Appendix A[1] to the simplified modalities and procedures for small-scale CDM project activities

CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL SCALE PROJECT ACTIVITIES (SSC-PDD)
Version 01 (21 January, 2003)

Introductory Note

1. This document contains the clean development mechanism project design document for small-scale project activities (SSC-PDD). It elaborates on the outline of information in appendix B 'Project Design Document' to the CDM modalities and procedures (annex to decision 17/CP.7 contained in document FCCC/CP/2001/13/Add.2) and reflects the simplified modalities and procedures (herewith referred as simplified M&P) for small-scale CDM project activities (annex II to decision 21/CP.8 contained in document FCCC/CP/2002/7/Add.3).

2. The SSC-PDD can be obtained electronically through the UNFCCC CDM web site (http://unfccc.int/cdm/ssc.htm), by e-mail (cdm-info@unfccc.int) or in print from the UNFCCC secretariat (Fax: +49-228-8151999).

3. Explanations for project participants are in italicized font *(e.g. explanation)*.

4. The Executive Board may revise the SSC-PDD if necessary. Revisions shall not affect small-scale CDM project activities validated prior to the date at which a revised version of the SSC-PDD enters into effect. Versions of the SSC-PDD shall be consecutively numbered and dated. The SSC-PDD will be available on the UNFCCC CDM web site in all six official languages of the United Nations.

5. In accordance with the CDM modalities and procedures, the working language of the Board is English. The completed SSC-PDD shall therefore be submitted to the Executive Board in English.

6. Small-scale activities submitted as a bundle, in accordance with paragraphs 9 (a) and 19 of the simplified M&P for small-scale CDM project

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[1] This appendix has been developed in accordance with the simplified modalities and procedures for small-scale CDM project activities (contained in annex II to decision 21/CP.8, see document FCCC/CP/2002/7/Add.3) and it constitutes appendix A to that document. For the full text of the annex II to decision 21/CP.8 please see http://unfccc.int/cdm/ssc.htm).

activities, may complete a single SSC-PDD provided that information regarding A.3 (*Project participants*) and A.4.1 *(Location of the project activity)* is completed for each project activity and that an overall monitoring plan is provided in section D.

7. A small-scale project activity with different components eligible to be proposed[2] as a small-scale CDM project activity may submit one SSC-PDD, provided that information regarding subsections A.4.2 (Type and category(ies) and technology of project activity), and A.4.3 (brief statement on how anthropogenic emissions of greenhouse gases (GHGs) by sources are to be reduced by the proposed CDM project activity) and sections B (Baseline methodology), D (Monitoring methodology and plan) and E (Calculation of GHG emission reductions by sources) is provided separately for each of the components of the project activity.

8. If the project activity does not fit any of the project categories in appendix B of the simplified M&P for small-scale CDM project activities, project proponents may propose additional project categories for consideration by the Executive Board, in accordance to paragraphs 15 and 16 of the simplified M&P for small-scale CDM project activities. The project design document should, however, only be submitted to the Executive Board for consideration after it has amended appendix B as necessary.

9. A glossary of terms may be found on the UNFCCC CDM web site or from the UNFCCC secretariat by e-mail (cdm-info@unfccc.int) or in print (Fax: +49-228-8151999).

[2] In paragraph 7 of simplified M&P for small-scale CDM project activities, on clarifications by the Executive Board on small-scale CDM project activities, the Board agreed that in a project activity with more than one component that will benefit from simplified CDM modalities and procedures, each component shall meet the threshold criterion of each applicable type, e.g. for a project with both a renewable energy and an energy efficiency component, the renewable energy component shall meet the criterion for "renewable energy" and the energy efficiency component that for "energy efficiency".

