



**CLEAN DEVELOPMENT MECHANISM  
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM  
(CDM-SSC-PoA-DD) Version 01**

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**NOTE:**

- (i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.
- (ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).



**SECTION A. General description of small-scale programme of activities (PoA).**

**A.1 Title of the small-scale programme of activities (PoA):**

**Punjab State Electricity Board: High Voltage Distribution System for Agricultural Consumers in the Rural Areas of the Punjab.**

Version: 01

Date: 23/12/2009

**A.2. Description of the small-scale programme of activities (PoA):**

***General operating and implementing framework of PoA***

The Punjab State Electricity Board (PSEB) is a statutory body fully owned by the Government of Punjab with an autonomous status. PSEB is responsible for electricity generation, transmission and distribution of power in the State of Punjab. The existing distribution system for the agricultural consumers in the state consists of feeders working at low voltage 3-phase 400V. The proposed PoA is an initiative to reduce green house gas emissions by reducing technical losses by replacing the existing 3-phase 400V Low Voltage Distribution System (LVDS) feeding Agricultural Pumps (AP), with an 11kV High Voltage Distribution System (HVDS) in the identified distribution divisions in the state.

The power distribution system in the State of Punjab is divided into five Distribution Zones (North, Central, South, West and Borders zones). Each Distribution Zone is further segregated into several Distribution Circles. Circles are further divided into Divisions and Sub-Divisions. PSEB is implementing the proposed programme of activities (PoA) in the five electricity Distribution Zones of Punjab. PSEB is the coordinating and managing entity of the PoA.

PSEB is currently facing a substantial energy deficit, which is met by a combination of dynamic load shedding and power purchase from various Independent Power Producers (IPPs). With increasing demand for power, this energy deficit is bound to go up. According to PSEB's business plan<sup>1</sup>, electricity demand in the state is expected to increase in the 11<sup>th</sup> five-year plan period from 27,900 GWh in 2007 to 40,800 GWh by 2012, imposing increasing strain on PSEB. PSEB's transmission & distribution (T&D) loss is currently reported to be around 20 percent<sup>2</sup>. The reduction in T&D loss will help in reducing the pressure on the system and facilitate availability of power to a wider section of people.

A total of 19 circles covering a total of 89 Divisions are part of the proposed PoA. In 2006-2007, PSEB delivered approximately 8,233 GWh<sup>3</sup> to APs in rural areas. The aforesaid program proposes to convert existing 950,000 AP consumers currently on LVDS to HVDS in two phases.

Implementation of the PoA titled Punjab State Electricity Board: High Voltage Distribution System for Agricultural Consumers in the Rural Areas of the Punjab ("The Program") will comprise of two phases. Phase-I covers 525,000 AP consumers being fed by 3-phase 3 wire system (segregated feeders supplying exclusively to the agriculture load). Phase-II covers 425,000 AP consumers being fed by 3-phase 4 wire;

<sup>1</sup> PSEB- Report on Business Plan- CARE Advisory, February 2007

<sup>2</sup> Estimated based on energy sent and energy delivered to consumers, measured through energy meters installed

<sup>3</sup> <http://www.pserc.nic.in/pages/Tariff%20Order%202007-08.pdf>



currently desegregated feeders comprising agriculture & commercial loads. However, these loads will be segregated for agriculture consumers and made 3-phase 3 wire system before conversion to HVDS.

The implementation of Phase I of the PoA, covering about 81,000 APs started in October 2007. The remaining part of Phase-I will be fully implemented within a three-year period (scheduled completion by March 2010). The implementation of Phase-II is planned to be completed by March 2011.

Once fully commissioned, The Programme will bring down the technical loss of the existing agriculture distribution system. The list of 46 schemes<sup>4</sup> comprising of Phase-I including their name, location and REC identification code is attached as Annex 4. The Programme is being implemented with loan assistance from Rural Electrification Corporation (REC).

#### ***Policy/measure or stated goal of the PoA***

The goal of the measures implemented under PoA is mainly to reduce technical loss in its rural distribution system<sup>5</sup> and hence to increase the amount of available energy in the State. The initiative is expected to increase the power availability, reduce load shedding requirements and need for power purchase from IPPs apart from reduction in technical losses.

#### **Program contribution to sustainable development**

The Programme contributes to sustainable development of the region and of the country in terms of environment, socio-economic and technological considerations. The following are the sustainable development benefits accruing from The Programme:

##### **Social well being**

The proposed PoA will result in significant energy savings which will help to meet the shortage of power to the public at large. There will therefore be an improvement in the availability of power to meet their power needs which will improve their quality of life. Also, In order to implement the SSC-CPA, PSEB will engage (directly and indirectly) a large number of workers. These workers will be involved in a variety of tasks, including dismantling of old transformers, installation of new transformers, laying of overhead lines etc. Staff will also be involved in various monitoring procedures. This will lead to social well being in the area.

##### **Economic well being**

The Programme will contribute to economic well being by eliminating the power losses. The State of Punjab has experienced a rise in its power demand over the past years. However, the electricity demand exceeds electricity supplies, leading to shortage of electricity. The technical and commercial losses make the situation worse. By implementing HVDS, PSEB is able to reduce the losses. Thus, with the same level of supply, it would be able to provide more electricity to its consumers or be able to cater to a larger section of society for its electricity needs.

##### **Environmental well being**

The project activity leads to reduced losses in electricity distribution. Thus, less energy, which is produced mainly from fossil fuel fired power plants, is required to supply power to the same consumers. This leads to a cleaner environment by having to produce relatively less power from the predominantly coal fired power plants of the NEWNE grid of India.

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<sup>4</sup> Scheme is a term used by REC in their loan approval process. A scheme may comprise of a single division or a group of divisions.

<sup>5</sup> PSEB-Report on Business Plan- CARE Advisory, February 2007



**Technological well being**

The Programme comprises of changing the existing low voltage distribution system to a high voltage one. This leads to a reduction of technical losses associated with distribution along with improvement in the quality of power supply to consumers.

Additional benefits that will accrue from the above initiative include:

- Improved voltage profile to AP consumers. The length of low voltage line will be limited to service lines as transformers will be installed close to APs. The voltage drop will be reduced (especially during peak time) improving the voltage profile available to the pump sets and consequently leading to improvement in the life of AP motors.
- Transformer failure resulting from overloading will become less frequent as the existing old transformers will be replaced by new ones which would match with the load requirements of a specific consumer.

***Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity***

According to CEA’s (Central Electricity Authority) recommendation, the State Governments will prepare a Five Year Plan with annual milestones to bring down electricity losses expeditiously. However, there is neither a law that obliges the state Governments or utilities to implement HVDS programmes nor recommendations for implementing any specific measure to reduce such losses.

There are no mandatory directives to PSEB to implement the HVDS programme. Thus the PoA is a voluntary initiative undertaken by PSEB to reduce green house gas emissions by reducing technical losses by replacing the existing 3-phase 400V LVDS feeding Agricultural Pumps (AP), with an 11kV HVDS in the identified distribution divisions in the state.

**A.3. Coordinating/managing entity and participants of SSC-POA:**

***Coordinating or managing entity of the PoA as the entity which communicates with the Board.***

PSEB is implementing the programme in all the Five Distribution Zones i.e. West, Central, North, South and Border zones of the state. PSEB will be the coordinating and managing entity of the PoA. The International Bank for Reconstruction and Development (IBRD), as Trustee of its Carbon Funds (Trustee) will manage the communications directly with the CDM Executive Board, in close coordination with PSEB.

Name of Party involved (host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India (Host)	Punjab State Electricity Board (Public Entity)	No
Denmark	International Bank for Reconstruction and Development (IBRD) as the Trustee of the Danish Carbon Fund (Public Entity)	Yes

***Project participants being registered in relation to PoA***



This programme is part of PSEB’s plan to improve the efficiency of its power distribution system. All the investments are also taken care of by PSEB.

**A.4. Technical description of the small-scale programme of activities:**

**A.4.1. Location of the programme of activities:**

**A.4.1.1. Host Party(ies):**

India

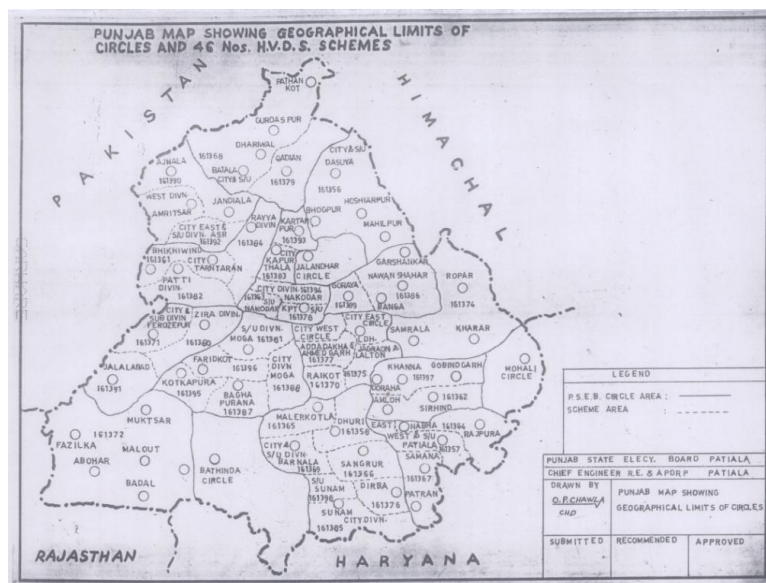
**A.4.1.2. Physical/ Geographical boundary:**

The power distribution system in the state of Punjab is divided into five Distribution zones (North, Central, South, West and Borders zones). Each Distribution Zone is further segregated into several Distribution Circles. Circles are further divided into Divisions and Sub-divisions. The PoA boundary comprises of all five Distribution Zones covering about 12,000 villages in the state. The boundary of each SSC-CPA includes a physical, geographical boundary of one or more Divisions where The Programme is implemented. The geographical coordinates for the Punjab state are Latitude: 30° 4' N Longitude: 75° 5' E.

The area under the PoA is depicted in the maps below –



**Location of state of Punjab in India**



**Location of the Distribution Circles in the state of Punjab**

**A.4.2. Description of a typical small-scale CDM programme activity (CPA):**

**A.4.2.1. Technology or measures to be employed by the SSC-CPA:**

The PoA objective is to reduce electrical loss by upgrading LVDS to HVDS (400V in the existing distribution system to 11kV system).

Technology / measures to be undertaken in a typical SSC-CPA include:

- Conversion of existing LVDS to HVDS using existing poles and conductors.
- Installing new transformers matching the load requirements of the agricultural consumers.
- Dismantling existing transformers and unnecessary lines.

The existing LV lines will be converted to 11kV lines by utilizing the existing supports. The supporting cross arms and the insulators will be replaced to suit the requirement of 11kV lines. Intermediate poles will be introduced wherever the existing spans are beyond the limits. For new transformers, a single pole mounting design will be adopted.

With the conversion of the LVDS to HVDS the technical line loss will reduce significantly due to a decrease in line current. Distribution system conversions will reduce lines current by 27.5 times (11,000/400) and thus the technical energy loss induced by Joule effect (proportional to the square current) by around 800 times (27.5 x 27.5). The 11kV feeders are starting from the bus-bar located at the 66kV grid sub-stations. Subsequently 11kV is stepped down, for use by a group of consumers, by using 11kV/400V distribution transformers (ratings 25/50/63/100/200kVA) to LV (Low Voltage that is 400V).



