



VERIFICATION / CERTIFICATION REPORT

“SASSA LOW PRESSURE SOLAR WATER HEATER PROGRAMME” IN SOUTH AFRICA

(UNFCCC Registration Ref. 4302)

Monitoring Period:
1 January 2012 to 31 December 2012

REPORT NO. 2013-9404

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DET NORSKE VERITAS



VERIFICATION / CERTIFICATION REPORT

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Client: International Carbon	Client ref.: Laura Lathi	

Summary:
 DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions reported for the programme of activities "SASSA Low Pressure Solar Water Heater Programme" (UNFCCC Registration Ref. No. 4302) for the period 1 January 2012 to 31 December 2012.
 In our opinion, the GHG emission reductions reported for the programme in the monitoring report (version 05) of 16 January 2014 are fairly stated.
 The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology *AMS-I.C* (version 17) and the monitoring plan contained in the PoA Design Document version 05 of 22 May 2013.
 DNV Climate Change Services AS is able to certify that the emission reductions from the programmed activity "SASSA Low Pressure Solar Water Heater Programme" in South Africa during the period 1 January 2012 to 31 December 2012 amount to 34 749 tonnes of CO₂ equivalent.

Report No.: 2013-9404	Indexing terms <table border="1"> <tr> <td>Key words Climate Change Kyoto Protocol Validation Clean Development Mechanism</td> <td>Service Area Verification</td> </tr> <tr> <td></td> <td>Market Sector</td> </tr> <tr> <td></td> <td>Renewable energy</td> </tr> </table>	Key words Climate Change Kyoto Protocol Validation Clean Development Mechanism	Service Area Verification		Market Sector		Renewable energy
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Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction(s)
CH ₄	Methane
CL	Clarification request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
CPA	Component project activity
CPA-DD	CDM component project activity design document
CRC	Cyclic Redundancy Check
DNV	Det Norske Veritas
DNA	Designated National Authority
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
MoC	Modalities of communication
PCP	Project Cycle Procedure
PoA	Programme of Activities
PoA-DD	Programme of Activities Design Document
PS	Project Standard
SABS	South Africa Bureau of Standards
SANS	South Africa National Standards
SQL	Structured Query Language
SWH	Solar Water Heater
TCP/IP	Transmission Control Protocol/Internet Protocol
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard



1 INTRODUCTION

International Carbon has commissioned DNV Climate Change Services AS (DNV) to carry out the verification and certification of the emission reductions reported for the CDM programme of activities 4302 “SASSA Low Pressure Solar Water Heater Programme” in South Africa (the programme) for the period 1 January 2012 to 31 December 2012.

During the selected monitoring period, the only active crediting periods were those of CPA-001 and CPA-002, therefore the verification only extended to the emissions reductions attributable to these CPAs.

This report contains the findings from the verification and a certification statement for the certified emission reductions.

1.1 Objective

Verification is the periodic independent review and *ex post* determination by a Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the registered CDM PoA during a defined monitoring period.

Certification is the written assurance by a DOE that, during a specific period in time, a PoA achieved the emission reductions as verified.

The objective of this verification was to verify and certify emission reductions reported for the “SASSA Low Pressure Solar Water Heater Programme” for the period 1 January 2012 to 31 December 2012.

1.2 Scope

The scope of the verification is to verify that:

- The PoA has been implemented and operated in accordance with the registered PoA-DD and CPA-DD or any approved revised PoA-DD and CPA-DDs;
- The monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan, including compliance with any guidance provided by the Board regarding deviations from the provisions of a registered monitoring plan and/or methodology;
- The data and calculation of GHG emission reductions have been assessed to correctly support the emission reductions being claimed.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

1.3 Description of the programme of activities

PoA Parties:	South Africa (host), United Kingdom
Title of PoA:	SASSA Low Pressure Solar Water Heater Programme
UNFCCC registration No:	4302
UNFCCC registration date:	12 March 2011



Baseline and
monitoring methodology

AMS-I.C (version 17)

Project Participants:

Solar Academy of Sub Saharan Africa (Pty) Ltd; Standard Bank Plc; International Carbon Ltd; Eneco Energy Trade B.V.

Location of the PoA:

Republic of South Africa

PoA's crediting period:

12 March 2011 to 11 March 2021

Period verified in this verification: 1 January 2012 to 31 December 2012

1.4 Methodology for determining emission reductions

According to the applied methodology AMS-I.C, 17, the emission reductions for the PoA are determined as the difference between the baseline emissions, project emissions and leakage:

$$ER_y = BE_y - PE_y - LE_y$$

PE_y and LE_y are considered as to be zero as stated in the registered PoA-DD, CPA-DD and validation report. Therefore, the emission reductions are accounted as:

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

where EF_{CO2} is the emission factor of the grid to which the installations that are part of the PoA are connected, and has been calculated following AMS-I.D. version 16 as the weighted average emissions (in tCO₂/MWh) of the generation mix of the year in which the generation occurs.

$EG_{BL, y}$ is the energy baseline in year y, which is determined by SABS test as follows:

$$Q = \alpha_1 H + \alpha_2 (T_a - T_c) + \alpha_3$$

Where:

Q = Energy output in MJ

H = The energy input i.e. irradiation in MJ per m²

T_a = The ambient air temperature and

T_c = Incoming cold water temperature

α_1 = H coefficient determined in the SABS test,

α_2 = Delta T coefficients determined in the SABS test,

α_3 = Intercept coefficients determined in the SABS test.

Both the baseline energy generation and the grid emission factor are monitored.



2 METHODOLOGY

DNV has assessed and determined that the implementation and operation of the PoA, and the steps taken to report emission reductions comply with the CDM criteria /64/ /65/ and relevant guidance provided by the Board.

The assessment involved a desk review of relevant documentation as well as an on-site visit(s).

The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the PoA. These include:

- i) Review of programme documentation;
- ii) The energy baseline which is multiplied with a monitored grid emission factor of 0.9996 tCO₂e/MWh;
- iii) The actual installed capacity of the low pressure solar water heaters installed as part of the CPA to ensure the conformance with the descriptions in the registered PoA-DD, CPA-DD.

Verification team

<i>Role</i>	<i>Last Name</i>	<i>First Name</i>	<i>Country</i>	<i>Type of involvement</i>					
				Desk review	Site visit	Reporting	Supervision of work	Technical review	TA 1.2 competence
Team leader (Verifier)	Feller	Francesca	Italy	✓		✓			✓
Verifier	Little	Grant	South Africa	✓	✓				✓
Technical reviewer	Antunes	Felipe	Brazil					✓	✓

Duration of verification

Monitoring report publication: 3 July 2013

Desk review: 1 August 2013 to 2 August 2013

On-site assessment: 7 August 2013 to 8 August 2013

Reporting, calculation checks and QA/QC: 9 August 2013 to 10 January 2014

Resubmission in response to issues raised in completeness check of UNFCCC: 8 May 2014

2.1 Desk review

In addition to the monitoring report /1/ (version 01 dated 25 June 2013 and version 05 dated 16 January 2014), DNV reviewed:

- The registered PoA-DD and CPA-DDs /3//4//5/;



- The validation report /57/;
- The emission reduction calculation template for a generic CPA /6/;
- The emission reduction estimation for CPA-001 and CPA-002 /7//8/;
- The emission reduction calculations for the first monitoring period /2/;
- Baseline and monitoring methodology AMS-I.C, version 17 /68/;
- Baseline and monitoring methodology AMS-I.D version 16 /71/;
- The Programme's online database /9/.

The monitoring report, version 01 dated 25 June 2013, has been made publicly available on the CDM website. In addition to the monitoring report /1/ (version 01 dated 25 June 2013 and version 05 dated 16 January 2014), the verification has been performed based on the review of the following documentation provided by the project participants:

- The PoA-DD and CPA-DDs /3//4//5/, including the monitoring plan and the corresponding validation report /57/;
- The approved baseline and monitoring methodology AMS-I.C, 17 /68/ applied by the programme;
- Relevant decisions, clarifications and guidance from the CMP and the CDM Executive Board;
- Other information and references relevant to the PoA resulting emission reductions.

During the desk review, DNV has applied standard auditing techniques to assess the quality of information provided. The following activities were performed:

- A review of the data and information presented to verify their completeness;
- A review of the monitoring plan and monitoring methodology, paying particular attention to the frequency of measurements, the quality of metering equipment including calibration requirements, and the quality assurance and quality control procedures; and
- An evaluation of data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

2.2 On-site assessment

From 7 August 2013 to 8 August 2013 DNV performed an on-site assessment. The key personnel of the programme were interviewed or assisted the verification team.

During the on-site assessment, DNV has applied standard auditing techniques to assess the quality of information provided. The following aspects of the CDM programme of activities have been verified:

- The implementation and operation of the CDM PoA;
- The information flow for generating, aggregating and reporting of the monitoring parameters; and

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- The operational and data collection procedures are implemented in accordance with the monitoring plan in the PoA-DD and CPA-DD.

Further, the following activities were performed:

- A cross-check between information provided in the monitoring report /1/ and data from other sources;
- A check of the monitoring equipment including calibration performance /11/ to /49/ and observations of monitoring practices against the requirements of the PoA-DD and CPA-DD and the selected methodology /68/;
- A review of calculations and assumptions made in determining the GHG data and emission reductions /2/; and
- A review of the quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

The data presented in the monitoring report was assessed through a review of the detailed PoA documentation and production records, as well as by interviews with personnel at the CME and at the database management company, observation of collection of measurements, observation of established monitoring and reporting practices and assessment of the reliability of monitoring equipment.

Given the large amount of data to be verified, DNV adopted an acceptance sampling approach. The verification of the PP's sampling was based on the requirements of the Standard for sampling and surveys for CDM project activities and programme of activities /67/ (which was the most recent guidance available at the time of performing the site visit) and consisted in the following steps:

A sample of households was selected out of the PP's records. The sample was selected from the PP's database so to comprise installations from different geographical areas within the boundaries of CPA-001 and CPA-002, but was otherwise random. The sample size was calculated in order to have a 5% probability to wrongly accept the PP's records, and a 5% probability to wrongly reject the PP's records the minimum sample size, which resulted in a sample size of 54 (Null hypothesis: proportion of discrepancy is $\leq 1\%$; alternative hypothesis: proportion of discrepancy is $\geq 10\%$; Alpha/Type I error = 0.05; Power/1-type II error = $1 - 0.05 = 0.95$). In practice, during the site visit DNV's team aimed to have a sample size of 100 in order to account for unavailable/non-respondent users. The sample that was eventually reached amounted to 109 households, and since it is above 54 users it was considered acceptable. In order to verify the full range of information relevant to the calculation of emissions reductions, DNV chose to apply the following methods of field/onsite checks to the selected sample:

- a. Check of database entries for the selected 109 households against documental evidence stored at the CME office in Johannesburg, South Africa: this method of verification allowed DNV to check the data that are relevant to the calculation of emissions reductions, as well as the PoA's management system. Information verified through this method included the number of systems installed, operational during the monitoring period, and linked to a monitoring site, information on solar irradiation, ambient air temperature and incoming water temperature recorded for the monitoring period, installation and calibration of monitoring equipment, and all agreements and relevant



documentation signed by the recipient family. For all selected households DNV verified the data contained in the ER calculation spreadsheet against the database.