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A General description of project activity

A.1 Title of the project activity:

Municipal Street Lighting Energy Efficiency Project, Bangalore Development Authority (BDA), Bangalore, India

A.2 Description of the project activity:

<u>*Description of present situation*</u>

Under the proposed CDM project activity, street lighting system installed along a 110 km ring road stretch of the National highway (No...........) between Bangalore city and Tumkur town in the state of Karnataka has been selected. The details of the existing infrastructure, connected load and the energy consumption are given in **Annexure A.1.** The present system has got the following features:

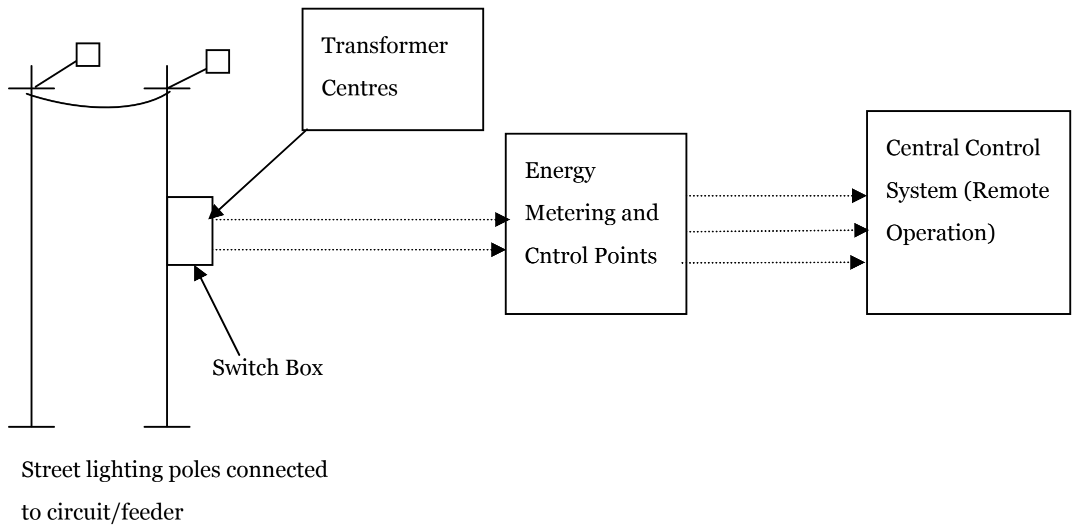
1. Though energy meters are installed at most of the circuits, monthly energy bills are not made as per the tariff based on the actual meter readings, leading to erroneous and excess/reduced energy consumption.
2. On the other hand, energy bills for non-metered circuits are based on the connected load of the circuit and the monthly operating hours. This generally excludes the energy consumption by the choke of the lamps, which creates a dent in the revenue for the utility.
3. Timer controls are installed for almost all circuits but there is no regular /seasonal check up to alter or regulate the time settings to switch ON/OFF lamps leading to extra lighting hours.
4. This is due to absence of any control systems on the input power supply quality especially voltage conditions. The voltage levels at light terminals vary in wide bandwidth, leading to higher power consumption. High voltage levels in the range between 260 – 280 V are not uncommon in the system. This not only increases the energy consumption but also leads to premature lamp failures and hence higher O & M (Operational and Maintenance) costs.
5. Inadequate/poor fault reporting mechanism in the system and hence delayed repair of the faulty lights and hence human discomfort (leading to road accidents).

6. Non uniform light intensity levels due to several reasons mentioned above and higher intensity levels during off peak traffic hours, leading to energy wastage
7. No control and/or mechanism to check the power theft from the lines meant for street lighting supply, causing revenue loss to both municipalities and to the utility.

Technical description of the project activity

The objective of the project is to improve the energy efficiency and to reduce the operational and maintenance costs of the street lighting system of 110 km long Bangalore – Tumkur national highway, which currently has a total load of 1.1 MW. The monthly energy consumption of the system is on an average 265,982 kWh amounting to an expenditure of Rs. 1.3 million. The project proposes installation of two-level HID (High Intensity Dimming) controls for lamps as well as installation of the ETrACS (Energy Tracking and Control System) to track the actual energy consumption of the system and take appropriate energy consumption reduction measures through voltage control mechanism. The proposed ETrACS involves setting up of a computer based central control station from which the entire Ring Road lighting of BDA is monitored and controlled, using a wireless system that is built around the next generation CDM (Code Division Multiple Access)/GSM (Global System for Mobile Communications) wireless communication. The proposed system still uses the entire existing infrastructure like timer controls and energy meters to control the burning hours of the lamps and to record the energy consumption of the feeder/circuit respectively. The energy consumed by the entire street lights will be monitored remotely over the wireless network using the energy meters approved by the State Electricity Board. The Central Control System will switch on the street lights in the normal mode in the Ist phase (at 6.00 pm), operate the street lights in the energy conservation mode up to 10.30 pm. in the night and then operate the street lights in the Dimming mode from 10.30 p.m. to morning. A daily log of energy consumed, glowing hours of the lights and a fault identification report is generated every day.

