CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

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NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

[1] The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

[2] At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

>>[**CLF Replacement Project + Serial Number XXXX-XXXX-CPA-xxxx**]

Generic CPA DD Date and Version
Date: **06/12/2012**
Version **07**

CPA DD Date and Version
Date: [**dd/mm/yyyy**]
Version: **[XXX]**

`

A.2. Description of the small-scale CPA:

>>
Small-scale CDM programme activities (SSC-CPAs) under the Sustainability CFL Replacement Programme of Activities in South Africa (PoA) will be implemented by Energy Service Companies (ESCOs) under the direction of Eskom Holdings SOC Limited, whom will act as the Coordinating/Managing Entity (CME). The objective of the SSC-CPAs are to boost the energy efficiency of South Africa's residential lighting stock by distributing Compact Fluorescent Lamps (CFLs) free of charge to households across South Africa.

The SSC-CPA aims to provide up to 1,000,000 CFLs free of charge to households via direct installation (of all possible CFLs in the household) or by exchange of incandescent lamps (ICLs) with up to 6 CFLs at designated exchange points. The exact number of bulbs distributed under this SSC-CPA will be documented in a data management system and provided to the DOE. As such, the projects will abate greenhouse gas emissions, significantly reduce national electricity demand and stress on energy infrastructure, and save individual households money on their electricity bills.

CFLs will be made available via the following distribution mechanisms:

Door to door installation
Door-to-door (direct) installation will be conducted by Energy Service Companies (ESCOs) staff, upon receiving agreement to do so by the householder. All working ICLs will be replaced by their equivalent CFL providing equal or better luminosity.

Gate to Gate Installation
The gate-to-gate exchange will be conducted by ESCO staff at the door step of the household when not granted permission, by the householder, to enter the premises to conduct a direct installation. Up to six ICLs will be exchanged for the same number of CFLs free of charge.

Stationary Point Exchange
A large number of distribution points will be located within the area covered by the Project Activity. Residents will come to distribution points with their ICLs and exchange them for up to 6 CFLs free of charge. Each stand will have a computer with a data management system, or paper based forms for

collecting the information (name, address, contact details) of each household, as well as the wattages and number of ICLs exchanged for CFLs.

All data relating to lamp exchanges taking place during implementation of the SSC-CPA will be captured within a Data Management System (DMS).

ICLs collected during the exchanges will be destroyed to prevent leakage. This process will be independently verified.

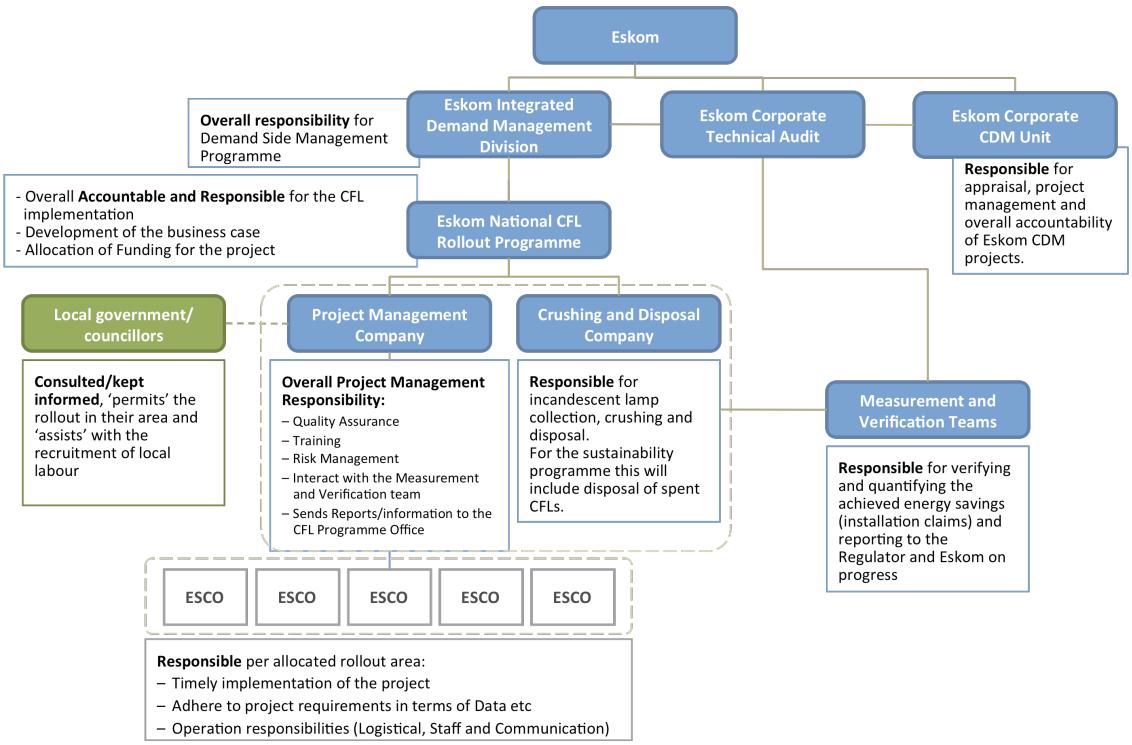
The Project Activity will include awareness raising through an information pamphlet provided with the CFLs, as well as targeted media. Such environmental messaging will promote behavioural change, encouraging further energy savings through addressing use of energy intensive technologies such as electrical appliances.

A.3. Entity/individual responsible for the small-scale CPA:

>>

Name of Party involved (*) ((host) indicates a host Party)	CPA Implementer	Kindly indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Republic of South Africa (host)	Eskom Holdings SOC Limited	No
France	BNP Paribas	No

The CPA Implementer is a project participant in the PoA: **Yes**



A.4. Technical description of the small-scale CPA:

A.4.1. Identification of the small-scale CPA:

>>ID Number: XXXX-XXXX-CPA [**XXXX**]

A.4.1.1. Host Party:

>>Republic of South Africa

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

>>Geographic reference or other means of identification[3], Name/contact details of the entity/individual responsible for the CPA, e.g. in case of stationary CPA geographic reference, in case of mobile CPAs means such as registration number, GPS devices.

For each SSC-CPA the project boundary will be defined by the specific location of the households in which CFLs are installed. The project boundary also includes the electricity grid to which those light fittings are connected.

To allow for ex-ante identification of the location of the SSC-CPA, the following geographic reference is provided. However, the precise project boundary will only be known after CFL distribution and installation has been completed and all household data has been entered into the DMS.

Name of City/Town/ Municipality(ies)	Type	Region/State/ Province	Coordinates

[**IMAGE/MAP to be inserted**]

Figure 1. Map of Municipalities involved in CPA-000X

[3] E.g. in case of stationary CPA geographic reference, in case of mobile CPAs means such as registration number, GPS devices.

A.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

>>[**dd/mm/yyyy**]
Starting date is the date on which CFL distribution begins.

A.4.2.2. Expected operational lifetime of the small-scale CPA:

>>Insert operational lifetime of equipment to be installed under the SSC-CPA.

The CFL lighting equipment to be installed as part of the SSC-CPA is expected to remain operational for 10 years.

A.4.3. Choice of the crediting period and related information:

Fixed Crediting period

A.4.3.1. Starting date of the crediting period:

>>[**dd/mm/yyyy**]

The crediting period shall not start earlier than the date of SSC-CPA inclusion under the Sustainability CFL Replacement PoA.

The start date of the crediting period should be the planned completion date of the CFL exchange process in the SSC-CPA target households by the CPA Implementer and accepted by the CME.

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

>>10 years

NOTE: Please note that the duration of crediting period of any *CPA* shall be limited to the end date of the *PoA* regardless of when the CPA was added.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

>>

Year 1	**Estimated annual emission reductions (tCO_2e)**
1	[**CPA implementer to insert values**]
2	
3	
4	
5	
6	

7	
8	
9	
10	
Total	
Total number of crediting years	**10**
Annual average over the crediting period of estimated emission reductions (tCO2e)	

A.4.5. Public funding of the CPA:

>>The source of funding of the SSC-CPA implementer(s) is:

Tick box as appropriate

☐ **Private**	SSC-CPA implementer(s) shall provide written confirmation to the CME that funds used to pay for the implementation of the SSC-CPA are from private sources.
☐ **Public**	Where public funding is utilised, the SSC-CPA Implementer(s) shall provide written confirmation to the CME of the following: "Information on sources of public funding for the project activity from Parties included in Annex 2 which shall provide an affirmation that such funding does not result in a diversion of official development assistance for the purchase of CERs, and is separate from and is not counted towards the financial obligations of those Parties;"

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

>>

1. For the purposes of registration of a Programme of Activities (PoA)[4] a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity[5], which:

   (a) Has the same activity implementer as the proposed small scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same sectoral scope, and;

[4] Only those POAs need to be considered in determining de-bundling that are: (i) in the same geographical area; and (ii) use the same methodology; as the POA to which proposed CPA is being added

[5] Which may be a (i) registered small-scale CPA of a PoA, (ii) an application to register another small-scale CPA of a PoA or (iii) another registered CDM project activity

(b) The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

2. If a proposed small-scale CPA of a PoA is deemed to be a debundled component in accordance with paragraph 2 above, but the total size of such a CPA combined with a registered small-scale CPA of a PoA or a registered CDM project activity does not exceed the limits for small-scale CDM and small-scale A/R project activities as set out in Annex II of the decision 4/CMP.1 and 5/CMP.1 respectively, the CPA of a PoA can qualify to use simplified modalities and procedures for small-scale CDM and small-scale A/R CDM project activities.

As per the latest version of the '*Guidance for determining of debundling under a Programme of Activities*' (v.3 EB 54), if each of the independent subsystems/measures included in the CPA of a PoA is no larger than 1% of the small-scale thresholds defined by the methodology applied (in this case the 60 GWh per year), then that SSC-CPA of PoA is exempted from performing de-bundling check i.e., considered as not being a de-bundled component of a large scale activity.

In the case of the installation of CFLs proposed under the SSC-CPA, annual energy savings of individual pieces of lighting equipment will be considerably lower than the 1% threshold level (i.e., less than 600,000 kWh of energy savings per year), and as such the SSC-CPA is considered as not being a de-bundled component of a large scale CDM activity. The example below clearly demonstrates the compliance of project activities with the debundling requirements of small-scale PoA:

Existing lighting equipment = 100W ICL

Replacement lighting equipment = 20W CFL

Usage = 3.5 hours per day, 365 days per annum

Annual Energy Savings = Exiting equipment annual usage – Replacement equipment annual usage
= ((100 x 3.5 x 365)/1000) – ((20 x 3.5 x 365)/1000)
= 127.75 – 25.55
= 102.2 kWh

As can be seen from this simple example individual lighting units will not exceed the 1% threshold amount of 600,000 kWh per annum, and as such is not a debundled component of a large-scale activity.

