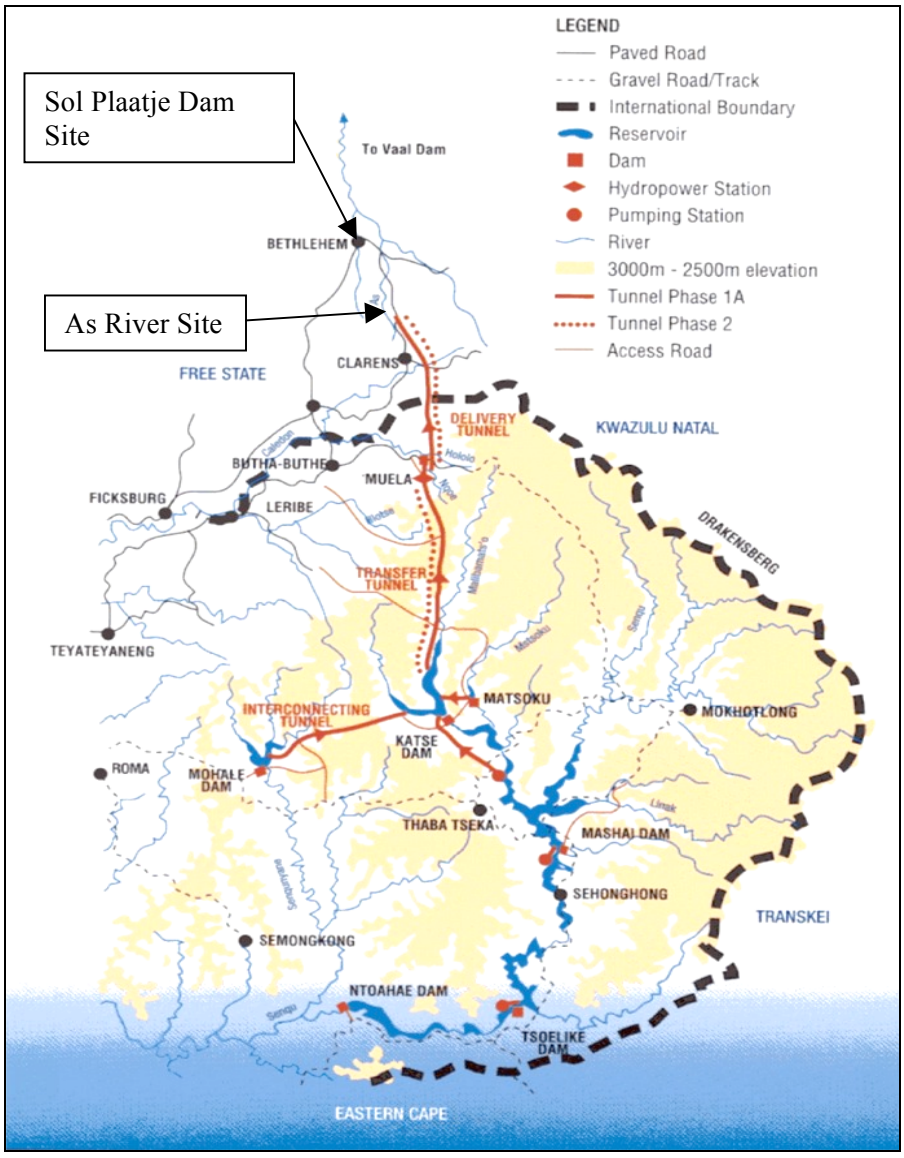
The co-ordinates for the two sites are:

Merino:
28deg 22' 09" South
028deg 21' 42" East

Sol Plaatje
28deg 12' 59" South
028deg 21' 50" East

Bethlehem Hydro (Pty) Ltd is located at NuPlanet house, 53 De Havilland Crescent , Persequor Park, Pretoria 0020, South Africa

Map showing project location



A.3. Technologies and/or measures

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The project will use small hydro technology at both of the following facilities:

1. Sol Plaatje unit – located at the Sol Plaatje dam will be a dam-installation and will use a Kaplan small hydro turbine
2. Merino unit – located on the Ash river, will be a run-of-river small hydro power plant that will use a Kaplan small hydro turbine

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	Bethlehem Hydro (Pty) Ltd	No
The Netherlands	Statkraft Markets BV	No

A.5. Public funding of project activity

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The Government of Netherlands provided resources for early project identification and development related activities with regard to this project from their AIJ programme. As such the funding did not result in a diversion of official development assistance. The Government of the Netherlands is not claiming any emission reductions as a result of their early support to the project.

No public funding from ODA has been used to acquire CERs from this project.

A.6. Debundling for project activity

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According to the Guidelines on Assessment of Debundling for SSC Project Activities (version 03) 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:

a) With the same project participants;
b) In the same project category and technology/measure; and
c) Registered within the previous 2 years; and
d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The project owner confirms that they have not registered any small scale CDM project activity or are applying for registration of another small scale CDM project activity within 1 km of the project boundary of the proposed small-scale activity, in the same project category and technology/measure. In addition, there is no other registered small-scale CDM project activity with the same project participants in South Africa (in the past two years or previous).

So the proposed project is not a debundled component of any large scale CDM activity and hence it qualifies as a small scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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Methodology used: 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 as a substitute for existing fossil fuel power.

B.2. Project activity eligibility

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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.

B.3. Project boundary

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As defined in the methodology AMS-I.D the *spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to*. According to the "Tool to calculate the emission factor for an electricity system" *a grid/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 project boundary encompasses the physical geographical location of the two generating units. Units may from time to time use a back up generator for which the diesel usage should be monitored. In addition, the Units may from time to time import electricity from the Grid – this is to be monitored accordingly.