**A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:**

A SSC-CPA in this PoA is the conversion of LVDS to HVDS by upgrading the voltage from 400V to 11kV. This will be the main criteria that any CPA shall meet to be eligible under the proposed PoA. Moreover, to be enrolled in the PoA, a SSC-CPA shall fulfil the following requirements *in toto*:

SN	Eligibility Criteria
1	The SSC-CPA shall comprise of a single division or a group of divisions.
2	The SSC-CPA shall be located in the State of Punjab
3	The SSC-CPA shall be located in an area not covered by any other SSC-CPA enrolled in this PoA
4	The SSC-CPA shall be located in an area not covered by any other PoA targeting LVDS to HVDS
5	An SSC CPA shall be constituted of one or more divisions with all divisions being part of an approved REC Scheme <sup>6</sup> with an REC assigned Scheme Code
6	The SSC-CPA shall involve conversion of LVDS to HVDS by upgrading the supply voltage from 400V to 11kV to Agriculture Consumers
7	The SSC-CPA shall not result in more than 60 GWh of electricity saving in a year
8	Each SSC-CPA must be approved by the coordinating entity prior to its incorporation into the PoA
9	The SSC-CPA activity is not a debundled component of a large scale activity

**A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):**

*In this section, it shall be demonstrated that:*

- *The proposed PoA is a voluntary coordinated action;*
- *If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA;*
- *If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;*
- *If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.*

***The proposed PoA is a voluntary coordinated action***

PSEB has embarked on a power sector reform which helps to reduce electricity losses for agriculture sector consumers in the rural areas though converting LVDS into HVDS. The current project activity is not part of any policy mandate or regulation and is a voluntarily coordinated action by PSEB.

***If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA;***

The proposed PoA is converting LVDS to HVDS to the agriculture sector in the rural areas of the state of Punjab. The Programme shall help PSEB in reducing the present losses in power distribution in these areas and in turn partly meet the power supply-demand gap that exists. PSEB is a statutory body formed under the Electricity Supply Act, 1948 and is responsible for generation and transmission & distribution of power in the State. PSEB has power generation facilities of its own and also receives a share in the Central Sector power projects. To meet the deficit in supply, it further procures power from IPPs. PSEB's

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<sup>6</sup> Scheme is a term used by REC in their loan approval process. A scheme may comprise of a single division or a group of divisions. The details of all Schemes are provided in Annex 4.



current power generation capacity stands at 6,841<sup>7</sup> MW (as on 31/03/2009) including its share from Central Sector power projects. Both India and the State of Punjab, including the agricultural sector, have experienced a growth in demand for power associated with economic growth. (See data from last 5 years below).

*Sector wise Energy Sale (MUs)<sup>8</sup>*

Description	2004-05	2005-06	2006-07	2007-08	2008-09
General	6338.7	6695.36	7253.55	8175.45	8326.9
Industrial	8937.35	9496.42	10115.56	10864.73	10739.32
Agricultural	6468.34	7313.85	8229.5	10022.2	9325.42
Others	1034.92	964.79	1018.43	1180.51	1417.95
Total	22779.31	24470.42	26617.04	30242.89	29809.59

Being a priority sector, agriculture uses the largest share of power in the state after Industry. The share of power consumption in agriculture has always been close to 30% of total power supplied in the State by PSEB. As part of state government's policy, power is supplied for free to the agriculture consumers. PSEB, however, gets compensated for the power supplied to the agriculture consumers by the state government. Therefore, in the event of a reduction in the loss in power distribution, PSEB will receive reduced compensation from the State, which is a one reason that CDM revenues are required for the project.

Under these circumstances, though it is imperative to cut down the losses to improve the power availability to consumers, the implementation of The Programme faces a number of barriers. To demonstrate that The Programme would not be implemented in the absence of the PoA, "***Non-binding best practice examples to demonstrate additionality for SSC project activities***", Annex 34, EB 35 is referenced. It says that the Project Participant shall provide an explanation to show that the project activity would not have occurred anyway **due to at least one** of the listed barriers. Accordingly, the project proponent has used the following barrier(s) to demonstrate the additionality:

*Investment barrier:*

The proposed programme is highly capital intensive. As per the estimates, the total fund requirement for The Programme is about INR 33928 million for 46 schemes in Phase-I. The Programme is proposed to be funded through a mix of equity from PSEB and debt from Rural Electricity Corporation Limited (REC). The funding of the project from REC is about 90% of the total project cost. For 40 schemes, REC approval has been obtained and for the other 6 schemes approval is expected in due course. Despite a large portion of funds coming from REC, PSEB is still required to invest substantially from internal resources. For cash strapped PSEB, even 10% equity would be a large and difficult investment to make. For the past few years, PSEB has incurred substantial cash losses. According to PSEB's annual statement of accounts, the total accumulated deficits amount to INR 73700<sup>9</sup> Million as on 31/03/2008. Also, as per the *PSEB's Aggregate Revenue Requirement*, the PSEB Board has projected a *cumulative revenue gap of Rs 8,546 crore for 2009-10 against the budgeted revenue gap of Rs 4,205 crore<sup>10</sup> in 2008-09, on the back*

<sup>7</sup> [http://www.psebindia.org/docs/growth\\_of\\_installed\\_capacity.htm](http://www.psebindia.org/docs/growth_of_installed_capacity.htm)

<sup>8</sup> [http://www.psebindia.org/docs/energy\\_sale.htm](http://www.psebindia.org/docs/energy_sale.htm)

<sup>9</sup> Annual Statement of Accounts, PSEB. Exchange rate: 1US\$ = 46 INR as of 5/12/2009

<sup>10</sup> 1 crore = 10 million



of annual power purchase of Rs 7,265 crore in current fiscal.”(The Hindu, 01/07/09)<sup>11</sup>. Beside the upfront investment requirement, PSEB would also need to maintain good cash situation to meet the liability of the loan principal repayment and incurred interest (REC has sanctioned a loan to PSEB with a 3 year moratorium on repayment +10 years principal payment terms based on a floating interest rate. The interest rate at the beginning of the loan was 9.75% and has increased at present to 11.75% putting additional burden on PSEB). The capacity of a project to repay the loan and the interest accruing on it is gauged by the Debt-Service-Coverage-Ratio (DSCR). A low DSCR value indicates risk in the project in terms of its capacity of meeting the requirement of debt-service i.e. repayment of loan and interest during the loan period. This is even more critical for cases, where the organization proposing the project runs a large deficit and the project is required to be financially sustainable on its own terms.

In the proposed programme, the only revenue stream is the induced savings on account of reduced losses of electricity. As explained earlier, PSEB gets compensated for the power that is supplied to AP consumers in the State. For this, PSEB proposes the Annual Revenue Requirement (ARR) to Government of Punjab (GoP) through Punjab State Electricity Regulatory Commission (PSERC). PSERC in turn sends its recommendation to GoP on the appropriateness of ARR. GoP then compensates PSEB accordingly. With reduced losses, PSEB would be required to purchase less power and would earn equivalent savings. It is demonstrated here that the expected revenue generation from the avoided losses would not be enough to cover the debt-service requirement of The Programme. The following set of information has been used for estimation of the DSCR of The Programme –

<b>Parameter</b>	<b>Value</b>	<b>Unit</b>	<b>Remarks</b>
Project cost	339284	INR lac <sup>12</sup>	Project cost of 46 REC Schemes
Loan amount	305356	INR lac	Loan is availed from REC
Moratorium period	3	Years	As per REC loan document
Loan period	13	Years	As per REC loan document
Equated quarterly installment	7294.4	INR lac	As per REC loan document
Net Power savings	1540	GWh/ a	Estimated savings
Interest Rate	11.75%	%	Loan from REC <a href="http://recindia.nic.in/download/interloan.pdf">/http://recindia.nic.in/download/interloan.pdf</a>

Based on the above data, the minimum DSCR is 0.72 and the average DSCR comes out at 1.02, which is below the benchmark DSCR of 1.5<sup>13</sup>. The analysis shows that average Debt-Service-Coverage-Ratio (DSCR) of the programme is just above 1.0 which means that debt-service is just about more than the expected revenue (it is also important to note that the revenue on account of reduced loss is not direct cash inflow but an avoided cash outflow only. With negative cash flow situation, avoided losses do not enhance cash availability for repayment of loan and interest). CER revenue will help in reducing the debt service burden of PSEB.

To further demonstrate the robustness of the financial analysis, it is tested against variation in the value of key parameters. The key parameters which can change and can have a direct impact on programme DSCR are described below.

*Lending Rate:*

<sup>11</sup> <http://www.thehindu.com/2009/07/01/stories/2009070151010300.htm>

<sup>12</sup> 1 lac = 0.1 million

<sup>13</sup> <http://www.scribd.com/doc/21042504/Union-Bank-credit-appraisal-project-report> ; page 19 of 43



PSEB is receiving a loan from REC for the implementation of the programme. The lending rate is floating and might change during the loan period of 13 years. Any change in the rate shall have direct effect on the debt service that PSEB would be catering to and thus on the DSCR. Since the time of approval of the loan for the initial schemes, the rate has changed from 9.75% to 11.75%. If it increases again it will further reduce the DSCR. However, a favourable change in rate does not improve the DSCR by much.

<b>Change in lending rate from base value (%)</b>	<b>DSCR</b>	<b>Remarks</b>
+10%	0.98	Any upward change in base value shall further reduce the capacity of the project to service debt.
-10%	1.08	Even a favorable change of 10% does not help much in improving the DSCR.

*Programme Cost:*

The Programme is funded through a mix of debt and equity. Debt financing is received from REC for about 90% of the total cost. The project cost has gone up from the time of approval. For many schemes, PSEB has applied to raise additional funds from REC. The impact of a change in the amount of debt is listed below-

<b>Change in Programme cost from base value (%)</b>	<b>DSCR</b>	<b>Remarks</b>
+10%	0.93	It is quite likely that The Programme cost will increase. This is going to affect the programme further.
-10%	1.14	Even a favorable change of 10% does not help much in improving the DSCR. This remains below the benchmark DSCR value.

*Savings achieved:*

The savings in The Programme on account of reduced losses in the supply of power to agriculture consumers. The savings are the difference in losses before and after conversion of LVDS to HVDS. Any change in savings would get reflected in the revenue stream.

<b>Change in power savings from base value (%)</b>	<b>DSCR</b>	<b>Remarks</b>
+10%	1.13	Even an increase in savings achieved does not improve the DSCR much.
-10%	0.92	-

*Rate of power:*

The financial savings from programme implementation also depend on the differences in the rates at which PSEB buys power from other plants to meet the demand supply deficit and the rate at which it gets compensated by GoP. The savings would change with change in either of the two rates. For sensitivity analysis, a change of  $\pm 10\%$  in the saving rate has been considered. It is evident from the results that a positive change of 10% is not sufficient to significantly change the DSCR and to make the project financially viable.

<b>Change in Effective</b>	<b>DSCR</b>	<b>Remarks</b>
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Rate of Saving from base value (%)		
+10%	1.13	The change can occur with change in either of the two components i.e. power buy rate and rate of compensation against sale of power to agriculture consumers.
-10%	0.92	-

To meet the expanded demand of power and close the demand-supply gap in the State, PSEB could have continued with drawing power from other sources in the grid. This would require no upfront capital investment but it would also not generate emission reductions either. In the absence of the PoA, business-as-usual investments in PSEB will continue to be prioritized on maintaining the LVDS systems in rural areas and not on conversion of LVDS to HVDS. Typical O&M (operation & maintenance) practices will maintain systems and equipment as they are, and replace them with similar equipment when required.

The CDM revenue stream motivates PSEB to undertake the PoA. CDM revenues will reduce the interest burden on loans taken by PSEB from REC to implement the PoA and also reduce risks of insufficient income to repay loans. Without CDM, the implementation of such a large scale initiative will be delayed indefinitely or not implemented.

*Barrier due to prevailing practice:*

The project activity is conversion of low voltage distribution system to high voltage distribution system for distribution systems of APs. The 11 KV feeders are starting from the bus-bar located at the 66 KV grid sub-stations. Subsequently 11KV is stepped down, for use by a group of consumers, by using 11KV/400 V distribution transformers (ratings 25/50/63/100/200 KVA) to a low voltage. A disadvantage of LVDS is the losses occurring in transmission and distribution. With the implementation of HVDS system, the losses are reduced resulting in more power availability and revenues. However, this activity has not gained a foothold in the country. Electrical losses in transmission and distribution of power are high in all of the states of India. In 2008-09 while T&D losses in Maharashtra were at ~36%, it was at 44% for Madhya Pradesh. In comparison, the losses were at 22.53%<sup>14</sup> in Punjab in 2007-08. PSEB's efforts in this direction are unique and shall help provide the confidence to other state electricity boards (SEBs) to take up such programmes in their states and help accelerate the process at a national level.