A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:

>>Prior to including a new SSC-CPA within the PoA, the CME will check the CDM project database to establish whether a CDM project activity or CPA of another PoA distributing CFLs has already been registered. Given that each SSC-CPA included in the PoA will be identified by geographical location of households where retrofits occur , it is possible to unambiguously identify CPAs or CDM project activities potentially operating in the same area. In addition, the CME will confirm with building owners and occupiers participating in the proposed SSC-CPA that they are not participating in any existing or proposed CDM project activity. If the CME identifies that there is an existing or proposed CDM activity involving the buildings targeted by the SSC-CPA, then those buildings will be excluded from

participating in the PoA.

Based on this review SSC-CPA implementers should indicate the following:

☐ **This Project will be neither registered as an individual CDM activity or is part of another Registered PoA.**

☐ **The CPA Implementer is undertaking another similar project activity in the same region, and the households are uniquely identified and are not overlapping.**

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

>>Sustainability CFL Replacement Programme of Activities in South Africa
Reference Number: [**Insert UNFCCC Registration Reference Number**]

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA :

>>A SSC-CPA able to demonstrate compliance with the criteria listed in the table below is considered eligible to participate in the PoA.

No.	Eligibility Criteria	Status
1	The SSC-CPA involves the distribution of CFLs to households within the geographical boundary of South Africa.	**Yes/No**
2	The SSC-CPA complies with the established procedures for avoiding double counting set out in the PoA-DD and CPA-DD (generic): – check of CDM database to confirm project is not registered as an individual CDM activity or part of another registered PoA; – unambiguous identification of households participating in the CPA within the database management system; and – data collection and signing of forms from participating households as to assign the rights to claim CERs for the project activity. – unambiguous identification of CFLs participating in the CPA marked with the Eskom logo (or equivalent) and meeting the technical characteristics captured in the data management system (e.g. type, model, wattage)	**Yes/No**
3	For each CFL participating in the SSC-CPA the total lumen output should be equal to or more than that of the ICL being replaced; lumen output of ICL and CLF shall be determined in accordance with relevant national or international standards.	**Yes/No**
4	The start date of the SSC-CPA has been confirmed through the provision of a document with regards to the date on which distribution of compact fluorescent light bulbs commences as wells as entries into the Data Management System.	**Yes/No**

5	The SSC-CPA will implement the baseline and monitoring methodology AMS-II.J. *'Demand-side activities for efficient lighting technologies' v.04. by confirming the criteria documented in Section E.2 of the PoA-DD*	**Yes/No**
6.	The SSC-CPA is additional because it confirms the additionality criteria set in section E.5.2 of the PoA-DD	**Yes/No**
7.	The SSC-CPA involves the distribution of compact fluorescent lightbulbs to residential households using either door-to-door, gate-to-gate or exchange points.	**Yes/No**
8.	The contact details of the households participating into the SSC-CPA are recorded in a data management system for future selection to participate in Ex Post Monitoring surveys in a random and representative manner.	**Yes/No**
9.	The aggregate energy savings by the SSC-CPA will not exceed the equivalent of 60 GWh per year as described in Section E.6.2 of the PoA-DD.	**Yes/No**
10.	The SSC-CPA satisfies de-bundling rules for PoA, and is not a de-bundled component of a large-scale CPA or CDM project.	**Yes/No**
11.	In the case that funding for the project comes from an Annex 1 party, the CME has received confirmation from the Annex 1 party that any funding involved in the implementation of the SSC-CPA does not result in a diversion of official development assistance for the purchase of CERs, and is separate from and is not counted towards the financial obligations of those Parties.	**Yes / No / Not applicable (no funding from Annex 1 Party has been received)**

B.3. Assessment and demonstration of additionality of the small-scale CPA , as per eligibility criteria listed in the Registered PoA:

Section A.4.3 of the PoA-DD provides evidence on how the SSC-CPAs included in the PoA meet the relevant criteria to be considered projects included in the positive list and therefore defined as automatically additional.

Based on the information provided in section A.4.3 of the PoA-DD, a CPA is considered automatically additional if meet the following criteria:

Criteria	Benchmark	Justification
CFLs will be distributed to households, communities and/or SMEs	The CPA-DD explains in section A.2 the distribution mechanism and target market. Only CFLs distributed to households, communities and SMEs are able to participate in the programme.	Paragraph 2(c) as per the latest Guidelines on the demonstration of additionality of small scale project activities (Version 09.0)
The size of each unit is no larger than the 5% of the small-scale	Section A.4.3 of the PoA-DD provides an example of the maximum annual energy savings associated with each individual piece	Paragraph 2(c) as per the latest Guidelines on the demonstration of additionality

threshold (i.e. 3,000 MWh of annual energy savings) and	of equipment. Given that the programme will distribute CFLs in exchange of ICLs, the annual energy savings of individual pieces of equipment will be always lower than 5% of the small scale threshold (3,000 MWh)	of small scale project activities (Version 09.0)

Based on the above analysis the CPA is considered to be additional.

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

>>

	Source	Gas	Included?	Justification
Baseline	Power plants servicing the electricity grid	CO_2	Yes	Main emission source
		CH_4	No	Minor Source
		N_2O	No	Minor Source
Project Activity	Power plants servicing the electricity grid	CO_2	Yes	Main emission source
		CH_4	No	Minor Source
		N_2O	No	Minor Source

SSC-CPA-DD will provide evidence that the light bulbs involved in the SSC-CPA are located within the geographical boundary of the Republic of South Africa.

B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

>>

Data / Parameter:	$EF_{CO2,ELEC,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 emissions factor for electricity displaced from the grid serving the households that participate in the SSC-CPA during the monitoring interval y, calculated according to the latest approved version Tools to Calculate Emission Factors V2.2.1.
Source of data used:	Eskom grid emissions data: http://www.eskom.co.za/live/content.php?Item_ID=4226
Value applied:	0.9506
Justification of the choice of data or description of measurement methods and procedures actually applied :	Project proponent has obtained latest data from national utility and applied calculation methodology specified in "Tool to calculate the emission factor for an electricity system" version 2.2.1. Details of calculations are provided in Annex 3.

Any comment:	-

Data / Parameter:	**X_i**
Data unit:	hours/year
Description:	Number of operating hours per year for equipment type i (hours)
Source of data used:	Calculated value
Value applied:	1,277.5 hours per year, or other value determined through a 90-day study.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The SSC-CPA implementer shall use either 3.5 hours per 24 hours period, or other value determined through a 90-day study. Hence the yearly value is fixed prior to the first ex-post monitoring survey.
Any comment:	-

Data / Parameter:	**NTG**
Data unit:	fraction
Description:	Net-to-gross adjustment factor
Source of data used:	Default AMS-II.J value
Value applied:	0.95
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Project Activity shall use a default value of 0.95.
Any comment:	-

Data / Parameter:	**L_i**
Data unit:	hours
Description:	rated average operating hours for CFL type *i*
Source of data used:	Life test report of CFLs
Value applied:	Determined on CPA by CPA basis
Justification of the choice of data or description of measurement methods and procedures actually applied :	Determined as per the independent life tests of the CFLs as per national/international standard and manufacturer technical data. The value is fixed ex-ante.
Any comment:	-

B.5.2. Ex-ante calculation of emission reductions:

>> The emission reduction achieved by the SSC-CPA project activity is determined using the AMS-II.J. "Demand-side activities for efficient lighting technologies". The sequence of calculations are reproduced as follows:

The electricity saved by the project activity in year y is calculated as indicated in equations (1) and (2):

$$NES_y = \sum_{i=1}^{n} Q_{PJ,i} \times \left(1 - LFR_{i,j}\right) \times ES_i \times \frac{1}{\left(1 - TD_y\right)} \times NTG \quad (1)$$

where

$$ES_i = \left(P_{i,BL} - P_{i,PJ}\right) \times O_i \times 365 / 1000 \quad (2)$$

NES_y	Net electricity saved in year y (kWh)
$Q_{PJ,i}$	Number (quantity) of pieces of equipment (CFLs) of type *i* distributed or installed under the project activity (units). In total for all "*i*", this value shall be equal to or less than documented number of all baseline incandescent lamps destroyed. Once all the project CFLs are distributed or installed, $Q_{PJ,i}$ is a constant value independent from *y*.
i	Counter for equipment type (i.e. wattage type of CFL, e.g. 20 W CFL)
n	Number of types of equipment *i*
ES_i	Estimated annual electricity savings for equipment of type *i*, for the relevant technology (kWh)
$LFR_{i,y}$	Estimated Lamp Failure Rate for equipment type *i* in year y (fraction)
TD_y	Average annual technical grid losses (transmission and distribution) (%) during year *y* for the grid serving the locations where the devices are installed, expressed as a fraction.
NTG	Net-to-gross adjustment factor, a default value of 0.95 is to be used unless a more appropriate value based on a lighting survey from the same region and not older than 2 years is available.
$P_{i,BL}$	Rated power of the baseline lighting devices of the group *i* lighting devices (Watts)
$P_{i,PJ}$	Rated power of the project lighting devices of the group *i* lighting devices (Watts)
O_i	Average daily operating hours of the lighting devices replaced by group of *i* lighting devices (Watts)

The Lamp Failure Rate ($LFR_{i,y}$) is the percentage of lamps that have failed during a year. The average life or rated average life is used to calculate the Lamp Failure Rate as follows:

If $y \times X_i < L_i$ $\quad LFR_{i,y} = y \times X_i \times (100 - R_i) / (100 \times L_i)$ (3)

If $y \times X_i \geq L_i$ $\quad LFR_{i,y} = 1$

where

L_i	Average Life (or Rated Average Life until average life value is available) for equipment type *i* (hours)
R_i	Percent of CFLs of type *i* operating at the rated lifetime (use a value of 50%)
X_i	Number of operating hours per year for CFL type *i* (hours)
y	Counter for year

Under the PoA, the Lamp Failure Rate is calculated ex-ante using the equation (3) and adjusted ex-post based on monitoring survey results.

Emission reductions made by the project per year can thus be deduced from the annual electricity saved multiplied by the emission factor:

$$ER_y = NES_y \times EF_{CO2,ELEC,y} \quad (4)$$

where

ER_y	Emission reductions in year *y* (tCO_2e)
$EF_{CO2,ELEC,y}$	Emission factor in year y calculated in accordance with the provisions in provisions in the "Tool to calculate the emission factor for an electricity system" (version 2.2.1) (tCO_2/MWh).

In order to ensure that the CPA remains below the annual small-scale threshold of 60 GWh, and given that the final composition of baseline vs. project lamps is unknown, the project developer will adjust the final number of CFLs accordingly in order to respect the small-scale threshold of energy savings.

B.5.3. Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
Year 1				
Year 2				
Year 3				

Year 4				
Year 5				
Year 6				
Year 7				
Year 8				
Year 9				
Year 10				
Total (tonnes of CO_2 e)				

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

>>A detailed description of the monitoring plan of the Project Activity is provided in Annex 4. In summary, the project proponent will implement the following monitoring activities:

1. CFL distribution
2. Ex-post Monitoring Survey
3. ICL destruction.

1. CFL Distribution

The SSC-PA will involve the replacement ICLs with new CFLs free of charge using the following distribution mechanisms:

(i) Door to door installation
(ii) Gate to gate exchange
(iii) Stationary point exchange.

