Monitoring report form for CDM project activity
(Version 07.0)

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

MONITORING REPORT		
Title of the project activity	Bethlehem Hydroelectric project	
UNFCCC reference number of the project activity	2692	
Version number of the PDD applicable to this monitoring report	12	
Version number of this monitoring report	1	
Completion date of this monitoring report	15/12/2020	
Monitoring period number	First Monitoring Period	
Duration of this monitoring period	08/10/2016 – 30/11/2020	
Monitoring report number for this monitoring period	1	
Project participants	Bethlehem Hydro (Pty) Ltd Statkraft Markets BV	
Host Party	South Africa	
Applied methodologies and standardized baselines	Methodology: AMS-1.D "Grid connected renewable electricity generation" (Version 18.0) Standardised baseline: • ASB0001 "Standardized baseline: Grid emission factor for the Southern African power pool" (Version 01.0) - Valid 31 May 2013 to 30 May 2017. • ASB0040-2018 "Standardized baseline Grid emission factor for Southern African Power Pool" (Version 01.0) - Valid 7 October 2018 to 6 October 2021.	
Sectoral scopes	Sectoral scope: 01, Energy industries (renewable - /non-renewable sources)	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	153,203 tCO2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	133,936 tCO2e	

SECTION A. Description of project activity

A.1. General description of project activity

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The Bethlehem Hydroelectric Project was registered on 08 October 2009. The project was implemented and the first crediting period ran from 08 October 2009 elapsed on 07 October 2016. The crediting period was renewed and second crediting period will run from 08 October 2016 and will lapse on 07 October 2023. This is the first monitoring report under the project's second crediting period.

The purpose of the project activity is to generate hydroelectricity, which will be distributed into the currently coal intensive South African grid. The hydro power generated from the project site will be replacing electricity from the national grid, consequently avoiding CO_2 emissions from fossil fuelled power plants connected to the grid. Prior to the implementation of the project activity, there was no hydro-power generated at the project sites.

The project involves the development and operation of 5.8 MW of hydro generation capacity within the boundaries of the Dihlabeng Local Municipality (Free State Province, South Africa). The projectis comprised of two generation facilities i.e.

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

The following dates are relevant to this project activity:

- Start date of project activity (defined in the PDD as the start of construction): 28 November 2006
- Commencement of Sol Plaatje unit generation based on the first metered power sales: 11 November 2009
- Commencement of the Merino unit generation based on the first metered power sales: 15 November 2010

The project involved the construction of these facilities as well as a 5km transmission line at 11kV, to the Panorama substation to link the project to the national grid. A step-up transformer was required at the power station in order to deliver power at 11kVA. Existing access roads to the site were 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).

The total GHG emission reductions achieved in this monitoring period amounts to 153,203 metric tonnes of carbon dioxide equivalent (tCO_2e).

A.2. Location of project activity

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Host Party - South Africa

Region/State/Province etc. - Free State

City/Town Bethlehem - (Dihlabeng Municipality)

Physical/Geographical location - The Sol Plaatje facility is 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.