B.4. Establishment and description of baseline scenario

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In accordance with Methodology I.D for small-scale CDM project activities, the baseline selected for the project is the 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'. The calculation and references used in calculation of the Combined Margin is attached to the PDD as Annex 3 baseline Information

The latest data for the calculation of the Combined Margin is 2005. The Combined Margin is calculated as follows:

$$\mathbf{EF}_{\mathbf{grid,CM,y}} = \mathbf{EF}_{\mathbf{grid,OM,y}} * \mathbf{w}_{\mathbf{OM}} + \mathbf{EF}_{\mathbf{grid,BM,y}} * \mathbf{w}_{\mathbf{BM}}$$

With

$EF_{grid,OM,}$ = 0.99 y t CO_2/MWh
W_{OM} = 0.5
$EF_{grid,BM}$, = 1.05 y t CO_2/MWh
W_{BM} = 0.5

Therefore

$\mathbf{EF}_{\mathbf{grid,CM,y}}$ = 0.99 *0.5 + 1.05*0.5
= 1.02 tCO_2/MWh

The calculations for $EF_{grid,OM}$ and $EF_{grid,BM}$ is given in Annex 3 Baseline Information. According to the Tool for calculating the Emission factor for an electricity system weighting given to the Operating Margin (W_{OM}) and the Built Margin (W_{BM}) for the first crediting period is 50% each.

B.5. Demonstration of additionality

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According to Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities, the project is additional in terms of the following barriers:

Barrier due to prevailing practice: the entry of Independent Power Producers in the South African power market is a recent phenomenon, with ESKOM still playing the dominant role in terms of generation capacity. Only some 5% of South Africa's generation capacity comes from non Eskom sources. These are all either municipally owned plants or generators imbedded in large industrial operations supplying primarily for own internal use. There are therefore almost no privately owned power plants in South Africa apart from co-generation plants owned by large industry. In fact private ownership within the power generation sector of South Africa was only mandated by the SA cabinet in 2003.

The National Energy Regulator of South Africa (NERSA) has licensed a total of 5 private power plants. These private plants have a combined installed capacity of 1387MW of which 1279 MW is coal fired plants run by large industrial companies for their own supply and 105MW is baggage plants run by the sugar mills for their own internal power consumption. A single 3MW hydro plant is licensed.
(Source: Energy Supply Statistics 2004
http://www.nersa.org.za/UploadedFiles/Publication/ESS2004.pdf)

The South African Department of Mineral and Energy (DME) provide the following information on the South African power generation sector:

Almost 90 percent of South Africa's electricity is generated in coal-fired power stations. Koeberg, a large nuclear station near Cape Town, provides about 5 percent of capacity. A further 5 percent is provided by hydroelectric and pumped storage schemes. In South Africa there are few, if any, new economic hydro sites that could be developed to deliver significant amounts of power. Generation is dominated by Eskom, the national wholly state-owned utility, which also owns and operates the national electricity grid. Eskom supplies about 95 percent of South Africa's electricity.
(Source: http://www.dme.gov.za/energy/electricity.stm)

This figure is supported by the electricity generation statistics published by the National Energy Regulator of South Africa (NERSA). Of the total electricity produced in 2004 in South Africa of 230 004GWh, Eskom produced 221 382GWh . In 2004 therefore Eskom produced 96% of the electricity in South Africa.
(Source: Energy Supply Statistics 2004 p 13
http://www.nersa.org.za/UploadedFiles/Publication/ESS2004.pdf)

Bethlehem Hydro will be the one of the first new (not refurbished) Independent Power Plant to be constructed in South Africa for the sole purpose of selling power commercially and not for internal use. The ability of new generators to break into this market is difficult as a result of a number of factors including the ability to negotiate access to the grid, the need for an Independent Power Producers license from the national regulator and the price paid for electricity. To date no other new IPP could compete with the low cost of power produced by Eskom. All of these requirements require resource levels that are generally beyond the capacity of producers. Therefore the grid contribution of small and independent hydro producers is currently extremely limited. In the case of Bethlehem this manifested itself in terms of the long lead time required to develop such a project (in the order of four years) as well as the time required to discuss and get agreement on the possibility of a power purchase agreement with the municipality.

Other barriers (financial resources): the ability of small and independent hydro power plants to be financially viable is constrained by their ability to compete with the prices of ESKOM electricity. ESKOM is one of the lowest cost producers in the world as a result of the historically subsidised

investment in generation capacity which is most coal based but includes a small (less than 10%) large hydro and nuclear. The effect of this is that income stream from electricity sales for independent power projects is strongly influenced by the wholesale prices ESKOM charges to its customers, rather than being directly related to the cost of production of power. The low electricity prices make small and independent hydropower in general, financially unattractive as investments as measured by their returns for investors. There have therefore been no new and independent small hydro power plants in South Africa since the early 1980's. The general price available to facilities is usually in the range 12 – 14 South African cents (approximately 2 US cents based on an exchange rate of R7 to the dollar) depending of course what the buyer (local municipality) is paying to Eskom. The national Electricity Regulator of South Africa (NERSA) requires distributors of electricity (municipalities) to purchase the cheapest electricity (Eskom or an own embedded generator) available for on sale to their customers.

Without the income from the carbon revenue, the project would not generate sufficient cash flow to meet the minimum debt service coverage ratio requirements of the Development Bank of Southern Africa (DBSA). The carbon revenue is an essential component of the project's income in order to meet its debt payment requirements. The DBSA has therefore included a signed sales agreement for the emission reductions as a suspensive condition for its loan disbursement. This barrier applies specifically to the proposed project activity; it is not necessary for thermal power plants to meet this requirement.

The timeline below shows the mayor milestones during the project's development.