- b. Check whether SWH had been received and installed by the CME for the selected 66 households whether they were functioning correctly, and whether there was any maintenance issue to report: This check was performed as a combination of household visits and telephone interviews with households. As each method has different strengths and weaknesses, these methods provided DNV with the information needed for the applied acceptance sampling approach
 - i) Household visit (in person): this method of verification allowed DNV to observe the installed system in a limited geographical area, gather approximate information on when the system was installed from the residents (the memories of the residents, however, proved to be rather unreliable in this respect), and occasionally check if maintenance had been performed and whether relevant documentation had been received by the residents (in case the family had kept the documentation);
 - ii) Telephone interviews: this method of verification allowed DNV to check a purely random sample of households, covering the entire geographical scope of the PoA, and check whether a SWH had been received and installed by the CME, whether it was functioning correctly, and whether there was any maintenance issue to report;

DNV performed household visits to 35 households (installed in the Alexandra suburb of Johannesburg). DNV visited the household where the system had been installed, and performed in person interviews with users concerning the programme's management system (documents they filled out, response time in case of failures, etc.) /81/ to /154/.

For the remaining 74 households the accuracy of the information contained in the database was verified through telephone interviews (/81/ - /154/).

Moreover, it should also be noted that at the time of writing this report DNV has performed in total three field/onsite checks to verify emission reductions report for this PoA:

Date	Calculated minimum sample size	Actual sample size	Field/onsite checks		
			Database checks	Household visit	Telephone interviews
22-24 Jan 2013	54	66	66	20	46
7-9 Aug 2013	54	109	109	35	74
17-18 Feb 2014	38	54	54	11	43
Total:			229	66	163

DNV checked the acceptability of the data for each record in the PPs sample record. Based on the sample size selected, the acceptability level was calculated to be 1 – meaning that the sample had to be rejected if 1 inconsistency with the PPs records was found.



For the samples selected by DNV during the three field/onsite checks performed, the database checks, household visits and telephone interviews found that the observed information was in agreement with the PP's records. Hence, DNV concluded that the PP's records are acceptable.

This acceptance sampling approach has enabled the verification team to assess the accuracy and completeness of reported monitoring results; to verify the correct application of the approved monitoring methodology and the determination of the emission reductions.

In addition, all parameters required by the monitoring methodology AMS-I.C, version 17, and the management system were assessed during the site visit.

2.3 Closing out of verification findings

The objective of this phase of the verification was to resolve any issues which needed be clarified prior to DNV's conclusion that i) the programme has been implemented and operated in accordance with the registered PoA-DD and CPA-DD or any approved revised PoA-DD and CPA-DDs, ii) the monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan and iii) the data and calculation of GHG emission reductions are correct.

A corrective action request (CAR) is issued, where:

- i. Non-conformities with the monitoring plan or methodology are found in monitoring and reporting and has not been sufficiently documented by the project participants, or if the evidence provided to prove conformity is insufficient;
- ii. Modifications to the implementation, operation and monitoring of the registered PoA has not been sufficiently documented by the project participants;
- iii. Mistakes have been made in applying assumptions, data or calculations of emission reductions that will impact the quantity of emission reductions;
- iv. Issues identified in a FAR during validation/or previous verification to be verified during verification that have not been resolved by the project participants.

A clarification request (CL) shall be raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

A forward action request (FAR) is issued for actions if the monitoring and reporting require attention and/or adjustment for the next monitoring period.

The verification identified 7 CARs and 4 CLs, but no FARs. The CARs and CLs were satisfactorily addressed by the project participants by among other revising the monitoring report (please refer to Appendix A for further details). In addition to the changes made to the monitoring report as a result of the verification findings, the following changes to the monitoring report (version 05 dated 16 January 2014) were made compared to the initial version of the monitoring report received for verification (version 01 dated 25 June 2013):

- The monitoring report was updated to reflect post-registration changes requested during the verification for the first monitoring period of the PoA and approved on 13 November 2013;
- The CPA-DD for CPA-002 was updated to reflect the post-registration changes to the PoA-DD approved on 13 November 2013;
- ER resulting from the operation of systems installed as part of CPA-002 before the date of inclusion of the CPA under the PoA has been excluded;



3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the “SASSA Low Pressure Solar Water Heater Programme” for the period 1 January 2012 to 31 December 2012.

3.1 Remaining issues, CARs, FARs from previous validation / verification

The validation report /57/ recorded no FARs to be addressed during following verifications. The first verification undertaken for this programme identified no FARs /63/.

3.2 Post registration changes

The post registration changes described in Appendix B were identified by DNV during this verification. These post registration changes were assessed by DNV.

Some of the post registration changes requested do not require prior approval by the CDM EB in accordance with Appendix 1 to the CDM Project Standard /65/. The assessment of the changes (in the form of a duly completed “Post-registration changes request form” (F-CDM-PRC and DNV’s assessment opinion on the changes /62/) is submitted together with the revised CPA-DD for CPA-002 (version 04 of 20 December 2013) for approval by the CDM EB as part of the request for issuance for this monitoring period.

Part of the post registration changes requested, i.e. permanent changes from the registered monitoring plan, require prior approval by the CDM EB in accordance with Appendix 1 to the CDM Project Standard /65/. These permanent changes from the registered monitoring plan made to the PoA-DD obtained approval by the CDM EB on 13 October 2013 prior to the request for issuance of the first monitoring period. In order to update the registered CPA-DD for CPA-002, an additional request for post-registration changes is submitted to the UNFCCC with this request for issuance /63/ in which the changes approved on 13 October 2013 were applied to the CPA-DDs for CPA-002.

The assessment of compliance with the programme description and the monitoring plan contained in the PDD, as described in the following sections, is based on the revised PoA-DD and CPA-DD for CPA-001 (version 05 of 22 May 2013), and on the CPA-DD for CPA-002 version 04 of 20 December 2013.

3.3 Programme implementation

As part of the site visit DNV was able to confirm that the programme implementation is in accordance with the programme description contained in the revised PoA-DD and CPA-DD (CPA-001 version 05 of 22 May 2013, and CPA-002 version 04 of 20 December 2013).

Programme component	Implementation in accordance with PDD	Description of how implementation was assessed by verification team
Installed SWH	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	A sample of 35 systems were visited by DNV in person in the areas of Alexandra (near Johannesburg), and were found to be compliance with the description contained in the PoA and CPA-DDs /80/ to /78/.
Monitoring equipment	<input checked="" type="checkbox"/> Yes	Calibration certificates for all monitoring



Programme component	Implementation in accordance with PDD	Description of how implementation was assessed by verification team
	<input type="checkbox"/> No	equipment were checked, and found to be compliance with the description contained in the PoA and CPA-DDs /11/ to /31//37//44/ to /46/.
On-line database	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The online database /9//75//79/ was accessed by DNV, who conducted random checks on the information recorded to test consistency between various programme documents. The database was found to be compliance with the description contained in the PoA and CPA-DDs.
Hard copies of documents related to the programme management system	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	A sample of hard copies of different programme documents, including operationality check forms /51/ to /56/ and households data, was observed by DNV, who conducted random checks to test consistency between various programme documents /76//74//77/. The documents checked were found to be compliance with the description contained in the PoA and CPA-DDs.

The verification team confirmed through visual inspection and document review that all physical features of the proposed CDM programme of activities including data collection systems and storage systems have been implemented in accordance with the registered PoA and CPA-DDs. DNV confirmed during the on-site visit that CPAs 01 is completely operational, while CPA-002 is still being completed, as are other other CPAs that were included afterwards. Since only CPA-001 and CPA-002 were active during the second monitoring period, the scope of this second verification consists of the first two CPAs only.

CPA-001 consists of the installation of 59 000 low pressure solar water heaters in residential buildings in the Republic of South Africa. All 59 000 were operational and assigned to monitored site during the monitoring period and hence form the total population of the CPA-001 during the monitoring period. This was verified against the programme's online database /9/. As for CPA-002, 25 632 systems were installed up to the end of the monitoring period. Out of the total 84 632 installations from both CPAs, only 79 498 could be successfully linked to a monitored site, and could therefore be considered in the ER calculations. Overall, the ER calculations have correctly been based on a total of 79 498 households.

The programme consists of the installation of low pressure solar water heaters on residential buildings throughout South Africa.

Installations under CPA-001 started on 1 July 2010, and continued until December 2011. Installations under CPA-002 started on 9 October 2010 and are still on-going. CPA-001 was included on 12 March 2011, and therefore systems installed under this CPA can claim ER for the entire monitoring period. CPA-002 was included on 29 March 2012; hence, only the emission reductions occurring after this day can be claimed as part of the current monitoring period. The selected monitoring period 1 January 2012 to 31 December 2012 is within the first crediting period of 12 March 2011 to 11 March 2021.

The programme implementation during the second monitoring period experienced delays



related to the installation of systems under CPA-002. The reasons for the delays are explained in the following section (3.4). The programme implementation is otherwise in line with the revised PoA and CPA-DD.

3.4 Information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD

The equivalent energy baseline reported in this monitoring period is 34 763 MWh in the period from 1 January 2012 to 31 December 2012 (i.e. 365 days). In terms of comparing the estimated carbon reductions with the actual ones, it was estimated at the time of validation that the programme would have reduced carbon emissions by 105 427 tCO₂, while in 2012 it only achieved 34 749 tCO₂. The variation is deemed to be within a reasonable range due to the following reasons:

- i) CPA-002 was not fully operational during the monitoring period, with less installations than the planned 59 000 units. This was partly due to restrictions introduced by Eskom (the national utility) on monthly installations;
- ii) Not all installed units under CPA-002 were successfully linked to a monitored site, and therefore not all operational units under CPA-002 could be considered in the calculation of emission reductions;
- iii) Some installations under CPA-002 were only linked to monitored sites in the second half of the monitoring period. For this reason, ER could be calculated and claimed only for part of the operational time of the systems;
- iv) Some monitored sites experience vandalism during the monitoring period, and were not operations, resulting in households within a 50 km radius not being able to calculate and claim ER;
- v) Ex-ante estimations were based on the highest water consumption the SWH is able to deliver (110 L), while the actual water consumption recorded was lower;

The causes for the overall output being lower than estimated listed above were confirmed on site through interviews with staff /74/77/. As a result of lower electricity generation, actual emission reductions are lower than the emission reductions estimated in the PDD.

3.5 Compliance of monitoring plan with monitoring methodology

According to AMS-I.C (version 17) monitoring shall consist of:

- i) The number of systems operating; and
- ii) Estimating the annual hours of operation of the average system.

Operationality of systems has been addressed in the monitoring plan through a provision for visiting 1% of households to check whether the system is operational.