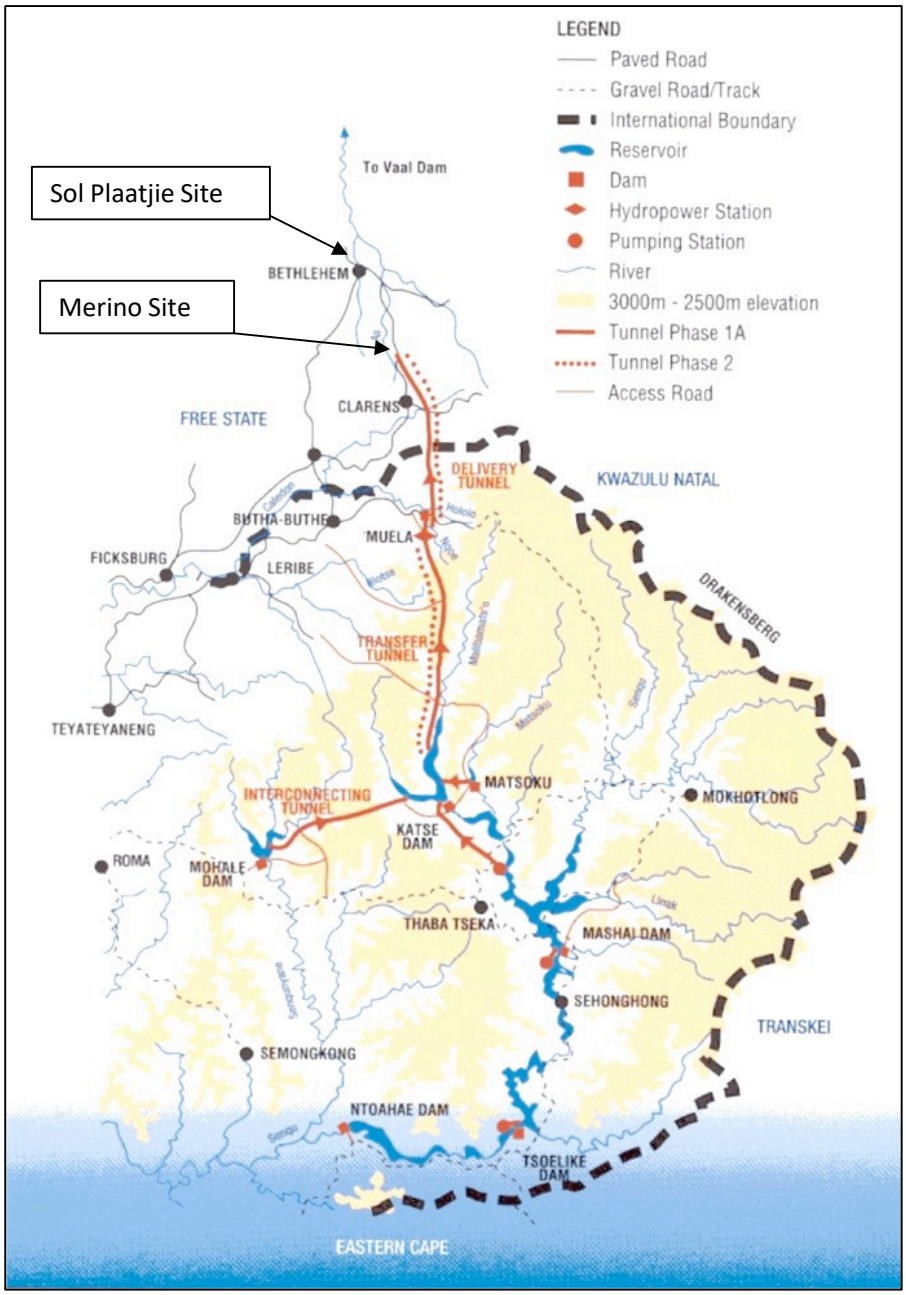
The Merino site is located on farmland on the As River on the farms ‘Merino’ and ‘De Burg Susan’, some 15 km outside Bethlehem in the direction of the town of Clarens.

The co-ordinates for the two sites are:

Merino:
28º 22' 09" S, 028º 21' 42" E

Sol Plaatje:
28º 12' 59" S, 028º 21' 50" E

The location of the sites are set out in the map below:



Bethlehem Hydro (Pty) Ltd is located at, Claremont Central, Corner of Main road and Vineyard road, Claremont, Cape Town, 7735, South Africa.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa	Bethlehem Hydro (Pty) Ltd	No
The Netherlands	Statkraft Markets BV	No

A.4. References to applied methodologies and standardized baselines

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Methodology:

- AMS-I.D.: “Grid connected renewable electricity generation” (Version 18.0) https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

Tools:

- "Methodological tool: Tool to determine the remaining lifetime of equipment" (Version 01) https://cdm.unfccc.int/EB/050/eb50_repan15.pdf
- "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1) https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

Water reservoir calculations use:

- ACM0002: "Grid-connected electricity generation from renewable sources" (Version 17.0) https://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

Standardised baseline:

- ASB0001 "Standardized baseline: Grid emission factor for the Southern African power pool" (Version 01.0) - Valid 31 May 2013 to 30 May 2017. https://cdm.unfccc.int/methodologies/standard_base/EB73_repan03_ASB-0001.pdf

- ASB0040-2018 "Standardized baseline Grid emission factor for Southern African Power Pool" (Version 01.0) - Valid 7 October 2018 to 6 October 2021. https://cdm.unfccc.int/methodologies/standard_base/2015/sb131.html

  ASB0001 v1 expired on 30 May 2017. As the monitoring period runs from 2016 – 2020, ASB0040-2018 has also been employed in the emission reduction calculations as per paragraph 263 of the CDM Project Standard (v02.0). Paragraph 263 requires that the more conservative value of the Standardized Baseline be used. The value for ASB0040 has been used from 1 June 2017 to the end of the monitoring period because the value for ASB0040 is more conservative and hence less emission reductions are accounted for.