Milestone	Date
Feasibility study completed	May 2003
Environmental Impact Assessment approval	5 July 2004
Water use licence awarded	26 May 2005
Loan Agreement Signed	6 June 2005
International Stakeholder Consultation	20 September 2005 to 19 October 2005
Power generation license awarded	7 November 2005
Power Purchase Agreement signed	21 November 2006
Emission Reduction Purchase Agreement signed	28 November 2006
Project Start date (Commencement of Civil Works notice)	28 November 2006
International Stakeholder Consultation (No Comments)	15 June 2007 to 14 July 2007
International Stakeholder Consultation (ISHC with updated Methodology)	12 March 2008 to 10 April 2008
Start of Crediting Period	30 March 2009 or Date of Registration, whichever is the latest

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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According to the Small Scale Methodology I.D. the baseline can be calculated as:

''A combined margin (CM) combined margin consisting as the combination of the operating Margin (OM)and Built Margin (BM) according to the procedure prescribed in the "tool to calculate the emission factor for an electricity system".

In addition, the methodological tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02 - Published by EB 41, Annex 11), was used to determine the project CO_2

emissions from the combustion of the fossil fuel diesel, which is used from time to time in the back up generators on site.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**EF**
Unit	Ton CO_2/MWh
Description	South African Emission factor calculated using the Combined Margin methodological tool
Source of data	Eskom Annual report figures for total electricity produced, coal consumption, calorific values of fuel and electricity output.
Value(s) applied	1.02
Choice of data or Measurement methods and procedures	No direct measurements will be taken. Figures published by Eskom (national utility) will be used
Purpose of data	Used in the calculation of the emission reductions and project emissions of the project
Additional comment	Refer to Section B4 for calculation

Data / Parameter	$\mathbf{NCV_{diesel}}$
Unit	GJ per mass unit (GJ/ton)
Description	Weighted average net calorific value of fuel type *diesel*
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	43.3
Choice of data or Measurement methods and procedures	As per Option B of Section II in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Purpose of data	Used in the calculation of the emissions caused by diesel usage in the back-up generators
Additional comment	Any future revision of the IPCC Guidelines should be taken into account

Data / Parameter	$\mathbf{EF_{CO2,diesel}}$
Unit	tCO_2/GJ
Description	Weighted average CO_2 emission factor of fuel type *diesel*
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	0.0748
Choice of data or Measurement methods and procedures	As per Option B of Section II in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Purpose of data	Used in the calculation of the emissions caused by diesel usage in the back-up generators

Additional comment	Any future revision of the IPCC Guidelines should be taken into account

Data / Parameter	ρ_{diesel}
Unit	kg/l (kilogram per litre)
Description	The density of diesel
Source of data	The South African Petroleum Industry Association (SAPIA) figure
Value(s) applied	0.75 kg/l (http://www.sapia.co.za/publications/special-interest.html). Used in the calculation of the emissions caused by the use of diesel on site in the standby generators.
Choice of data or Measurement methods and procedures	The density can be updated should SAPIA ever change the figure in the future.
Purpose of data	Used in the calculation of the emissions caused by diesel usage in the back-up generators
Additional comment	Any future updates on the diesel density by SAPIA should be taken into account

B.6.3. Ex-ante calculation of emission reductions

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ER = ((E1+E2) * EF) – PE - LE

Where:

ER = annual emission reductions in tons CO2
E1 = annual electricity generated at generating unit 1
E2 = annual electricity generated at generating unit 2
EF = Emission Factor
PE = Project Emission
LE = Project Leakage

E1 = 15 084.882 MWh/annum
E2 = 18 946.229 MWh/annum
EF = 1.02 tonCO_2/MWh
PE = assumed to be less than 1% of project emission reductions
LE = assumed to be 0 (zero)

ER = ((18 946.229 + 15 084.882) * 1.02) – 0 - 0
= 34 712 ton CO_2/annum

B.6.4. Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
Year 2009	11 868	0	0	11 868
Year 2010	34 712	0	0	34 712
Year 2011	34 712	0	0	34 712
Year 2012	34 712	0	0	34 712
Year 2013	34 712	0	0	34 712
Year 2014	34 712	0	0	34 712
Year 2015	34 712	0	0	34 712
Year 2016	8 678	0	0	8 678
Total	228 818	0	0	228 818
Total number of crediting years	7 (seven)			
Annual average over the crediting period	32 688	0	0	32 688

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	**E1g**
Unit	kWh
Description	Total annual power generated at the Sol Plaatje generating unit
Source of data	Electricity meter installed at the generating unit's connection point, which is situated at the Panorama Substation. This is the point of supply for the Unit, in accordance with the Power Purchase Agreements signed with the Dihlabeng Municipality.
Value(s) applied	15 084 882
Measurement methods and procedures	Remote monitored meter will be used which records each Wh produced. Data will be downloaded daily via a wireless GPRS (cell phone) system.
Monitoring frequency	Continuous real time monitoring, with a daily download of data and monthly recording thereof
QA/QC procedures	According to the National Standard for Metering (NRS-057), the meters need to be at least of Class 1. Meters' calibration to be checked by accredited calibration authority every 3 (three) years. Real time digital data recording.
Purpose of data	Used in the calculation of the project emission reductions
Additional comment	

Data / Parameter	E2g
Unit	kWh
Description	Total annual power generated at the Merino generating unit
Source of data	Electricity meters installed at the generating unit's connection point, which is situated at the power station. This is the point of supply for the Unit, in accordance with the Power Purchase Agreements signed with Eskom Holdings.
Value(s) applied	18 946 229
Measurement methods and procedures	Remote monitored meter will be used which records each Wh produced. Data will be downloaded daily via a wireless GPRS (cell phone) system.
Monitoring frequency	Continuous real time monitoring, with a daily download of data and monthly recording thereof
QA/QC procedures	According to the National Standard for Metering (NRS-057), the meters need to be at least of Class 1. Meters' calibration to be checked by accredited calibration authority every 3 (three) years. Real time digital data recording.
Purpose of data	Used in the calculation of the project emission reductions
Additional comment	