The number of operating hours in the case of solar water heaters is calculated based on the energy output $EG_{BL,y}$ and the capacity of the SWH as per SABS tests:

$$h = EG_{BL,y} [\text{kWh}] / Q [\text{kW}]$$

The monitoring plan therefore complies with the provisions of the methodology.

DNV is able to confirm that the monitoring plan contained in the revised PoA and CPA-DDs (CPA-001 version 05 of 22 May 2013, and CPA-002 version 04 of 20 December 2013) is in accordance with the approved methodology applied by the programme of activities, i.e. AMS-I.C (version 17).



3.6 Compliance of monitoring with the monitoring plan

The monitoring has been carried out in accordance with the monitoring plan contained in the revised PoA and CPA-DD (CPA-001 version 05 of 22 May 2013, and CPA-002 version 04 of 20 December 2013). All parameters stated in the validated monitoring plan are monitored and reported appropriately. The monitoring report lists each parameter required by the monitoring plan and the information flow (i.e. from data generation, aggregation, to recording, calculation and reporting) for these parameters is provided in the monitoring report. The information flow for the each parameter is further verified in the following sections.

Monitoring parameters

According to the monitoring plan of the registered PDD, there are 8 parameters to be monitored:

- N – Number of SWH operating in the year;
- Q_{y} – Solar energy output by the SWH in the year y, MWh;
- H_{year} – Annual average irradiation;
- $T_{a,year}$ – The average annual ambient air temperature;
- $T_{c,year}$ – The average annual Cold Water Temperature;
- V – Volume of daily cold water flow;
- $Q_{on-site}$ – Solar energy output by the SWH in the years y, MWh
- EF_{grid} – The emission factor for the electricity system

The below tables describe for each parameter, which is to be measured according to the monitoring plan, how DNV has verified that i) the actual monitoring complies with the monitoring plan and that ii) data have been assessed to correctly support the emission reductions being claimed.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	N – Number of SWH operating in the year
Measuring frequency:	Annual sample
Reporting frequency:	Annual sample
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>) No monitoring frequency is indicated in the registered PoA-DD, and the PP selected to take annual samples and indicated this in the MR. In addition to the annual sample, the parameter is monitored continuously based on failure reporting.
Type of monitoring equipment:	Visual and technical checks performed in person, as well as failure reporting by users.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the	The accuracy of the measurement meets the requirements indicated in the monitoring plan. The PoA-DD indicates that in order to confirm the



monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	<p>number of operating systems 1% of the installations in each CPA are to be sampled for functionality. This sample size was selected because the PP demonstrated at the time of registration that the sample was sufficient to meet the required 90/10 confidence/precision level. 1% of 79 498 is equal to 795 installations to be checked. The PP visited 803 households for this purpose. Although the total number of installations under CPA-001 and CPA-002 is 84 632, only 79 498 households were allocated to measured sited during the second monitoring period and therefore considered in ER calculations. For this reason the sample size is considered acceptable.</p> <p>The calculation of the precision achieved is included in Appendix 1 /2/</p>
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	Not applicable: visual check do not have a measuring range.
Calibration frequency /interval:	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
Is the calibration of measuring equipment carried out by an accredited person or institution?	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
Is(are) calibration(s) valid for the whole reporting period?	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
If applicable, has the reported data been cross-checked with other available data?	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	Not applicable: no monitoring equipment is used, but monitoring is carried out through visual checks.
How were the values in the monitoring report verified?	The values were verified on site against a randomly selected sample of operationality checks forms, including archived logsheets from storeroom /51/ to /56/ and found to be correct.



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Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>) <i>Comments (as necessary):</i> Safe storage of hard copies, CD's backups and electronic backups are eventually stored in an external drive kept in a safe. In its final form, the data management ensure correct transfer of data and reporting of emission reductions and the necessary QA/QC processes are in place.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<input type="checkbox"/> Parameter was monitored fully in accordance with monitoring plan <input checked="" type="checkbox"/> Only partial data was available In case information could not be gained, the house was excluded from the calculation of the operability level. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period. Maintenance sweeps and operability checks adequately covered the monitoring period.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	Q,y – Solar energy output by the SWH in the year y, MWh
Measuring frequency:	Daily
Reporting frequency:	Daily
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>) The monitoring plan does not indicate the monitoring and reporting frequency. Since this parameter is calculated based on other parameters monitored directly and discussed below, and that the data relevant to these parameters is measured every 5 minutes and aggregated daily, the monitoring and reporting frequency is considered acceptable
Type of monitoring equipment:	Not applicable: this parameter is calculated.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the	Not applicable: this parameter is calculated



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manufacturer's specification?	
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	Not applicable: this parameter is calculated
Calibration frequency /interval:	Not applicable: this parameter is calculated
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?	Not applicable: this parameter is calculated
Is the calibration of measuring equipment carried out by an accredited person or institution?	Not applicable: this parameter is calculated
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable: this parameter is calculated
Is(are) calibration(s) valid for the whole reporting period?	Not applicable: this parameter is calculated
If applicable, has the reported data been cross-checked with other available data?	Not applicable: this parameter is calculated
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	Not applicable: this parameter is calculated
How were the values in the monitoring report verified?	The values reported in the MR were verified against the ER calculations /2/, as well as against the database where measurements are recorded /9/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<p>The data management system ensures correct transfer of data and reporting of emission reductions, and necessary QA/QC processes are in place /50/.</p> <p>In fact, the logged information is sent via GSM (GPRS) via TCP/IP protocol to the company responsible for the management and maintenance of the database. The propriety protocol takes care of all handshaking and CRC checks to make sure no data is lost and arrives in the correct order.</p> <p>All data is written to a SQL database with its own proprietary driver. The database has been designed specifically for this PoA based on the monitoring requirements of the CDM methodology, and the monitoring plan described in the PoA-DD. The database is designed in such a way that Tables that require human input have an "audit" function, to identify and address mistakes, and values that are not in the correct format are not saved by the system, but give an error message.</p>
In case project participants have temporarily	<input type="checkbox"/> Parameter was monitored fully in accordance



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not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<p>with monitoring plan</p> <p><input checked="" type="checkbox"/> Only partial data was available</p> <p>Data sourced from other measured parameters is not available for all households for the entire monitoring period. ER have been calculated based on the data available, and households for which data are not available on a specific day have not been included in the calculations. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period.</p> <p>The timing of the SABS tests ensure the period in which SWH installed in 2012 were produced is fully covered.</p>
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	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	H _{year} – Annual average irradiation
Measuring frequency:	Data is recorded every 5 minutes.
Reporting frequency:	Data is aggregated daily.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p> <p>The measuring and reporting frequency is indicated in the registered PoA-DD, and the applicable methodology does not give indications on the minimum monitoring frequency, as this parameter is not explicitly contemplated by the methodology, but it is used to calculate parameter Q_{on-site}.</p>
Type of monitoring equipment:	<p>Pyranometer – Li-COR Sensors “LI 200”. A total of 21 pyranometers were used during this monitoring period, having the following serial numbers:</p> <p>PY 67126 PY 69976 PY 71636 PY71635 PY 71637 PY 71638 PY 71639 PY 71645 PY 71640 PY 71632 PY 71633 PY 79120 PY 67482</p>



	PY 79118 PY 79121 PY 79119 PY 79124 PY 79123 PY 79122 PY 79125 PY 79132
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	Accuracy: +/- 5% maximum +/- 3% typical <input type="checkbox"/> Yes, accuracy is as per monitoring plan <input checked="" type="checkbox"/> monitoring plan does not specify the accuracy, but the accuracy represents good monitoring practise <input type="checkbox"/> No, accuracy is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>) This is the accuracy indicated by the instruments' technical specifications issued by the manufacturer /32/.
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	<input checked="" type="checkbox"/> Yes, accuracy is valid for the entire measuring range <input type="checkbox"/> No, different accuracy levels apply Considering the manual specifies the range of operating temperature, and that temperatures recorded during the monitoring period fall well within this range, the values recorded are considered acceptable.
Calibration frequency /interval:	The instruments have been calibrated by the manufacturer at the time of commissioning, and replacement or recalibration will be needed after 4 years of service in the field /34/ At the end of the 4 years period in the field the PP intends to replace the pyranometers.
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?	<input type="checkbox"/> Yes, frequency is as per monitoring plan <input checked="" type="checkbox"/> monitoring plan does not specify the frequency, but the frequency represents good monitoring practise <input type="checkbox"/> No, frequency is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>) The monitoring plan does not specify the frequency of calibration. The PP submitted a letter issued and signed by the manufacturer indicating that the instruments have been calibrated by the manufacturer at the time of commissioning, and replacement or recalibration will be needed after 4



	<p>years of service in the field /34/. At the end of the 4 years period the PP intends to replace the pyranometers.</p> <p>The installation dates of the monitoring equipment /77//74/ used to indicate the expiry date in the MR were crosschecked against the database and found correct.</p>
Is the calibration of measuring equipment carried out by an accredited person or institution?	<p><i>Name of institution / person:</i> The calibration has been performed by Inteltronics Instrumentation, which is the entity performing all accredited calibration for Campbell Scientific Africa (the Manufacturer). A statement stating this and signed by Campbell Scientific Africa has been submitted to DNV /36/.</p> <p><input checked="" type="checkbox"/> Yes, institution / person is accredited by South African National Accreditation System</p> <p><input type="checkbox"/> No, institution / person is not accredited (<i>If No, raise a CAR/CL - only applicable to SSC projects</i>)</p> <p>Inteltronics Instrumentation is a calibration laboratory accredited by the South African National Accreditation System for meteorological instrument calibration. A certificate of accreditation has been submitted to DNV. Since it is valid from 31 July 2011 and expires on 31 July 2016 it is considered valid for the duration of the second monitoring period.</p>
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p>
Is(are) calibration(s) valid for the whole reporting period?	<p><i>Validity of calibration(s):</i> 4 years</p> <p><input checked="" type="checkbox"/> Yes, valid for the whole reporting period</p> <p><input type="checkbox"/> No, not valid for the whole reporting period (<i>If No, raise a CAR/CL</i>)</p> <p>The validity of the calibration certificates /11/ to /31/ extends to 2015 or 2016 depending on the commissioning dates. For this reason the calibration of all pyranometers is considered valid for the entire duration of the monitoring period.</p>
If applicable, has the reported data been cross-checked with other available data?	<p><i>Has data been cross-checked with other available data:</i></p> <p><input type="checkbox"/> Yes</p> <p><input checked="" type="checkbox"/> No</p>
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>)</p>



	The calibration procedure for the LI-COR piranometers /34/ indicates that that piranometers are calibrated under the outdoor horizontal global sky conditions for which they were designed.
How were the values in the monitoring report verified?	Data were verified against the database /9/
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>) <p>The data management system ensures correct transfer of data and reporting of emission reductions, and necessary QA/QC processes are in place /50/.</p> <p>In fact, the logged information is sent via GSM (GPRS) via TCPIP protocol to the company responsible for the management and maintenance of the database. The propriety protocol takes care of all handshaking and CRC checks to make sure no data is lost and arrives in the correct order.</p> <p>All data is written to a SQL database with its own proprietary driver. The database has been designed specifically for this PoA based on the monitoring requirements of the CDM methodology, and the monitoring plan described in the PoA-DD. The database is designed in such a way that Tables that require human input have an “audit” function, to identify and address mistakes, and values that are not in the correct format are not saved by the system, but give an error message.</p>
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<input type="checkbox"/> Parameter was monitored fully in accordance with monitoring plan <input checked="" type="checkbox"/> Only partial data was available <p>Data on irradiation is not available for all households for the entire monitoring period. ER have been calculated based on the data available, and households for which data are not available on a specific day have not been included in the calculations. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period.</p>

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	Ta _{,year} – The average annual ambient air temperature
Measuring frequency:	Data is recorded every 5 minutes.