The implementation of such schemes is still rare in India. There are only a few schemes, being proposed/implemented in the country on a test/pilot basis, unlike this programme which is state wide. The Bangalore Electricity Supply Company Limited<sup>15</sup> implemented conversion of LVDS to HVDS in one of the towns near Bangalore. Though, there has been extensive investment in the up-gradation of distribution system in the state of Haryana<sup>16</sup>, which involves conversion of LVDS to HVDS. However, exclusive schemes for APs have not been implemented. A large scale conversion of LVDS to HVDS for Agricultural Pumps, similar to the project activity, is being carried out only in the state of Andhra Pradesh. Here, the existing low voltage lines are being converted into high voltage lines for the entire rural area, which consists mainly of irrigation pump connections. The power distribution company for the state, Andhra Pradesh Southern Power Distribution Company Limited (APSPDCL) is also seeking carbon finance in order to implement the project. In this regard, the company has already received Host Country Approval (HCA)<sup>17</sup> from the Ministry of Environment and Forests, Govt. of India. Apart from the

<sup>14</sup> Annual Statement of Accounts 2007-08, PSEB

<sup>15</sup> <http://www.druminia.org/admine/download/Case%20Study%20-%20HVDS%20-%20Bescom.pdf>

<sup>16</sup> <http://www.dhbn.com/main/arr/executivesummary-2008-09.pdf>

<sup>17</sup> <http://www.cdminia.nic.in/cdminia/projectList.jsp?search=search>



mentioned project (in the state of AP) and the proposed programme, there is no similar activity taking place at such a large scale in the country. Hence, it is evident that the implementation of such schemes is not a common practice in the country and the proposed programme is a unique effort from PSEB. **Considering the arguments above, the PoA can be considered to be ‘Additional’.**

***If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;***

This is not applicable as the proposed PoA is not being implemented as part of a mandatory policy or regulation.

***If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.***

This is not applicable as the proposed PoA is not being implemented as part of a mandatory policy or regulation.

**Demonstration of Prior Consideration of CDM**

As per the **GUIDANCE ON THE DEMONSTRATION AND ASSESSMENT OF PRIOR CONSIDERATION OF THE CDM –**

- a) *The project participant must indicate awareness of the CDM prior to the project activity start date, and that the benefits of the CDM were a decisive factor in the decision to proceed with the project. Evidence to support this would include, inter alia, minutes and/or notes related to the consideration of the decision by the Board of Directors, or equivalent, of the project participant, to undertake the project as a CDM project activity.*
  
- b) *The project participant must indicate, by means of reliable evidence, that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation. Evidence to support this should include, inter alia, contracts with consultants for CDM/PDD/methodology services, Emission Reduction Purchase Agreements or other documentation related to the sale of the potential CERs (including correspondence with multilateral financial institutions or carbon funds), evidence of agreements or negotiations with a DOE for validation services, submission of a new methodology to the CDM Executive Board, publication in newspaper, interviews with DNA, earlier correspondence on the project with the DNA or the UNFCCC secretariat;*

PSEB was well aware of the CDM benefits prior to the start of the project activity. PSEB made all efforts to secure CDM status through the implementation phase of the project. To demonstrate consideration of the CDM, the following chronology of events is provided below:

<b>Date</b>	<b>Stage</b>	<b>Remarks</b>
13/03/2006	PSEB’s in-principle approval for HVDS scheme	The approval letter from PSEB has reference to CDM benefit consideration.
29/06/2006	First Loan sanction from REC for 15 Schemes part of PoA	REC is providing loan facility to PoA.
13/10/2006	REC Sanction for another set of 19 schemes	-do-
07/11/2006	REC Sanction for another set of 6 schemes	-do-
28/12/2006	PIN approval by World Bank	World Bank approved the Project Idea Note of programme.
01/06/2007	Contract with CDM consultant - I	WB engaged CDM consultant to carry out



		PoA registration work.
18/05/2007	Approval from WTMs authorizing Member/ Distribution to sign LOI with WB with regard to CDM benefits	Chief Engineer sent a memorandum in this regard to WTMs on 30/04/2007.
01/10/2007	LOI signed by WB and PSEB	LOI with regard to CDM benefits signed by the two parties.
25/10/2007	Work orders released for 6 schemes	PSEB released work orders to contractors for implementation of the programme in 6 REC Schemes.
29/05/2008	Meeting with CDM consulting firm at PSEB for discussing CDM	The meeting was conducted to discuss the progress of CDM project.
25/06/2008	Contract with first CDM consultant terminated	WB terminated contract with CDM consultant.
30/6/2008	First DOE appointed	WB appointed DOE for validation of PoA.
07/02/2009	Newspaper advertisement regarding the HVDS project under CDM	PSEB published the advertisement seeking comments on CDM programme from people in general.
21/03/2009	Newspaper advertisement regarding Environmental and Social Review (ESR)	PSEB published the advertisement seeking comments on CDM programme from people in general.
24/04/2009	Stakeholder meeting conducted	PSEB conducted the meeting to discuss PoA.
28/05/2009	Memo (no.288) sent to PSEB board for 34 schemes	This has reference to CDM benefits.
15/09/2009	Contract of WB with another CDM consultant	-
March 2010	Expected completion of implementation of Schemes – Phase I	6 Schemes are under completion with bids invited for another 34 Schemes. Remaining 6 Schemes are under approval stage from REC.

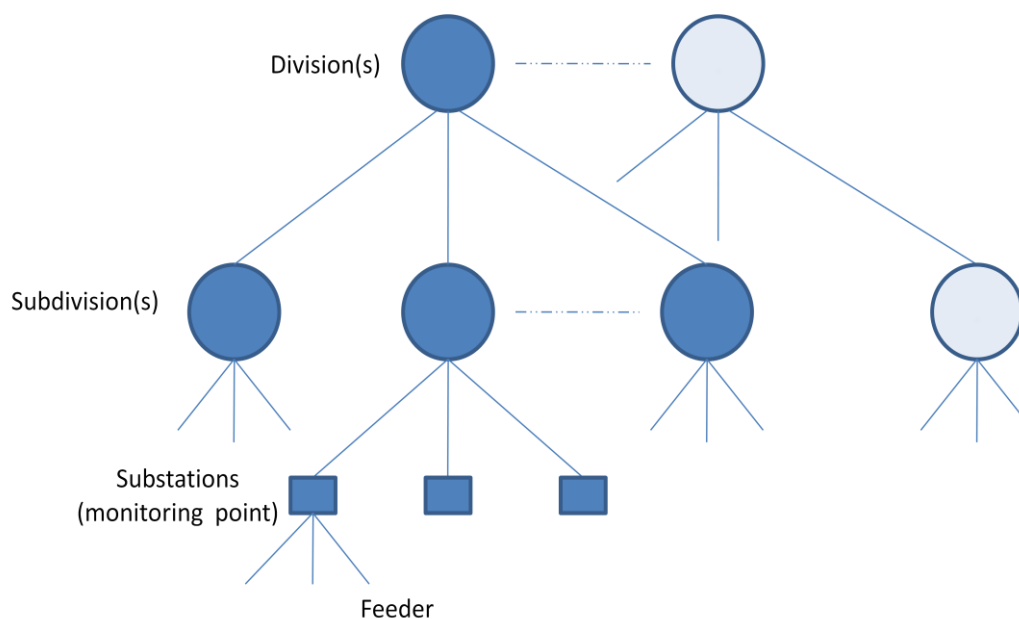
The above table clearly shows the serious and continual efforts from PSEB to secure CDM status during the implementation of the project. The documents for all the stages mentioned above are available for reference.

**A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):**

**A.4.4.1. Operational and management plan:**

***A record keeping system for each CPA under the PoA***

The block diagram below shows the structure of a typical SSC-CPA:



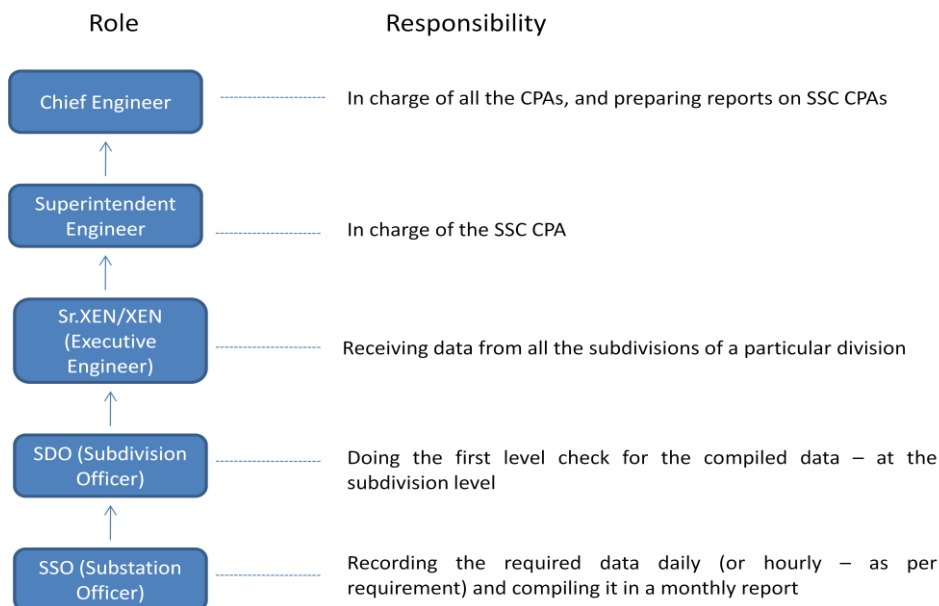
One SSC-CPA comprises of one or more divisions which are further divided into subdivisions. Monitoring & recording of data and information happens at the substation level which supplies energy to the connected feeders. The substation officer is responsible for proper record keeping of the feeders connected to the particular substation. Log sheets are maintained in which all the required data are recorded manually on hourly and/ or daily basis as per the requirement. Please refer to section E.7 for details about the monitoring plan.

Each SSC-CPA will be maintained as a separate file. The SSC-CPA file will include the details of data to be collected as described in section E.6.3 and E.7, collation and checking responsibilities, and all relevant technical information so as to minimize data errors along with data / records & retention rules. All the SSC-CPA files will be compiled at the Superintendent Engineer office and will be stored at the Chief Engineer office for the PoA level monitoring. For each CPA, all the data mentioned above will be kept in electronic versions and hard copies. In addition, a systematic compilation of data on the equipment bought and installed, with the procurement bills and relevant information about the technical specifications of the installed material will be carried out.

Dismantled equipment will be recorded and their final destination (scrap, reuse) will be documented to enable cross-check. In any case, the old equipment will not be used to replace projects equipment. To avoid the reintroduction of the old equipment within the CPA, all maintenance works and network extension will be documented. Moreover, before reusing old cables, it will be checked that they have the optimum characteristics (length, section, resistance) for the application they are used for, i.e. current circulating the cable should be lower than the maximum admissible amperage and hence the losses. The evidence will be provided for the equipments that are scrapped or sold as scrap.



**Typical Data Flow Diagram for SSC-CPA**



***A system/procedure to avoid double accounting e.g. to avoid the case of including a new SSC-CPA that has been already registered either as a CDM project activity or as a SSC-CPA of another PoA,***

The division(s) constituting a SSC-CPA fall under an REC approved Scheme. Every REC approved Scheme has a unique identification code. One SSC-CPA can contain divisions from different schemes but all the divisions are identified by a unique official name, which precludes any possibility of double counting of any SSC CPA.

An SSC-CPA shall provide information on Division(s). Also, Division(s) shall have details on feeders which are unique to a Division. The information on Division(s) and feeders shall be made available for validation and verification to DOE.

***The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.***

*For the purposes of registration of a Programme of Activities (PoA)<sup>18</sup> 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<sup>19</sup>, which:*

<sup>18</sup> 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 the proposed CPA is being added

<sup>19</sup> 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



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

In the HVDS program case, PSEB is the only organization mandated to carry out transmission and distribution projects in Punjab. Power generation is liberalized, but transmission and distribution is mandated for PSEB only. No other project or PoA has been developed /implemented in the same sectoral scope in the State of Punjab.