Data / Parameter	$FC_{1,j}$
Unit	Gg
Description	Quantity of Diesel consumed by stand by generator at the Sol Plaatje Unit during crediting period *j*
Source of data	Diesel purchase invoices or material claims from operators. The volume will be multiplied by an appropriate density of diesel to ascertain the mass of diesel consumed
Value(s) applied	0 (zero)
Measurement methods and procedures	The diesel consumption will be monitored on a per-purchase basis, as the use of diesel is not planned nor constant. $FC_{1,j} = \rho_{diesel}$ * volume of diesel consumed in litres
Monitoring frequency	Continuously
QA/QC procedures	Compare to operator reimbursement claims where applicable
Purpose of data	Used in the calculation of the project emissions
Additional comment	

Data / Parameter	$FC_{2,j}$
Unit	Gg
Description	Quantity of Diesel consumed by stand by generator at the Merino Unit during crediting period *j*
Source of data	Diesel purchase invoices or material claims from operators. The volume will be multiplied by an appropriate density of diesel to ascertain the mass of diesel consumed
Value(s) applied	0 (zero)
Measurement methods and procedures	The diesel consumption will be monitored on a per-purchase basis, as the use of diesel is not planned nor constant. $FC_{2,j} = \rho_{diesel}$ * volume of diesel consumed in litres
Monitoring frequency	Continuously
QA/QC procedures	Compare to operator reimbursement claims where applicable
Purpose of data	Used in the calculation of the project emissions
Additional comment	

Data / Parameter	**E1i**
Unit	kWh
Description	Total power imported from the grid for use at Sol Plaatje generating unit. Total annual electricity imported from the grid (kWh) will be used to calculate part of the project's internal emissions (along with diesel emissions)
Source of data	Electricity meters installed at each generating unit
Value(s) applied	0 (zero)
Measurement methods and procedures	Remote monitored meter will be used which records each Wh produced. Data will be downloaded daily via a wireless GPRS (cell phone) system.
Monitoring frequency	Continuous real time monitoring, with a daily download of data and monthly recording thereof
QA/QC procedures	According to the National Standard for Metering (NRS-057), the meters need to be at least of Class 1. Meters' calibration to be checked by accredited calibration authority every 3 (three) years. Real time digital data recording.
Purpose of data	Used in the calculation of the project emission
Additional comment	

Data / Parameter	E2i
Unit	kWh
Description	Total power imported from the grid for use at Merino generating unit. Total annual electricity imported from the grid (kWh) will be used to calculate part of the project's internal emissions (along with diesel emissions)
Source of data	Electricity meters installed at each generating unit
Value(s) applied	0 (zero)
Measurement methods and procedures	Remote monitored meter will be used which records each Wh produced. Data will be downloaded daily via a wireless GPRS (cell phone) system.
Monitoring frequency	Continuous real time monitoring, with a daily download of data and monthly recording thereof
QA/QC procedures	According to the National Standard for Metering (NRS-057), the meters need to be at least of Class 1. Meters' calibration to be checked by accredited calibration authority every 3 (three) years. Real time digital data recording.
Purpose of data	Used in the calculation of the project emission
Additional comment	

B.7.2. Sampling plan

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Not applicable to this project activity as sampling will not be utilised.

B.7.3. Other elements of monitoring plan

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The approved monitoring methodology for category Type I.D, renewable electricity generation for a grid is described as follows in appendix B of the simplified M&P for CDM small-scale project activities:

"Monitoring shall consist of metering the electricity generated by the renewable technology."

This methodology will be applied to the two hydropower generating facilities that constitute the project. Separate remote monitored electricity meters will be installed at each generation unit. Data will be transmitted daily via a GPRS (cell phone) connection and recorded electronically.

The total electricity generated by the project will be the sum of the generation at each power unit, which will be calculated as:

Total project generation = E1g + E2g

Where,

E1g = annual electricity generated at Unit 1 (Sol Plaatje) in MWh

E2g = annual electricity generated at Unit 2 (Merino) in MWh

In addition, the internal project emissions will be monitored. If they contribute more than 1% of the total emission reductions for a given monitoring period, then the emissions will be deducted from the emission reductions. If they contribute less than 1% then the emissions do not need to be taken into account. There are two sources of emissions within the project boundary, namely the imported electricity from the Grid and the diesel consumption in the back up generators.

The total emissions generated by the project will be calculated as the sum of the emissions resulting from the internal consumption of electricity and the emissions resulting from the diesel use in the back up generator:

Total project emissions (PE) = $PE_{EL} + PE_{FC,diesel,y}$

Where:
PE_{EL} = is the total emissions in tons CO_2 as a result of grid import (tCO_2)
$PE_{FC,diesel,y}$ = is the total CO_2 emissions from fossil fuel combustion (diesel) during period y (tCO_2)

The total emissions as a result of grid import is calculated as:

$PE_{EL} = (E1_i + E2_i)$ X EF

Where

PE_{EL} = emissions in tons CO_2 as a result of grid import during monitoring period
$E1_i$ = electricity imported at Unit 1 in MWh during monitoring period
$E2_i$ = electricity imported at Unit 2 in MWh during monitoring period
EF = emission factor in tCO_2 / MWh

Where Sol Plaatje is Unit 1 and Merino is Unit 2

The total emissions from the fossil fuel combustion process during the relevant monitoring period will be calculated as:

$PE_{FC,diesel,y}$ = $(FC_{1,j} + FC_{2,j}) * COEF_{diesel,y}$

Where:
$FC_{1,j}$ = the mass of diesel consumed by unit 1 (Sol Plaatje) ascertained by the multiplication of the volume of diesel consumed by the known density of diesel (Gg)
$FC_{2,j}$ = the mass of diesel consumed by unit 2 (Merino) ascertained by the multiplication of the volume of diesel consumed by the known density of diesel (Gg)
$COEF_{diesel,y}$ = is the emission coefficient of diesel in period y in tCO_2/Gg

$COEF_{diesel,y}$ is calculated as:

$COEF_{diesel,y}$ = $NCV_{diesel} * EF_{CO2,diesel}$ = 3.23884 tCO_2/Gg

Where:
NCV_{diesel} = 43.3 GJ/ton
$EF_{CO2,diesel}$ = 0.0748 ton/GJ

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity
>>
28/11/2006

C.1.2. Expected operational lifetime of project activity
>>
In excess of 20 years

C.2. Crediting period of project activity
C.2.1. Type of crediting period
>>
Renewable crediting period

C.2.2. Start date of crediting period
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30/03/2009 or the date of registration, whichever comes the latest.