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Reporting frequency:	Data is aggregated daily.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>) The measuring and reporting frequency is indicated in the registered PoA-DD, and the applicable methodology does not give indications on the minimum monitoring frequency, as this parameter is not explicitly contemplated by the methodology, but used to calculate parameter $Q_{on-site}$.
Type of monitoring equipment:	Temperature is measured by means of a temperature probe. A total of 21 temperature probes were used during this monitoring period, having the following serial numbers: T-01-1001 T-03-1001 T-05-1001 TE-02-1101 TE-04-1101 TE-06-1101 TE-08-1101 TE-10-1101 TE-12-1101 TE-14-1101 TE-16-1101 TE-02-1102 TE-04-1102 TE-06-1102 TE-08-1102 TE-10-1102 TE-12-1102 TE-14-1102 TE-16-1102 TE-18-1102 TE-20-1102
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	<i>Accuracy:</i> The temperature probes have a maximum accuracy of ± 0.15 °C at 0 °C, and ± 0.35 °C at 100 °C <input type="checkbox"/> Yes, accuracy is as per monitoring plan <input checked="" type="checkbox"/> monitoring plan does not specify the accuracy, but the accuracy represents good monitoring practise <input type="checkbox"/> No, accuracy is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>) This is the accuracy indicated by the instruments' technical specifications issued by the manufacturer /40/.



<p>Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?</p>	<p><input type="checkbox"/> Yes, accuracy is valid for the entire measuring range <input checked="" type="checkbox"/> No, different accuracy levels apply</p> <p>The temperature probes have a maximum accuracy of ± 0.15 °C at 0 °C, and ± 0.35 °C at 100 °C. Moreover, the technical information sheet produced by the manufacturer /40/ indicates a tolerance range of $\pm 0.30 + 0.0050$ °C across a temperature range of -196 °C to +600 °C.</p>
<p>Calibration frequency /interval:</p>	<p>The instruments have been calibrated by the manufacturer at the time of commissioning. The instruments cannot be calibrated, but it is recommended that a function test is performed every 4 to 5 years /41/. At the end of this period the PP intends to replace the probes.</p>
<p>Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?</p>	<p><input type="checkbox"/> Yes, frequency is per monitoring plan <input checked="" type="checkbox"/> monitoring plan does not specify the frequency, but the frequency represents good monitoring practise <input type="checkbox"/> No, frequency is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>)</p> <p>The monitoring plan does not specify the frequency of calibration. The PP submitted a letter issued and signed by the manufacturer indicating that the instruments have been calibrated by the manufacturer at the time of commissioning, and that a function test should be performed every 4 to 5 years /41/. At the end of this period the PP intends to replace the probes.</p>
<p>Is the calibration of measuring equipment carried out by an accredited person or institution?</p>	<p><i>Name of institution / person:</i> The calibration has been performed by Wika Instruments, the manufacturer</p> <p><input checked="" type="checkbox"/> Yes, institution / person is accredited by the South African National Accreditation System <input type="checkbox"/> No, institution / person is not accredited (<i>If No, raise a CAR/CL - only applicable to SSC projects</i>)</p> <p>A certificate of accreditation dated 22 December 2008 and expiring on 21 December 2013 has been submitted to DNV /42/.</p>
<p>Did calibration confirm proper functioning of monitoring equipment? (Yes / No):</p>	<p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p>
<p>Is(are) calibration(s) valid for the whole reporting period?</p>	<p><i>Validity of calibration(s):</i> 4 to 5 years <input checked="" type="checkbox"/> Yes, valid for the whole reporting period</p>



	<input type="checkbox"/> No, not valid for the whole reporting period (<i>If No, raise a CAR/CL</i>) The validity of the calibration certificated extends to 2015 or 2016 depending on the commissioning dates /77//74/. For this reason the calibration of all temperature probes is considered valid for the entire duration of the monitoring period.
If applicable, has the reported data been cross-checked with other available data?	<i>Has data been cross-checked with other available data:</i> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>) The calibration certificates provided /37/ to /39/ indicate that the test was conducted on a temperature range = PT100. The technical specifications for the model used /40/ indicate that the resistance thermometer meets the characteristics of PT100 and has a temperature range of -30° to +300°. The range for which measurements have been carried out does not exceed the range indicated in the technical specifications.
How were the values in the monitoring report verified?	Data were verified against the database
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>) The data management system ensures correct transfer of data and reporting of emission reductions, and necessary QA/QC processes are in place /50/. In fact, the logged information is sent via GSM (GPRS) via TCP/IP protocol to the company responsible for the management and maintenance of the database. The propriety protocol takes care of all handshaking and CRC checks to make sure no data is lost and arrives in the correct order. All data is written to a SQL database with its own proprietary driver. The database has been designed specifically for this PoA based on the monitoring requirements of the CDM methodology, and the monitoring plan described in the PoA-DD. The database is designed in such a way that Tables that require human input have an “audit” function, to identify and address mistakes, and values that are not in the correct format are not saved by the system, but give an error message.



In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<input type="checkbox"/> Parameter was monitored fully in accordance with monitoring plan <input checked="" type="checkbox"/> Only partial data was available Data on ambient air temperature is not available for all households for the entire monitoring period. ER have been calculated based on the data available, and households for which data are not available on a specific day have not been included in the calculations. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period.
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	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	T _{c,year} – The average annual cold water temperature
Measuring frequency:	Data is recorded every 5 minutes.
Reporting frequency:	Data is aggregated daily.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>) The measuring and reporting frequency is indicated in the registered PoA-DD, and the applicable methodology does not give indications on the minimum monitoring frequency, as this parameter is not explicitly contemplated by the methodology, but used to calculate parameter Q _{on-site} .
Type of monitoring equipment:	Temperature is measured by means of a temperature probe. A total of 21 temperature probes were used during this monitoring period, and their serial numbers are listed in the MR.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	<p><i>Accuracy:</i> The temperature probes have a maximum accuracy of ± 0.15 °C at 0 °C, and ± 0.35 °C at 100 °C</p> <input type="checkbox"/> Yes, accuracy is as per monitoring plan <input checked="" type="checkbox"/> monitoring plan does not specify the accuracy, but the accuracy represents good monitoring practise <input type="checkbox"/> No, accuracy is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>) This is the accuracy indicated by the instruments' technical specifications issued by the manufacturer /40/.



<p>Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?</p>	<p><input type="checkbox"/> Yes, accuracy is valid for the entire measuring range <input checked="" type="checkbox"/> No, different accuracy levels apply</p> <p>The temperature probes have a maximum accuracy of ± 0.15 °C at 0 °C, and ± 0.35 °C at 100 °C. Moreover, the technical information sheet produced by the manufacturer /40/ indicates a tolerance range of $\pm 0.30 + 0.0050$ °C across a temperature range of -196 to +600.</p>
<p>Calibration frequency /interval:</p>	<p>The instruments have been calibrated by the manufacturer at the time of commissioning. The instruments cannot be calibrated, but it is recommended that a function test is performed every 4 to 5 years /41/. At the end of this period the PP intends to replace the probes.</p>
<p>Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?</p>	<p><input type="checkbox"/> Yes, frequency is per monitoring plan <input checked="" type="checkbox"/> monitoring plan does not specify the frequency, but the frequency represents good monitoring practise <input type="checkbox"/> No, frequency is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>)</p> <p>The monitoring plan does not specify the frequency of calibration. The PP submitted a letter issued and signed by the manufacturer indicating that the instruments have been calibrated by the manufacturer at the time of commissioning, and that a function test should be performed every 4 to 5 years /41/. At the end of this period the PP intends to replace the probes.</p>
<p>Is the calibration of measuring equipment carried out by an accredited person or institution?</p>	<p><i>Name of institution / person:</i> The calibration has been performed by Wika Instruments, the manufacturer</p> <p><input checked="" type="checkbox"/> Yes, institution / person is accredited by the South African National Accreditation System <input type="checkbox"/> No, institution / person is not accredited (<i>If No, raise a CAR/CL - only applicable to SSC projects</i>)</p> <p>A certificate of accreditation dated 22 December 2008 and expiring on 21 December 2013 has been submitted to DNV /42/.</p>
<p>Did calibration confirm proper functioning of monitoring equipment? (Yes / No):</p>	<p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p>
<p>Is(are) calibration(s) valid for the whole reporting period?</p>	<p><i>Validity of calibration(s):</i> 4 to 5 years <input checked="" type="checkbox"/> Yes, valid for the whole reporting period <input type="checkbox"/> No, not valid for the whole reporting period (<i>If</i></p>



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	<p><i>No, raise a CAR/CL)</i></p> <p>The validity of the calibration certificated extends to 2015 or 2016 depending on the commissioning dates /77//74/. For this reason the calibration of all temperature probes is considered valid for the entire duration of the monitoring period.</p>
If applicable, has the reported data been cross-checked with other available data?	<p><i>Has data been cross-checked with other available data:</i></p> <p><input type="checkbox"/> Yes</p> <p><input checked="" type="checkbox"/> No</p>
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>)</p> <p>The calibration certificates provided /37/ to /39/ indicate that the test was conducted on a temperature range = PT100. The technical specifications for the model used /40/ indicate that the resistance thermometer meets the characteristics of PT100 and has a temperature range of -30° to +300°. The range for which measurements have been carried out does not exceed the range indicated in the technical specifications.</p>
How were the values in the monitoring report verified?	<p>Data were verified against the database /9/</p>
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>)</p> <p>The data management system ensures correct transfer of data and reporting of emission reductions, and necessary QA/QC processes are in place /50/.</p> <p>In fact, the logged information is sent via GSM (GPRS) via TCPIP protocol to the company responsible for the management and maintenance of the database. The propriety protocol takes care of all handshaking and CRC checks to make sure no data is lost and arrives in the correct order.</p> <p>All data is written to a SQL database with its own proprietary driver. The database has been designed specifically for this PoA based on the monitoring requirements of the CDM methodology, and the monitoring plan described in the PoA-DD. The database is designed in such a way that Tables that require human input have an “audit” function, to identify and address mistakes, and values that are not in the correct format are not saved by the system, but give an error message.</p>