The distribution process will be supported by an education campaign to ensure households are aware of the Project Activity, and that distribution occurs relatively quickly. The method of distribution and associated awareness-raising campaigns will focus on maximizing the number of CFLs provided to participating household, and that those CFLs provided are installed in high usage areas.

In all cases, a data form has to be filled and signed by the household. The data from these forms will be captured within a data management system (DMS) shortly after CFLs being installed or exchanged. The Project Activity will follow the record keeping and monitoring requirements stipulated in ASM II.J and maintain appropriate records documenting the following variables for each household participating in the Project Activity:

- Geographical location of each SSC-CPA
- Name of household (name and surname)
- The address (street number, name and suburb) of household (pole numbers and transformer numbers to be used when house numbers and street names aren't available)
- Meter number of household
- Date of distribution and installation (if different) of CFLs
- Specifications of ICLs replaced, including: number replaced, power rating or wattage

- Specifications of CFLs installed, including: number installed, power rating or wattage, type and/or model
- Date of return and destruction of ICLs replaced
- Date of return and disposal of distributed CFLs that were broken
- A household signature accepting to transfer all the carbon credits to Eskom.

The Project Activity implementer will be responsible for the management of records and data associated with the Project Activity. Data will be stored in secure project databases for the duration of the Project Activity crediting period, plus two years. The information stored in the databases will be used as the basis of the production of monitoring reports used to quantify emission reductions and claim CERs.

The number and power rating of all ICLs collected will be used to determine the weighted average power rating of the baseline light bulbs ($P_{i,BL}$). Similarly, the number and power rating of all CFLs installed will be used to determine weighted average power rating of the project light bulbs ($P_{i,PJ}$).

The diagram below summarises the Quality Control Process post installation:

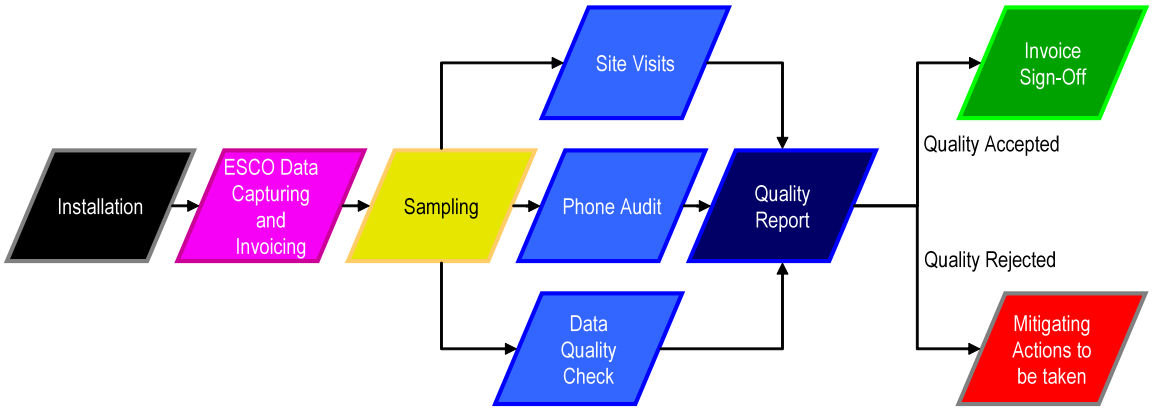
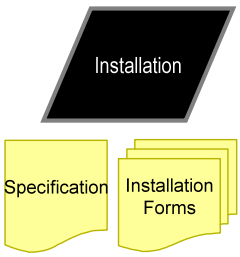


Figure 2: Quality Control Process

a. Installation



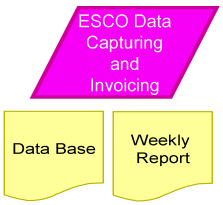
The ESCO will provide the Eskom & Karebo Project Team with an installation plan. The Eskom Project Team will only interface with the ESCO and not with any subcontractor. The ESCO will carry all risks associated with installation.

The ESCO will receive a Specification Document (ESCO Requirements) outlining the basic requirements.

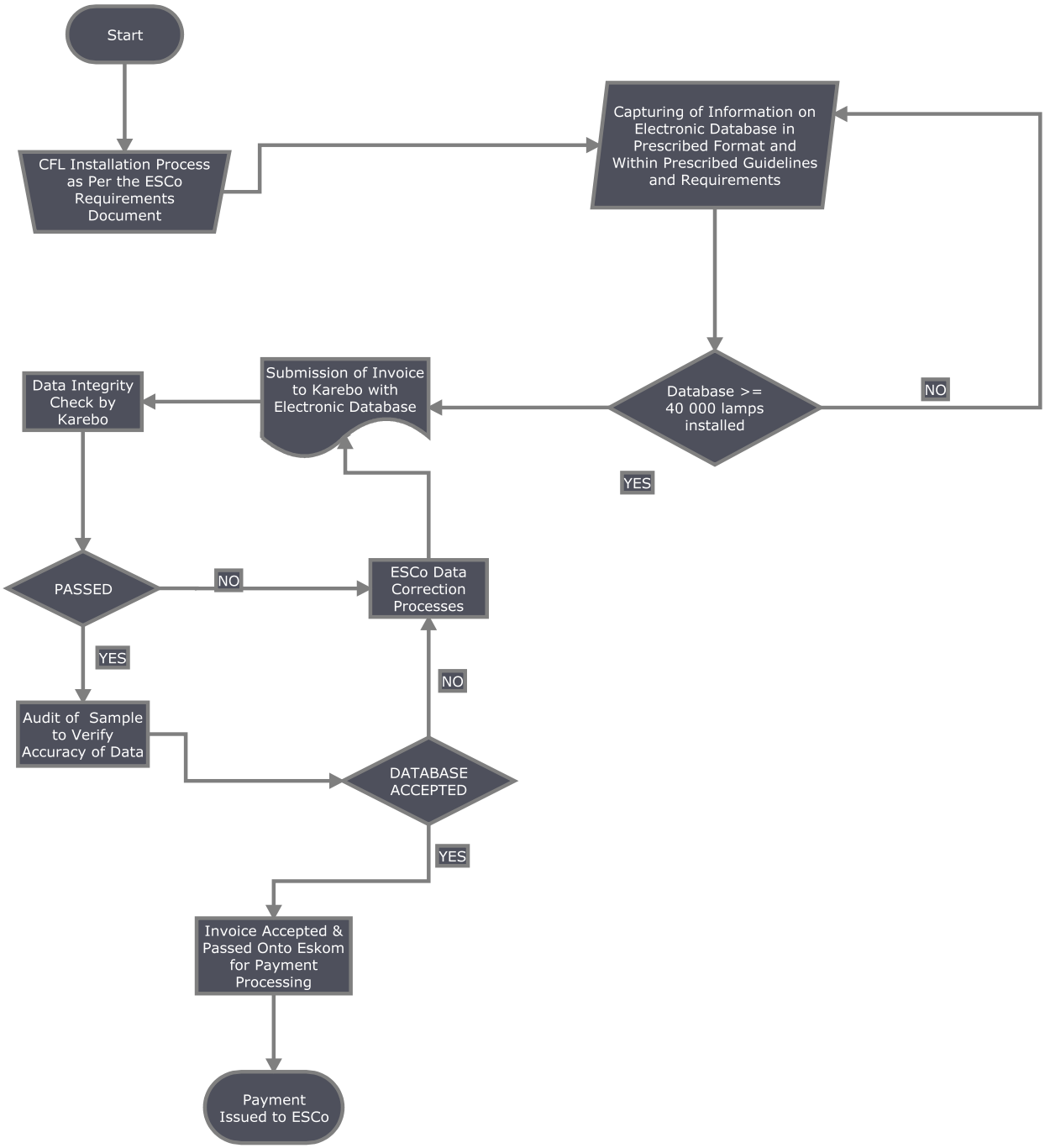
Installers are required to complete installation forms for each and every

installation. The forms must be filed and submitted to Eskom where they will be stored for audit purposes.

b. ESCO Database and Invoicing



Installation data will be captured by the ESCO/s in a prescribed database template. Weekly Reports and Invoices will be derived from the database. Weekly Reports, Invoices and databases must be submitted (Dates for submitting will be provided).

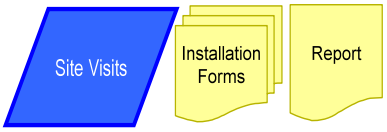

Start
CFL Installation Process as Per the ESCo Requirements Document
Capturing of Information on Electronic Database in Prescribed Format and Within Prescribed Guidelines and Requirements
Database >= 40 000 lamps installed
NO
YES
Submission of Invoice to Karebo with Electronic Database
Data Integrity Check by Karebo
PASSED
NO
ESCo Data Correction Processes
YES
NO
Audit of Sample to Verify Accuracy of Data
DATABASE ACCEPTED
YES
Invoice Accepted & Passed Onto Eskom for Payment Processing
Payment Issued to ESCo

c. Sampling

The Project Team will take a weekly sample from each of the Databases submitted for that week.
a) Minimum of 0.85% of the total installations will be submitted for site visits.
b) Minimum of 0.15% of the total installations will be submitted for a Telephone Audit.

Random samples will be generated, utilizing the "Random" function on Microsoft Excel. Planning for the Audit will be derived from the Planning submitted by the ESCO/s.

d. Site Visits

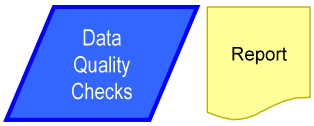


Karebo Systems will be conducting site visits. They might also be accompanied by a Eskom DSM representative. During the site visit Karebo Systems will complete a form and they will capture the data after the installation in the site visit report.

e. Phone Audits

This function will also be conducted by Karebo Systems by the aid of the sample data (including telephone numbers). The audit results will be captured in a report.

f. Data Quality Checks



Data purity will be checked during site visits and Phone Audits. "Sanity Checks" will also be done from time to time to ensure the quality of data. Should issues occur, a report will be drafted and submitted to the relevant ESCO. Any irregularities will result in non-payment of invoices.

g. Quality Report

A Weekly Quality Report will be submitted with the invoices to Eskom for sign-off. The Report will summarize the findings of the site visits, phone audit and data purification reports and note the approval or rejection of the invoice submitted by the ESCO.

2. Ex-post Monitoring Survey

The emission reductions of the Project Activity are calculated *ex ante* and adjusted *ex post* using data from the *ex post* monitoring surveys. *Ex post* monitoring surveys are required within the first year after installation to adjust the Net Electricity Savings (NES_y) considering the actual Lamp Failure Rate ($LFR_{i,y}$) data, the actual average daily operating hour of the light bulbs replaced (O_i) (if a default value is not selected), the CFL Average Life (if a CFL Rate Average Life was used initially), and using the actual quantity of CFLs for each wattage group i ($Q_{PJ,i}$).