The sample model of the proposed project activity is as shown below:



The above picture depicts that the supply to each feeder/circuit of street lighting i.e. to switch boxes, is given from various transformer centres in the area. Each feeder/circuit has got an individual energy meter. All these energy meters are connected to the central control system through which the energy consumption will be monitored continuously. The same central control system also controls the voltage applied to the circuit/feeder to conserve the energy during the off-peak periods.

Purpose of project activity

The main purpose of this project activity is to control and monitor the energy consumption and wastage in the street lighting system with the adaptation of new techniques, incorporation of better energy efficiency and energy management technologies available in the market. The project aims at overall reduction in the energy consumption and demand required to provide municipal lighting services without affecting the quality of lighting level. This project will lead to reduced GHG (Greenhouse Gas) Emissions, because it will reduce the additional fossil fuels consumption required to generate the energy saved by this project, while maintaining or enhancing the service levels.

Contribution of project activity to sustainable development of Bangalore municipality:

The savings of electric power resulting from this project can be used by BDA to expand and improve their service. Ultimately, this may lead to lower marginal unit costs for electricity, of particular importance to low income consumers who pay a disproportionate share of their income for those goods and services.

As the proposed project has a high degree of replication in other municipalities in the country and areas within the state, the main social and economic benefits of this project activity are:

- Reduction in coal and other fuel consumed to generate electricity and all of the associated emissions: carbon dioxide, carbon monoxide, SO_2, NO_x, mercury and particulates.
- The project provides for continuing training and education of the municipal employees, which creates awareness on the efficient use of electricity and the positive of proper energy management effects on the environment.

A.3 Project participants:

M/s Elpro Energy Dimensions Pvt. Ltd is the project promoter involved directly in the project activity as an ESCO (energy saving company).

M/s Elpro undertakes concept-to-commissioning of Energy Efficiency Projects especially for street lighting applications. M/s Elpro will be the project developer who has facilities for manufacturing and marketing these systems under the proposed project activity.

TERI is the PDD consultant and will be the agency for official contact for the CDM PDD. BDA (Bangalore Development Authority) will be the project beneficiary under the proposed activity.

A.4 Technical description of the project activity:

A.4.1 Location of the project activity: Bangalore – Tumkur National Highway, Karnataka State, India

A.4.1.1 Host country Party (ies):