The proposed CPA is not a de-bundled component of any large scale activity because PSEB, the CPA implementer, is not involved in any other small-scale CPA in any other large scale PoA of the same sectoral scope.

***The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA***

The PoA and each SSC-CPA under the project activity is implemented and managed by PSEB. The PoA is decided at PSEB Board level and implemented at the SSC-CPA levels. The distribution divisions of PSEB will operate all the SSC-CPAs as part of a PoA as integrated entities of PSEB.

**A.4.4.2. Monitoring plan:**

>>

*The following information shall be provided here:*

- (i) *Description of the proposed statistically sound sampling method/procedure to be used by DOEs for verification of the amount of reductions of anthropogenic emissions by sources or removals by sinks of greenhouse gases achieved by SSC-CPAs under the PoA.*
- (ii) *In case the coordinating/managing entity opts for a verification method that does not use sampling but verifies each SSC-CPA (whether in groups or not, with different or identical verification periods) a transparent system is to be defined and described that ensures that no double accounting occurs and that the status of verification can be determined anytime for each SSC-CPA;*

In the proposed PoA, *Option (ii)* is chosen i.e. coordinating/ managing entity opts for a verification method that does not use sampling. In the PoA, each of the SSC-CPAs shall be separately verified and status of verification can be determined anytime for each SSC-CPA by the following -

*Identification of SSC-CPA:*

- Division(s) of an SSC-CPA shall be identified by their unique names delineating the physical boundary of SSC-CPA
- Each Division shall be further verified by a unique REC Scheme Code it falls in.

*Determination of Status of Verification of SSC-CPA:*

- Detailed SSC-CPA reports shall be prepared and kept for the purpose of verification. The report shall cover data of a definite time period under monitoring. The time periods covered under



different reports shall be mutually exclusive for each SSC-CPA to avoid double counting. An audit of the project reports will enable the current status of each SSC-CPA. All the information is to be signed by the concerned authority.

The above measures will ensure that no double counting occurs in the PoA.

In line with AMS II.A, version 10, the CPA proposes to reduce the ‘Technical Loss’ through conversion of LVDS to HVDS. The ‘Technical Loss’ have been analytically calculated using the standard formulas derived by REC. This is in line with point (ii) of Option 2, para 4 of AMS II.A., version 10. The details have been provided in the PoA.

The ‘Technical loss’ reduction by conversion of the LVDS to HVDS and the corresponding Emission Reduction calculated using the REC derived formula’s are provided in sections E.6.2 of the PoA.

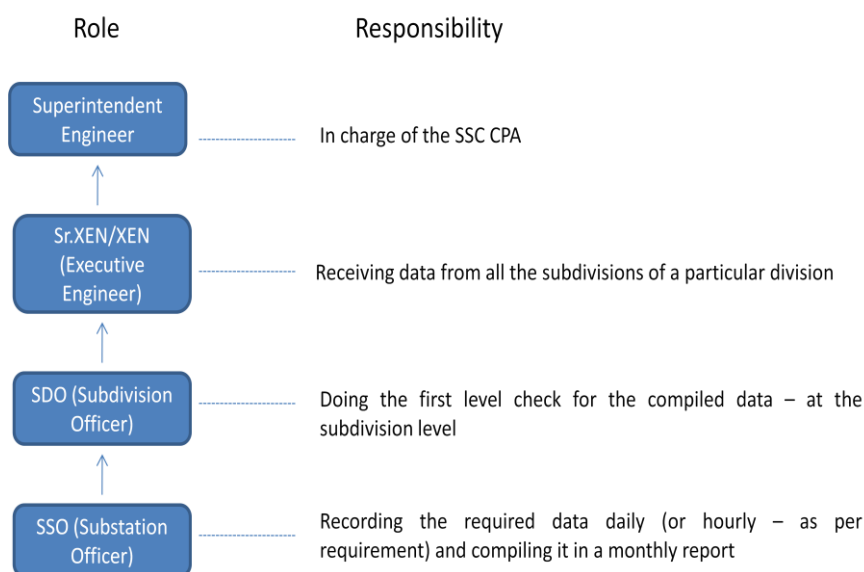
Proper monitoring of the data will be performed at the CPA level. The method of monitoring including the information flow structure is described below.

*Data to be monitored*

Following set of data/ information shall be required for a typical SSC-CPA monitoring for the feeders:

- Name of Division(s) in SSC-CPA
- Name of feeder(s) in SSC-CPA
- Capacity wise no of transformers installed in SSC-CPA
- Section-wise Connected Load for feeder(s) in SSC-CPA
- Section-wise length of distribution line(s) of the feeder(s) in SSC-CPA
- Section-wise resistance of distribution lines of feeder(s) in SSC-CPA
- Peak Load in feeder(s)
- Energy sent for feeder(s)
- Power Factor of power supplied for feeder(s)
- Number of operating hours for feeder(s)

Roles and Responsibility





Each substation distributes power to the APs through a number of feeders. Monitoring for all these feeders is done separately through separate meters. Sub-Station Officer (SSO) is in charge of recording data in log sheets and then compiling them on a monthly basis. He reports to the Sub-Division Officer (SDO) who in turn reports to the Sr. Executive Engineer (XEN). Executive engineer is in charge of one division and reports to the superintendent engineer who is in charge of the SSC CPA. He reports to the chief engineer who is in charge of all the SSC-CPAs (PoA). At each stage of reporting the monthly data will be compiled up the reporting line for each CPA and finally by CPAs into the overall data base for the Program.

*Calibration and data archiving*

The calibration of the meters involved in data monitoring and recording will be done as detailed out in section E.7. The archiving of all the records will be done on regular intervals. Data for as long as 70 days remains stored in electronic form in the meters, which can be downloaded for crosschecking/verifying.

**A.4.5. Public funding of the programme of activities (PoA):**

There is no public funding available for the project activity. The PoA is funded through a mix of loan from REC and internal accruals of PSEB.

**SECTION B. Duration of the programme of activities (PoA)**

**B.1. Starting date of the programme of activities (PoA):**

25/10/2007 (Signing of works contract for first 6 REC schemes under PoA)

**B.2. Length of the programme of activities (PoA):**

28 years

**SECTION C. Environmental Analysis**

>>

**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:**



This energy efficiency activity is not included in the Schedule of Ministry of Environment and Forests, Government of India as an activity that requires Environment Impact Assessment (EIA) or environmental clearance before its implementation. However, voluntarily, an environmental analysis has been undertaken at the PoA level by PSEB named *Environmental and Social Review (ESR) on High Voltage Distribution Project for Agriculture Consumers in the State of Punjab* (prepared by Engineer-in-Chief/RE & APDRP).

1. Environmental Analysis is done at PoA level
2. Environmental Analysis is done at SSC-CPA level

Since the SSC-CPAs are considered to be identical in the PoA; and since PSEB is the sole co-ordinating entity, there is no need to have the ESR conducted at the SSC-CPA level.

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

An advertisement regarding the ESR report was released on 21/03/2009 in the daily newspaper *The Tribune*, inviting comments from the general public (also the stakeholders). During the web hosting for more than 4 weeks, no comments were received. The ESR covers all the important aspects and impacts of the project in the following chapters:

- Introduction of the project & activities involved
- Impacts of the project
- Occupational safety during execution of the project
- Entities responsible for various activities

The report covers all aspects from project execution to safety. A separate safety manual was issued along with the report. It has been confirmed in the report that the project will in no way lead to any harm to the environment. Rather this project shall lead to a better environment due to a reduction in green house gas emissions and improved power supply.

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

All SSC-CPAs are identical in the PoA. This activity is not included in the Schedule of Ministry of Environment and Forests as an activity that requires an environmental clearance before its implementation. EIA is also not required for an SSC-CPA included in this PoA.

**SECTION D. Stakeholders' comments**

>>

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

The stakeholder comments were invited at a PoA level. Since the SSC-CPAs are considered to be identical in the PoA; and since PSEB is the sole co-ordinating entity, there is no need to have the stakeholders' consultation at the SSC-CPA level.

1. Stakeholder consultation is done at PoA level
2. Stakeholder consultation is done at SSC-CPA level



The PoA information was placed in the public domain through the PSEB web site and a stakeholders meeting to explain the project details and modalities. Comments were received, answered and recorded in a meeting minute, which was then filed.

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

Various documents related to the PoA, including: the Project Design Document (PDD), Environment, Safety and Health issues were web hosted on PSEB's web site for a period of more than four weeks soliciting comments and feedback. Moreover, an advertisement seeking stakeholders' comments, and concerns was published on 07/02/2009 in the daily newspaper *The Tribune*. Neither of these media received any negative feedback.

PSEB held the stakeholders' consultation meeting on April 24, 2009, in their Shakti Vihar Complex in Patiala. The meeting was conducted in the attendees' native language Punjabi. Representatives from various groups such as farmers, industrialists, technocrats and educationalists attended the meeting. The project was explained to the attendees as follows:

Mr. Karamjit Singh Khaira, a senior executive representative of PSEB, along with Mr. A.K. Verma, the Chief Engineer of PSEB were the mediators for the meeting. They started the proceedings by introducing The programme and highlighting some of the benefits of the proposed activity. These include:

- Theft of energy will be reduced to zero
- Reduction of GHGs
- Failure of Distribution Transformers will be almost negligible
- Drastic reduction in line loss
- Chances of adding illegal motors are completely eliminated
- Reduction of the peak power losses shall also reduce considerably
- Greater consumers' involvement in maintaining the system
- Improvement in overall system efficiency leading to increased efficiency of the existing pumping system, resulting in greater quantity of water

Er. Verma also discussed the project implementation schedule and the step wise process that is being adopted for development of the CDM project. He also explained the socio-economic benefits that the project would bring about in the region including ensuring uninterrupted power to farmers. After stressing the major benefits of the proposed Program, the two PSEB representatives opened the floor for discussion and encouraged attendees to voice any concerns.

#### **D.3. Summary of the comments received:**

Overall, The Programme had a very warm reception. However, some minor concerns were raised, mostly by farmers of the BKU Farmer's Union:

- i. They requested PSEB to inform the farmers well in advance of the project implementation timeframe. This would help the farmers plan for the various activities required of them during the roll out stage.
- ii. They stressed the need for safety. They urged PSEB to conduct training programs for labour working on the installation of the High Voltage Distribution System (HVDS) at the sites. This would minimize the risk of any accidents or mishaps.
- iii. They asked that all the transformers be tag welded in order to prevent theft.



As a comment, at the end of the open forum, a representative from industry, expressed interest in PSEB carrying out such a project in the industrial sector, as there is a major shortage of power in that segment.

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

After all concerns were raised and everyone was heard, Mr. A. K. Verma assured all the stakeholders that the feedback provided by them would be converted into an action plan, specifically with regard to training programme on safety and health issues and consumers would be informed well in advance about the implementation schedule in the respective districts. The detailed ESR report containing detailed safety manual addresses the issues comprehensively.

**SECTION E. Application of a baseline and monitoring methodology**

**E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:**

- Type II – Energy Efficiency Improvement Projects;  
Category A - *Supply side energy efficiency improvements – transmission and distribution*,  
Version 10, EB 48.  
Reference: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>

Other methodologies and methodological tools referred to:

- Version 15 of AMS I.D – Grid connected renewable electricity generation  
Reference: <http://cdm.unfccc.int/UserManagement/FileStorage/7QXAZ5036WN8BEYKUDFRPJGL21V419>

As per Paragraph 6 of AMS II.A, if the energy saved by the project is electricity, which is the case with present PoA, the emission factor shall be calculated as per the procedures described in AMS.I.D and hence this methodology is referred.

- Version 2 of “Tool to calculate the emission factor for an electricity system”  
Reference: <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf>

As the paragraph 11 of AMS I.D refers to the Tool to calculate the emission factor for an electricity system, the latest version of the tool is referred to calculate the grid emission factor.