Due to the large number of installations, it is not possible to monitor all households in the Project Activity. Establishing a project sample group is a statistical procedure to determine a sampling mean that can be applied to the broader population within a project. The *ex post* monitoring surveys are conducted following the generic instructions for conducting the surveys and sampling (AMS-II.J, point 20 and UNFCCC Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (version 03)):

- The sampling size is determined by minimum 95% confidence interval and the 10% maximum error margin; the size of the sample shall be no less than 100;
- Sampling must be statistically robust and relevant, i.e., the survey has a random distribution and is representative of target population (size, location);
- The method to select respondents for interviews is random;
- The survey is conduced by site visits;
- Only persons over age 12 are interviewed;
- The SSC-CPA-DD must contain the design details of the survey.

The procedure to determine the project sample group is presented in Annex 4.

3. ICL Destruction

ICLs collected during the exchanges will be stored and then destroyed to prevent leakage. The number of ICLs collected and destroyed, as well as their power rating shall be recorded in the data management system. In addition, the method of destruction and its supervision must be documented and witnessed.

To ensure there is no leakage, at the beginning of the monitoring interval, the SSC-PA implementer must confirm that the amount of ICLs destroyed, matches the data collected in the DMS and the amount of CFLs distributed.

The processes for the destruction of incandescent lightbulbs is described below:

- A separate company will be used to verify the quantity and wattage type of lamps collected.
- A representative must be present on behalf of the ESCO during crushing in case any discrepancies should occur and paperwork must be signed off between both crushing company and the ESCO.
- Escos are responsible for the disposal of egg trays and empty boxes.

Sorted lightbulbs must be kept with the ESCO unless stated otherwise and transported by the ESCO to crushing venue

- Boxes will be checked randomly at the crushing location for correct quantification and wattage type before crushing, if there are any discrepancies the entire consignment of returns will be sent back to be corrected by the ESCO.

B.6.2. Data and parameters to be monitored by each SSC-CPA:	
Data / Parameter:	**N**
Data unit:	-
Description:	Sample size of Monitoring Survey.
Source of data to be used:	Calculated as per statistical requirements in UNFCCC Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (version 03) (95% confidence interval and +-10% error margin) as detailed in Annex 4
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Presented in the SSC-CPA monitoring report but it will be no less than 100 houses
Description of measurement methods and procedures to be applied:	Calculated as per statistical requirements in UNFCCC Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (version 03) (95% confidence interval and +-10% error margin).
QA/QC procedures to be applied:	Independent statistical experts from an appropriately qualified South African University will design the sampling methodology. The project proponents shall determine the representative sample size with minimum 95% confidence interval and 10% maximum error margin. To be conservative the minimum number of households surveyed should be one hundred.
Any comment:	-

Data / Parameter:	**$Q_{PJ,i}$**
Data unit:	number
Description:	Number of CFLs of the group of I CFLs (e.g. 20W CFL) in operation during the first 12 months of distribution
Source of data to be used:	Data Management System and Ex-post survey
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be recorded by SSC-CPA based on the ex-post $Q_{PJ,i}$ survey
Description of measurement methods and procedures to be applied:	The project proponents will determine $Q_{PJ,}$ using the ex-post survey and the data will be entered into the Project Activity Data Management System.
QA/QC procedures to be applied:	Use of standardised data forms and compliance protocols of Project Activity.

	The DMS will use industry standard software, databases, infrastructure and back-up procedures to allow full auditability with the aim of ensuring long-term data integrity and security so that data is not misrecorded, overwritten or lost. Data is verified in a timely manner at point of data entry to ensure valid and non-duplicate customer/building information, and an accurate number of lamps and equipment replaced is recorded.
Any comment:	All data will be stored in the project database for at least two years after the crediting period or the last issuance of CERs, for this programme, whichever occurs later.

Data / Parameter:	**$LFR_{i,y}$**
Data unit:	%
Description:	Lamp Failure Rate for CFL type *i* in year y.
Source of data to be used:	Ex-ante as per AMS-II.J and Ex-post from Monitoring Survey
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Linear rate of 6.39% per year for the purposes of Ex Ante Calculations however actual value to be recorded by SSC-CPA based on the ex-post monitoring survey
Description of measurement methods and procedures to be applied:	Determine as per monitoring surveys of the installed CFLs. The survey will consist of identifying CFLs, with unique Project Activity markings that are installed and operating. Under the survey, only CFLs with an original marking can be counted as installed. While CFLs replaced as part of a regular maintenance or warranty program can be counted as operating, CFLs cannot be replaced as part of the survey process and counted as operating.
QA/QC procedures to be applied:	Independent statistical experts from an appropriately qualified South African University will design the sampling methodology. The project proponents shall determine the representative sample size with minimum 95% confidence interval and 10% maximum error margin. To be conservative the minimum number of households surveyed should be one hundred.
Any comment:	All data will be stored in the project database for at least two years after the crediting period or the last issuance of CERs, for this programme, whichever occurs later.

Data / Parameter:	**Lamp distribution data**
Data unit:	-
Description:	The start and completion date of CFL Distribution will be clearly described. Household information will be available in the Data Management System as described in the Operational Manual.
Source of data to be used:	Data Management System
Value of data applied for the purpose of calculating expected emission reductions in	To be recorded for each SSC-CPA: Distribution of CFLs - Start date: dd/mm/yyyy Distribution of CFLs - Completion date: dd/mm/yyyy

section B.5	Household details will be provided in the SSC-CPA Data Management System.
Description of measurement methods and procedures to be applied:	ESKOM will engage the Project Management Company to ensure all data is properly captured and stored as per the Operational Manual (ESCO Requirements Document V6).
QA/QC procedures to be applied:	The data should be documented and verifiable by the project proponents and the DOE at random. Each employee involved in the project will be trained in the use of the DMS to ensure accurate record keeping. The DMS will use industry standard software, databases, infrastructure and back-up procedures to allow full auditability with the aim of ensuring long-term data integrity and security so that data is not misrecorded, overwritten or lost. Data is verified in a timely manner at point of data entry to ensure valid and non-duplicate customer/building information, and an accurate number of lamps and equipment replaced is recorded.
Any comment:	All data will be stored in the project database for at least two years after the crediting period or the last issuance of CERs, for this programme, whichever occurs later.

Data / Parameter:	$N_{Destroyed}$
Data unit:	number
Description:	Number of ICLs collected and destroyed
Source of data to be used:	Data Management System and scrapping reports.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	For ex ante calculations a figure of 1,000,000 ICLs has been used. This figure may be adjusted accordingly as described in Section E.6.2 Table 1 of the PoA-DD.
Description of measurement methods and procedures to be applied:	The total number of ICLs will be available through the data management system and will be verified with the scrapping reports provided to Eskom by the independent waste management contractor.
QA/QC procedures to be applied:	The data for the destruction of the baseline ICLs should be documented and verifiable by the DOE. The results of the ICL crushing reports will be stored in the DMS. The DMS will use industry standard software, databases, infrastructure and back-up procedures to allow full auditability with the aim of ensuring long-term data integrity and security so that data is not misrecorded, overwritten or lost. Data is verified in a timely manner at point of data entry to ensure valid and non-duplicate customer information, and an accurate number of lamps replaced is recorded.
Any comment:	All data will be stored in the project database for at least two years after the crediting period or the last issuance of CERs, for this programme, whichever occurs later.

Data / Parameter:	**$P_{i,BL}$**
Data unit:	W
Description:	Rated power of the baseline ICLs in group *i*
Source of data to be used:	Weighted average calculated using rated power of the baseline ICLs as recorded in the Project Activity database.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	For ex ante calculations a figure of 63 Watts has been used. To be recorded in the Data Management System.
Description of measurement methods and procedures to be applied:	The project proponents will monitor $P_{i,BL}$ during the ICL replacement. The data will be entered into the Data Management System (as per Operational Manual procedures) and fixed for crediting period duration.
QA/QC procedures to be applied:	Each employee involved in the project will be trained in the use of the DMS to ensure accurate record keeping. Use of standardized data forms and compliance protocols of the Project Activity. The DMS will use industry standard software, databases, infrastructure and back-up procedures to allow full auditability with the aim of ensuring long-term data integrity and security so that data is not misrecorded, overwritten or lost. Data is verified in a timely manner at point of data entry to ensure valid and non-duplicate customer information, and an accurate number of lamps replaced is recorded.
Any comment:	All data will be stored in the project database for at least two years after the crediting period or the last issuance of CERs, for this programme, whichever occurs later.

Data / Parameter:	**$P_{i,PJ}$**
Data unit:	W
Description:	Rated power of the project CFLs in group *i*
Source of data to be used:	Weighted average calculated using rated power of the CFLs as recorded in Project Activity Data Management System.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	For ex ante calculations a figure of 17.98 Watts has been used. To be recorded in the Data Management System.
Description of measurement methods and procedures to be applied:	The project proponents will monitor $P_{i,PJ}$ during the CFL distribution. The data will be entered into the Data Management System (as per Operational Manual procedures) and fixed for crediting period duration.
QA/QC procedures to be applied:	Use of standardized data forms and compliance protocols of Project Activity. The DMS will use industry standard software, databases, infrastructure and back-

	up procedures to allow full auditability with the aim of ensuring long-term data integrity and security so that data is not misrecorded, overwritten or lost. Data is verified in a timely manner at point of data entry to ensure valid and non-duplicate customer information, and an accurate number of lamps replaced is recorded.
Any comment:	All data will be stored in the project database for at least two years after the crediting period or the last issuance of CERs, for this programme, whichever occurs later.

Data / Parameter:	**O_i**
Data unit:	hours/day
Description:	Average daily operating hours of the baseline ICLs of the group *i*
Source of data to be used:	Either default value or results of 90 day monitoring survey
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3.5 hours per 24 hours period or other value determined through 90 day study
Description of measurement methods and procedures to be applied:	As per footnote 6 in AMS-II.J v4, the project participant can decide prior to the first *ex- post* measurement whether to use the 3.5 hours default value or ex post measured operating hours for determining O_i. The design approach to a possible 90-day monitoring survey is provided in Annex 4 – Monitoring Plan.
QA/QC procedures to be applied:	In the case that the 90-day survey option is selected, the CME will engage independent statistical experts from an appropriately qualified South African University to undertake the 90-Day survey method and precision as per Annex 4.
Any comment:	-

Data / Parameter:	**TD_y**
Data unit:	%
Description:	Average annual technical grid losses
Source of data to be used:	Published in Eskom Annual report 2011
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8.3%
Description of measurement methods and procedures to be applied:	The methodology requires that the average technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. The project proponents have chosen to source the data from the national utility, Eskom.
QA/QC procedures to be applied:	The project proponents have chosen to source the data from the national utility, Eskom Annual Report.

Any comment:	-

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

✓ Please tick if this information is provided at the PoA level. In this case sections C.2. and C.3. need not be completed in this form.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>Not required – environmental analysis undertaken at PoA level

C.3. Please state whether an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA), in accordance with the host Party laws/regulations:

>> An Environmental Impact Assessment is not required for a typical SSC-CPA included in the PoA.