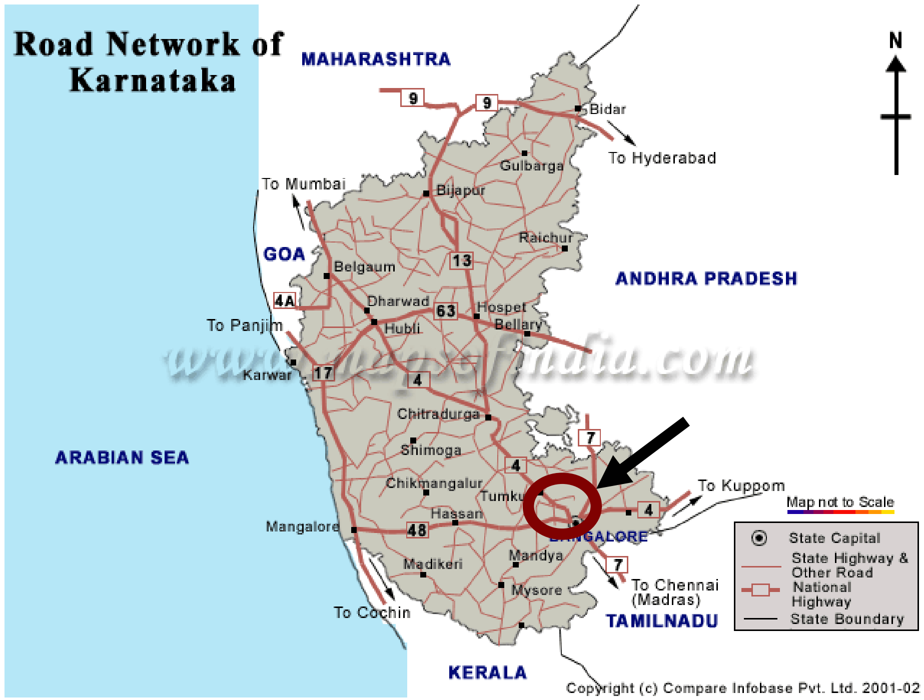
India

A.4.1.2 Region/State/Province etc.:

The project area would cover 110 km long Bangalore – Tumkur National Highway, Karnataka, India (as shown below).

A.4.1.3 City/Town/Community etc:

The city/towns for the proposed activity will be Bangalore – Tumkur National highway. The road covers Bangalore city and some of the adjacent villages in the state of Karnataka. The location of the project activity is as shown below:



A.4.1.4 Detailed description of the physical location, including information allowing the unique identification of this project activity (maximum one page):

The city/town for the proposed project activities is Bangalore – Tumkur national highway. The main reasons behind selecting this location is:

(i) Single stretch of road with around 3500 street lights and of 1100 kW connected load

(ii) Voltage conditions for each of the circuit vary significantly throughout the night which is the key parameter from the energy conservation point of view in the proposed system

(iii) Uniform light mix throughout the stretch of road. All lamps are of 250 W HPSV (High Pressure Sodium Vapour) lamps

(iv) Ease of monitoring the energy savings and hence the green house gas emission reductions.

A.4.2 Type & Category(ies) and Technology of project activity

Type & Category(ies) : Type IIC – Demand Side Energy Efficiency
Technology of project activity:
There is an increasing demand to maximize energy savings of lighting sources. While HID lamps are inherently very efficient, many users would like to further increase the energy savings of HID lamps through dimming.

There are two general classes of HID dimming systems. In bi-level (two) dimming, HID lamps are run in a low mode of reduced lamp power when less light is required. Lamps are then switched to 100% lamp power (high mode) when full illumination is needed. The other common class of dimming systems is called 'continuous' and allows for user settings from 0% to 100% wattage, and thus complete light control. In the proposed project activity, bi-level (two) dimming system is used.

ETrACS (Energy Tracking And Control System) is basically a computer based energy monitoring and control system for controlling and monitoring a maximum of 50,000 energy consuming nodes spread in an wide area (any distance). The day-to-day transactions (switching on/off) of the loads, energy usage data, status of glowing hours and health of street lights can be monitored and further analyzed by computer generated reports. The following benefits are foreseen with the application for the proposed technology:

- Time based switching on/off of street light
- Energy conservation mode during peak hours
- Demand side management through dimming of lights during non-peak periods
- Energy tracking and planning
- Precise monitoring of energy consumed for street lighting.
- Monitoring of faulty street lights and ensuring a effective fault repair and servicing system
- Energy theft monitoring
- Keeping a close check on maintenance

A.4.3 Brief statement on how anthropogenic emissions of GHGs (greenhouse gases) by sources are to be reduced by the proposed CDM project activity:

This project will reduce GHG emissions by improving the street lighting efficiency of the 110 km stretch Bangalore – Tumkur National highway. The street lighting system of the municipalities are all served by grid power, and the project will result in reduced energy consumption for the provision of basic municipal services. The energy savings are both direct, from installation of more energy efficient technologies and indirect, from reducing operation and maintenance costs due to prolonged life of the lamps. The energy savings (kWh) that accrue at the municipal (site) level can be converted directly to carbon emission reductions using an appropriate CEF (Carbon Emissions Factor) for the electric power being supplied by various sources to the state of Karnataka/southern region.