C.2.3. Length of crediting period
>>
7 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
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In terms of South Africa's Environmental Impact Assessment (EIA) Regulations an EIA Scoping study was completed by independent consultants. The environmental impacts assessed during the scoping study covered both the construction and the operational phases of the project. An Environmental Control Officer (ECO) has been appointed and mandated by the Free State Provincial Authority to monitor environmental impacts on their behalf. The conclusions and recommendations of the scoping study as approved by the Free State Provincial Authorities were:

Conclusions
This Report has assessed the potential impacts associated with the proposed hydropower scheme construction. This investigation has not identified any potential impacts on the environment, which are so severe as to suggest that the proposed infrastructure should not be constructed. However, an environmental cost associated with the development of the 4MW mini hydro power station at the As River Site, is the flooding of a wetland identified in a natural basin.

The proposed development is aimed at enhancing/ augmenting the electricity supply to nearby Bethlehem. The expected long term effects on the environment is mostly positive, while the short term negative effects of construction activities of has limited impact on the environment, and with the implementation of the recommendations contained in this report, could be managed and minimised.

Considering the present environmental conditions, the assessment of the environmental issues, and the recommendations contained in this report, it is believed that the Environmental Assessment could be completed at this Scoping Stage, and that no further assessment is required.

Recommendations
The following recommendations are considered professional opinions and are based on experience in the field, knowledge of the local environment, and are informed by comments received during the course of the Scoping process. The recommendations can be separated into the following groups:
- Construction recommendations; and
- Operational and maintenance recommendations

Construction recommendations
- It is recommended that the mitigation measures detailed in the report be implemented in order to reduce the significance of the impacts associated with the construction of the proposed hydropower scheme.
- In order to manage construction and limit the significance of impacts mentioned in Section 4, an EMP

should be developed and implemented. An appropriately qualified environmental consultant, taking cognisance of the mitigation measures outlined in this report should draft this EMP. It is crucial that the implementation of the EMP is enforced by an Environmental Control Officer during construction, and that the environmental conditions, costs and penalties are written onto the contract documentation

- In particular, it is recommended that disturbed areas should be rehabilitated and re-vegetated with suitable vegetation.
- The initial design of the Merino site would have flooded a small wetland. The flooding of the wetland was approved under the Record of Decision. However, a change from a head pond to a canal design at Merino managed to avoid any impact on the wetland

Operational and maintenance recommendations

- Develop and implement an operational Environmental Management Programme (EMP), with appropriate guidelines for the optimal operation of the plant and a contingency plan to deal with upset operating conditions and emergency situations (*e.g.* flooding, mechanical failure) should they arise. The EMP should incorporate appropriate monitoring protocols and make adequate provision for appropriate action in the event of potentially significant thresholds being reached or trends indicating potentially significant adverse impacts be noted.
- Related to the aforementioned EMP, ensure the continued implementation of a monitoring programme.
- Ensure that the plant operators have been properly trained in the operation of the works.

In accordance with the Record of Decision requirements an EMP has been developed. The EMP clearly identifies the environmental indicators to be monitored during construction and operation as well as the monitoring procedures. The enforcement of compliance with the EMP lies with the ECO who conducts regular site visits and reports to the relevant ministry

The Construction indicators monitored for compliance by the ECO are (EMP table 4.1 p 20):

- Compliance with relevant legislation
- Site established and access roads constructed to minimise environmental impact
- Injuries to construction workers and residents
- Water supply
- Proper signage
- Visual Impact
- Dust pollution
- Noise levels
- Litter and waste production
- Disposal sites
- Terrestrial and aquatic fauna and flora
- Sensitive sites
- Soil and Surface water
- Security
- Traffic
- Fires
- Flooding

The Operational Indicators monitored for compliance by the ECO are (EMP table 4.1p 21):

- Visual
- Terrestrial fauna and flora
- Sensitive sites
- Erosion

- Infrastructure

Recreational use of river

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

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The main form of stakeholder consultation was through the environmental impact assessment (EIA) process. Local stakeholders were invited to comment on the scoping report, produced for the EIA process through the following mechanisms:

- Scoping advertisements were released in the local press in May 2003.
- In May 2003, poster notices of the EIA process were erected.
- Letters including a background information document and response form were distributed to the identified stakeholders in May 2003. Moreover various authorities were consulted during the process.
- In June 2003, the public meeting was held in Bethlehem to provide the local stakeholders with an opportunity to meet with the consultants, project proponent and authorities and to comment on the proposed development and raise any issues and concerns.
- Following the completion of the draft scoping report in July 2003, the report was sent to the stakeholders and also lodged in the library in Bethlehem. The public was notified to the lodging of the draft report by means of letters to identified stakeholders and given a three week period in which to comment on the report. At the end of the comment period, all relevant issues and concerns raised by the public have been noted and incorporated into the final scoping report.

In addition the project draft PDD was posted on the South African DNA website for comments for the period 24 October 2005 to 23 November 2005. Any interested party could post comments on the project to the DNA. As indicated in the DNA's letter of "Host Country Approval", the DNA approved the project without requiring any changes.