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<p>In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?</p>	<p><input type="checkbox"/> Parameter was monitored fully in accordance with monitoring plan</p> <p><input checked="" type="checkbox"/> Only partial data was available</p> <p>Data on ambient air temperature is not available for all households for the entire monitoring period. ER have been calculated based on the data available, and households for which data are not available on a specific day have not been included in the calculations. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period.</p>
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	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	V – volume of daily cold water flow
Measuring frequency:	Continuous
Reporting frequency:	Continuous
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p> <p>The measuring frequency is in line with that indicated in the revised PoA-DD, and the applicable methodology does not give indications on the minimum monitoring frequency, as this parameter is not explicitly contemplated by the methodology, but used to calculate parameter Q_{on-site}.</p>
Type of monitoring equipment:	<p>The volume of daily cold water is measured by means of flow meters. A total of 21 flow meters were used during this monitoring period, having the following serial numbers:</p> <p>100016981 100016982 100016986 100016983 100016984 100016988 100016985 100016987 120053141 120053142 120053143 120026915 120053146</p>



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	120026912 120026914 120026904 120026916 120026909 120026905 120026917 120027220
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	<p>Accuracy: +/- 2%</p> <p><input type="checkbox"/> Yes, accuracy is as per monitoring plan</p> <p><input checked="" type="checkbox"/> monitoring plan does not specify the accuracy, but the accuracy represents good monitoring practise</p> <p><input type="checkbox"/> No, accuracy is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>)</p> <p>The accuracy of the flow meters is not indicated in the registered PoA-DD.</p> <p>The flow meters have a maximum accuracy of $\pm 2\%$. This is the accuracy indicated by the instruments' technical specifications issued by the manufacturer /47/.</p>
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	<p><input checked="" type="checkbox"/> Yes, accuracy is valid for the entire measuring range</p> <p><input type="checkbox"/> No, different accuracy levels apply</p> <p>The manufacturer's specification present an accuracy curve which indicated that at the typical flow recorded in households in 2011 (previous monitoring period) of 20 to 250 liters/hour, the accuracy is $\pm 2\%$.</p>
Calibration frequency /interval:	<p>The instruments are supplied by the manufacturer as calibrated units from the factory. It is recommended that the equipment is recalibrated or replaced every 5 years from the first day of operation /49/. At the end of this period the PP intends to replace the meters.</p>
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?	<p><input type="checkbox"/> Yes, frequency is per monitoring plan</p> <p><input checked="" type="checkbox"/> monitoring plan does not specify the frequency, but the frequency represents good monitoring practise</p> <p><input type="checkbox"/> No, frequency is not as per monitoring plan or does not represent good monitoring practise (<i>If No, raise a CAR/CL</i>)</p>



	The monitoring plan does not specify the frequency of calibration. The PP submitted a letter issued and signed by the manufacturer indicating that the instruments are supplied by the manufacturer as calibrated units from the factory. The manufacturer recommends that the equipment is recalibrated or replaced every 5 years from the first day of operation /49/. At the end of this period the PP intends to replace the meters.
Is the calibration of measuring equipment carried out by an accredited person or institution?	<p><i>Name of institution / person:</i> The calibration has been performed by Sensus, the manufacturer</p> <p><input checked="" type="checkbox"/> Yes, institution / person is accredited by South African National Accreditation System</p> <p><input type="checkbox"/> No, institution / person is not accredited (<i>If No, raise a CAR/CL - only applicable to SSC projects</i>)</p> <p>Sensus is accredited by the South African National Accreditation System. An accreditation certificate dated 3 January 2011 and expiring on 2 January 2015 has been submitted to DNV /48/. Since measurements started in March 2011, the certificate is considered acceptable.</p>
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p>
Is(are) calibration(s) valid for the whole reporting period?	<p><i>Validity of calibration(s):</i> The validity of the calibration certificated extends to 2015 or 2016 depending on the commissioning dates /77//74/</p> <p><input checked="" type="checkbox"/> Yes, valid for the whole reporting period</p> <p><input type="checkbox"/> No, not valid for the whole reporting period (<i>If No, raise a CAR/CL</i>)</p>
If applicable, has the reported data been cross-checked with other available data?	<p><i>Has data been cross-checked with other available data:</i></p> <p><input type="checkbox"/> Yes</p> <p><input checked="" type="checkbox"/> No</p>
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>)</p> <p>The calibration certificates provided /44/ to /46/ clearly state the error observed at Qmin (minimum flow), Qt (transitional flow) and Qs (maximum flow).</p>
How were the values in the monitoring report verified?	Data were verified against the database /9/
Does the data management ensure correct	<input checked="" type="checkbox"/> Yes



transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>) The data management system ensures correct transfer of data and reporting of emission reductions, and necessary QA/QC processes are in place /50/. In fact, the logged information is sent via GSM (GPRS) via TCPIP protocol to the company responsible for the management and maintenance of the database. The propriety protocol takes care of all handshaking and CRC checks to make sure no data is lost and arrives in the correct order. All data is written to a SQL database with its own proprietary driver. The database has been designed specifically for this PoA based on the monitoring requirements of the CDM methodology, and the monitoring plan described in the PoA-DD. The database is designed in such a way that Tables that require human input have an "audit" function, to identify and address mistakes, and values that are not in the correct format are not saved by the system, but give an error message.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<input type="checkbox"/> Parameter was monitored fully in accordance with monitoring plan <input checked="" type="checkbox"/> Only partial data was available Data on water flow is not available for all households for the entire monitoring period. ER have been calculated based on the data available, and households for which data are not available on a specific day have not been included in the calculations. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	Q _{on-site} – Solar energy output by the SWH in the years y, MWH
Measuring frequency:	Daily
Reporting frequency:	Daily
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>) The monitoring plan does indicate the monitoring and reporting frequency. Since this parameter is calculated based on other



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	parameters monitored directly and discussed above, and that the data relevant to these parameters is measured every 5 minutes and aggregated daily, the monitoring and reporting frequency is considered acceptable.
Type of monitoring equipment:	Not applicable: this parameter is calculated
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	Not applicable: this parameter is calculated
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	Not applicable: this parameter is calculated
Calibration frequency /interval:	Not applicable: this parameter is calculated
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?	Not applicable: this parameter is calculated
Is the calibration of measuring equipment carried out by an accredited person or institution?	Not applicable: this parameter is calculated
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable: this parameter is calculated
Is(are) calibration(s) valid for the whole reporting period?	Not applicable: this parameter is calculated
If applicable, has the reported data been cross-checked with other available data?	Not applicable: this parameter is calculated
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	<i>Has data been cross-checked with other available data:</i> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
How were the values in the monitoring report verified?	The values reported in the MR were verified against the ER calculations /2/, as well as against the database where measurements are recorded /9/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (If No, raise a CAR/CL/FAR) The data management system ensures correct transfer of data and reporting of emission reductions, and necessary QA/QC processes are in place /50/.



	<p>In fact, the logged information is sent via GSM (GPRS) via TCP/IP protocol to the company responsible for the management and maintenance of the database. The propriety protocol takes care of all handshaking and CRC checks to make sure no data is lost and arrives in the correct order.</p> <p>All data is written to a SQL database with its own proprietary driver. The database has been designed specifically for this PoA based on the monitoring requirements of the CDM methodology, and the monitoring plan described in the PoA-DD. The database is designed in such a way that Tables that require human input have an “audit” function, to identify and address mistakes, and values that are not in the correct format are not saved by the system, but give an error message.</p>
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<p><input type="checkbox"/> Parameter was monitored fully in accordance with monitoring plan</p> <p><input checked="" type="checkbox"/> Only partial data was available</p> <p>Data solar energy output is not available for all households for the entire monitoring period. ER have been calculated based on the data available, and households for which data are not available on a specific day have not been included in the calculations. This approach meets the requirements of Appendix 1 of the Project Standard in that no ER have been claimed for household that could not be fully monitored during the monitoring period.</p>

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	EF _{grid} – The emission factor for the electricity system
Measuring frequency:	Annually
Reporting frequency:	Annually
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL</i>)</p> <p>This parameter is calculated annually</p>
Type of monitoring equipment:	Not applicable: this parameter is calculated.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	Not applicable: this parameter is calculated
Is the accuracy valid for the entire measuring	Not applicable: this parameter is calculated



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range or do different accuracy levels apply to different measuring ranges?	
Calibration frequency /interval:	Not applicable: this parameter is calculated
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications (if local/national standards or the manufacturer's specifications are not available, international standards may be used)?	Not applicable: this parameter is calculated
Is the calibration of measuring equipment carried out by an accredited person or institution?	Not applicable: this parameter is calculated
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable: this parameter is calculated
Is(are) calibration(s) valid for the whole reporting period?	Not applicable: this parameter is calculated
If applicable, has the reported data been cross-checked with other available data?	Not applicable: this parameter is calculated
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	<p><i>Has data been cross-checked with other available data:</i></p> <p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p>Yes, the value has been cross-checked against the standardized baseline for the Southern African power pool /70/ applicable to solar power generation projects (0.9801 tCO₂/MWh), and although slightly higher, the difference is considered acceptable because the two results were reached following different calculations (the programme calculates the weighted average emissions of the generation mix of the selected year, while the standardized GEF is calculated following the CDM Tool to calculate the emission factor for an electricity system /71/), and the standardized GEF also includes generation from less carbon intensive grids than the South African one.</p>
How were the values in the monitoring report verified?	The values reported in the MR were verified against the ER calculations /2/, as well as against Eskom's website /58/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	<p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No (<i>If No, raise a CAR/CL/FAR</i>)</p> <p>The calculation of the grid emission factor relies on data from one source only (Eskom), and no QA/QC process is required for its calculation.</p>
In case project participants have temporarily	<input type="checkbox"/> Parameter was monitored fully in accordance



not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	with monitoring plan <input type="checkbox"/> Only partial data was available Not applicable: the parameter is calculated, and relies on data monitored by Eskom.
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Calibration records and accreditation certificates have been provided to the verification team. DNV can confirm that the meters were calibrated covering this monitoring period as per the monitoring plan.

The monitoring plan contained in the revised PoA-DD has been properly implemented and followed by the project participants.

Baseline emissions have been monitored and updated based on the parameters stated in the monitoring plan, and the responsibilities and authorities for monitoring and reporting are in accordance with the responsibilities and authorities stated in the monitoring plan. The equipment used for monitoring is in accordance with the requirements of the VVS, and is controlled and calibrated in accordance with the manufacturer's specification; monitoring results are consistently recorded as per approved frequency; and the quality assurance and quality control procedures have been applied in accordance with the revised monitoring plan.

The revised monitoring plan is in accordance with the requirements of the applicable methodology, in that it comprises following:

- Continuous operation of the equipment/system: this is monitored through technical checks performed on 1% of the installations every year, as well as recorded system failures;
- Net quantity of thermal energy supplied by the PoA during the year y: this is measured through SABS test results and through real-time measurement of average annual solar radiation, annual average ambient temperature, inlet and outlet water temperature, and water flow for 1 every 10 000 units installed in order to adjust the energy output determined in the SABS tests for the specific SWH.
- The grid emission factor is monitored as required by AMS-I.D.

The results of these checks confirm the quality of data is acceptable.