Currently Karnataka, like the rest of India and much of the developing world, suffers from the shortage in supply of grid electricity. Thus, the baseline demand for the electricity will continue to grow. This demand will be met through thermal (coal, lignite and natural gas) power plants planned for the future. The proposed project for improving energy efficiency at the end use will ultimately reduce the demand for the thermal based grid power and will thus lead to reduction of GHG.

The proposed project activity reduces the present energy consumption of the lighting system with the help of retrofit devices that control and regulate the light output based on the requirement. It is expected that at least 30% of the present energy consumption could be reduced. The annual CO_2 reductions for the estimated period of 10 years are about 10 840 MT i.e. 1084 MT per year for a southern region (CEF @ 0.75 kg/kWh.)

A.4.4 Public funding of the project activity:

No public or donor funding is being used in this project

A.4.5 Confirmation that the small-scale project activity is not a de-bundled component of a larger project activity:

The proposed project is not a de-bundled component of a larger project activity. The municipal street lighting energy efficiency project does not form a small portion of a larger project activity. The proposed project activity is well within the limits for small-scale CDM project activities in terms of aggregate energy savings by a single project not exceeding 15 GWh per year.

However the same project can be replicated to many other roads in the state and thus reduce the green house gas emissions further. As similar kind of conditions prevail at almost all street lighting systems in the state, the same technology can be adopted to reduce the energy consumption to the extent of at least 30%.

B Baseline methodology

B.1 Title and reference of the project category applicable to the project activity:

Type IIC - Demand-side energy efficiency programmes for specific technologies (in accordance with paragraph 6 (c) of decision 17/CP.7) for small scale project activity.

B.2 Project category applicable to the project activity:

The proposed project reduces electricity consumption on the demand side through introduction of HIDs and the ETrACS system. The average annual electricity savings estimated reaches 1.4 GWh and thus lies below the small-scale threshold (less than 15 GWh) as per the article (46) of the simplified m&p for small-scale CDM project activities.

B.3 Description of how the anthropogenic GHG emissions by sources are reduced below those that would have occurred in the absence of the proposed CDM project activity (i.e. explanation of how and why this project is additional and therefore not identical with the baseline scenario)

The project is additional because it faces the following prohibitive barriers:

Investment barriers:
Municipal governments in India are extremely strapped for cash and therefore neither have the resources to implement significant infrastructure improvements, nor the creditworthiness to borrow money. Even if that were the case, most banks and other lending institutions in India are hesitant to lend for projects that reduce operating costs alone. Financial institutions in India (and elsewhere) are generally not familiar or adept at analyzing the financial aspects of these investments, and hence even less willing to extend credit for energy conservation projects. It is possible in more developed countries to obtain capital from private investors that finance the projects

and are paid back through the energy savings (energy service companies or ESCOs). However, the ESCO market isn't yet mature enough in India, particularly with regards to the municipal sector, due to a number of market barriers including lack of finance, lack of experience in ESCO/performance contracting, and weak contract law. To date, there have been no large-scale municipal ESCO projects implemented in India. In addition, ESCOs still need capital themselves, and bank financing is relatively expensive in India, ranging from 11.5% to 14.5% for small-scale infrastructure projects. In the past, most bankers have shown little interest in projects that do not explicitly raise revenues through new production (energy efficiency projects lower costs). And companies that do provide financing for energy efficiency projects will not provide them for municipal governments, given the lack of creditworthiness. The fact is, even attractive ROI and IRR figures for efficiency projects are not enough incentives for management, particularly in the public sector, to make the decision to go ahead with implementation. As a source of revenue that is not dependent on the cost-recovery of set tariffs or on the rate of non-payment by consumers, carbon financing from energy efficiency improvements reduces the risk of such investments, even if financing costs are high.

There are extra burdens in terms of comparatively higher costs involved for obtaining and checking information, planning and design, arranging financing, implementation scheduling, monitoring initial performance and implementing necessary adjustments. These costs are additional to the actual implementation cost, due to the costs involved with over dependence on external consultants to get the above work done due to poor knowledge and awareness level of the municipal staff.

Many of the municipalities approached for energy efficiency projects claimed that they had all conducted some sort of energy audits done in the past, but were unable to fund implementation projects.