E.2. Summary of comments received

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The only comments that can be summarised are those associated with the EIA process. These included;

- The requirements that the project would be subject to in terms of the licensing requirements of the Department of Water Affairs and Forestry;
- The actual benefits that would accrue to the community from such a project;
- What employment opportunities would actually be created by the project;
- The nature of the diversions to be created as part of the project;
- A request for an archaeological impact assessment report; and,
- Discussions with regard to the alternatives associated with the project.

E.3. Report on consideration of comments received

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The comments received were incorporated into the final scoping report that was submitted to the Provincial Environmental Authorities, and was used by the authorities to give the record of decision. As a

result of the comments received an archaeological impact assessment report was commissioned and used in the EIA process.

SECTION F. Approval and authorization

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In terms of South Africa's Environmental Impact Assessment (EIA) Regulations the project had to undertake an EIA and was given a positive Record of Decision authorisation by the Free State Provincial Authorities which will enable the project to go into operation, as no environmental flaws were identified. The Record of Decision covered both the construction and the operational phases of the project. The bulk of the environmental impact will occur during construction and will be mitigated as part of the construction process according to the Environmental Management Plan.

The project was also granted a water licence as required by the National Water Act (36 of 1998).

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Appendix 1: Contact information of project participants

Organization	Statkraft Markets BV
Street/P.O. Box	Gustav Mahlerplein 100
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Fax	+31 (20) 795 78 99
E-mail	stef.peters@statkraft.com
Website	www.statkraft.nl
Contact person	Stef Peters
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Salutation	Mr
Last name	Peters
Middle name	
First name	Stef
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Organization	Bethlehem Hydro (Pty) Ltd
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Contact person	Anton-Louis Olivier
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Middle name	
First name	Anton-Louis
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2: Affirmation regarding public funding

The Government of Netherlands provided resources for early project identification and development related activities with regard to this project from their AIJ programme. As such the funding did not result in a diversion of official development assistance. The Government of the Netherlands is not claiming any emission reductions as a result of their early support to the project.

Appendix 3: No public funding from ODA has been used to acquire CERs from this project.

Appendix 4: Applicability of selected methodology

Appendix 5: Further background information on ex ante calculation of emission reductions

Refer to the attached PDF document: "Calculation of the emission factor for Eskom'' Promethium Carbon 2 April 2008

Refer to the attached Excel spread sheet: "Bethlehem Hydro EF calcs"

Appendix 6: Further background information on monitoring plan

1 Overall project management

Bethlehem Hydro has a clear and well defined management structure Consisting of Managing Director, a Operational Manager and an Administrative Clerk Overall responsibility at the plant lies with the Managing Director who also has final responsibility for the CDM project. The management structure is flat with the Managing Director and the Operational Manager having direct day to day responsibilities in the running of the plant.

2 Management of project registration, monitoring, measurement and reporting

The Operational Manager will have final responsibility for all aspects relating to data measurements, monitoring of data recording and will sign off all reports on monitoring.

Data will be collected digitally and consolidated by the Bethlehem Hydro Administrative Clerk, who will also draw up the monthly and annual emission reduction monitoring reports.

Monitoring itself will be integrated as far as possible into existing plant operating procedures. The data required for the monitoring of the emission reductions will come from data already collected as part of the plant's operations, i.e the metering of electricity sales

Data will be recorded at in real time with remote monitored electricity meters that records each Watt hour (Wh) generated intervals according to the table attached to the monitoring plan. The actual measured data will be entered into the "Emission Reduction Spreadsheet" attached to the PDD to calculate the emission reductions for the period.

Training of monitoring personnel
Due to the nature of the project and its monitoring needs there is no need for specific or specialised training of personnel for monitoring. The data which will be collected is also collected for general plant operational and financial administration.

3 Emergency preparedness procedures

The following emergency events can be foreseen which could have an impact on the project's emission reductions or the data collection procedures:

3.1 Loss of power at plant

In the case of loss of power at a plant no data will be lost. When power is lost the meter retains an internal record of the electricity metered since the last transmission of data. Once power is restored the meter will continue to record electricity production.

4 Monitoring Equipment

4.1 Calibration of monitoring equipment

The only relevant monitoring equipment for this project relates to the electricity meters. An electricity meter will be installed at each generation unit's "point of supply" to the off taker. The metering equipment (meters and GPRS data transmission systems) is provided with factory calibration certificates.

Each meter will be submitted for calibration verification tests at least once every 3 years to a duly qualified and accredited entity, which provides such calibration services.

4.2 Accuracy class of monitoring equipment

The meters are of accuracy class:

- Main meter: 0.2s (IEC 62053-22)
- Check meter: 0.5s (IEC 62053-22)