A.5. Crediting period type and duration

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Type: Renewable Crediting Period.
Duration: 08/10/2016 – 07/10/2023 (7 years).

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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The project activity has been implemented and has been operational during the monitoring period (08/10/2016 – 30/11/2020), producing electricity during this period.

Current Status of the project:

- The start date of the project is 28 November 2006.
- The project was registered by the CDM Executive Board on the 8 October 2009.
- The Sol Plaatje Power Plant has been fully operational from 11 November 2009. Generation of electricity and the export of power to the grid commenced on this date.
- The Merino power plant was commissioned in March 2012.
- The First crediting period ran from 8 October 2009 – 7 October 2016 and the second crediting period is running from 8 October 2016 – 7 October 2023.
- Credits have been issued for the period of 8 October 2009 – 30 November 2013 as well as the period from 1 December 2013 – 7 October 2016.

The tables below lists significant shutdown events of the Sol Plaatje plant during the monitoring period. A shutdown is considered to be significant where the plant is down for two or more hours at a time. There were shorter shutdowns which vary between 5 minutes and 2 hours, however, such shutdowns do not have a material impact on the emission reduction calculations given the short periods of time which the plants were down and are consequently not reflected below.

Date	Duration (hours)	Reason for shutdown
December 2016	24.5	Planned - Water flow related
January 2017	4.8	Unplanned - Grid related
February 2017	38	Unplanned - Flow related and equipment failure
March 2017	29.5	Planned – Plant Maintenance
April 2017	44.3	Unplanned – Grind related and maintenance
May 2017	2.6	Unplanned – Equipment failure
September 2017	316.2	Planned – Plant Maintenance (314 hours) Unplanned - Grid related (2.2 hours)
November 2017	7.5	Planned – Plant Maintenance
February 2018	24.7	Unplanned – water flow related
March 2018	109.8	Unplanned – Grid related
April 2018	11	Unplanned – Equipment failure
September 2018	6.3	Planned – Grid related (3.6 hours) Unplanned – Grid related (2.7 hours)
October 2018	126.3	Unplanned – Grid related (4.3 hours) Planned – Plant Maintenance (122 hours)
November 2018	7.3	Unplanned – Grid related
December 2018	27.6	Unplanned – Grid related
February 2019	25.4	Unplanned – Grid related and Flow related
March 2019	12.1	Unplanned – Grid related
May 2019	2.7	Unplanned – Grid related
June 2019	2.2	Unplanned – Grid related
September 2019	9.8	Planned – Plant maintenance
October 2019	3.8	Planned – Grid related
December 2019	27.3	Unplanned – Grid related and Plant maintenance
January 2020	10.3	Unplanned – Grid related (2.5 hours) Planned – Plant maintenance (7.8 hours)
February 2020	5.5	Unplanned – Grid related and maintenance
October 2020	12.1	Unplanned – Grid related

The tables below lists shut down events of the Merino plant during the monitoring period. A shutdown is considered to be significant where the plant is down for two or more hours at a time.