Technological barriers:
Market-based institutions, such as the ESCOs (Energy Service Companies) developed in other countries to pursue contract energy management ventures are very small in number in India. This is largely due to the lack of familiarity and any experience in the concept, and the degree of difficulty and perceived high risks of establishing and enforcing energy management contracts. The ESCO scenario in India is still under evolution. Though it is premature to draw conclusions based on past trends or recent developments on ESCO in India, it has not been popularised as yet. The Indian ESCO industry at present faces certain constraints relating to credibility and neutrality. While the issue of neutrality may be one of perception, the other problems such as inadequate support from utilities or Government, as well as the issue of wider acceptance and credibility of the ESCO concept, are real barriers. In addition, the system of legal redress in India also leaves much to be desired. Some of these constraints in the operating environment have forced certain industrial houses or equipment manufacturers to discontinue their ESCO operations.

Common practice barrier:
Upgrades to existing systems generally do not take place until a larger capital improvement project is planned. Surveys done indicate that the kW load per km of road of similar application (for national highway) is similar in other cities of about the same size, indicating that the situation is the same everywhere in the country.

Though the notification of Energy Conservation Act (2001), and the institution of the BEE (Bureau of Energy Efficiency) a statutory body under the Ministry of Power, is expected to bring in a comprehensive policy and approach to energy efficiency in India, it presently covers energy efficiency issues for industries and buildings only and has not mentioned the similar issues for public infrastructure projects like street lighting. It is unclear at the present moment of the status of inclusion of these areas in the Act to make it mandatory to maintain the energy efficiency standards (refer www.bee-india.com/EC Act). As per the schedule on list of energy intensive industries and other establishments specified as designated consumers, all the consumers belong to various industry types and not public infrastructure projects like street lighting in cities, towns etc.

B.4 Description of the project boundary for the project activity:

All project installations and improvements will take place at 110 km long Bangalore – Tumkur National highway which defines the project boundary

B.5 Details of the baseline and its development:

B.5.1 Proposed baseline for the proposed project activity

The present project activity uses the retrofit to the existing system to reduce the energy consumption. The proposed project activity mainly aims at the reduction of kWh directly using these retrofits. The baseline energy consumption will be directly related to the energy consumption after the project implementation and hence the reduction in kWh consumption will be the direct monitoring parameter. This directly relates to the article 29 (b) of the simplified m&p for small scale CDM project activity. The reduced kWh consumption will be multiplied with CO_2 emission coefficient arrived from the weighted average emissions from the current generation mix in the southern grid. Hence, the simplified energy baseline used in this project is the energy consumption of the lamps before installation of HID and ETrACS:

Step 1:
Annual energy baseline (kWh/year)

$$Eb = \sum_i ni \ x \ pi \ x \ oi / (1 - l)$$

where
Eb = annual energy baseline in kWh per year
Σi = the sum over the group of 'i' feeder/circuits installed as part of the project.
ni = the number of devices of the group of 'i' feeders/circuits.
pi = the power of the devices of the group of 'i' feeders/circuits, 'power' is the weighted average of the feeders installed.
oi = the average annual operating hours of the devices of the group of 'i' feeders/circuits.

l = average technical distribution losses for the grid serving the locations where the devices are installed, expressed as a fraction (calculated based on the size, length, resistance, current carried, number of runs of the cables/conductors).

The electricity baseline is then calculated as the weighted average of the Southern grid for the most recent year for which comprehensive data is available. It is proposed to use a static baseline due to continuing trend in the thermal capacity additions in the Southern grid and to minimise the transaction cost involved in updating the baseline every year for such a small-scale category project.

Step 2:
Annual emissions baseline (tonnes CO_2/year) = Annual energy baseline (saved) (kWh/year) * electricity baseline (kg of CO_2/kWh) * (1/1000).