3.7 Assessment of data and calculation of emission reductions

DNV confirms that appropriate methods and formulae for calculating baseline emissions, project emissions and leakage have been followed, and the assumptions, emission factors and default values that are applied in the calculation have been justified.

The calculation are performed by the SQL database managed by Real Time Energy, which collects the hard data received from the remote recording of water and air temperature, water temperature and water flow from monitored sites, and calculates the emissions reductions for each household, once this has been allocated to a CPA. The calculations are then imported to an Excel file for each request for issuance. In order to comply with CDM requirements for transparency and replicability, the PP has replicated the ER calculations so that formula are clearly readable.

As stated in the section 1.4, the emission reductions ER_y by the programme during the



monitoring period is the difference between the baseline emission, project emissions or leakage.

$$ER_y = BE_y - PE_y - LE_y$$

3.7.1 Baseline emissions

Baseline emissions (BE_y in tCO_2) are the product of the baseline emission factor (EF_y in tCO_2/MWh) times the energy baseline (EG_y in MWh).

EF_{CO_2} is the emission factor of the South African's grid, and has been calculated following AMS-I.D. version 16 as the weighted average emissions (in tCO_2/MWh) of the generation mix of the year in which PoA generation occurs. This is calculated based on the fuel consumption, net calorific value and emission factor for the fuel used, and electricity generation for each power plant, and in 2012 amounted to $0.9996 tCO_2/MWh$ based on the information on fuel consumption and electricity generation published by Eskom for 2012 /58/. The source of data used for the calculation of the grid emission factor is consistent with the one indicated in the PoA-DD /3/, and the data were verified against Eskom's published electricity generation and fuel consumption data /58/ and found to be correct.

$EG_{BL,y}$ is the solar energy output (Q_y) of SWHs, which is multiplied by the operationality ratio (i.e. number of SWHs operational, N) and further adjusted with maintenance downtime.

The rated capacity of the SWH was calculated in accordance with the formula provided by the SABS. The specific coefficients α_1 , α_2 and α_3 used were verified against the SABS test report issued to Tasol's SWH /10/, and are considered acceptable as they reflect the local environmental conditions that influence the energy output, while the values used for average ambient temperature, solar irradiation, and average cold water temperature were recorded at 8 monitored sites. Measurements were taken every 5 minutes, aggregated daily, and input in the calculations. DNV was given access to the programme's database /9/, where measurements can be observed in real time for each measured site, and where records for each monitored site are stored. Moreover, since the ER calculations are performed directly within the database, an excel spreadsheet with sample measurements was created by the project participant where the calculations are shown in a transparent way /2/.

The operationality of the systems was based on the results of the operationality survey performed in November 2012 (hence towards the end of the monitoring period). The results of the operationality check are reported in the MR, and demonstrate that the check achieved the required confidence/precision level. DNV checked a randomly selected sample of forms completed by the technicians responsible for the operationality checks and stored at SASSA's office /51/ to /56//76/, and found the information checked to be acceptable. The high number of operational systems recorded can be explained by the fact that maintenance is provided in all locations, and that non-operational systems are replaced by SASSA on a continuous basis. This was also confirmed by the staff responsible for maintenance on site /80//78/. Maintenance and downtime was calculated based on the call log kept during the monitoring period.

Hence,

$$EG_{BL,y} = Q_y * \text{Number} - \text{Maintenance and Downtime} = 34\,763 \text{ MWh}$$

$$BE_y = EF_y * EG_{BL,y} = 34\,749 tCO_2e$$



3.7.2 Project emissions

The project emissions are regarded as zero according to the methodology AMS-I.C.

3.7.3 Leakage

There are no leakages that need to be considered in applying the methodology AMS-I.C.

3.7.4 Emission reductions

Therefore, the emission reductions in this monitoring period are:

$$ER_y = BE_y - PE_y - LE_y = 34\,749 - 0 - 0 = 34\,749 \text{ tCO}_2\text{e}.$$

The expected annual emissions reductions at the time of registration of the PoA are indicated as 105 427 tCO₂, while the actual emission reductions achieved are 34 749 tCO₂.

As outlined above, the input data for calculating the emission reductions, the calculating process and the result are complete and transparent. Therefore, DNV is able to confirm the accuracy of the emission reductions.

3.8 Quality of evidence to determine emission reductions

DNV confirms that a complete set of data for this monitoring period was available to be verified and was in accordance with the registered PDD.

All necessary documentation were collected, referenced and aggregated and were easily accessible in hard-copy and electronic format. Measurements are performed by calibrated equipment, and the key data were cross-checked via other sources. No assumptions are used that have any material influence on reported emission reductions.

3.9 Management system and quality assurance

SASSA is responsible for the operation and maintenance of the programme, the monitoring equipments and data collection. The management system for the programme has been verified to be in place by DNV on site. The organization structure with the responsibilities, personnel competencies, monitoring procedure and monitoring management have been properly identified and put into operation.

DNV confirms that the responsibilities and authorities in the management and operational system for monitoring and reporting are in accordance with the responsibilities and authorities stated in the registered PDD and monitoring plan.



4 CERTIFICATION STATEMENT

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions that have been reported for the CDM programme of activities 4302 “SASSA Low Pressure Solar Water Heater Programme” in South Africa for the period 1 January 2012 to 31 December 2012.

The project participants are responsible for the collection of data in accordance with the monitoring plan and the reporting of GHG emissions reductions from the programme.

It is DNV’s responsibility to express an independent verification statement on the reported GHG emission reductions from the programme of activities. DNV does not express any opinion on the selected baseline scenario or on the validated and registered PDD.

DNV conducted the verification on the basis of the baseline and monitoring methodology AMS-IC (version 17), the monitoring plan contained in the PoA-DD and CPA-DD (CPA-001 version 05 of 22 May 2013 and CPA-002 version 05 of 22 May 2013) and the monitoring report (version 05) dated 16 January 2014. The verification included i) checking whether the provisions of the monitoring methodology and the monitoring plan were consistently and appropriately applied and ii) the collection of evidence supporting the reported data.

DNV’s verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. DNV planned and performed the verification by obtaining evidence and other information and explanations that DNV considers necessary to give reasonable assurance that reported GHG emission reductions are fairly stated.

In our opinion the GHG emissions reductions reported for the programme of activities for the period 1 January 2012 to 31 December 2012 are fairly stated in the monitoring report (version 05) dated 16 January 2014.

The GHG emission reductions were calculated correctly on the basis of the approved baseline and monitoring methodology AMS-IC (version 17) and the monitoring plan contained in the PoA-DD and CPA-DDs (CPA-001 version 05 of 22 May 2013 and CPA-002 version 04 of 20 December 2013).

DNV Climate Change Services AS is able to certify that the emission reductions from the CDM programme of activities “SASSA Low Pressure Solar Water Heater Programme” in South Africa during the period 1 January 2012 to 31 December 2012 amount to 34 749 tonnes of CO₂ equivalent.

Venice and Oslo, 8 May 2014

Francesca Feller
Verifier
DNV Venice, Italy

Michael Lehmann
Director of Services and Technologies
DNV Climate Change Services AS



5 REFERENCES

Documentation provided by the project participants

- /1/ International Carbon: *CDM monitoring report for the programme of activities "SASSA low pressure solar water heater programme" for the monitoring period 1 January 2012 to 31 December 2012*, version 01 of 25 June 2013 and version 05 of 16 January 2014
- /2/ International Carbon: *Appendix I*, version 1 of 25 June 2013 and version 02 of 29 November 2013
- /3/ International Carbon: *CDM-PoA-DD for PoA "SASSA low pressure solar water heater programme"*, version 05 of 22 May 2013
- /4/ International Carbon: *CDM-CPA-DD for CPA "SASSA low pressure solar water heater programme – CPA-001"*, version 05 of 22 May 2013
- /5/ International Carbon: *CDM-CPA-DD for CPA "SASSA low pressure solar water heater programme – CPA-002"*, version 04 of 20 December 2013
- /6/ International Carbon: *Appendix 1 - Appendix III ER for generic CPA*, of 28 December 2010
- /7/ International Carbon: *Appendix I – Appendix IV Ex ante Emission for CPA001*, 12 March 2011
- /8/ International Carbon: *Appendix 1 – CPA002 Final ER calculation spread sheet*, 29 March 2012
- /9/ Real Time Energy: Solar Tracker database, available at: <http://www.rtenergy.co.za/RTETelemetryV1/> (accessed: August-December 2013)
- /10/ South Africa Bureau of Standards: *Mark of Approval SAS 1307_2009*, 21 December 2011
- /11/ Li-COR: Certificate of calibration – serial number PY67126, 25 September 2009
- /12/ Li-COR: Certificate of calibration – serial number PY69976, 15 July 2010
- /13/ Li-COR: Certificate of calibration – serial number PY71632, 8 September 2010
- /14/ Li-COR: Certificate of calibration – serial number PY71633, 8 September 2010
- /15/ Li-COR: Certificate of calibration – serial number PY71635, 8 September 2010
- /16/ Li-COR: Certificate of calibration – serial number PY71636, 8 September 2010
- /17/ Li-COR: Certificate of calibration – serial number PY71637, 8 September 2010
- /18/ Li-COR: Certificate of calibration – serial number PY71638, 8 September 2010
- /19/ Li-COR: Certificate of calibration – serial number PY71639, 8 September 2010
- /20/ Li-COR: Certificate of calibration – serial number PY71640, 8 September 2010
- /21/ Li-COR: Certificate of calibration – serial number PY71645, 8 September 2010
- /22/ Li-COR: Certificate of calibration – serial number PY79118, 6 March 2012
- /23/ Li-COR: Certificate of calibration – serial number PY79119, 6 March 2012
- /24/ Li-COR: Certificate of calibration – serial number PY79120, 6 March 2012
- /25/ Li-COR: Certificate of calibration – serial number PY79121, 6 March 2012
- /26/ Li-COR: Certificate of calibration – serial number PY79122, 6 March 2012