Date	Duration (hours)	Reason for shutdown
December 2016	4	Unplanned shutdown - Water Flow related
January 2017	120	Planned Shutdown – Annual Maintenance
February 2017	16	Unplanned Shutdown – Plant Trips, Equipment Failure and Water Flow related
May 2017	20	Planned shutdown (12.5 hours) – Grid related Unplanned shutdown (7.5 hours) – Unknown
July 2017	5	Unplanned – Water Flow related
November 2017	110.4	Planned shutdown – Annual Maintenance
January 2018	22	Unplanned – Grid related
February 2018	30.8	Planned (17.3 hours) – Water Flow related Unplanned (13.5 hours) – Water Flow related
March 2018	13.4	Planned (10.4) Water Flow related and plant maintenance. Unplanned (3 hours) – Equipment failure
April 2018	3.1	Planned – Plant Maintenance
July 2018	12.2	Unplanned – Grid related
November 2018	151.2	Planned – Annual Maintenance
December 2018	40.8	Unplanned – Equipment Failure

February 2019	153.6	Planned – Water Flow related
April 2019	6.6	Unplanned – Plant Trip and Grid related
May 2019	4.5	Unplanned – Water Flow related
August 2019	81	Planned – Plant Maintenance (3 days)
September 2019	8.7	Planned – Plant Maintenance
October – Nov 2019	1488	Planned - Annual maintenance
Dec 2019 – Jan 2020	1312	Planned – Annual Maintenance and Grid related
February 2020	67.2	Unplanned – Equipment Failure and Plant shut down
March 2020	11.9	Planned – Plant Maintenance
April 2020	36	Unplanned – Grid related
June 2020	12.2	Unplanned - Grid Related
September 2020	412.8	Unplanned – Annual Maintenance
October 2020	11.7	Planned – flow related

The project activity contributes to technology transfer to the host country South Africa, since it utilises hydro power technology developed outside South Africa, imported from India.

The project is using small hydro technology at both of the following facilities:

1. Sol Plaatje unit – located at the Sol Plaatje damis a dam-installation, but operates as a run-of-river power station and doesn't affect the water volumes of the dam. The facility uses a single 2.1m diameter, double-regulated horizontal axis Kaplan small hydro turbine with a 2.5 MW rating. The equipment was installed in 2009 and has been in operation for approximately 8 years. The lifespan of the equipment is in excess of 20 years. The overall efficiency at net operating head and maximum flow through the turbine is approximately 85.17%. The site has a generating head of approximately 11 meters.

2. Merino unit – located on the As River, is a run-of-river small hydro power plant that uses a single double-regulated horizontal axis Kaplan small hydro turbine with a 3.6 MW rating. The equipment was installed in 2010 and has been in operation for approximately 7 years. The lifetime of the equipment is in excess of 20 years. The overall efficiency at net operating head and maximum flow through the 3.6 MW Kaplan turbine installed at the Merino site is approximately 86.37%. The site has a generating head of approximately 13 meters.

Prior to the implementation of this project activity "the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the grid-connected power plants and by the addition of new generation sources into the grid." The South African grid is predominantly coal-fired grid."

The arrangement of the two facilities in the project activity are as follows (Figure 1):