For the description and explanation on why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances see B. 3

Calculation of the electricity baseline

The Southern Region of India comprises of four states and one U.T. (union territory). They are Karnataka, Tamil Nadu, Kerala, Andhra Pradesh and Pondicherry (U.T). Pondicherry has only one combined cycle gas power generating station (32.50 MW), and hence receives power from other states in the Southern Region through allocations and also imports power from Western, Eastern and Northern Regions. (Southern Regional Electricity Board Annual report 2002-2003)

The SRG (southern regional grid) had an installed capacity of 26 882.5 MW as on 31 March 2002 and 29 299.26 MW and as on 31 May 2004. The installed capacity details as on 31 May 2004 are given in **Annexure – B.1** and for the year 2001-02 in **Appendix – B.3**. The total energy generated during the year 2001-2002 was 130 478 TWh. The interregional assistance received in terms of energy is to the tune of 4 462 TWh 4 306 TWh* from Eastern Region and 0.155 TWh (as on December 2002) from Western

* TWH – TERA WATT HOUR

Region). While the simultaneous maximum demand was around 20 428 MW, the minimum demand was 11 950 MW. The overall energy consumption in the Southern Region was around 140 435 TWh. The region system load factor was 78 %.

The region and state-wise installed capacity and generation of the southern region as on March 2003 is given in Table B.1.

Table B.1 Installed capacity and generation in Southern Regional Grid (2001-2002) (MW / GWh)

Type of Generation	Installed Capacity (MW)	Generation (GWh)
Hydro	10102.0	26917.0
Thermal + Gas + Diesel	16000.5	98320.0
Nuclear	780	5241.0
Total (Region)	26882.5	130478

Source: Southern Regional Electricity Board Annual report (2001-2002)

The hydro, thermal and nuclear generation in the southern region in the state sector and the central sector for the year 2001-2002 is given in the Table. From which it is evident that the thermal share of the power generation was the highest at 75 %, followed by hydro (21%) and nuclear (4%).

The southern region is having peak as well as energy shortages. In the year 2002-03 the peak shortage was in the range of 5-16% while as the energy shortage was in the range of 0-9%. This trend is continuing with the peak deficit in the period from January 2004 till April 2004 being 4.7% and the energy deficit 5.1% during the same period.

Demand projections and capacity additions

The Fifteenth EPS (Electric Power Survey) of India has made long term demand projections, in terms of peak and energy. As per the 15th EPS, the peak demand in the southern regional grid would be about 37 996MW and the energy requirement would be 23 4164 million units by 2011-12. The demand projections have been revised in the sixteenth EPS, and as per the 16th EPS the peak demand in the year 2011-12 would be 42 061MW and the energy requirement would be about 26 2718 million units. Thus is clear that the demand for electricity in the southern region is increasing, at about 6%.

The capacity addition studies are carried out by the CEA (Central Electricity Authority), based on the demand projections. The capacity addition studies are carried out in order to arrive at optimum resource mix to meet the demand. The CEA uses EGEAS (Electric Generation Expansion Analysis System) and ISPLAN (integrated System Planning) models for optimisation. The EGEAS model selects the optimum generation mix among different fuel options. The ISPLAN model analyses the integrated system of capacity addition along with fuel and power transportation. The capacity addition plans are based on such studies and thus could be considered as optimum generation mix/low cost system mix for meeting the future demand. About 7673 MW is planned to be added in the southern region in the 10th five year plan, i.e. from 2003 to 2007. Coal and lignite remain the major fuel for future capacity additions with about 58% share. The overall capacity additions as per the fuel type are as shown below:

Table B.2 Overall capacity additions as per the fuel type

Type of fuel	Capacity (MW)	Percentage
Lignite + coal	3820	51.8%
Gas	2178	29.5%
Hydro	1158.2	15.7%
Nuclear	220	3%
Total	**7376.2**	**100%**

Source: Central Electricity Authority, Government of India (http://cea.nic.in/opt3_10thplan.htm)

Plant-wise details of planned capacity additions are given in the **Annexure B.2**.