**E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:**

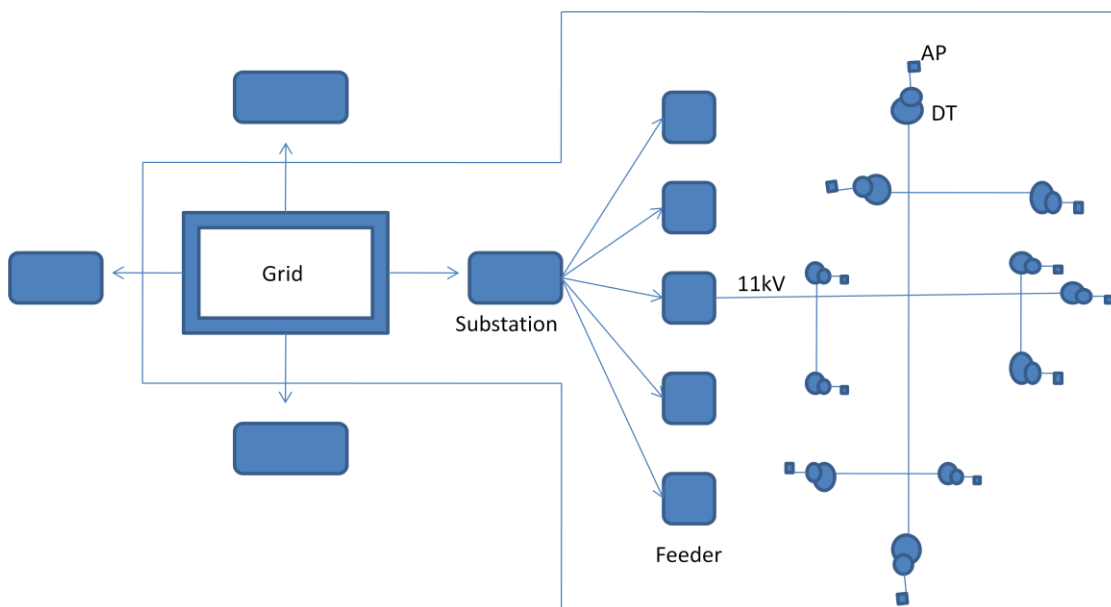
<b>Applicability conditions (as per the methodology)</b>	<b>The project activity</b>
<p><i>This category comprises technologies or measures which reduce technical energy loss through improving the energy efficiency of either</i></p> <p><i>a) An electricity transmission/distribution system resulting in electricity savings of up to 60 GWh per year, or</i></p> <p><i>b) A thermal energy (e.g., steam or hot water)</i></p>	<p>The proposed PoA is an energy efficient electricity distribution system. The savings from each SSC-CPA shall be less than 60 GWh per year.</p> <p>Hence, this meets the criteria.</p>



<p><i>distribution system resulting in fossil fuel savings of up to 180 GWh per year.</i></p>	
<p><i>This category does not include:</i></p> <ul style="list-style-type: none"> <li><i>a) Measures that reduce technical loss solely by improving operations and/or maintenance practices. For example low-voltage conditions in the network, uneven distribution of loads, loose connections, etc.</i></li> <li><i>b) The introduction of capacitor banks and tap changing transformers for reducing loss in an electricity distribution; this is because technical loss reductions due to such measure can not be determined using the simplified approaches defined in this methodology.</i></li> </ul>	<p>PoA involves reducing the technical losses due to the replacement of LVDS with HVDS in power distribution.</p>

**E.3. Description of the sources and gases included in the SSC-CPA boundary**

The project boundary defined as per AMS –IIA is the physical & geographical area of each of the SSC-CPAs under the PoA. The diagram below depicts the boundary of a typical SSC-CPA:



*Note:*  
*AP is Agriculture Pump set*  
*DT is Distribution Transformer*

The PoA aims at reduction of the technical loss as a result of conversion of LVDS to HVDS resulting in reduction in emission of CO2 equivalent to reduced power generation from the fossil based power plants.

**Emissions Sources and Gases Included in the SSC-CPA Boundary**

	Source	Gas	Included?	Justification/Explanation
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Baseline	CO2 emissions from electricity generation (equivalent to technical loss in LVDS in the baseline) in fossil fuel fired power plants of the grid	CO <sub>2</sub>	Yes	Main Emission Source
		CH <sub>4</sub>	No	Minor Emission Source
		N <sub>2</sub> O	No	Minor Emission Source
SSC-CPA	CO2 emissions from electricity generation (equivalent to technical loss in HVDS in SSC-CPA) in fossil fuel fired power plants of the grid	CO <sub>2</sub>	Yes	Main Emission Source
		CH <sub>4</sub>	No	Minor Emission Source
		N <sub>2</sub> O	No	Minor Emission Source

**E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

The alternatives to the PoA includes -

- a) Continuation of current scenario i.e. supply of power to agriculture consumers using LVDS and continue incurring the technical loss at the current level
- b) Conversion of the LVDS to HVDS so as to achieve reduction in the technical loss leading to reduction of GHGs – *but* without CDM

The proposed PoA is highly capital intensive. In the PoA, the only revenue stream is the induced savings on account of reduced losses of electricity. With reduced losses, PSEB would be required to purchase less power and would earn equivalent savings. Given that PSEB is cash strapped and faces a high cash deficit, implementation of PoA seems highly unlikely in normal course. DSCR for the PoA is very low and it is evident that the PoA would not be able to generate enough revenue to cover the debt service during the loan period. This is more critical in the project case as PSEB has a large deficit and the project is required to be financially sustainable on its own terms. CER revenue will help in reducing the debt service burden of PSEB.

As explained in earlier sections, implementation of the PoA is not a business-as-usual scenario in the country and only a few similar projects have been implemented as test cases. The penetration of the project activity is low in the country and it seems highly unlikely that the PoA will be implemented without CER revenue. Hence, only Option (a) above shall be the baseline for the PoA.

*Selection of baseline option*

PSEB rural feeders could be perfectly assimilated to a radial electricity grid. In this configuration, a particular feeder supplies various rural areas connected with agriculture pump sets from main lines. Besides, there is no national or international standard in India to measure technical loss. The standards



selected for this project are the guidelines of REC. The guidelines provide a step-wise approach for calculating technical loss for different transmission/distribution voltages based on recorded loads, grid parameters and cable characteristics for rural feeders. This option is found to be more appropriate to calculate technical loss in the PSEB rural distribution network within the SSC-CPA boundary. Accordingly, baseline formulation is done as per the option 2(b) of the baseline and monitoring methodology AMS II A. It is further detailed in section E.6.1.

**E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA): >>**

**E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:**

*Here the PPs shall demonstrate, using the procedure provided in the baseline and monitoring methodology applied additionality of a typical CPA.*

The PoA and all the proposed SSC-CPAs under The Programme are undertaken by PSEB. PSEB is the coordinating agency for the PoA and also the implementing agency for SSC-CPAs. Moreover, all SSC-CPAs of the PoA are identical in principle for structure, baseline, implementation plan etc. The barriers applicable to PoA as detailed out in section A.4.3 are also applicable to individual SSC-CPAs.

Hence, it can be said that all SSC-CPAs face the same barriers and thus are additional.

**E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:**

*Here the PPs shall provide the key criteria for assessing additionality of a CPA when proposed to be included in the registered PoA. The criteria shall be based on additionality assessment undertaken in E.5.1 above. The project participants shall justify the choice of criteria based on analysis in above section.*

*It shall be demonstrated how these criteria would be applied to assess the additionality of a typical CPA at the time of inclusion.*

*NOTE: Information provided here shall be incorporated into the PoA specific CDM-SSC-CPA-DD that shall be included in documentation submitted by project participants at registration of PoA.*

To demonstrate that any SSC-CPA part of the proposed PoA is additional, following set of conditions should be met. The conditions are in line with the additionality argument for the PoA as described in section E.5.1 & A.4.3 of this document.

<b>Additionality criterion</b>	<b>Justification of choice of Additionality criterion</b>	<b>Comment on how the criterion shall be applied to SSC-CPA</b>
The power from the feeders under SSC-CPA is supplied to Agriculture Consumers for free.	As explained in section A.4.3, power for Agriculture Consumers is free, for which PSEB is compensated by State Government. Due to the	PSEB shall provide documents for validation that show that power for agriculture consumers from the feeders under SSC-CPA is available for free.



	scenario, implementation of PoA and SSC-CPA is not a priority for PSEB.	
SSC-CPA is undertaken using the funds from REC	Implementation of PoA and SSC-CPA is a highly capital intensive proposition for PSEB. Due to a large cash deficit at PSEB, availability of funds from private banks is not available and hence, REC providing the loan to the programme is important and a requisite.	PSEB shall demonstrate that divisions under SSC-CPA are part of an approved REC Scheme with a unique REC Scheme Code.
DSCR for the division(s) part of SSC-CPA is not attractive	High DSCR for the programme is very important to maintain cash flows to meet the requirement of loan repayment and interest accruing on it. If DSCR is low then this capacity is constrained. Hence, this is a requisite too.	For each proposed SSC-CPA, DSCR shall be demonstrated to be below 1.5.

**If SSC-CPA meets all of the above conditions then it shall be proved that the SSC-CPA is additional and is not business-as-usual scenario.**

**E.6. Estimation of Emission reductions of a CPA:**

**E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:**

As defined in AMS-II.A for retrofit projects, *the energy baseline is the technical energy loss within the project boundary calculated using one of the following options:*

<b>Baseline Options as per AMS II.A</b>	
<p>Option 1: <i>The average measured technical loss of the existing equipment or existing transmission/distribution system as determined using data from all of the immediate past three years. For existing facilities that are less than 3 years old, a minimum of one year's worth of data are required.</i></p>	<p>PSEB calculates energy loss based on measured data at the feeder level and on the energy sold to customers. The downside of this method is that it includes both technical loss and non-technical loss. The current metered energy would not be convenient since difficulties will arise in isolating technical loss only for a typical SSC-CPA.</p> <p><b>Therefore, Option 1 could not be used in the SSC-CPA.</b></p>



<p>Option 2:</p>	<p>(i) <i>The technical energy losses of the existing equipment or transmission/distribution system as determined using a standard selected in accordance with the procedures described in the General Guidance for SSC methodologies<sup>20</sup> under the section “Equipment Performance”.</i></p>	<p>The SSC-CPA mainly involves replacement of LVDS with HVDS and installation of transformers of various capacities meeting the actual requirements. The performance of these types of measures could not be treated as required in the General Guidance for SSC methodologies. The approach is different for equipment like transformers.</p> <p><b>Option 2 (i) is not chosen to determine technical energy loss.</b></p>
	<p>(ii) <i>For existing radial electricity distribution systems (e.g., rural distribution network), for which no national or international standards are available to measure the performance (e.g., technical loss) of the existing system, the technical losses are determined using a well established peer reviewed method included in the guidelines of a relevant national Government agency (e.g. rural electrification corporation/agency in the public sector or standards bureau/organizations in the region/country).</i></p>	<p>PSEB rural feeders could be perfectly assimilated to a radial electricity grid. In this configuration, a particular feeder supplies various rural areas connected with agriculture pump sets from main lines.</p> <p>Besides, there is no national or international standard in India to measure technical loss.</p> <p>The standards selected for this project are the guidelines of the REC. The guidelines provide a step-wise approach for calculating technical loss for different transmission/distribution voltages based on recorded loads, grid parameters and cable characteristics for rural feeders.</p> <p><b>This option is found to be more appropriate to calculate technical loss in the PSEB rural distribution network within the SSC-CPA boundary.</b></p>

The article by Rao et al<sup>21</sup> published in IEEE Transactions on Power Delivery, which is peer reviewed, proposes a methodology, also known as the km-kVA method for such situations which is also same as the method proposed and adopted by REC for India. The same method has been selected for the estimation of technical energy loss in the proposed PoA.

The step-wise calculation is described according to the selected standard in section E.6.2.

**E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:**

<sup>20</sup> General guidance to Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories (version 12, EB 41 Annex 20).