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- /27/ Li-COR: Certificate of calibration – serial number PY79123, 6 March 2012
- /28/ Li-COR: Certificate of calibration – serial number PY79124, 6 March 2012
- /29/ Li-COR: Certificate of calibration – serial number PY79125, 6 March 2012
- /30/ Li-COR: Certificate of calibration – serial number PY79132, 6 March 2012
- /31/ Li-COR: Certificate of calibration – serial number PY67482, 6 March 2012
- /32/ Li-COR: LI-COR Solar radiation sensors, October 2010
- /33/ Li-COR: Calibration interval of the LI-COR LI-200 pyranometer, 26 November 2012
- /34/ Li-COR: Calibration procedures for LI-COER spectroradiometers, radiation sensors & lamps, 6 September 2002
- /35/ SANAS: Certificate of accreditation, 20 December 2011
- /36/ Campbell Scientific Africa: Calibration Relationship between Campbell Scientific Africa (CS Africa) and Inteltronics Instrumentation, 23 April 2013
- /37/ Wika Instruments: Temperature conformity certificate WCT-CF-DBN-T1118, 8 March 2011
- /38/ Wika Instruments: Temperature conformity certificate WCT-CF-DBN-T1001, 15 March 2010
- /39/ Wika Instruments: Temperature conformity certificate WCT-CF-DBN-T1111, 8 March 2011
- /40/ Wika Instruments: Usage limitations and accuracies of platinum resistance thermometers (DIN EN 60751:2009) in industrial application, October 2010
- /41/ Wika Instruments: Information on calibration interval, 19 December 2012
- /42/ Wika Instruments: *Certificate of accreditation*, 22 December 2008
- /43/ Wika Instruments: *Temp VS Ohm for PT 100*, 22 December 2008
- /44/ Sensus metering systems: Meter verification certificate, calibration date: 13 June 2011
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- /46/ Sensus metering systems: Meter test report, certificate date: 2 March 2013
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- /48/ South African National Accreditation System: *Certificate of Accreditation*, 3 January 2011 (expires 2 January 2015)
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- /50/ Real Time Energy: Measurement System Architecture, 16 November 2012
- /51/ Tasol: Operationality inspection, 18 February 2012
- /52/ Tasol: Operationality inspection, 20 February 2012
- /53/ Tasol: Operationality inspection, 20 February 2012
- /54/ Tasol: Operationality inspection, 20 February 2012
- /55/ Tasol: Operationality inspection, 20 February 2012
- /56/ Tasol: Operationality inspection (all), various dates

Other programme documents or documents used by DNV to verify the information provided by the project participants

- /57/ Japan Consulting Institute (JCI): PoA validation report, 4 March 2011
- /58/ Eskom: CDM calculations, available at: <http://www.eskom.co.za/c/article/236/cdm->



[calculations/](#) (accessed in August 2013)

- /59/ Intergovernmental Panel on Climate Change: Guidelines for National Greenhouse Gas Inventories, available at: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html> (accessed: August 2013)
- /60/ DNV: Validation opinion for post-registration changes, 2 April 2013
- /61/ UNFCCC: Approval of post-registration changes, 13 November 2013
- /62/ DNV: Validation opinion for post-registration changes, 3 December 2013
- /63/ DNV: Verification/Certification Report for the “SASSA low pressure solar water heater programme” in Africa, 25 November 2013

Methodologies, tools and other guidance by the CDM Executive Board

- /64/ CDM Executive Board: *Clean Development Mechanism Validation and Verification Standard*, version 04.0
- /65/ CDM Executive Board: *Clean Development Mechanism Project Standard*, version 04.0
- /66/ CDM Executive Board: *Clean Development Mechanism Project Cycle Procedure*, version 04.0
- /67/ CDM Executive Board: *Sampling and surveys for CDM project activities and programme of activities*, version 04.0
- /68/ CDM Executive Board: *Baseline and monitoring methodology AMS-I.C*, version 17
- /69/ CDM Executive Board: *Baseline and monitoring methodology AMS-I.D*, version 16
- /70/ CDM Executive Board: *Standardized baseline – Grid emission factor for the Southern African power pool*, version 01.0
- /71/ CDM Executive Board: *Tool to calculate the emission factor for an electricity system*, version 2.2.1

Persons interviewed during the verification

	Date / Type of interview	Name / Organization	Topic
/72/	7 Aug 2013 <input checked="" type="checkbox"/> On-site <input checked="" type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Laura Lathi International Carbon	• PoA design, ER calculations, application of methodology
/73/	7 Aug 2013 <input checked="" type="checkbox"/> On-site <input checked="" type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Olivia Tuchten International Carbon	• PoA design, ER calculations, application of methodology
/74/	7 Aug 2013	Leandi Streeter	• Operations, data collection



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	<input checked="" type="checkbox"/> On-site <input checked="" type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	SASSA	and storage, management system
/75/	7 Aug 2013 <input checked="" type="checkbox"/> On-site <input checked="" type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Shaun Worthmann Real Time Energy	<ul style="list-style-type: none"> Data collection and storage, measurement equipment, database design and management, ER calculations
/76/	7 Aug 2013 <input type="checkbox"/> On-site <input checked="" type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Michael Keyser SASSA	<ul style="list-style-type: none"> Data management system, Eskom programme
/77/	7 Aug 2013 <input checked="" type="checkbox"/> On-site <input checked="" type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Riaan Swanepoel SASSA	<ul style="list-style-type: none"> SWH production, certification and testing, management system, Eskom programme
/78/	8 Aug 2013 <input checked="" type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Jessie Tagg SASSA	<ul style="list-style-type: none"> CPA implementation, maintenance, users support
/79/	8 Aug 2013 <input checked="" type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Mbulelo David SASSA	<ul style="list-style-type: none"> CPA implementation, maintenance, users support
/80/	8 Aug 2013 <input checked="" type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Joice Tshabalala SASSA	<ul style="list-style-type: none"> CPA implementation, maintenance, users support
/81/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone	Household 6997, Welbedacht West, Ekurhuleni	<ul style="list-style-type: none"> Operationality, maintenance



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/82/	<input type="checkbox"/> E-mail	7-27 Aug 2013	Household 7005, Welbedacht West, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/83/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 7024, Welbedacht West, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
/84/	<input type="checkbox"/> Face-to-face at office	7-27 Aug 2013	Household 7029, Welbedacht West, Ekurhuleni	• Operationality, maintenance
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
/85/	<input checked="" type="checkbox"/> Telephone	7-27 Aug 2013	Household 7030, Welbedacht West, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
/86/	<input type="checkbox"/> E-mail	7-27 Aug 2013	Household 7093, Welbedacht West, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/87/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 7102, Welbedacht West, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
/88/	<input type="checkbox"/> Face-to-face at office	7-27 Aug 2013	Household 7124, Ekurhuleni	• Operationality, maintenance
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
/89/	<input checked="" type="checkbox"/> Telephone	7-27 Aug 2013	Household 7174, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at			



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	office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/90/	7-27 Aug 2013	Household 7177, Ekurhuleni	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/91/	7-27 Aug 2013	Household 7180, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/92/	7-27 Aug 2013	Household 7181, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/93/	7-27 Aug 2013	Household 7220, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/94/	7-27 Aug 2013	Household 7238, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/95/	7-27 Aug 2013	Household 7246, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/96/	7-27 Aug 2013	Household 7257, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/97/	7-27 Aug 2013	Household 7373, Ekurhuleni	• Operationality, maintenance



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	<input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail		
/98/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7438, Ekurhuleni	• Operationality, maintenance
/99/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7439, Ekurhuleni	• Operationality, maintenance
/100/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7570, Ekurhuleni	• Operationality, maintenance
/101/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7582, Ekurhuleni	• Operationality, maintenance
/102/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7586, Ekurhuleni	• Operationality, maintenance
/103/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7591, Ekurhuleni	• Operationality, maintenance
/104/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone	Household 7593, Ekurhuleni	• Operationality, maintenance



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/105/	<input type="checkbox"/> E-mail	7-27 Aug 2013	Household 7638, Ekurhuleni	• Operationality, maintenance
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/106/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 2445, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/107/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 2457, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/108/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 2458 Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/109/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 3209, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/110/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 2483, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/111/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 2485, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/112/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 2831, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at			



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	office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/113/	7-27 Aug 2013	Household 2839, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/114/	7-27 Aug 2013	Household 2840, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/115/	7-27 Aug 2013	Household 2841, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/116/	7-27 Aug 2013	Household 2953, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/117/	7-27 Aug 2013	Household 2968, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/118/	7-27 Aug 2013	Household 3014, Chatsworth	• Operationality, maintenance
	<input type="checkbox"/> On-site		
	<input type="checkbox"/> Face-to-face at office		
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	<input type="checkbox"/> E-mail		
/119/	7-27 Aug 2013	Household 3115, Chatsworth	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office		
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	<input type="checkbox"/> E-mail		
/120/	7-27 Aug 2013	Household 12931/3, Middelburg	• Operationality, maintenance



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	<input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail		
/121/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 12931/4, Middelburg	• Operationality, maintenance
/122/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 12931/6, Middelburg	• Operationality, maintenance
/123/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 12931/7, Middelburg	• Operationality, maintenance
/124/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 12931/10, Middelburg	• Operationality, maintenance
/125/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 12931/17, Middelburg	• Operationality, maintenance
/126/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 12931/21, Middelburg	• Operationality, maintenance
/127/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone	Household 12931/53, Middelburg	• Operationality, maintenance



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/128/	<input type="checkbox"/> E-mail	7-27 Aug 2013	Household 12931/55, Middelburg	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/129/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 12931/56, Middelburg	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/130/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 12931/57, Middelburg	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/131/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 12931/58, Middelburg	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/132/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 12931/88, Middelburg	• Operationality, maintenance
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	<input type="checkbox"/> E-mail			
/133/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 133, Waterval Boven	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/134/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 151, Waterval Boven	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
/135/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 153, Waterval Boven	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at			



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	office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/136/	7-27 Aug 2013	Household 205, Waterval Boven	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office		
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	<input type="checkbox"/> E-mail		
/137/	7-27 Aug 2013	Household 208, Waterval Boven	• Operationality, maintenance
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	<input type="checkbox"/> E-mail		
/138/	7-27 Aug 2013	Household 212, Waterval Boven	• Operationality, maintenance
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	<input type="checkbox"/> E-mail		
/139/	7-27 Aug 2013	Household 266, Waterval Boven	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/140/	7-27 Aug 2013	Household 7482, Alexandra	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/141/	7-27 Aug 2013	Household 7476, Alexandra	• Operationality, maintenance
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	<input type="checkbox"/> E-mail		
/142/	7-27 Aug 2013	Household 7579, Alexandra	• Operationality, maintenance
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	<input type="checkbox"/> Face-to-face at office		
	<input checked="" type="checkbox"/> Telephone		
	<input type="checkbox"/> E-mail		
/143/	7-27 Aug 2013	Household 74501, Alexandra	• Operationality, maintenance



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	<input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail		
/144/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7594, Alexandra	• Operationality, maintenance
/145/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7609, Alexandra	• Operationality, maintenance
/146/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7610, Alexandra	• Operationality, maintenance
/147/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7494, Alexandra	• Operationality, maintenance
/148/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7713, Alexandra	• Operationality, maintenance
/149/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> E-mail	Household 7473, Alexandra	• Operationality, maintenance
/150/	7-27 Aug 2013 <input type="checkbox"/> On-site <input type="checkbox"/> Face-to-face at office <input checked="" type="checkbox"/> Telephone	Household 7732, Alexandra	• Operationality, maintenance

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/151/	<input type="checkbox"/> E-mail	7-27 Aug 2013	Household 7677, Alexandra	• Operationality, maintenance
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	<input type="checkbox"/> E-mail			
/152/	<input type="checkbox"/> On-site	7-27 Aug 2013	Household 7684, Alexandra	• Operationality, maintenance
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
/153/	<input type="checkbox"/> Face-to-face at office	7-27 Aug 2013	Household 7705, Alexandra	• Operationality, maintenance
	<input checked="" type="checkbox"/> Telephone			
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
/154/	<input checked="" type="checkbox"/> Telephone	7-27 Aug 2013	Household 7642, Alexandra	• Operationality, maintenance
	<input type="checkbox"/> E-mail			
	<input type="checkbox"/> On-site			
	<input type="checkbox"/> Face-to-face at office			
	<input checked="" type="checkbox"/> Telephone			