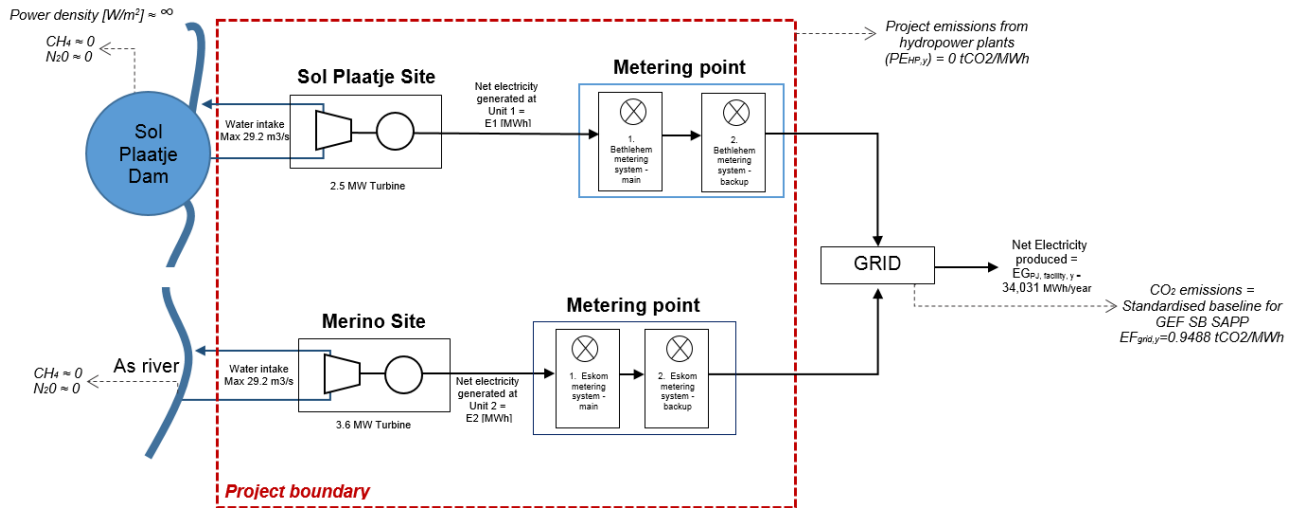

Figure 1: Project Activity equipment arrangement and delineation of project boundary

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

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Not applicable.

B.2.2. Corrections

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Corrections that have been approved by the Board as applicable from the period prior to this monitoring period:

Request for corrections were submitted to the EB during September 2016. The corrections were submitted prior to the submission of the first monitoring report. The version number of the revised PDD is version 12 and the completion date of the revised PDD is 05/08/2016. The latest PDD was submitted to the EB as part of the application to renew the crediting period, as well as for the purpose of requesting post registration changes. The DOE's assessment opinion was that the conclusion of the validation report shows that the project, as it was described in the project documentation was in line with all criteria applicable for the renewal of the crediting period. The reference number for the post registration change was not provided on the UNFCCC website.

The registered monitoring plan for electricity generation and consumption was updated to comply with the latest version of the monitoring methodology (AMS-I.D version 18), where the total net generation is now monitored, instead of monitoring import and export separately. In addition the revised PDD included the adoption of the standardised baseline grid emissions factor for Southern Africa (ASB0001 which provides fixed value of EFGRID,y, fixed ex-ante).

The emission reduction calculations for this monitoring period reflects the post registration changes. As a result of the approval of the post registration changes and the standardised baseline grid emissions factor for Southern Africa.

Approval date: 05/10/2017.
Reference number: PRC-2692-002.

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

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Not applicable.

B.2.4. Inclusion of monitoring plan

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Not applicable.

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

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Not applicable.

B.2.6. Changes to project design

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Corrections that have been approved by the Board as applicable from the period prior to this monitoring period:

Change to project design included the removal of the back-up diesel generators from site. During the previous verification onsite visit, the DOE inspected the diesel generators. The generators were not operational and not functional. The South African power grid is sufficient as a back-up and the diesel generators were never used. The diesel generators were subsequently removed from the site. This was confirmed by an official affidavit signed at the South African Police Service. The diesel consumption was removed from the calculation of project emissions in the PDD, in order to account for the removal of the back-up diesel generators from site.
The version number of the revised PDD is version 12 and the completion date of the revised PDD is 05/08/2016. The DOE's assessment opinion was that the conclusion of the validation report shows that the project, as it was described in the project documentation was in line with all criteria applicable for the renewal of the crediting period.

Approval date: 05/10/2017.
Reference number: PRC-2692-002.

B.2.7. Changes specific to afforestation or reforestation project activity

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Not applicable.

SECTION C. Description of monitoring system

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The monitoring plan ensures that the project emission reductions are accurately monitored, recorded and reported.

The relevant standardized baselines for the Southern African Power Pool, ASB0001 v1 and ASB0040-2018 v1 respectively, have been used to calculate the baselines emissions.

The monitoring system includes the electricity meters installed at both the generating unit's connection point (Sol Plaatje and Merino sites). There is a bidirectional meter recording imports and exports of energy for each of the two facilities, as well as a check meter in each facility. The total net electricity generation is obtained from the sum of the net electricity generation from both main meters (Sol Plaatje and Merino).

The electricity meters at the Sol Plaatje facility, during the monitoring period, are described below. During the monitoring period, the meters were replaced once: the old Iskra meters were replaced with new Landis+Gyr meters.