<sup>21</sup> Rao P. S. N., Deekshit, R. 2006. Energy Loss Estimation in Distribution Feeders. IEEE Transactions on Power Delivery, Vol. 21, No. 3, July 2006



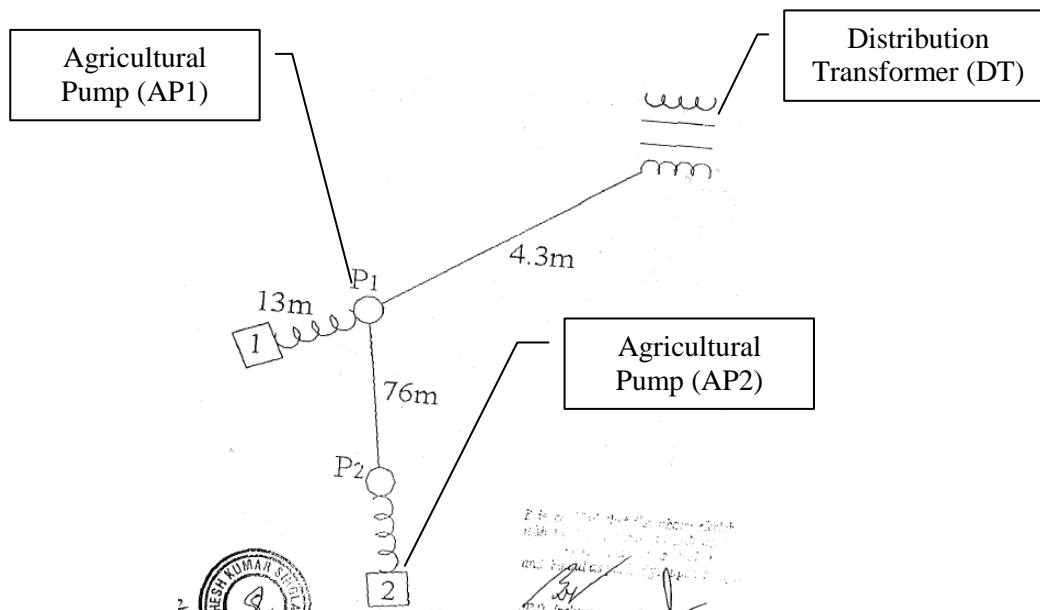
The project activity is the conversion of 400V LVDS to 11kV HVDS. The purpose of the activity is to effect reduction of technical loss in electricity distribution. Emission reductions take place as there is net energy saving due to reduction in loss. Below is the method of calculation of loss reduction for the baseline as well as for the SSC-CPAs –

**Loss in baseline (LVDS)**

Each SSC-CPA is a group of Division(s) and each Division is further divided into Sub Divisions and substations. Each of the sub-stations then is connected to many feeders. Each feeder supplies power to Distribution Transformers (DT) connected to the consumers.

**Step 1: Retrieval of section-wise information for a feeder**

Following shows the arrangement of power distribution to consumers from a typical DT.



The above figure shows the connected loads to a particular distribution transformer (DT). There are two line sections here, after the transformer: DT to P<sub>1</sub> & P<sub>1</sub> to P<sub>2</sub>. All the DTs have a particular code assigned to them. The following information is to be retrieved for each section.

Sr. No.	Section	Load in BHP*	Load P (kVA)	Resistance R <sup>#</sup> (Ohms/km)	Length L (km)
1	DT-P <sub>1</sub>	Load – AP <sub>1</sub> +AP <sub>2</sub>	Equivalent of Load in BHP	R of DT-P <sub>1</sub>	0.0043
2	P <sub>1</sub> -P <sub>2</sub>	Load – AP <sub>2</sub>	Equivalent of Load in BHP	R of P <sub>1</sub> -P <sub>2</sub>	0.0760

\*This is the connected load of Agriculture Pumps for a section.

<sup>#</sup>R value depends on the type of resistance; which is also to be known section wise for the calculation

For example, for above arrangement this would be the sum of load of AP<sub>1</sub> and AP<sub>2</sub> for section DT-P<sub>1</sub> and load of AP<sub>2</sub> for section P<sub>1</sub>-P<sub>2</sub>

### Step 2: Calculation of section-wise baseline loss (kW)

$$kW_{\text{loss,s,b}} = P^2 * R * L * (10^{-3} / V^2)$$

### Step 3: Calculation of section-wise annual baseline loss (kWh)

$$kWh_{\text{loss,s,b}} = P^2 * R * L * (10^{-3} / V^2) * h$$

h is the number of operating hours for one year for a section. PSEB has taken 'h' as 1920 based on historical data of operation.

Applying the value of V = 0.350kV (in reality, the value is a little less than 400V), and h = 1920 the formula is simplified into:

$$kWh_{\text{loss,s,b}} = 15.67 * P^2 * R * L$$



**Step 4: Calculating the feeder-wise annual baseline loss**

The loss for a full feeder will become the summation of all the section-wise loss.

$$kWh_{loss,b,i} = \sum kWh_{loss,s,b}$$

**Step 5: Calculating the annual baseline loss in SSC-CPA**

The loss for a full feeder will become the summation of all the feeder-wise loss.

$$E_{loss,b} = \sum_{i=1}^F kWh_{loss,b,i}$$

As all the feeders considered under CPA are radial feeders with only agriculture consumers connected, the loss percentage out of total energy sent out will be calculated for a sample of feeders using the above mentioned approach and the same value will be applied to all other feeders uniformly.

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**Loss in SSC-CPA (HVDS)**

For 11kV lines losses, load distribution factor and load loss factor have to be considered as it would be difficult to calculate losses on each section of all 11kV feeders. The present practice adopted by the electricity utility for computing line losses is to use what is generally known as the km-kVA method<sup>22</sup>. The annual feeder losses are computed using the following formula given below -

**Step 1: Calculating the feeder-wise annual project loss**

$$AnnualLoss_{section} = 0.105 \times \frac{P^2 R_T}{2 * LDF} \frac{LLF}{DF^2}$$

where;

Annual Loss: kWh loss per annum (feeder wise)

P: Sum of kVAs of all installed DTs (connected load on DTs)

R<sub>T</sub>: Resistance of the feeder (ohms)

LLF: Loss load factor

LDF: Load distribution factor

DF: Diversity factor

The above formula assumes the operating hours of 8,760 and the actual hours will be as per the substation recordings.

**The resistance of the feeder, R<sub>T</sub> is calculated as:**

$$R_T = \sum_{i=1}^N R_i L_i$$

<sup>22</sup> Rao P. S. N., Deekshit, R. 2006. Energy Loss Estimation in Distribution Feeders. IEEE Transactions on Power Delivery, Vol. 21, No. 3, July 2006



Where,

$R_i$ : Resistance per unit length of the feeder section <sup>23</sup> (ohm/km)

$L_i$ : Length of the feeder section  $i$  (km)

$N$ : Number of sections of the feeder

**Loss Load Factor is calculated as:**

$$LLF = 0.2LF + 0.8LF^2$$

Where,

LF is the load factor

LF values is considered as 0.3 (provided by REC)

**Load Distribution Factor is calculated as:**

$$LDF = P \times L / \text{km-kVA}$$

Where,

$$L = \sum L_i$$

$$\text{Km-kVA} = \sum_{i=1}^N L_i P_i$$

The value of LDF is 2 for the uniformly distributed load as per REC.

**Diversity Factor is calculated as:**

$$DF = P / \text{Peak Load in kVA}$$

This is considered as 1.2.

**Load Factor is calculated as:**

$$LF = \text{energy sent} / \text{peak load} \times h \text{ (no of hours)}$$

The value of LF is taken as 0.3.

$$AnnualLoss_{feeder} = \sum_1^S AnnualLoss_{section}$$

### Step 3: Calculating the annual project loss in SSC-CPA

The loss for a full feeder will become the summation of all the feeder-wise loss.

$$E_{loss,CPA} = \sum_{i=1}^F AnnualLoss_{feeder(i)}$$

### Baseline emissions:

<sup>23</sup> The value of  $R_i$  shall be taken as per REC standards for a line type



As per approved small scale methodology AMS II A version 10, the baseline emissions are the energy baseline multiplied by the emission factor. In this case, the emission factor is the combined margin grid emission factor ( $EF_{grid,CM}$ ) for NEWNE grid of India, which comes out to be 0.840 tCO<sub>2</sub>/ MWh (see Annex 3 for details).

Thus, baseline emissions shall be calculated as:

$$BE_y = E_{loss,b} * EF_{grid,CM}$$

#### Project emissions:

Similarly, project emissions shall be calculated by multiplying the grid emission factor by the  $E_{loss}$  in the project activity scenario, i.e.

$$PE_y = E_{loss, CPA} * EF_{grid,CM}$$

#### Leakage

In accordance with the AMS II.A methodology, “If the energy efficiency technology is equipment transferred from another activity, leakage is to be considered”.

The project will only involve the procurement and installation of new HV conductors through an open bidding process. No equipment will be transferred from another activity. Also, the replacement of old transformers will also happen with the new low capacity transformers.

For the PoA, the methodology states the following: “*In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of the scrapping of replaced equipment needs to be implemented. The monitoring should include checking if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose, scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified*”.

The project principally targets line loss reductions by replacing LVDS with HVDS and rearranging the system. All removed cables as well as transformers will be scrapped in an organized and monitored way. Annex 6 shows the detail of the transformer replacements. In the specific case of this PoA, as mentioned above, the dismantled LV cables could be used if the cables are suitable for new applications. No leakage is expected as a result of such re-use.

Based on the above discussions, there is no possible leakage for the proposed SSC-CPA.

$$LE_y = 0$$

#### Emission Reductions



Emission reductions will be the difference between the emissions that would have occurred without the CDM project activity and the emissions due to energy loss in the project activity. Emission reductions are calculated by:

$$ER_y = BE_y - PE_y - LE_y$$

Where,

- $ER_y$  Emission reductions in tCO<sub>2</sub> for year “y” due to technical energy loss within the SSC-CPA boundary.
- $BE_y$  Baseline emissions in tCO<sub>2</sub> for year “y” due to technical energy loss within the SSC-CPA boundary in the absence of the proposed SSC-CPA.
- $PE_y$  Project emissions in tCO<sub>2</sub> for year “y” due to project technical energy loss within the SSC-CPA boundary.
- $LE_y$  Leakage emissions in tCO<sub>2</sub> for year “y”.

**E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:**

<b>Data / Parameter:</b>	<b>Name-Div<sub>i</sub></b>
Data unit:	Text
Description:	Name of Division i
Source of data used:	Detailed Project Report
Value applied:	Division is identified with its respective name, which is unique
Justification of the choice of data or description of measurement methods and procedures actually applied :	Each SSC-CPA is identified by the Division(s) it comprises of. To avoid double accounting and uniquely identify a SSC-CPA, recording name of the division(s) is essential.
Any comment:	Refer to Annex 4 for details of Divisions part of PoA.

<b>Data / Parameter:</b>	<b>Name-feeder<sub>i,j</sub></b>
Data unit:	Text
Description:	Name of Feeder j of Division i
Source of data used:	Detailed Project Report
Value applied:	Feeder is identified with its respective name, which is unique
Justification of the choice of data or description of measurement methods and procedures actually applied :	Each SSC-CPA is identified by the Division(s) it comprises of. Each Division further comprises of Feeder(s). To avoid double accounting and uniquely identify a SSC-CPA, recording name of the feeder(s) is essential.
Any comment:	-

<b>Data / Parameter:</b>	<b>EF<sub>grid,CM</sub></b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Grid Emission Factor (Combined Margin) for NEWNE grid
Source of data used:	CEA data
Value applied:	0.840



Justification of the choice of data or description of measurement methods and procedures actually applied :	Central Electricity Authority (India) is a government body and data published is in line with the ACM0002 and tool for calculating grid emission factor (version 2). <a href="http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver5.zip">http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver5.zip</a>
Any comment:	This is ex-ante fixed for the entire crediting period.

<b>Data / Parameter:</b>	$N_{\text{transformer},i,j,\text{baseline}}$
Data unit:	kVA
Description:	Capacity-wise number of Transformer(s) dismantled in the baseline in feeder j of division i in the baseline
Source of data used:	Detailed Project Report
Value applied:	Varies from feeder to feeder and is available in the DPR
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is required to demonstrate that each of the dismantled transformers has been safely disposed off. This detail shall be made available for each SSC-CPA for future verification. Each substation officer will monitor the list of transformers in the baseline and of those replaced under each SSC-CPA. Records will be maintained for verification purpose. The transformer procurement details in the store can be used to cross-check the rating of each transformer procured and that of the replaced ones.
Any comment:	Transformers are of varying capacities.