SECTION D. Stakeholders' comments

>>

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

`

✓ Please tick if this information is provided at the PoA level. In this case sections D.2. to D.4. need not be completed in this form.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

>> Not required – Stakeholder Consultation completed at PoA level

D.3. Summary of the comments received:

>>Not required – Stakeholder Consultation completed at PoA level

D.4. Report on how due account was taken of any comments received:

>>Not required – Stakeholder Consultation completed at PoA level

Annex 1

CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA

Organization:	BNP Paribas
Street/P.O.Box:	10 Harewood Avenue
Building:	
City:	London
State/Region:	
Postfix/ZIP:	NW1 6AA
Country:	United Kingdom
Telephone:	+44 207 595 3418
FAX:	
E-Mail:	francois.carre@uk.bnpparibas.com
URL:	www.bnpparibas.co.uk
Represented by:	Francois Carre
Title:	Carbon Portfolio Manager
Salutation:	Mr.
Last Name:	Francois
Middle Name:	
First Name:	Carre
Department:	Commodity Derivatives
Mobile:	+44 792 045 0329
Direct FAX:	
Direct tel:	+44 207 595 3418
Personal E-Mail:	francois.carre@uk.bnpparibas.com

Organization:	Eskom Holdings SOC Limited
Street/P.O.Box:	*Megawatt Park, Maxwell Drive*
Building:	
City:	*Sunninghill, Sandton*
State/Region:	Gauteng
Postfix/ZIP:	
Country:	South Africa
Telephone:	+27 11 800 6995
FAX:	
E-Mail:	Enoch.Liphoto@eskom.co.za
URL:	www.eskom.co.za
Represented by:	
Title:	Senior Advisor – Climate Change
Salutation:	Mr
Last Name:	Liphoto

Middle Name:	Lerato
First Name:	Enoch
Department:	Sustainability and Innovation Department
Mobile:	+27 72 356 6373
Direct FAX:	
Direct tel:	+27 11 800 6995
Personal E-Mail:	liphote@eskom.co.za

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No Public Funding is used for this project

Annex 3

BASELINE INFORMATION

The baseline scenario for the SSC-CPA has been determined to be the ongoing use of ICLs. The emissions associated with continued ICL use are monitored by proxy based on measuring the use of CFLs distributed under the PoA, and multiplying energy savings by a grid emission factor. This Annex presents a calculation of the emission factor for the South African electricity grid which will be used for the duration of the PoA crediting period to determine baseline emissions. This Annex should be read in conjunction with the GEF Calculation spreadsheet provided to the DOE for the purposes of validation.

GRID EMISSION FACTOR

The methodological tool to calculate the emission factor for an electricity system determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system. In order to achieve this, the project developer must calculate the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM). The operating margin refers to existing power plants whose electricity generation would be affected by the proposed CDM Project Activity. The build margin reflects the power units whose construction would be affected by the proposed CDM Project Activity.

The *"Tool to calculate emission factors for an electricity system" (version 2.2.1)* mentions the following steps:

Step 1: Identify the relevant electric power system
Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)
Step 3: Select an operating margin method
Step 4: Calculation of the operating margin emission factor
Step 5: Calculate the build margin emission factor
Step 6: Calculate the combined margin emission factor

Step 1: Identify the relevant electric power system

The "*Tool to calculate emission factors for an electricity system*" (version 2.2.1) stipulates that:

"For the purpose of this tool, the reference system is the project electricity system. Hence electricity transfers from a connected electricity systems to the project electricity system are defined as electricity imports while electricity transfers from the project electricity system to connected electricity systems are defined as electricity exports.

For the purpose of determining the build margin emission factor, the spatial extent is limited to the project electricity system;

For the purpose of determining the operating margin emission factor, use one of the following options to determine the CO_2 emission factor(s) for ***net electricity imports*** *from a connected electricity system:*

0 tCO_2/MWh; or

(a) The weighted average operating margin (OM) emission rate of the exporting grid, determinedas described in Step 4 (d) below; or
(b) The simple operating margin emission rate of the exporting grid, determined as described inStep 4 (a), if the conditions for this method, as described in Step 3 below, apply to the exporting grid; or
(c) The simple adjusted operating margin emission rate of the exporting grid, determined as described in Step 4 (b) below."

The project will be implemented within the geographic boundary of South Africa. Therefore the relevant project electricity system is the South African national grid. National utility, Eskom generates, transmits, and distributes electricity to industrial, mining, commercial, agricultural, and residential customers, and also to redistributors. The regional generation and consumption of Eskom transmission grids are interlinked and no distinction can be made between provincial or sectoral generation and consumption. The whole transmission system is taken as a homogenous mix of electricity supply by all generators.

Although since 2002 Eskom has not had exclusive generation rights in South Africa, it does have the practical monopoly on the bulk of electricity generated in the country, supplying about 95 percent of South Africa's electricity[6].

The national transmission network is partly interconnected with countries from the Southern African Development Community region (SADC). Hence electricity transfers from SADC to the project electricity system are defined as electricity imports.

According to The "*Tool to calculate emission factors for an electricity system*" (version 2.2.1) only **net electricity imports** are to be taken into account for the purpose of calculating the operating margin. Eskom is a net exporter (exports exceed imports) of electricity to the region[7], therefore there are no net electricity imports to be considered in the calculation of the operating margin.

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

Option I has been chosen for this step: Only grid power plants are included in the calculations.

No off-grid power plants have been included since these play a very minor role in South Africa's overall power generation as explained in Step 1.

Step 3: Select an operating margin method

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[6] Proportion of Eskom generation into South African grid reported at: http://www.energy.gov.za/files/electricity_frame.html
[7] Source: Eskom Holdings Limited Integrated Report 2011, p 179 and Eskom Holdings Limited Integrated Report 2011, p 150.

In accordance with the Tool, the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) must be based on one of the following methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch data analysis OM, or
d) Average OM.

The project developer has selected option a) Simple OM. As described by Eskom electricity production tables, the Low Cost/Must Run power plants in the system account for 0.30% of average electricity production for the past 5 years.[8]

"The simple OM method (option a) can only be used if low-cost/must-run resources2 constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production."

The Tool also states in its footnote number 2 that:

"Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants."

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

- Ex ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation.

- Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the Project Activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used.

For this project, the project developer has chosen to use the Ex ante option. The latest data available from the Eskom website (2009/10) are the electricity generation and fuel consumption from coal fired power plants for the years 2007/8, 2008/9 and 2009/10. This data is available from the CDM calculations

[8] See Grid Emission Factor calculation sheet for determination of the electricity generation by Low Cost/Must Run power plants. Data for the GEF calculation sheets is sourced from Eskom: http://www.eskom.co.za/content/calculationTable.htm

webpage provided by Eskom[9].

Step 4: Calculation of the operating margin emission factor

The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The project developer has chosen Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit using equation (1) from the Tool:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(1)}$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	=	All power units serving the grid in year *y* except low-cost / must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3

The project developer has also chosen Option A1 to calculate the emission factor of each power unit as per equation (2) from the Tool:

[9] http://www.eskom.co.za/content/calculationTable.htm

Option A1. If for a power unit *m* data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}} \quad \textbf{(2)}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units
i	=	All fossil fuel types combusted in power unit *m* in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

Electricity and fuel consumption were obtained from Eskom CDM Calculations website[10] while net calorific values for each year were obtained from Eskom Annual Report 2010[11]. The project developer also used the emission factors from 2006 IPCCC guidelines[12] for sub-bituminous coal[13] and natural gas.

A summary of the Operating Margin Emission Factor calculation can be found below:

[10] http://www.eskom.co.za/content/calculationTable.htm. All sources are referenced further in the GEF Calculation sheet.

[11] http://financialresults.co.za/2011/eskom_ar2011/fact_sheets_11.php. All sources are referenced further in the GEF Calculation sheet.

[12] 2006 IPCC Guidelines for National Greenhouse Gas Inventories – Table 1.4 Lower Level. All sources are referenced further in the GEF Calculation sheet.

[13] Greenhouse Gas Inventory South Africa, Environment Affairs & Tourism, May 2009 (page 13)

OPERATIONAL MARGIN			
	2007/8	**2008/9**	**2009/10**
Total Electricity Generated (ex LC-MR) (MWh)	222,906,667	211,690,925	215,953,317
Emissions (tCO2)	215,195,689	215,219,017	219,314,650
Emission Factor (tCO2/MWh)	0.965	1.017	1.016

OPERATIONAL MARGIN (tCO2/MWh)	**0.999**

Step 5: Calculate the build margin emission factor

Identify the cohort of power units to be included in the build margin

As per the Tool to Calculate Emission Factors Version 2.2.1, in terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The project developer has chosen **Option 1** to calculate the Emission Factor.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual= electricity generation ($AEG_{SET\text{-}5\text{-units}}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. Ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2$ Å~ AEG_{total}), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{-}>10yrs}$).

As per the process described above:

(a) The most recently built power plants that provided electricity and fuel consumption data according to

the Eskom CDM calculations[14] website are:

Power Plant	Commissioned Date	2009/10 Electricity Production (MWh/Year)
Majuba	1/04/96	22,340,081
Kendal	1/10/88	23,307,031
Matimba	4/12/87	27,964,141
Lethabo	22/12/85	25,522,698
Tutuka	1/06/85	19,847,894
Total		118,981,845

The project participants excluded the power plants Palmiet (1988), Ankerli (2007) and Gourikwa (2007) as no electricity generation and/or fuel consumption data is provided by Eskom[15]. Removing these power plants from the build margin makes the calculation of Build Margin more accurate and conservative by allowing power plants with higher electricity production and fuel consumption to be included.

The total Energy Production of the selected plants is equivalent to 55.1% of the electricity produced by the system in 2009/10 (215,953,317 MWh)

(b) The total Electricity Generation of the System in 2009/10 is 215,953,317. To reach 20% of electricity generation with the most recently built power plants the project developer has identified the following plants:

Power Plant	Commissioned Date	2009/10 Electricity Production (MWh/Year)
Majuba	1/04/96	22,340,081
Kendal	1/10/88	23,307,031
Total		45,647,112

The total Energy Production of the selected plants is equivalent to 21.1% of the electricity produced by

[14] ESKOM website http://www.eskom.co.za/content/calculationTable.htm

[15] See data provided by Eskom http://www.eskom.co.za/content/calculationTable.htm

the system in 2009/10 (215,953,317 MWh)

(c) $SET_{5\text{-units}}$ = 118,981,845 MWh = 55.1% of the total electricity produced by the system

$SET_{\geq 20\%}$ = 45,647,112 MWh = 22.1% of the total electricity produced by the system

Therefore $SET_{5\text{-units}}$ will be selected as per the tool, however all power plants from $SET_{5\text{-units}}$ started to generate electricity more than 10 years ago. As such, the project developer has identified registered CDM projects generating electricity in South Africa and has included them in the calculation of the Build Margin as set out below.

(d) As per the date of this PDD being completed (6th July 2011), 11 CDM projects have been registered for South Africa in the Energy Industries (renewable - / non-renewable sources) scope.