The meter details for the old electricity meters at the Sol Plaatje Power Plant electricity are set out below:

Sol Plaatje: Old Iskra Electricity Meter details		
Sol Plaatje Power Station	**Main Meter**	**Check Meter**
Meter Type	Iskra MT860s	Iskra MT831
Accuracy (tolerance)	Class 0.2s	Class 0.5s
Serial Number	41506004	35597712
Last Calibration	2016/03/29	2016/03/29
Calibration Validity	2019/03/29	2019/03/29
Meter Functionality	Bidirectional	Bidirectional

The old Iskra meters were replaced on 19 March 2020 with new Landis+Gyr meters. The meter details for the new Landis+Gyr meters at the Sol Plaatje Power Plant are set out below:

Sol Plaatje: New Landis+Gyr Electricity Meter details		
Sol Plaatje Power Station	**Main Meter**	**Check Meter**
Meter Type	Landis+Gyr ZMD402 CT	Landis+Gyr ZMD402 CT
Accuracy (tolerance)	2%	2%
Serial Number	43474372	43474374
Calibration valid from installation	2020/03/19	2020/03/19
Calibration Validity	2023/03/19	2023/03/19
Meter Functionality	Bidirectional	Bidirectional

The electricity meters at the Merino facility, during the last and current monitoring period, are described below.

The details for the old Iskra electricity meters at the Merino Power Plant are set out below:

Merino: Old Iskra Electricity Meter details		
Merino Power Station	**Main Meter**	**Check Meter**
Meter Type	Iskra MT860s	Iskra MT860s
Accuracy	Class 0.5s	Class 0.5s
Serial Number	41508058	41510596
Last Calibration	2016/03/29	2016/03/29
Calibration Validity	2019/03/29	2019/03/29
Meter Functionality	Bidirectional	Bidirectional

The old Iskra electricity meters at the Merino facility were replaced on 19 March 2020 with Landis+Gyr meters. The meter details for the new Landis+Gyr electricity meters at the Merino Power Plant are set out below:

Merino: New Electricity Meter details		
Merino Power Station	**Main Meter**	**Check Meter**
Meter Type	Landis+Gyr ZMD402 CT	Landis+Gyr ZMD402 CT
Accuracy	+/-2%	+/-2%
Serial Number	55234177	55234176
Calibration valid from installation	2020/03/19	2020/03/19
Calibration Validity	2023/03/19	2023/03/19
Meter Functionality	Bidirectional	Bidirectional

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	$EF_{grid,y}$
Unit	tCO_2/MWh
Description	• Southern African standardised baseline grid emissions factor, ASB0001 and ASB 040. ASB0001 was applied in the calculations from the start of the monitoring period (08/10/2016) up to the validity start date of ASB 040 (07/10/2018).
Source of data	• ASB0001 "Standardized baseline: Grid emission factor for the Southern African power pool" (Version 01.0) • ASB0040-2018 "Standardized baseline Grid emission factor for Southern African Power Pool" (Version 01.0)
Value(s) applied	ASB0001 v1: 0.9488 tCO_2/MWh, applied from 8 October 2016 – 31 May 2017. ASB0040-2018 v1: 0.9091 tCO_2/MWh, applied from 1 June 2017 to 30 November 2020.
Choice of data or measurement methods and procedures	No direct measurements are required. The combined margin emission factor "applicable to all project activities other than wind and solar for the second or third crediting period" from the ASB0001 "Standardized baseline: Grid emission factor for the Southern African power pool" (Version 01.0) has been used for the period from 8 October 2016 – 31 May 20172017. The combined margin emission factor "applicable to all project activities except wind and solar generation" for the second crediting period from the ASB0040-2018 "Standardized baseline Grid emission factor for Southern African Power Pool" (Version 01.0) has been used for the period from 1 June 2017 to 30 November 2020.
Purpose of data/parameter	Used in the calculation of the baseline emissions.
Additional comments	This project activity meets the applicability criteria of the ASB0001 standardised baseline, and ASB00400 standardised baseline in that it is situated in South Africa and is connected to the project electricity system. The grid emission factor is calculated ex-ante.