<b>Data / Parameter:</b>	$L_{s,i,j,\text{baseline}}$
Data unit:	Km
Description:	Length of distribution line for section s of feeder j in division i.
Source of data used:	Detailed Project Report
Value applied:	Varies from feeder to feeder and is available in the DPR
Justification of the choice of data or description of measurement methods and procedures actually applied :	The actual loss calculation is performed separately for different line sections carrying different loads. The details of length of distribution line for each section are listed in detail in DPRs prepared for the divisions and the same information will be used for baseline emission calculations.
Any comment:	

<b>Data / Parameter:</b>	$R_{s,i,j,\text{baseline}}$
Data unit:	Ohm/km
Description:	Resistance of distribution line for section s of feeder j in division i.
Source of data used:	REC standard for a type of line
Value applied:	Varies from feeder to feeder and is available in the DPR
Justification of the choice of data or description of measurement methods and procedures actually applied :	The actual loss calculation is performed separately for different line sections carrying different loads. The DPRs have details on type of conductors and their resistance values (as per standard specifications) and the same information will be used for baseline emission calculations.
Any comment:	



<b>Data / Parameter:</b>	$P_{s,i,j, \text{baseline}}$
Data unit:	kVA
Description:	Load in a distribution line for section s of feeder j in division i.
Source of data used:	Detailed Project Report
Value applied:	Varies from feeder to feeder and is available in the DPR
Justification of the choice of data or description of measurement methods and procedures actually applied :	The actual loss calculation is performed separately for different line sections carrying different loads. The load in a distribution line for each section will be collected based on the connected loads of each section and the details will be based on the information of the DPRs. The connected load details can also be cross checked with the PSEB consumer database for agriculture loads.
Any comment:	Data is available in BHP which will be converted into kVA.

<b>Data / Parameter:</b>	$N_{\text{transformer},i,j, \text{CPA}}$
Data unit:	kVA
Description:	Capacity-wise number of Transformer(s) dismantled in feeder j of division i in the SSC-CPA
Source of data used:	On-site data
Value applied:	Varies from feeder to feeder and is available in the calculation sheet
Justification of the choice of data or description of measurement methods and procedures actually applied :	The list of the distribution transformers in the baseline and of those replaced under each SSC-CPA will be monitored and records will be maintained for verification purpose. The transformer procurement details in the store can also be used to cross-check the rating of each transformer procured and replaced ones.
Any comment:	-

<b>Data / Parameter:</b>	$L_{s,i,j, \text{CPA}}$
Data unit:	Km
Description:	Length of distribution line for section s of feeder j in division in SSC-CPA
Source of data used:	On-site data
Value applied:	Varies from feeder to feeder and is available in the calculation sheet
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is required for loss calculation in the SSC-CPA. This data will be collected from the PSEB database on procurement of new materials for implementation for each SSC-CPA. The information can also be cross checked with the invoices of the material procured.
Any comment:	

<b>Data / Parameter:</b>	$R_{s,i,j, \text{CPA}}$
Data unit:	Ohm/km
Description:	Resistance of distribution line for section s of feeder j in division i in SSC-CPA
Source of data used:	REC standard for a type of line
Value applied:	Varies from section to section
Justification of the choice of data or description of measurement methods	This is required for loss calculation in the SSC-CPA. This will be based on the type of the material procured for implementation and the resistance value will be collected from standard references and/or literature or from supplier details.



and procedures actually applied :	
Any comment:	

<b>Data / Parameter:</b>	<b><math>P_{s,i,j,CPA}</math></b>
Data unit:	kVA
Description:	Load in section s of feeder j in division i in SSC-CPA
Source of data used:	On-site data
Value applied:	Varies from section to section of feeder
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is required for loss calculation in the SSC-CPA. This information will be based on the connected loads (APs) for each section of the feeder and is based on the PSEB database on the agriculture consumers connected to each feeder.
Any comment:	Data is available in BHP for all APs which will be converted into kVA.

<b>Data / Parameter:</b>	<b><math>LF_{i,j}</math></b>
Data unit:	-
Description:	Load Factor of feeder j part of division i
Source of data used:	Calculated based on the data recorded on a daily basis.
Value applied:	0.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is based on REC guidelines and is constant throughout. However, this value will be cross checked with actual values on a sample feeder and the conservative value will be chosen for calculation purposes.
Any comment:	

<b>Data / Parameter:</b>	<b><math>LLF_{i,j}</math></b>
Data unit:	-
Description:	Loss Load Factor of feeder j part of division i
Source of data used:	Calculated based on the data recorded on a daily basis.
Value applied:	0.132
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is based on REC guidelines and is constant throughout. However, this value will be cross checked with actual values on a sample feeder and the conservative value will be chosen for calculation purposes.
Any comment:	

<b>Data / Parameter:</b>	<b><math>LDF_{i,j}</math></b>
Data unit:	-
Description:	Load distribution factor
Source of data used:	Calculated based on the data recorded on a daily basis.
Value applied:	2



Justification of the choice of data or description of measurement methods and procedures actually applied :	This is based on REC guidelines for uniformly distributed load and is a constant throughout. However, this value will be cross checked with actual values on a sample feeder and the conservative value will be chosen for calculation purposes.
Any comment:	

<b>Data / Parameter:</b>	<b>DF<sub>i,j</sub></b>
Data unit:	-
Description:	Diversity factor for feeder j of division i
Source of data used:	Calculations based on the data recorded on a daily basis.
Value applied:	1.2
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is based on REC guidelines. This value will be considered as constant throughout based on REC guidelines. However, this value will be cross checked with actual values on a sample feeders and the conservative value will be chosen for calculation purposes.
Any comment:	

**E.7. Application of the monitoring methodology and description of the monitoring plan:**

**D.7.1. Data and parameters to be monitored by each SSC-CPA:**

*(Copy this table for each data and parameter)*

<b>Data / Parameter:</b>	<b>P<sub>max,i,j</sub></b>
Data unit:	kVA
Description:	Peak Load in feeder j of division i
Source of data to be used:	Energy meter for the feeder installed at the respective substation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Value varies for each feeder in the CPA.
Description of measurement methods and procedures to be applied:	The reading is taken by the substation officer from the Electronic Tri-vector Meter (accuracy class of 0.5) in the hourly log sheets.  Frequency of recording- Daily
QA/QC procedures to be applied:	The readings will be recorded in the required format daily by the substation officer. For each SSC-CPA, the first control will be done by the sub division officer. The Executive Engineer will approve the records at division level and then goes to the Superintendent Engineer for CPA level approval and finally to the Engineer in Chief for the PoA level approval. Energy meter shall be tested/ calibrated once a year as per PSEB internal standards. In case of discrepancies, the readings will be cross checked with the connected load details of the feeder.
Any comment:	-



<b>Data / Parameter:</b>	<b>EG<sub>i,j</sub></b>
Data unit:	kWh
Description:	Energy sent from feeder j of division i
Source of data to be used:	Energy meter for the feeder installed at the respective substation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Value varies for each feeder in the CPA.
Description of measurement methods and procedures to be applied:	The reading is taken by the substation officer from the Electronic Tri-vector Meter (accuracy class of 0.5) in the hourly log sheets.  Frequency of recording- Daily
QA/QC procedures to be applied:	The readings will be recorded in the required format daily by the substation officer. For each SSC-CPA, the first control will be done by the sub division officer. The Executive Engineer will approve the records at division level and then goes to the Superintendent Engineer for SSC-CPA level approval and finally to the Chief Engineer for the PoA level approval. Energy meter shall be tested/calibrated once a year as per PSEB internal standards. In case of discrepancies, the readings will be cross checked with the connected load details of the feeder and operating hours.
Any comment:	

<b>Data / Parameter:</b>	<b>PF<sub>j,i</sub></b>
Data unit:	-
Description:	Power Factor for feeder j of division i
Source of data to be used:	Energy meter for the feeder installed at the respective substation.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Varies for each feeder and will be provided for each CPA
Description of measurement methods and procedures to be applied:	The reading is taken by the substation officer from the Electronic Tri-vector Meter (accuracy class of 0.5) in the <i>daily</i> log sheets.
QA/QC procedures to be applied:	The readings will be recorded in the required format daily by the substation officer. For each SSC-CPA, the first control will be done by the sub division officer. The Executive Engineer will approve the records at division level and then goes to the Superintendent Engineer for SSC-CPA level approval and finally to the Engineer in Chief for the PoA level approval. Energy meter shall be tested/calibrated once a year as per PSEB internal standards. In case of discrepancies, the readings will be cross checked with the kW and kVA details of the feeder.
Any comment:	-

<b>Data / Parameter:</b>	<b>n<sub>i,j</sub></b>
Data unit:	-



Description:	Number of operating hours for a feeder j for division i
Source of data to be used:	On-site power supply schedule
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Varies for each feeder and will be provided for each CPA
Description of measurement methods and procedures to be applied:	The reading is taken by the substation officer.
QA/QC procedures to be applied:	The readings will be recorded in the required format daily by the substation officer. For each SSC-CPA, the first control will be done by the sub division officer. The Executive Engineer will approve the records at division level and then goes to the Superintendent Engineer for SSC-CPA level approval and finally to the Engineer in Chief for the PoA level approval. Energy meter shall be tested/ calibrated once a year as per PSEB internal standards. Any discrepancy of data will be tracked and corrected using data from the 132 or 33 kV substations that feed the particular 11 kV substation.
Any comment:	-

**E.7.2. Description of the monitoring plan for a SSC-CPA:**

In line with AMS IIA version 10, the CPA proposes to reduce the ‘Technical Loss’ through conversion of LVDS to HVDS. The ‘Technical Loss’ have been analytically calculated using the standard formulas derived by REC. This is in line with point (ii) of Option 2, para 4 of AMS IIA, version 10. The details have been provided in the PoA.

The ‘Technical loss’ reduction by conversion of the LVDS to HVDS and the corresponding Emission Reduction calculated using the REC derived formulas provided in sections E.6.2 of the PoA. The detailed monitoring plan for a SSC-CPA has been detailed in section A.4.4.2.

PSEB is responsible for the implementation of the Monitoring Plan (see Figure in Section A.4.4.2). Under this, various sub-divisional and divisional officers will:

- Supervise data collection and ensure the completeness, timeliness and correctness of the monitoring records
- Calculate emission reductions
- Ensure quality control and quality assurance, administrate and maintain all CPA databases at the PSEB head office in Patiala.

Operational data will be recorded on an hourly basis by substation officer and daily compilation will be transmitted to the subdivision office.

The Monitoring Plan will also consist in the following:

**Electricity Monitoring:**

- The metering system consists in ampere meters (A), power meters (kVA), voltmeters (kV) and energy meters (MWh). The substation officers will record important parameters for energy loss



calculations on an hourly basis. PSEB substations and feeders are equipped with an in-house metering system, which monitors the performance of the individual substations and feeders. Professional metering equipment will be installed at substations where required, whereas existing meters will be calibrated.

- The parameters to be metered include current and MW drawn by the substation concerned and each connected feeder, the voltage (kV) energy sent out by substation and feeder (MWh), power supply time (hours), power outage time (hours).
- The operators at individual substations shall take hourly readings of the meters and shall keep complete and accurate records in the substation log book for proper administration.

Reports will be reviewed by the subdivision officers, who will then prepare a monthly report based on these and send it to the Executive Engineer.

**Calibration:**

The calibration of electricity meters is the responsibility of the PSEB using internal procedures. The results of the calibration will be included in the monitoring report at the CPA and the PoA levels. If there are any anomalies in the readings of the metering instruments throughout the year, the instruments will be recalibrated.

**Data Management:**

All electronic and hard copy records of the metering devices, electricity monitoring records, relevant documentation and the results of calibration will be collated in a central area by the Superintendent Engineer. All recorded data in the project activity used in the calculation of emission reductions or in terms of quality control and quality assurance will be archived for a period of 2 years after the end of the crediting period.