Registered	Title	Methodology
25-Dec-10	Fuel switch project on the Gluten 20 dryer of Tongaat Hulett Starch Pty (Ltd) Germiston Mill	AMS-III.B. ver. 14
8-Oct-09	Bethlehem Hydroelectric project	AMS-I.D. ver. 13
24-Aug-09	Alton Landfill Gas to Energy Project	AMS-I.D. ver. 13 AMS-III.G. ver. 6
26-Mar-09	Durban Landfill-Gas Bisasar Road	AM0010
18-Jul-08	Kanhym Farm manure to energy project	AMS-I.D. ver. 11 AMS-III.D. ver. 12
19-Oct-07	Transalloys Manganese Alloy Smelter Energy Efficiency Project	AM0038 ACM0002 ver. 6
20-May-07	Mondi Richards Bay Biomass Project	AM0036 ver. 1
12-Feb-07	Tugela Mill Fuel Switching Project	AMS-I.C. ver. 8
15-Dec-06	Durban Landfill-gas-to-electricity project – Mariannhill and La Mercy Landfills	AM0010
29-Sep-06	PetroSA Biogas to Energy Project	AMS-I.D. ver. 9
27-Aug-05	Kuyasa low-cost urban housing energy upgrade project, Khayelitsha (Cape Town; South Africa)	AMS-I.C. ver. 5 AMS-II.C. ver. 5 AMS-II.E. ver. 5

Out of these 11 projects, only 3 CDM projects are producing electricity and feeding it back into the grid:

Power Plant	Installed capacity (MW)	Commissioning Date	Fuel type	2009/10 Electricity Production (MWh)
Bethlehem Hydroelectric project (**)	7	8/10/09	Hydro	1,497
Durban Landfill-Gas Bisasar Road (**)	4	26/03/09	Landfill-Gas	13,218
Durban Landfill-gas-to-electricity project – Mariannhill and La Mercy Landfills (**)	0.5	15/12/06	Landfill-Gas	4,198
			Total	18,913

The total Energy Production of the selected CDM plants is equivalent to 0.01% of the total electricity produced by the system in 2009/10 (215,953,317 MWh).

(e) As identified by the project developer, only 3 CDM power plants are supplying electricity into the grid, and there are no further $SET_{sample\text{-}CDM}$ plants that can be included in the Build Margin calculation as suggested by the Tool.

(f) By using the initial set of power plants identified in step (a) ($SET_{5\text{-}units}$) plus the set of CDM power plants identified in $SET_{sample\text{-}CDM}$ the final group of plants that compromise 20% of the electricity system is as follows:

Power Plant	Commissioned/ Registration Date	2009/10 Electricity Production (MWh/Year)
Majuba	1/04/96	22,340,081
Kendal	1/10/88	23,307,031
Bethlehem Hydroelectric project (**)	8/10/09	1,497
Durban Landfill-Gas Bisasar Road (**)	26/03/09	13,218
Durban Landfill-gas-to-electricity project – Mariannhill and La Mercy Landfills (**)	15/12/06	4,198
Total		45,666,025

The total Energy Production of the selected plants is equivalent to 21.1% of the electricity produced by the system in 2009/10 (215,953,317 MWh)

Calculate the build margin emission factor

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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(3)}$$

Where:

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

Given that power units included in the build margin *m* correspond to the sample group $SET_{sample\text{-}CDM\text{->}10yrs}$, then, as a conservative approach, only option A2 from guidance in Step 4 (a) (equation 3) can be used and the default values provided in Annex 1 shall be used to determine the parameter $\eta_{m,y}$.

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \textbf{(4)}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$	=	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3

A summary of the Build Margin Emission Factor calculation can be found below:

BUILD MARGIN 2009/10	
Total Electricity Generation (MWh)	215,953,317
BM Plants - Electricity Generation (MWh)	45,666,025
% of Total Electricity Generation	21.15%
BM Plants - Emissions (tCO2)	41,215,641
BUILD MARGIN (tCO2/MWh)	**0.903**

Step 6: Calculate the combined margin emission factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (5)$$

Where:

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

The following default values should be used for W_{OM} and W_{BM}:

- Wind and solar power generation project activities: W_{OM} = 0.75 and W_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;
- All other projects: W_{OM} = 0.5 and W_{BM} = 0.5 for the first crediting period, and W_{OM} = 0.25 and W_{BM} = 0.75 for the second and third crediting period,9 unless otherwise specified in the approved methodology which refers to this tool.

Therefore, the combined margin emission factor for this project is:

$$\mathbf{EF_{grid,CM,y}} = (0.999 * 0.5) + (0.903 * 0.5) = 0.4995 + 0.4515 = 0.9506$$

Annex 4

MONITORING INFORMATION

The following is an extract from the Operational Manual to be used by ESCOs involved in the distribution of CFLs. It specifies the procedures for entering data from hard copy forms into the Project Activity DMS.

1. DATA CAPTURE

- Capturing to be done within 100 km of implementation area.
- The address for the capturing facility must be forwarded prior to the implementation of the project.
- ESCOs are required to remove all duplications and make the necessary corrections to their database as per their audit results.
- ESCOs must make their data forms available for inspection at the capturing facility.
- Only the format supplied by Project Management Company may be used. ESCOs can use their own front-end software to capture, only if the Project Management Company approves it.
- The database must remain on an Access 2007 format at all times.
- Forms must be captured within 48 hours of the physical installation.
- ESCOs are required to have their own IT support with the relevant experience in access, excel and word.
- Computers must be networked to allow for automatic consolidation.
- ESCOs are required to backup files daily and ensure that a suitable UPS unit is in place to accommodate power outages and other power failures.
- The door-to-door installations, door-to-door exchanges at the gate and exchange point forms should be kept on separate databases, as required for measurement and verification.

The following are mandatory fields:

- Home owner's name and surname
- House number (pole numbers to be used where there are no house numbers)
- Street name (transformer numbers where there is no street name)
- Suburb/Village
- Ward number
- Municipality
- ID number
- Meter number
- Details of CFL's installed
- Details of incandescents (ICLs) removed
- Installers reference number
- Exchange point (only if done through an exchange program)
- Date of installation
- Type of exchange
- Household signature accepting to transfer all the carbon credits to Eskom.

Minimum Computer and Software Specifications

- Processor: 1.3 GHz
- Ram: 1 GB Ram
- Windows operating system
- Windows office 2007 Business edition (including Access).

2. DATA STORAGE AND REPORTING

Information will be electronically saved in the Project Management Company's system and progress reports will be available every week.

The project proponent will develop and manage a data management system (DMS) that will record all information relevant to the Project Activity and monitoring, including:

- A list of households participating in the project, including information to identify households by name and address.
- A record of the incandescent bulbs collected (number and power) surrendered by, and replacement CFLs (number, power, type, model) provided to, each participating household.
- A list of households participating in ex post monitoring survey and the results of periodic checks of distributed CFLs. The proportion of CFLs still operating at the end of each monitoring period will be calculated and entered into the DMS.

3. EX POST MONITORING SURVEYS

As per AMS-II.J, paragraph 17 (a), *Ex post* monitoring surveys are required within the first year after installation to adjust the Net Electricity Savings (NES_y) considering the actual Lamp Failure Rate ($LFR_{i,y}$) data, the actual average daily operating hour of the light bulbs replaced (O_i) (if a default value is not

selected), the CFL Average Life (if a CFL Rate Average Life was used initially), and using the actual quantity of CFLs for each wattage group i ($Q_{P,J,i}$).

Subsequent *ex post* monitoring surveys to determine the *ex post* Lamp Failure Rate ($LFR_{i,y}$) can be carried out at one of the following intervals:

(1) Once every 3 years
(2) Once for every 30% of the elapsed Rated Average Life or Average Life of lamp.

A sample of CFLs installed in participating households will be surveyed as per the requirements described above to ensure continuing operation.

The households included in the ex post monitoring survey will be randomly selected from the database of participating households. The result of this sampling will determine the proportion of the total number of devices still operating at the end of each monitoring period, which will be applied to the calculation of emissions reductions for that period. CFLs distributed under the Project Activity will be marked with an Eskom logo (or equivalent) to ensure that they can be unambiguously differentiated from other light bulbs installed in the selected households.

As discussed above, the results obtained from the sampling process will be directly extrapolated across the entire population of households participating in the Project Activity. Therefore, the proportion of CFLs installed and continuing to function as determined through the household ex post monitoring survey will be taken to be representative of the pattern occurring in all households.

4. 90 DAY SURVEY TO DETERMINE DAILY HOURS OF USE

To determine the average daily operating hours of the lighting devices (ICLs) replaced by the group of *i* lighting devices, a default value of 3.5 hours per 24 hour period can be used. This default value can be used *ex ante* as well as *ex post* throughout the crediting period. Alternatively, the daily operating hours can be deduced from a continuous measurement of the usage hours of baseline or project lamps for a minimum of 90 days at a representative sample of households. This can be conducted prior to or concurrent with the first *ex post* monitoring survey. The days selected for measurement of operating hours shall be either representative of the annual variation of daylight hours in the region, or a correction factor must be applied in order to account for the variation in daylight.

As per footnote 6 in AMS-II.J v4, the project participant can decide prior to the first *ex- post* measurement whether to use the 3.5 hours default value or ex post measured operating hours for determining O_i in equation 2. At the time of commencing validation, the CME is undecided as to which option to pursue. A decision regarding whether the 3.5 hours/day default value or another value determined through a 90 day study shall be used will be made prior to the first ex-post monitoring survey of the initial SSC-CPA included under the PoA. This value will then be applied to all SSC-CPAs included under the PoA.

As per the "General Guidelines for Sampling and Surveys for Small Scale CDM Project Activities

(Version 01)" the sampling plan and approach for the 90-day and ex post monitoring Surveys (independently developed by experts from the North West University) can be found below:

5. 90 DAY SURVEY SAMPLINNG PLAN

a. Sampling Objective

Within the methodology it prescribes that if another daily operational hour value than the default 3.5 hour needs to be used, a 90 day survey is required. During this 90 day survey a representative amount of lights should be measured satisfying the 90/10 (confidence/precision) requirement [1]. During the 90 day period the daily operational hours of a sample of lights will be measured. An appropriate and representative time frame will be chosen and if required, compensation for difference in daylights hours will be incorporated.

b. Field Measurement Objectives and Data to be collected

The focus of the field measurements is to determine the average operational hours of a light in a South-African residential home. From 2004 the local power utility Eskom distributed millions of CFLs to residents in South Africa. During these rollouts Eskom specifically targeted the lights mostly used in a household. From databases compiled during all these rollouts, it was calculated that on average 6 CFLs were distributed per household.

Therefore it is also the aim to determine the average operational hours of the six most used CFLs in a South African household. The field metering should capture the following variables and data:

- Time stamp of when a light was switched on;
- Time stamp of when a light was switched off;
    - From this the duration the light was on can be determined.

Using the above the operational hours of each light for specific day can be recorded.
From an analysis of available technologies able to capture these variables the desired metering technology also had to satisfy the following:

- Remote transmission of data through a reliable technology;
- A non-intrusive technology that will not require rewiring or replacement of the current light fitting;
- A device with plug and play capabilities to reduce installation and maintenance time; and
- Most important, the technology should not change the lighting use behaviour of the household.