D.2. Data and parameters monitored

Data/Parameter	$EG_{PJ,facility,y}$		
Unit	MWh		
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)		
Measured/calculated/ default	Measured		
Source of data	Electricity meters installed at both the generating unit's connection point (Sol Plaatje and Merino sites).		
Value(s) of monitored parameter	**Year**	**$EG_{facility\ Merino,y}$** (MWh/year)	**$EG_{facility\ Sol\ Plaatje,y}$** (MWh/year)
	2016	6,265	4,034
	2017	27,208	17,183
	2018	28,136	18,522
	2019	20,380	13,425
	2020	19,058	13,129

Monitoring equipment

The **old** meters details for the Sol Plaatje Power Plant is as below:

Sol Plaatje: Old Iskra Electricity Meter details		
Sol Plaatje Power Station	**Main Meter**	**Check Meter**
Meter Type	Iskra MT860s	Iskra MT831
Accuracy	Class 0.2s	Class 0.5s
Serial Number	41506004	35597712
Last Calibration	2016/03/29	2016/03/29
Calibration Validity	2019/03/29	2019/03/29
Meter Functionality	Bidirectional	Bidirectional

The **new** meters details for the Sol Plaatje Power Plant is as below:

Sol Plaatje: New Landis+Gyr Electricity Meter details		
Sol Plaatje Power Station	**Main Meter**	**Check Meter**
Meter Type	Landis+Gyr ZMD402 CT	Landis+Gyr ZMD402 CT
Accuracy (tolerance)	2%	2%
Serial Number	43474372	43474374
Calibration valid from installation	2020/03/19	2020/03/19
Calibration Validity	2023/03/19	2023/03/19
Meter Functionality	Bidirectional	Bidirectional

The **old** meters details for the Merino Power Plant is as below:

Merino: Old Iskra Electricity Meter details		
Merino Power Station	**Main Meter**	**Check Meter**
Meter Type	Iskra MT860s	Iskra MT860s
Accuracy	Class 0.5s	Class 0.5s
Serial Number	41508058	41510596
Last Calibration	2016/03/29	2016/03/29
Calibration Validity	2019/03/29	2019/03/29
Meter Functionality	Bidirectional	Bidirectional

The **new** meters details for the Merino Power Plant is as below:

Merino: New Electricity Meter details		
Merino Power Station	**Main Meter**	**Check Meter**
Meter Type	Landis+Gyr ZMD402 CT	Landis+Gyr ZMD402 CT
Accuracy	+/-2%	+/-2%
Serial Number	55234177	55234176
Calibration valid from installation	2020/03/19	2020/03/19
Calibration Validity	2023/03/19	2023/03/19
Meter Functionality	Bidirectional	Bidirectional

Measuring/reading/recording frequency	Continuous real time monitoring, with a daily download of data and monthly recording thereof.
Calculation method (if applicable)	The quantity of net electricity supplied by the project is calculated by the difference between: (a) The quantity of electricity supplied by the project plant to the grid; and (b) The quantity of the electricity delivered to the project plant from the grid.

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.
Purpose of data/parameter	Used in the calculation of the project emission reductions
Additional comments	As stated above, the electricity meters at both sites were replaced during the monitoring period. Delayed calibration was employed for both sites, from the last date of calibration validity of the old Iskra meters, to the date that the new Landis+Gyr meters was installed. Sol Plaatje: delayed calibration occurred from 29 March 2019 to 19 March 2020, when the new Landis+Gyr meters were installed. Merino: delayed calibration occurred from 29 March 2019 to 19 March 2020, when the new Landis+Gyr meters were installed. A conservative approach was taken in the employment of delayed calibration and the maximum permissible error of the meters was applied to the electricity generation and consumption figures for the period of the delayed calibration. This is as per the "CDM validation and verification standard", Version 09.0, paragraph 395(a). In the case of Sol Plaatje the maximum permissible error was 2% and in the case of Merino it was 5%.

D.3. Implementation of sampling plan

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A sampling plan does not form part of this project activity. This section is not applicable.

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

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According to the methodology AMS-I.D, version 18.0, the baseline emissions are calculated as the product of quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity multiplied by the grid emission factor (equation (1) of the methodology).

$$BE_y = EG_{PJ,y} * EF_{grid,y}$$

BE_y = Baseline emissions in year y (t CO_2)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{grid,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

The sample calculation for the year 2019 follows:

$$BE_y = 33{,}805\ MWh \times 0.9091\ \frac{tCO_2}{MWh} = 30{,}732\ tCO_2$$

As per the applied Southern African power pool standardized baseline, ASB0001, version 01.0:

$EF_{grid,y}$ = 0.9488 t CO_2/MWh

The calculation of $EG_{PJ,y}$ for greenfield power plants are calculated according to equation (2) of the methodology as:

$$EG_{PJ,y} = EG_{pj,facility,y}$$

Where:

$EG_{PJ,facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)

A sample calculation for the year 2019 follows:

$$EG_{PJ,y} = EG_{pj,facility,y} = 20{,}380\ MWh_{Merino} + 13\,425\ MWh_{Sol\ Plaatje} = 33{,}805\ MWh$$

The values of $EF_{grid,y}$ are as per the applied Southern African power pool standardized baseline, ASB0001, version 01.0 and ASB0040-2018, version 01.0, according to the respective time period:

- ASB0001 v1: 0.9488 tCO_2/MWh, applied from 8 October 2016 – 31 May 2017.
- ASB0040-2018 v1: 0.9091 tCO_2/MWh, applied from 1 June 2017 to 30 November 2020.

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

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According to the AMS-I.D. methodology (version 18.0) project emissions (PE_y) for most renewable energy project activities are equal to zero.

However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of "ACM0002: Grid-connected electricity generation from renewable sources" (Version 16.0):

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

Point a) does not apply to this project activity as it is not a geothermal power plant. Point b) does apply to this project activity as there is an existing water reservoir, the Sol Plaatje Dam, at the one turbine. However, the existing reservoir is not used as a storage facility for dispatch production of energy. Instead, the facility only utilises the water as and when the water flows out the dam, and thus the facility does not affect the water volumes of the dam.

According to ACM0002, version 16.0 the emissions from water reservoirs of hydro power plants ($PE_{HP,y}$) are calculated depending on the value of the power density (PD) of the project activity, which is calculated according to equation (3) of the methodology as follows:

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

PD = Power density of the project activity (W/m^2)
Cap_{pj} = Installed capacity of the hydro power plant after the implementation of the project activity (W)

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

A_{PJ} = Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)

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

In this project activity the difference between $A_{PJ} – A_{BL}$ is zero as the project activity has not changed the water volume of the dam. The volume of water in the dam is not affected by the project activity but only by the water requirements of the town where the water is being delivered. The project activity is only able to produce power as and when the water is transported to the town for consumption. The facility does not use the reservoir as a storage facility for dispatch energy production.

With power density (PD) equation being divide by zero it results in a PD = ∞, infinity. According to paragraph 45 of the large scale methodology ACM0002, version 16.0, if PD > 10 W/m^2 then $PE_{HP,y}$ = 0, equation (6) of the methodology.

In addition, according to methodology AMS-I.D version 18.0, CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". However, the project activity does not consume any diesel on site. Thus, there are no project emissions related to fossil fuel consumption.

As such project emission for this project activity are equal to zero, PE_y = 0.

E.3. Calculation of leakage emissions

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According to methodology AMS-I.D, version 18.0, leakage emissions only apply to biomass project activities. Thus, leakage emissions are zero for this project activity.

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

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
2016	9,772	0	0	0	9,772	9,772
2017	41,020	0	0	0	41,020	41,020
2018	42,417	0	0	0	42,417	42,417
2019	30,732	0	0	0	30,732	30,732
2020	29,261	0	0	0	29,261	29,261
Total	153,203	0	0	0	153,203	153,203

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

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante for this monitoring period in the PDD (t CO_2e)
153,203	133,936

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

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For the period, 8 October 2016 to 31 December 2019, the values reported in section B.6.4 were summed as provided. This yields a sub total of 104,383 tCO_2e. For the period, 1 January 2020 to 30 November 2020, the value reported in section B.6.4 was adjusted to account for the days excluded from that year. This was done by calculating the number of days within the monitoring period (335 days). The reported total was then divided by 365 and then multiplied by the days within the period. This yields a sub total of 29,553 tCO_2e for 2020.

Adding the sub totals together, 104,383 tCO_2e + 29,553 tCO_2e, yields 133,936 tCO_2e.

E.6. Remarks on increase in achieved emission reductions

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The actual emission reductions achieved in the monitoring period are 14% higher than the estimated ex ante emission reductions. The increase is due to higher generation resulting from the higher plant availability. This is related to an increase in water flow during the monitoring period.

E.7. Remarks on scale of small-scale project activity

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Not applicable.

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Document information

Version	*Date*	*Description*
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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