4.3 Installation of Monitoring Equipment

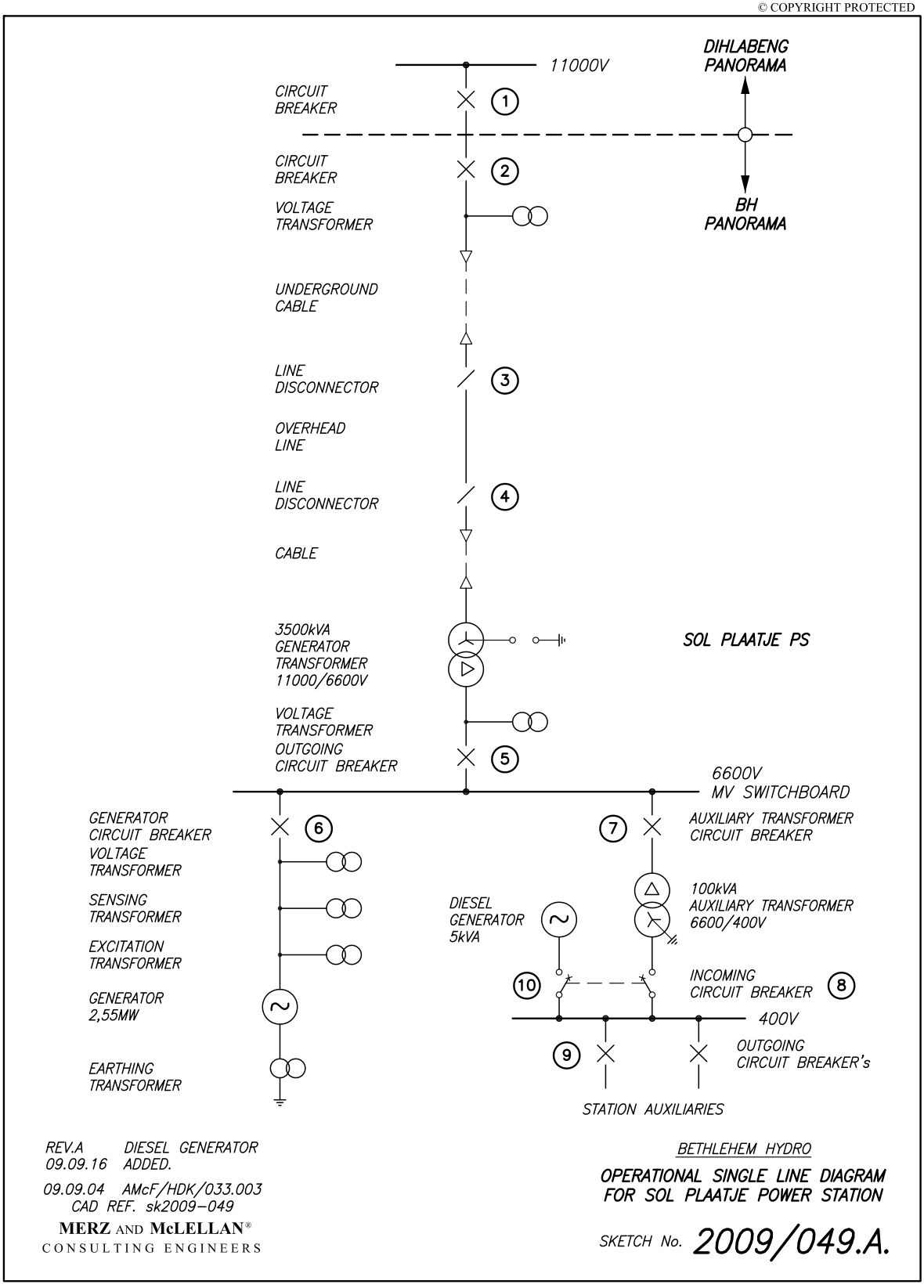
4.3.1 Sol Plaatje electricity meters

The electricity production of the Sol Plaatje unit will be measured by an electricity meter, installed at the Panorama substation. The meter will be located in a small closed building constructed specifically to house the Bethlehem Hydroelectric project switchgear and meter located at the point of supply (POS) into the grid. The meter is "bidirectional" , meaning that it measures and records 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, e.g. for lighting, pumping and machine tools during maintenance periods when the plant is shut down.

Power produced by the Sol Plaatje unit will be 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 Dihlabeng Municipality's electricity department. Access to the Bethlehem Hydroelectric project switchgear is restricted to Bethlehem Hydro and NuPlanet operational personnel.

The Sol Plaatje Unit Single Line Diagram is shown on the next page.
Dihlabeng Panorama, shown in the top left hand corner of the diagram.