The only technology satisfying all these criteria and which will be appropriate for SA conditions, are a GSM based hour meters that sends the recorded data via SMS. The SMS data is received by a receiving SMS server and interpreted by the system. Every time the light is switched on the meter will send an SMS containing the information of the past 12 switching events. This improves robustness and ensures data delivery even thou some SMSs may get lost within the Mobile Network.

c. The target Population and Sampling Frame

The target population is South-African residents connected to the power grid of the local power utility Eskom which were included in the Eskom CFL rollout.

The sampling frame refers to all the information sources on the basis of which the project database is developed. During the Eskom CFL Rollouts, databases were accumulating listing relevant information of the households CFLs were distributed to.

The sample frame is developed from these databases with the frame consisting of street addresses or house location info (lot number etc). These databases are representative and can be used for CDM purposes since it covers the different income groups and also the different provinces and municipalities in SA.

d. Sample Method

The Sample Method used is known as Simple Random Sampling. This implies that each household in the project database holds an equal probability of being identified for the sample group.

A direct application of this on the total project data base is not plausible due to limitations when incorporating field metering.

i. Field metering approach limitations

The Eskom CFL rollouts were done all over South-Africa. It is therefore also necessary to capture the light usage behaviour of residents all over SA which formed part of the CFL rollouts. However, attempting to install field metering equipment all over South Africa will be too costly and impracticable. This is due to the following;

- Within SA there are 262 municipalities
  - It will have to be arranged with each municipality where a meter needs to be installed;
  - The local leaders of that area will need to be informed; and
  - Residents will have to be informed of the installation through the media.
- Some houses forming part of the sample may be more than a 1000 km from each other. Due to the vast distances, meter installers need to drive, the following will be too difficult and costly:
  - Meter installation;
  - Meter maintenance; and
  - Meter retrieval after the 90day period was completed.
- Due to the sample size and amount of towns/municipalities in SA, it might occur that only one meter will be installed in a town. Although the meters will be typographically representative distributed over SA it may not be representative of a community (area/municipality). Having a representative sample of each community where meters are installed implies stratification which in return increases the original sample size up to ten times.

ii. Sample Household area selection

Considering the field meter limitation it was therefore decided that instead of having the meter distributed all over SA a different approach is required. Four representative cities within the Eskom distribution regions will be chosen. Within each city a representative suburb will be chosen wherein the meter rollout will take place. See Figure 1 below for a flow descriptive flow chart.

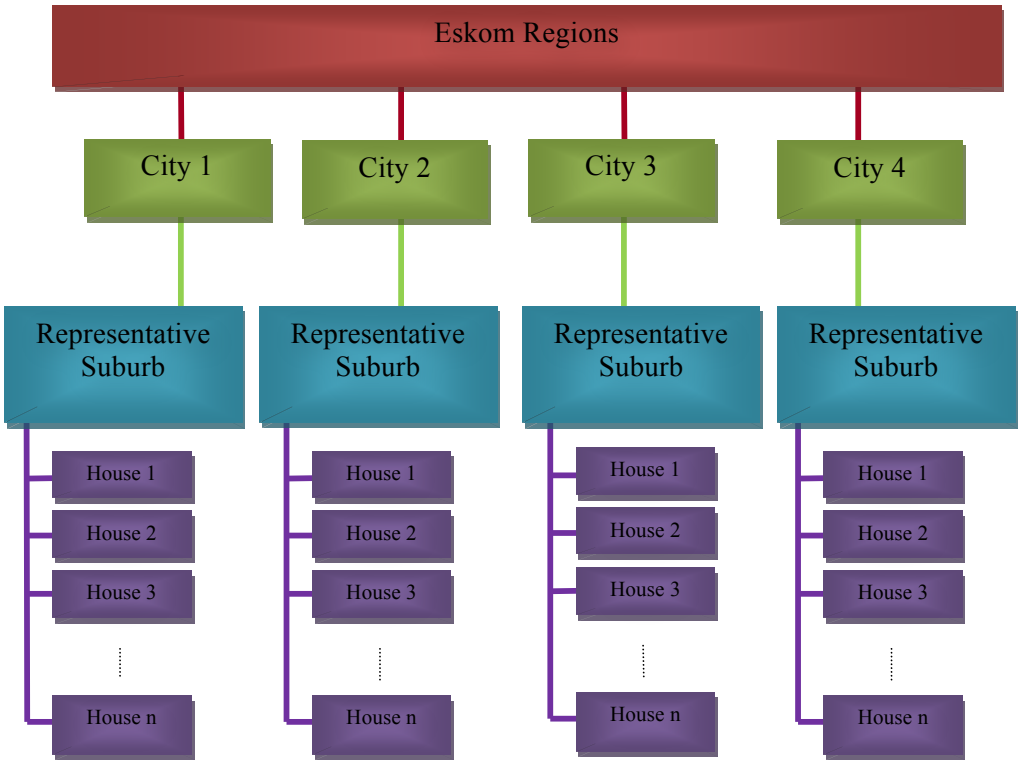

Figure 1: Flow chart of sample household area and household selection

1. Eskom Distribution regions

Eskom have divided South-Africa into different distribution regions for their transmission network. See Figure 2. These regions were also used for the CFL rollouts that started in 2004.
The selection of the cities will be done to representative of the different Eskom regions:

- Central
- Eastern
- Northern
- North-West
- Southern
- Western

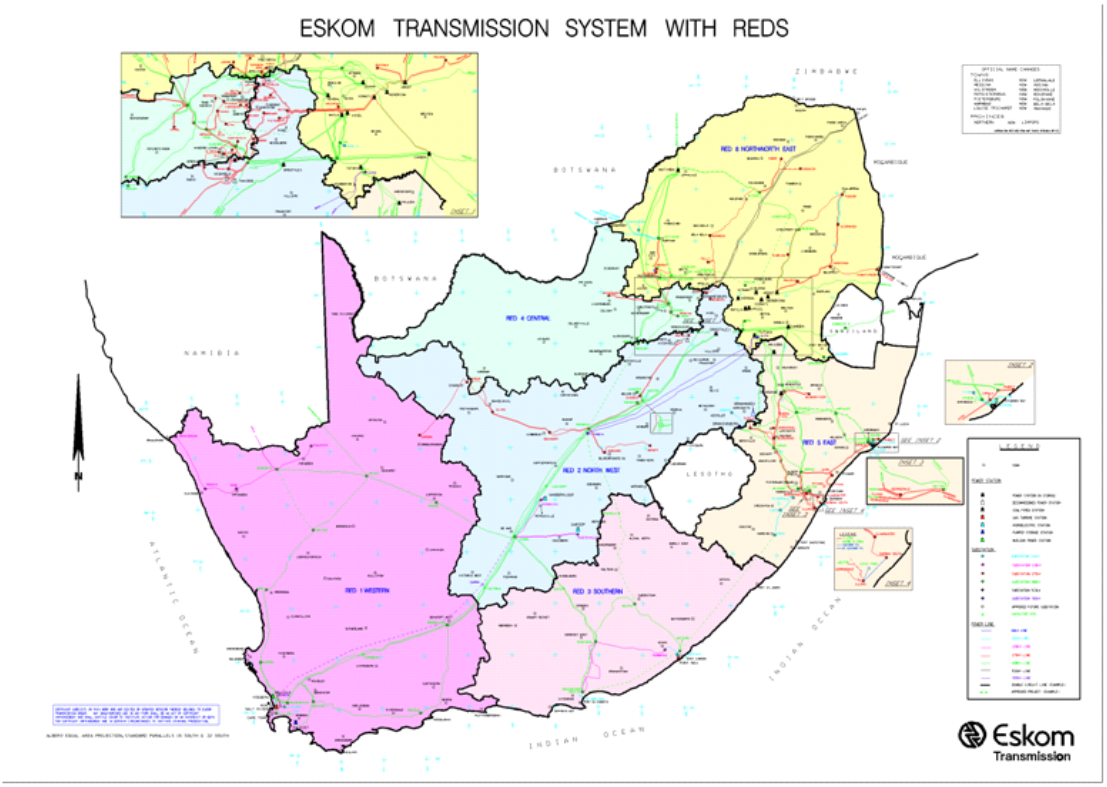

Figure 2: Eskom Regions

2. Metering within Cities

The cities selected should conform to the following criteria:

- Typographic representatively distributed over SA
  - This will ensure that the difference in behaviour people in different regions (business and socially related) have will be captured;
  - The difference in climate may have on the residents' behaviour (like the time they get up in the morning).
- The city should be representative of a specific region
  - Representative of the region in the amount of CFLs rolled out within the city as part of the 43million;
  - Representative of the businesses and operations in that region (with regarding aspects that may influence lighting operational hours).

Even having the metering area reduced to four cities there are still too many different suburbs/areas and municipalities within in some cities. In addition, the CFL rollout programs focussed on certain suburbs within cities.

3. Metering at suburb level

Using the project database a suburb within a city will be selected to represent the lighting use of the city (a suburb in the city covered by the Eskom CFL rollouts). A suburb will have to comply with the following:

1. A large part of the CFL rollouts within the city should have taken place in the specific suburb;
2. The suburb should be representative of the other suburbs in the city also included in the CFL rollouts;
3. The suburb should be accessible by the M&V Teams.
    - (Some suburbs are very hostile towards anyone associated with Eskom)

A suburb for a city will be randomly selected from a list of suburbs satisfying the above criteria.

i. Sampling from selected suburbs

Having the representative suburbs within each region, sample metering houses can be randomly selected from the database for these suburbs. The selection will be done in such way that the amount of houses selected in a region will also be represent of the percentage of CFLs rolled out in that region (percentage of the total amount of Eskom CFLs rolled out).
The owners of the selected houses will be informed via a phone call ahead of the meter installation that they were selected for the metering group. Once the M&V Teams arrive at the house for the physical installation and the house may not be appropriate to host the meters, specific rules will be in place to select another household. This is to ensure that the selection of houses is unbiased. The first step is to randomly choose more houses form a suburb than actually required to allow a buffer group.
A clear motivation with proof needs to be given on a formal document why the house is not appropriate. Motivation may be:

- The light fittings in the house may not be able to support the GSM meters;
- The house is not lockable and the meters will not be safe.
- The homeowner were not at home;
    - In this case the M&V Team have to call the homeowner and return at least once at different time of the day.

e. <u>Desired Precision/Expected Variance and Sample Size</u>

i. Desired precision

As prescribed by the methodology there is 90/10 (confidence/precision) requirement.

ii. Expected variance

Since the start of the CFL rollouts Eskom contracted M&V teams to independently measure and verify the MWh and MW reduction due the project initiative. Part of the M&V process there were hundreds of small event logger meters installed with lights to measure the average operational hours of a typical residential light. The focus was to get an average value per room type in a house. Therefore the measurements evaluated all lights in a house and not only the ones used the most.

These meters were installed for a period of two weeks in each household. The measurements were done in several houses in different regions in SA. See Table 1 for an example of the measurements taken. As a conservative measure, the standard deviation obtained from these measurements was used to calculate the standard deviation.