**Damages to Monitoring Equipment:**

In case monitoring equipment is damaged and no reliable readings can be recorded, the PoA managing entity will use the lowest historical values to estimate the technical losses in the CPA.

**Emergencies:**

In the case of emergencies, emission reductions will not be claimed for the duration of the emergency. Emergencies cases include events that do not allow the project activity to be physically operational: natural disasters, such as earthquakes, hurricanes, floods, tornados, and fires. At the end of the emergency period, the following procedure will be launched to re-establish emission reductions accounting: the PoA entity will examine all meters and notify the readiness of all requirements for the monitoring of emission reductions and normal operations. A third party could witness the procedures.

**E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)**

Date of completion of the baseline study & monitoring methodology: 10/12/2009

Name of the responsible person:

**Er. V.K. Singhal,**  
Engineer-in Chief/RE-APDRP, PSEB



Shakti Vihar, Patiala  
Punjab - 147001, India



**Annex 1**

**CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and  
PARTICIPANTS IN THE PROGRAMME of ACTIVITIES**

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SMALL-SCALE CDM PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM  
(CDM SSC-PoA-DD) - Version 01



CDM – Executive Board

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Annex 2

**INFORMATION REGARDING PUBLIC FUNDING**

There is no public funding available for this program.



### Annex 3

## BASELINE INFORMATION

### **Grid emission factor:**

As per AMS 1.D, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO<sub>2</sub>e/kWh) calculated in a transparent and conservative manner as:

A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the ‘Tool to calculate the emission factor for an electricity system’ Version 2 Annex 14 EB 50.

OR

The weighted average emissions (in kg CO<sub>2</sub>e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used. Calculations must be based on data from an official source (where available) and made publicly available.

Baseline for the project activity is power generated from renewable energy source multiplied by the grid emission factor of NEWNE grid calculated in transparent and conservative manner.

Option (a) has been considered to calculate the grid emission factor as per the ‘Tool to calculate the emission factor for an electricity system’ version 2 Annex 14 EB 50 as per the methodology as data is available from an official source.

### **Baseline Methodology Procedure**

Project participants shall apply the following six steps:

STEP 1: Identify the relevant electric power system.

STEP 2: Select an operating margin (OM) method.

STEP 3: Calculate the operating margin emission factor according to the selected method.

STEP 4: Identify the cohort of power units to be included in the build margin (BM).

STEP 5: Calculate the build margin emission factor.

STEP 6: Calculate the combined margin (CM) emissions factor.

### **STEP 1: Identify the relevant electric power system**

The tool defines the electric power system as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. Keeping this into consideration, the CEA<sup>24</sup>, Government of India has divided the Indian Power Sector into five regional grids as East, West, North, South and North Eastern grids respectively.

However for the purpose of estimation of baseline emissions, CEA has classified the grid system into two parts, Southern Region grid and NEWNE grid. The NEWNE grid comprises of –

<b>Northern</b>	<b>Eastern</b>	<b>Western</b>	<b>North-Eastern</b>
Chandigarh	Bihar	Chhattisgarh	Arunachal Pradesh
Delhi	Jharkhand	Gujarat	Assam
Haryana	Orissa	Daman & Diu	Manipur
Himachal Pradesh	West Bengal	Dadar & Nagar Haveli	Meghalaya

<sup>24</sup> [http://www.cea.nic.in/planning/c%20and%20e/user\\_guide\\_ver5.pdf](http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver5.pdf)



Jammu and Kashmir	Sikkim	Madhya Pradesh	Mizoram
<b>Punjab</b>	Andaman- Nicobar	Maharashtra	Nagaland
Rajasthan		Goa	Tripura
Uttar Pradesh			
Uttarakhand			

Since the project supplies electricity to the Northern Region grid a part of NEWNE grid, emissions generated due to the electricity generated by the NEWNE grid as per CM calculations will serve as the baseline for this project.

**STEP 2: Select an operating margin (OM) method**

The calculation of the operating margin emission factor ( $EF_{OM,y}$ ) is based on one of the following methods:

- Simple OM, or
- Simple adjusted OM, or
- Dispatch data analysis OM, or
- Average OM

Any of the four methods can be used. However, the simple OM method (option a) can only be used if low-cost/must-run resources 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.

<b>Region</b>	<b>2005-06</b>	<b>2006-07</b>	<b>2007-08</b>	<b>2008-09</b>
NEWNE	18.0%	18.5%	19.0%	17.3%
South	27.0%	28.3%	27.1%	22.8%
India	20.1%	20.9%	21.0%	18.6%

(Source: [http://www.cea.nic.in/planning/c%20and%20e/user\\_guide\\_ver5.pdf](http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver5.pdf))

The above table clearly shows that the percentage of total grid generation by low-cost/must-run plants (on the basis of average of four most recent years) for the NEWNE grid is only 18.2% which is much lesser than 50% of the total generation. Thus, Simple OM method can be used for calculating the emission factor.

**STEP 3: Calculate the operating margin emission factor according to the selected method**

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: 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, without requirement to monitor and recalculate the emissions factor during the crediting period, or
- Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required for calculating 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 preceding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.



The simple OM emission factor is calculated as the generation-weighted average CO<sub>2</sub> emissions per unit net electricity generation (tCO<sub>2</sub>/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

Method adopted for Simple OM in the project activity

In the project activity, (ex-ante) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission has been considered. The data is published annually by the CEA.

It is confirmed that ex-ante vintage is considered in the project activity and cannot be changed during the crediting period.

Parameter	Value (tCO <sub>2</sub> / MWh)	Source
Simple OM, 2006-07	1.008	The OM is based on ACM0002 as calculated in CEA database for grid emission factor (Version 5). <a href="http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm">http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm</a>
Simple OM, 2007-08	1.000	
Simple OM, 2008-09	1.006	
Simple OM, average	1.005	

**STEP 4: Identify the cohort of power units to be included in the build margin (BM)**

The value of the data has been taken from the data published by CEA as referred in earlier step. The details of the key assumptions considered to calculate the figure can be found in the User Guide of the same.

Project participants can choose one of the following two options:

**Option 1**

Calculate the Build Margin emission factor EF<sub>BM,y</sub> ex-ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

**Option 2**

For the first crediting period, the Build Margin emission factor EF<sub>BM,y</sub> must be updated annually ex-post for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, EF<sub>BM,y</sub> should be calculated ex-ante, as described in option 1 above. The sample group m consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

**STEP 5: Calculate the build margin emission factor (EF<sub>grid,BM,y</sub>)**

Option 1 as described above is chosen in the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PDD and is fixed for the entire crediting period.

As per the CEA CO<sub>2</sub> Baseline Database, the BM for the 2008-09 has been calculated to be EF<sub>grid,BM,y</sub> = 0.675 tCO<sub>2</sub>e/MWh



**STEP 6: Calculate the combined margin (CM) emissions factor ( $EF_{grid,CM,y}$ )**

The CM can be calculated as per the following:

$$EF_{CM,grid,y} = EF_{OM,grid,y} \times W_{OM} + EF_{BM,grid,y} \times W_{BM}$$

Where,

$EF_{grid,OM,y}$  = Build Margin CO<sub>2</sub> emission factor in the year y (tCO<sub>2</sub>/GWh)

$EF_{grid,BM,y}$  = Operating Margin CO<sub>2</sub> emission factor in the year y (tCO<sub>2</sub>/GWh)

$W_{OM}$  = Weighting of operating margin emission factor (%)

$W_{BM}$  = Weighting of build margin emission factor (%)

Where:

The default weights for OM and BM are as follows:  $W_{OM} = 50\%$  and  $W_{BM} = 50\%$

In the project activity, combined margin has been chosen as the baseline emission factor for grid emission factor. The value chosen is taken from relevant official sources and is publicly available<sup>25</sup>.

Parameter	Value (tCO <sub>2</sub> / MWh)
OM, Operating Margin	1.005
BM, Build Margin	0.675
<b>CM, Combined Margin</b>	<b>0.840</b>

Thus, the CM emissions factor ( $EF_{grid,CM,y}$ ) for the project has been calculated to be  $EF_{grid,CM,y} = 0.840$  tCO<sub>2</sub>/MWh and is fixed ex-ante for the entire crediting period.

Source: Baseline Carbon Dioxide Emissions from Power Sector Version 5 published by the CEA, India<sup>26</sup>.

<sup>25</sup> [http://www.cea.nic.in/planning/c%20and%20e/user\\_guide\\_ver5.pdf](http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver5.pdf)

<sup>26</sup> <http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>



**Annex 4**

**MONITORING INFORMATION**

**List of the Divisions (46 HVDS REC Schemes) under Phase I**

SN	Name of Division(s)*	Name of the Circle	REC Scheme Code
1.	City West Circle, Ludhiana	Ludhiana	Awaiting Sanction from REC
4.	City East Circle, Ludhiana	Ludhiana	Awaiting Sanction from REC
2.	Bathinda Circle	Bathinda	Awaiting Sanction from REC
3.	Mohali Circle	Mohali	Awaiting Sanction from REC
5.	Ropar, Samrala and Kharar Division	Ropar	Code-161374
6.	Sangrur Division.	Sangrur	Code-161366
7.	Jalandhar Circle	Jalandhar	Awaiting Sanction from REC
8.	City and Suburban Division, Barnala	Sangrur	Code-161369
9.	Suburban Division. Sunam	Sangrur	Code-161398
10.	Dhuri Division	Sangrur	Code-161358
11.	Dirba Division	Sangrur	Code-161376
12.	Khanna ,Doraha & Gobindgarh Division under Khanna Circle	Khanna	Code-161397
13.	Samana & Patran Division	Patiala	Code-161367
14.	Nabha and Rajpura Division	Patiala	Code-161364
15.	City HSP, Sub HSP, Dusuha, Bhogpur, and Mahilpur.	Hoshiarpur	Code-161356
16.	Sub Batala, Pathankot, City Batala, Dhariwal and Gurdaspur	Gurdaspur	Code-161368
17.	City Division, Sunam	Sangrur	Code-161385
18.	East, West and Suburban Patiala	Patiala	Code-161357
19.	West Division, Amritsar	Sub. Amritsar	Awaiting Sanction from REC
20.	Malertkotla Division	Sangrur	Code-161365
21.	Adda Dakha & Ahmedgarh Division	Sub. Ludhiana	Code-161377
22.	Jagraon and Lalto Kalan	Sub. Ludhiana	Code-161375
23.	Mukatsar, Malout, Abohar, Fazilka, Gidderbaha and Badal Division	Mukatsar	Code-161372
24.	Nawanshehar, Banga & Garshankar Division.	Nawanshehar	Code-161386
25.	Suburban and East Division.,Amritsar	Sub. Amritsar	Code-161392
26.	Jalalabad	Ferozpur	Code-161391
27.	Goraya	Nawanshehar	Code-161389
28.	Rayya Division	Taran Taran	Code-161384
29.	Ajnala & Jandiala	Sub. Amritsar	Code-161390
30.	Suburban Nakodar	Kapurthala	Code-161363
31.	Ferozpur City and Sub Division.,	Ferozpur	Code-161371
32.	Raikot Division	Sub. Ludhiana	Code-161370
33.	Sub Division Kapurthala	Kapurthala	Code-161378
34.	City Division Nakodar	Kapurthala	Code-161394
35.	Sirhind and Amloh Division	Khanna	Code-151362



36.	City Kapurthala	Kapurthala	Code-161383
37.	City Tarn Taran & Bhikhiwind	Taran Tarn	Code-161361
38.	Kartarpur Division	Kapurthala	Code-161393
39.	Sub Division Moga	Faridkot	Code-161381
40.	Baghapurana Division	Faridkot	Code-161387
41.	City Division Moga	Faridkot	Code-161388
42.	Patti Division	Taran Tarn	Code-161382
43.	Kotkapura Division	Faridkot	Code-161395
44.	Zira Division	Ferozepur	Code-161380
45.	Quadian Division	Gurdaspur	Code-161379
46.	Faridkot Division	Faridkot	Code-161396

\*The details of feeders falling under a division shall be provided in each of the SSC-CPAs at the time of inclusion.