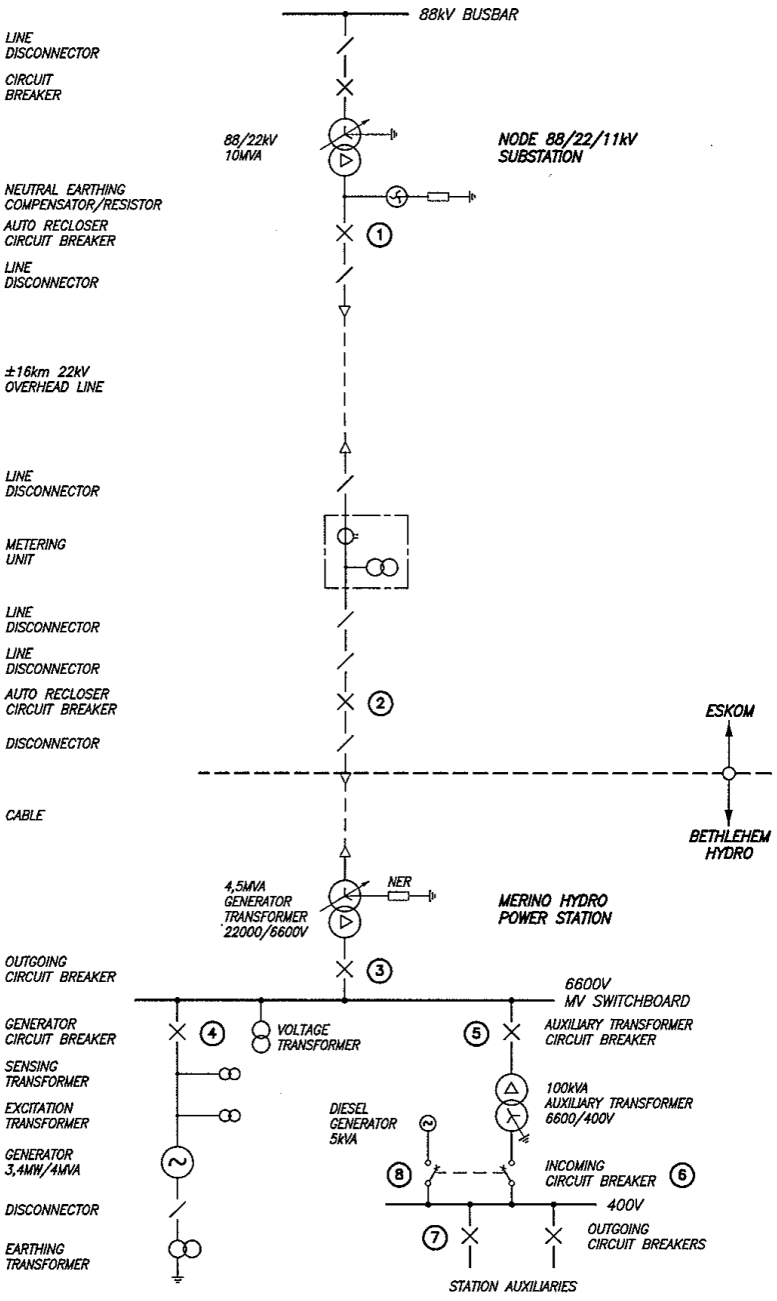
4.3.2 Merino electricity meters

Identical to the Sol Plaatje unit, a electricity meter will measure the electricity production of the Merino unit. For this unit, Eskom installed a dedicated 22kV line, which runs to the boundary of the power station. As a result, the power generated at the Merino unit interconnects directly into the Eskom line, without being routed through a substation. The electricity meters are located in an enclosed box at the meeting point of the Eskom line. 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, for example when the plant is shut down, but lighting is required in the plant.

Power produced by the Merino unit will be transmitted away from the power station by a dedicated 22kV power line. This line is used exclusively for the supply of power by the Merino unit to the electricity grid.

Access to the Bethlehem Hydroelectric project switchgear and point of supply is restricted to Bethlehem Hydro and NuPlanet operational personnel.

The Merino Unit Single Line Diagram is shown on the next page.



BETHLEHEM HYDRO

OPERATIONAL SINGLE LINE DIAGRAM FOR MERINO POWER STATION

10-05-14 GWL/HDK/033.005
CAD REF. sk2010-010

MERZ AND McLELLAN®
CONSULTING ENGINEERS

SKETCH No. 2010/010

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5 Maintenance of monitoring equipment and installations

The digital electricity meters will be subjected to calibration tests at least once every three years by an accredited entity.

6 Day-to-day records handling procedures

Day to day record keeping is done according to a fixed programme indicating what measurements are taken, who is responsible and how the data is processed as outlined in the table below.

Variable	Monitoring interval	Monitoring methodology	Responsible person	Quality control	Data storage procedure
Electricity generated at Merino site	Per Watt hour (Wh) generated	Automatic reading by electricity meters	Operational Manager Back up: Managing Director	Compare to Dihlabeng Meters	Data transmitted daily and digitally stored
Electricity generated at Sol Plaatje site	Per Watt hour (Wh) generated	Automatic reading by electricity meters	Operational Manager Back up: Managing Director	Compare to Dihlabeng Meters	Data transmitted daily and digitally stored
Electricity imported from grid at Merino site	Per Watt hour (Wh) imported	Invoices from Eskom utility	Operational Manager Back up: Managing Director	N/A	Invoices stored on file
Electricity imported from grid at Sol Plaatje site	Per Watt hour (Wh) imported	Automatic reading by electricity meters	Operational Manager Back up: Managing Director	N/A	Data transmitted daily and stored at Office
Diesel consumed at Merino Site	Continuously on occurrence	Operator claims on diesel purchased	Operational Manager	N/A	Claims stored on file
Diesel consumed at Sol Plaatje	Continuously on occurrence	Operator claims on diesel purchased	Operational Manager	N/A	Claims stored on file

7 Monitoring data adjustment procedures

Data will be collected on a daily and monthly basis and consolidated on a monthly basis where the data will be cross checked against records for sold/purchased electricity (example invoices) for quality control purposes on a regular basis. The meter will be checked on regular basis and will be calibrated, serviced and maintained according to the manufacturers' instructions but at least every 3 years as per Guidelines for Assessing Compliance with the Calibration Frequency Requirements (version 01; EB 52, Annex 60). Corrective measures will be applied in case any discrepancy is observed. To ensure that the data is reliable and transparent, Quality Assurance and Quality Control (QA&QC) measures will be establish to effectively control and manage data reading, recording, auditing as well as archiving data and all relevant documents.

8 Data and reports review procedures

Data will be reviewed by the Operational Manager and signed off by the Managing Director on a monthly basis again predicted and historical values. Should there be discrepancies in the data the procedure indicated in Point 7 above will be followed to adjust the data.

9 Internal GHG audit procedures

There are no requirements for internal audits of GHG project compliance with the plants operational requirements

10 Project performance review before verification

Data and project performance will be reviewed by the Managing Director and the Operational Manager on a monthly basis against predicted and historical values. The consolidated annual project emission reduction reports will be reviewed by Bethlehem Hydro's auditors for compliance before being submitted for verification.

11 Procedures for improving quality of project monitoring

The main procedure for improving the accuracy of the monitoring is the quality control procedures described above in the Monitoring Plan. The data collection and reporting formats are checked on a monthly basis for accuracy and the monitoring procedures will be adjusted as required for improved integration with plant operations and to minimise faulty measurement or meter reading errors.

Emission reduction data recording and calculation format

Merino Generating Plant

Month	Start Meter reading (kWh)	End Meter reading (kWh)	Electricity generated
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
Total			

Month	Diesel consumption
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
Total	

Month	Imported electricity
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
Total	

Sol Plaatje Generating Plant

Month	Start Meter reading (kWh)	End Meter reading (kWh)	Electricity generated
01			

02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
Total			

Month	Diesel consumption
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
Total	

Month	Imported electricity
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
Total	

Appendix 7: Summary of post registration changes

Changes in the description of the monitoring parameters
Detail added regarding the calibration frequency and the accuracy class of the electricity meters
Changes in the power meter location
Monitoring now includes the monitoring of diesel consumption at both units
Monitoring now includes the monitoring of imported electricity usage at both units
Updated to Project Standard template

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 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.
02	EB 20, Annex 14 08 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>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		