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND FORWARD ACTION REQUESTS

Corrective action requests

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	The value for parameter Q from the SABS tests is indicated differently between the MR and the calculation spreadsheet (in the "operationality hours" sheet). The PP is requested to ensure all figures are used consistently between different documents.	The inconsistency has been corrected and all documents now refer to the correct Q-factor of 13.692 MJ. The revised MR has been provided to the DOE.	The Q-factor of 13.692 MJ indicated in the registered PoA-DD has been applied to all calculations. CAR 1 is closed.
CAR 2	In the "data 2012" sheet of the ER calculation spreadsheet, it is not possible to univocally match the name of the monitored site to the one indicated in the MR tables 6, 7, and 8. The PP is requested to ensure all information is presented consistently between different documents.	The sheet "Monitored sites" gives the full name/address of the sites and the applied shortening. The use of the full name is difficult for the pivot tables as it is very long. The shortenings used are the names the SASSA and RTE team uses from the sites. However, the full address has been applied for the MR as it is more informative than the shortening.	The monitoring report /1/ and the spreadsheet /2/ now include numbers to more easily match sites. CAR 2 is closed.
CAR 3	The unit of measure of parameter Q, in the MR is not consisted (both TJ and MJ indicated for the same value). The PP is requested to correct the inconsistency.	The inconsistency has been corrected. Revised MR has been provided to the DOE.	Units of measure are used consistently in the programme documents. CAR 3 is closed.
CAR 4	The monitoring report includes information on monitored parameter " Q_{on-site} ". However, the name of the parameter is not consistent with the one used in the registered PoA-DD. The PP is requested to keep parameters 'names consistent between different documents.	The registered PoA-DD includes the parameter " Q_{on-site} " – "Solar energy output by the SWH in the year y, MWh" Please specify.	This CAR referred to an older version of the document, and is no longer relevant. CAR 4 is closed.

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 5	With regard to the pyranometers used for monitoring solar irradiation, it was noted that the calibration date for pyranometer PY67126 was not consistent with the dated indicated on the calibration certificates submitted. Moreover, the serial number PY79120 appears twice in the same table of the MR. The PP is requested to correct the information presented in the MR.	The pyranometer serial numbers and dates have been double-checked and corrected. Revised MR has been provided to the DOE together with the calibration certificates.	The calibration dates of the pyranometers have been corrected and are now consistent with the documentation submitted /11/ to /31/. CAR 5 is closed.
CAR 6	With regard to the temperature probes used to monitor air and water temperature, it was noted that the calibration date for T1111 and T1111_1 was not consistent with the dated indicated on the calibration certificates submitted. The PP is requested to correct the information presented in the MR.	The calibration dates for temperature probes have been double-checked and corrected. Revised MR has been provided to the DOE together with the calibration certificates.	The calibration dates of the temperature probes have been corrected and are now consistent with the documentation submitted /37/ to /39/. CAR 6 is closed.
CAR 7	With regard to the flow meters used to monitor water flow, it was noted that the calibration date for meters 100016981 to 120053143 and for meter 120053146 were not consistent with the dated indicated on the calibration certificates submitted. The PP is requested to correct the information presented in the MR.	The flow meter serial numbers and dates have been double-checked and corrected. Revised MR has been provided to the DOE together with the calibration certificates.	The calibration dates of the flow meters have been corrected and are now consistent with the documentation submitted. /44/ to /46/. CAR 7 is closed.

Clarification requests

CL ID	Clarification request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	Out of 803 households selected for the operationality check, 10 could not be accessed. So data are only available for 793 households, which is less of 1% of the total population. The PP is requested to explain how this can be considered compliant with the sampling requirements described in the registered PoA-DD.	<p>The methodology requires definition of “the number of systems operating” and furthermore the “General guidelines for sampling and surveys for SSC project activities” states that the sample size shall be determined with minimum 90% confidence interval and 10% maximum error margin. In the registered PoA-DD following is stated:</p> <ul style="list-style-type: none"> • 1 % of the installations are sampled for functionality; • The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 years period i.e. 10 % of all the installations will be inspected over the 10 years; <p>According the “General guidelines for sampling and surveys for SSC project activities”, the sample size shall be determined with minimum 90% confidence interval and 10% maximum error margin. This implies to determine the sample size with 90% probability of falling in the range of $\pm 10\%$ of the true population value (often denoted as 90/10 precision) and can be calculated based on a normal / Gaussian distribution giving a sample size of $n=65$. However, to gain meaningful data for the mean and the standard deviation a more conservative sample group</p>	<p>The reduced sample is acceptable since it stil satisfies applicable confidence/precision requirements.</p> <p>CL 1 is closed.</p>

		<p>between 100 and 200 is often selected.</p> <p>A 1 % sample was issued and inspected. However, 10 out of the 803 households selected could not be inspected due to the fact that no one was home and no safe access to unit or next door unit could be granted. Furthermore, in some of the cases the access to the area was not safe due to civil unrest in the communities. A total of 793 units were inspected, which give a sample size of 0.988%, of which we can say in 90 % confidence that 99.1 % of the units are operational or in 95 % confidence that 99.25% of the units are operational. This fulfils the set confidence/precision requirements and gives meaning full data.</p>	
CL 2	The PP is requested to clarify how the expiry date of calibration certificates of the pynanometers reported in the MR has been determined.	As per the “Calibration Interval” statement letter provided by the equipment supplier the expiry date is 4 years after the commissioning date of the meter. Supporting documents have been provided to the DOE.	<p>The end of the calibration interval is based on the date of installation. This is considered acceptable as it is in line with the indications issued by the manufacturer and submitted to DNV /34/.</p> <p>CL 2 is closed.</p>
CL 3	The PP is requested to submit evidence for the calibration of all monitoring equipment being conducted for a measuring range comparable with the range for which measurements have been carried out.	Supporting evidence for each relevant piece of monitoring equipment has been provided to the DOE.	<p>The supporting evidence submitted was found adequate to close CL 3. The evidence submitted is discussed in the verification report under each parameter.</p> <p>CL 3 is closed.</p>

CL 4	The PP is requested to submit a copy of the information check performed through telephone interviews during the site visit.	Copy of telephone interview log book has been provided to the DOE.	A copy of telephone interview log book has been provided to the DNV /81/ to /154/. CL 4 is closed.
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Forward action requests from previous verification

FAR ID	Forward action request	Summary of how FAR has been addressed in this reporting period	Assessment of how FAR has been addressed
	No FAR have been identified as part of the previous verification.		

Forward action requests from this verification

FAR ID	Forward action request	Response by Project Participants
	.No FAR have been identified as part of the current verification	

APPENDIX B

POST REGISTRATION CHANGES

Type of post registration change	Description of post registration change*	Is prior approval by CDM EB required?	In case prior approval by CDM EB is required, when was post registration change approved?
Corrections	<p>The CPA-DD for CPA-002 has been updated to incorporate the corrections made to the PoA-DD and the CPA-DD for CPA-001. The corrections made are:</p> <ul style="list-style-type: none"> - The list of information to be recorded in the database has been modified to exclude the confirmation that the dwelling has electricity and water connection, since this is a pre-requisite for installation by SASSA. Moreover, the PoA-DD now indicates that households are identified in the database based on street address, GPS coordinates, and an additional unique ID number allocated to each system in the database, since the PP realized during the implementation of the programme that ERF numbers were not univocal - In the CPA-DD, parameter EF grid was moved to the monitoring plan. In the CPA-DD template version available at the time of inclusion this parameter was listed among the data and parameters available at validation, but the registered monitoring plan clearly indicated the parameter has to be updated at the time of each issuance. The correction therefore makes it more clear that the parameter is monitored 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Not applicable	Not applicable
Temporary deviations from the registered monitoring plan and/or monitoring methodology	Not applicable	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable	Not applicable
Permanent changes from the registered monitoring plan or applied methodology	The CPA-DD for CPA-002 has been updated to apply the post registration changes approved by the CDM EB on 13 October 2013.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable	13 October 2013
Changes to the project design of a registered project activity	Not applicable	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable	Not applicable

* For further details refer to the "Post-registration changes request form" (F-CDM-PRC) and DNV's assessment opinion on the changes

APPENDIX C

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Francesca Feller

Francesca started working in 2004 on the introduction of sustainable development and corporate responsibility best practices in Italy, to promote the adoption by national firms of the most recent sustainability strategies emerging from the international sustainability discourse. She subsequently moved on to work on climate change mitigation and adaptation in the urban environmental in London, taking part to a large urban regeneration project. The role combined achieving carbon reductions and climate-proof urban planning through interventions on existing structures as well as embedding sustainability in the design of new ones. In 2009 Francesca moved to a company specialised in taking part to tenders financed by the United Nations, the World Bank, the European Union and the Italian Ministry of Foreign Affairs for development programmes. Her role as Project Manager focused on the supply of off-grid renewable energy technologies for rural electrification and improved access to energy. She currently works as Senior Climate Change Consultant for DNV Accredited Climate Change Services, where her position involves executing and managing CDM/JI validation and verification assignments, verification under voluntary schemes, and third party services within the institutional climate change department, providing advisory services on climate change adaptation and mitigation to institutional customers, chairing DNV's community of practice on Programmes of Activities under the UNFCCC, managing relations with large customers, and providing global support and training in the relevant specialized technical areas within the DNV global Climate Change Services team.

Grant Little

Grant holds a Bachelor Degree in Pure and Applied Chemistry; with a Secondary Degree in Forest Products Manufacture and a Masters Degree in Business Administration (MBA). He has over 20 years of industrial experience. Prior to joining DNV, Grant gained 16 years' experience in the forest products industry covering Process Engineering, energy projects, Sustainable Development, Forest eco-labelling and Environmental Management Systems. He also has over 5 years' experience in the business development for carbon project development and carbon markets in Africa and the Middle East where he worked for a carbon aggregator and a government owned carbon management and environmental project development company. He is passionate about Africa and sees his work as a contribution to the development of the continent.

Felipe Antunes

Felipe Antunes holds a Master's Degree in Production Engineering (Quality) and a Post Graduate Diploma in Environmental Management and Industrial Waste Management and Treatment. Possesses an International experience of more than 10 years in the field of quality and environmental auditing, working two years as the responsible of the QMS of Rede Metrológica RS and since 1999 as a QMS and EMS auditor in DNV.

He has experience of more than 3 years in validation and verification of numerous CDM projects in DNV, both in South America & abroad. He has also been actively involved in Management System Audits such as ISO 9001, ISO 140001 and OHSAS 18001 standards in various industrial sectors for more than 10 years in DNV.

His qualification and experience in CDM demonstrate him sufficient sectoral competence in energy generation from renewable energy sources, waste handling and disposal, and animal waste management.

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