Table1: Average daily operation hours of CFLs measured

Average daily operational hours - Soweto and Daveyton									
Number	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
1	5.64	3.91	4.06	10.79	3.19	9.82	7.50	0.05	0.37
2	14.06	1.23	2.38	4.82	1.99	3.57	8.58	2.65	0.61
3	5.04	0.31	6.30	5.21	8.22	7.96	7.00	2.14	4.56
4	4.07	6.06	0.46	8.16	6.42	9.55	9.79	2.31	1.73
5	2.18	1.33	8.30	6.33	0.68	10.00	6.20	3.20	2.86
6	0.94	7.55	2.14	4.49	0.26	6.15	5.39	2.46	4.87
7	9.41	5.58	4.62	4.97	2.53	10.92	6.28	2.53	5.03
8	7.26	1.70	3.45	6.30	2.94	8.63	0.46	2.96	2.50
9	0.95	2.89	9.26	3.88	1.83	10.55	8.32	0.96	8.36
10	1.34	1.76	1.20	1.57	4.68	2.56	2.13	3.97	4.00

iii. Sample size

The following approach was followed for the statistical analysis of the sample size:

Under the assumption of an infinite population and a sufficiently large sample, the sample distribution of a sample mean x is approximately normal and the finite population correction factor is approximately 1 and therefore negligible. Under these assumptions the relationship between the margin of error *(e)* and the sample size (n) of a variable x in a simple random sample design can be derived as follows [2]:

$Px-\mu x\leq e=1-\alpha \quad Px-\mu xsx\leq esx=1-\alpha$

But $PZ\leq z\alpha 2=1-\alpha$ and $x-\mu xsx\sim N0,1$

$\therefore z\alpha 2\cong esx$

$\therefore e\cong z\alpha 2sx=z\alpha 2sxn$

$\therefore n\cong z\alpha 22sx2e2$

Where:

n denotes the sample size

x denotes the sample mean

μx denotes the population mean of x

e denotes the margin of error

$sx2$ is the sample variance of the variable x

$sx2$ is the sample variance of the sample mean x

Z denotes the stogastic variable of a standard normal distribution

$N0,1$ means: normal distribution with a mean of 0 and a variance of 1.

α denotes the specified significance level (i.e. the probability of a Type I Error)

$z\alpha 2$ is the critical value of a standard normal distribution at significance level $\alpha 2$

Similar to the above, the relative *precision* may be expressed as

$Px-\mu x\mu x\leq e=1-\alpha$

Using the required precision of 0.1 (or 10%), then

$Px-\mu x\mu x\leq 0.1=Px-\mu x\leq 0.1\mu x=1-\alpha$

If the population mean, μx, is then taken to be 5 hours, for example, then

$Px-\mu x\leq 0.5=1-\alpha$

This is equivalent to working with a margin of error of 30 minutes, in this instance.

Using the above method and considering the two weeks of data collected that with the 90/10 requirement a sample size of only 130 meters is necessary. However due to the nature of the project and the risks involved during the 90 day measuring period the sample size will have to be significantly increased. The risks include:

- Theft of meters;
- Damage to meters;
- Removal of the meters by the home owner;
- Data loss through meter malfunctioning; and
- Data loss through extended periods with no communication to the meter.

Considering these it was decided that at least 400 lights should be measured at all times. To realise this, 600 field meters will be employed. The 200 extra meters will be used for extra buffering and replacement for malfunctioning/stolen meters.

f. Procedures for Administering Data Collection and Minimizing Non- Sampling Errors

The NWU M&V Team have an ISO9001 accredited QMS system in place to ensure a clear and transparent data audit trail of all or M&V activities. In addition, a QMS system was specially designed for this CFL CDM project. The function of the QMS is to:

- Ensure reliability of data considering the nature of the parameters and interest of the project;
- Ensuring that measurement errors are avoided as far possible;
- Incorporation of check measures to verify data recording to pick up any measurement errors or data deviations;
- Specific reporting on measurement errors identified (such events is physically reported in a non-conformance document);
- Incorporation of approved procedures on how to handle measurement errors.

The QMS provides a data audit trail having check measures making sure that what was measured by a meter is what actually occurred. The QMS guards al steps, processes and calculations the data undergoes till the final reporting.

g. Implementation

i. Implementation Schedule

As per the provisions in AMS-II.J it is expected that the 90-day survey will be implemented prior the first Ex Post monitoring survey.

ii. Data collection and analysis

The NWU M&V Team will perform the actual data collection and analyses.

6. EX-POST MONITORING SURVEYS SAMPLING METHOD

a. Sampling Objective

The sampling objective is to establish a reliable estimate of the flowing two key variables:

- Proportion of project CFLs placed in service and operating (First ex-post monitoring survey)
- Project CFL failure rate (Subsequent ex-post monitoring surveys)

Within the methodology there are two types of ex-post monitoring survey:

1. First Ex Post Monitoring Survey - A survey has to be conducted within the first year after installation of all efficient lighting equipment will provide a value for the number of CFLs placed in service and operating under the project activity.
2. Subsequent Ex Post Monitoring Surveys - Life Failure Rate (LFR) Survey – the LFR has to be carried on, as a minimum, every 3 years or once for every 30% of the elapsed rated lifetime of the lamp.

Reliability Requirements
According to UNFCCC Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (version 03), section V, point 20, the "*Parameter values shall be estimated by sampling in accordance with the requirements in the applied methodology separately and independently for each of the CPAs included in a PoA except when a single sampling plan covering a group of CPAs is undertaken applying 95/10 confidence/precision for the sample size calculation*."

For the present Programme of Activities representative samples for the Ex Post Monitoring surveys will be monitored at the PoA level therefore the required confidence/ precision criteria to be met is 95/10.

b. The target Population

The target population is the total project lights distributed during the monitored period under consideration.

c. Sampling Frame

As discussed in Section 5.c the sampling frame refers to all the information sources on the basis of which the project database is developed. During the Eskom CFL Rollouts, databases were accumulating listing relevant information of the households CFLs were distributed to.
The sample frame is developed from these databases with the frame consisting of street addresses or house location info (lot number etc). These databases are representative and can be used for CDM purposes since it covers the different income groups and also the different provinces and municipalities in SA.

The sampling frame is comprised of the list of households that participate in the PoA during each "vintage year" (South African financial year, for example April 2011 to March 2012) as recorded in the data management system. The "vintage years" are mutually exclusive and they are also collectively exhaustive: no population element is excluded. Each vintage year will have its own universe of CFLs and associated households. This universe comprises all the CPAs formally included and active in the PoA and is representative of the population because it contains all the CFLs distributed and associated households that participated in the PoA during that vintage year. This universe will be the basis for obtaining the sample groups for ex-post monitoring surveys.

d. Sample Method

The selected sampling method is a stratified multistage random sampling. The stratified approach was chosen because when sub-populations vary considerably, it is advantageous to group elements into relatively homogeneous subpopulations and sample each subpopulation independently. The multistage sampling method was chosen in order to limit the potential high cost of information gathering that could arise from using a simple random sampling method to measure a homogeneous but rather large and geographically dispersed population. In effect a significant component of the cost of data collection is the travel time between households, but there is minimal cost to collect data on units within a household.

As mentioned before, the project lights and associated households will first be classified based on the South African financial year of distribution ("vintage year") and a representative sample will be monitored. The "vintage years" are mutually exclusive and they are also collectively exhaustive: no population element is excluded.

Within each vintage year a multistage sampling method will be applied in order to select a representative sample of 100 to 300 project lights.

Once the vintage years have been defined, the approach chosen will consist of the following steps:

- *Group the population by relevant geographical areas.*

- *Simple Random selection of a minimum of 50 households per vintage year within the last clusters units selected.*

  The selected households may be within the geographical boundary of 1 or more CPAs.

- *Data collection on all the project lighting fixtures in the selected household.*

  Given that an average of 6 CFLs were distributed to participating households, up to 300 lighting fixtures will be sampled within each vintage year, for every monitored period. This figure sits well above the 95/10 confidence/precision required in the Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (version 03), and also compensates for the loss of accuracy inherent to a multistage sampling method.

e. Desired Precision/Expected Variance and Sample Size

i. Desired precision

As prescribed by the methodology there are 95/10 (confidence/precision) requirements.

ii. Sample size

The minimum sample size will be estimated by using the formula described in the EB 67 Annex 6 - "*Best Practice Examples Focusing on Sample Size and Reliability Calculations – Version 01*"::

$$n \geq \frac{1.96^2 N V}{(N-1) \times 0.1^2 + 1.96^2 V} \qquad (1)$$

Where,

$$V = \frac{p(1-p)}{p^2}$$

n	=	Sample Size
N	=	Total Number of project lights (i.e. 1,000,000)
p	=	Our expected proportion
1.96	=	Represents the 95% confidence level
0.1	=	Represents the 10% relative precision

Therefore, with a confidence level of 95% with 10% precision, and an expected lamp failure rate of not higher than 20% per years (i.e. p = 0.8), the estimate of required sample size will be:

$$V = \frac{0.8(1-0.8)}{0.8^2}$$

V = 0.25

$$n \geq \frac{1.96^2 * 1{,}000{,}000 * 0.25}{(1{,}000{,}000 - 1) \times 0.1^2 + 1.96^2 * 0.25}$$

n >= 96.03

For the first monitoring period, the values as described above are applied. For the following monitoring periods, the estimates shall be adjusted taken into account the results of the previous monitoring period(s).

In order to ensure the quality of the sampling results, the CME will draw on the provisions for reliability calculations as provided by the *Best Practices Examples: Focusing on Sample Size and Reliability Calculation* (EB 67). In the event that the sampling results do not fulfil the required level of confidence and precision, the CME will undertake additional samples. If the reliability is still not sufficient after additional samples, the sampling may be repeated with an increased sample size.

According to the methodology "the size of the sampling shall be no less than 100 project lights". In this case, as mentioned above, the sampling design chosen by the project proponent ensure that the minimum sample size will be between 100 to 300 project lights for every vintage year. Just as an example, if the PoA distributes CFLs during 3 years (i.e. 3 vintage years), a total of 900 project lights could be monitored in total across the PoA. This figure is well above the UNFCCC requirements for PoA sampling.

The result of this sampling will determine the proportion of the total number of devices still operating at the end of each monitoring period, which will be applied to the calculation of emissions reductions for that period. CFLs distributed under the Project Activity will be marked with an Eskom logo (or equivalent) to ensure that they can be unambiguously differentiated from other light bulbs installed in the selected households.

As discussed above, the results obtained from the sampling process will be directly extrapolated across the entire population of households participating in the Project Activity. Therefore, the proportion of CFLs installed and continuing to function as determined through the household ex post monitoring survey will be taken to be representative of the pattern occurring in all households within the monitored period.

f. Procedures for Administering Data Collection and Minimizing Non- Sampling Errors

The same QMS system described in Section 5.f will be used to guard the data quality during the ex-post monitoring surveys.

g. Implementation

i. Implementation Schedule

The different ex-post monitoring surveys will be performed as prescribed in the methodology and set out in Section 6.a.

ii. Data collection and analysis

The NWU M&V Team will perform the actual data collection and analyses. Please see Appendix A for a summary of the NWU M&V Teams experience.