The possible generation mix with tentative identification is available for the planned capacity additions during the five year plan, i.e. from 2007 to 2012. Based on the status of the planned power generation projects, about 11 097 MW would be added in the southern region in the period from 2007-2012. The overall capacity addition as per the fuel type is as shown below:

Table B.3 Overall capacity addition as per the fuel type

Type of fuel	Capacity (MW)	Percentage

Lignite + coal	4710	42.4
Gas	3798.2	34.2
Nuclear	2220	20.0
Hydro	369.4	3.4
Total	**11097.6**	**100**

Source: Annual Report 2002-03 Southern Regional Electricity Board, Government of India

Plant-wise details of these power plants are given in the **Annexure B.2**. Thus by the end of 2012 the total installed capacity in the southern region would be about 40 000 MW against the projected peak demand of 42 061 MW. However the part achievement rate in the capacity additions has been low e.g. in the ninth plan, the target was to install additional 40 000 MW while the actual capacity additions which took place were about 1 900 MW, 47% of the target. In case of the eighth plan, the achievement was about 54%. Thus it may be concluded that the southern region would face the demand supply gap even after 2012.

To accurately estimate the GHG emissions from thermal power plants, recent, authentic and accurate performance data at individual power plant level is required. The most critical parameters are the heat rate and the auxiliary power consumption. There is a large variation in availability of power plant level data in different regional grids and states within the regional grids. The parameters, required for estimation of baseline at individual thermal power plant level are shown in Table below.

Table B.4 Parameters required for estimation of baseline

Sl.	Parameter
1	Installed capacity and fuel type
2	Generation
3	Heat Rate
4	Specific fuel consumption
5	Auxiliary Consumption

The installed capacity data is compiled from different CEA publications and from state electricity boards. Installed capacity, though not used directly in baseline estimations, gives an idea about the size of individual power plants, which is useful in future projections about the size of individual power plants which would be added. The most critical set of parameters, which reflects the performance of the power plant pertains to heat rate and/or specific fuel consumption and auxiliary consumption. The annual performance review of thermal power plants carried out by CEA gives data about the specific coal consumption for different coal based power plants. The heat rates for different state utility owned coal power plants for the year 2000-01 were available from TERI report 'Preparatory and Pre-Planning for Geneff Project' . The norms regarding the performance of power plants, prepared and used by CEA in various planning studies also provides recommended heat rates for thermal power plants. Tables B.5 and B.6 give the norms regarding heat rate and auxiliary consumption for different type of power plants.

Table B.5 CEA norms for unit heat rates

Unit capacity	Unit heat rate (net) kCal/kWh
660 MW	2663
500 MW	2717
200 MW	2762
100 MW	3017
50 MW	3352
30 MW	3652
Combined cycle units	2061
Open cycle units	2929

Table B.6 CEA norms for Auxiliary Consumption

Unit capacity	Auxiliary consumption, %
660 MW class of units	8.0
500 MW class of units	8.0
200 MW class of units	9.5
100 MW class of units & below	10.5
Gas based combined cycle units	3.0
Gas based open cycle units	1.0
Hydro stations	0.5

Coal of different grades from D to F is being used by power plants. The calorific values for different grades of coal, used by CEA in planning studies, and other fuels are given in Table B.7.

Table B.7 Calorific values for different grades of coal

Coal type	Avg. Calorific value (kCal/kg)
Grade D	4583
Grade E	4045
Grade F	3437
Washed Coal	4100
Improved coal	6400
Lignite	2800
Natural Gas	12428

Coal type	Avg. Calorific value (kCal/kg)
Diesel	10316
Heavy Fuel Oil	9596

For estimation of CO_2 emissions, the IPCC emission values for India for different fuels are used.

Baseline estimation

The emissions from the thermal power plants were estimated using either the heat rate or specific fuel consumption. Preference was given to the recent heat rate data followed by the specific coal consumption. If any of these values were not available, then the heat rates recommended in the CEA norms were used. In case of gas based power plants, the heat rates provided in the CEA norms were used for estimation of plant emissions. It is evident that use of these norms would lead to a conservative estimate of emissions, since in practice the heat rates or specific fuel consumption values for power plants are normally higher than the norms. Further, the emissions resulting from secondary fuel consumption, in case of coal power plants, are not used in baseline estimations, as they constitute only 2–3% of emissions from primary fuel.

Estimation of emissions based on heat rate

The plant heat rate gives the amount of heat required to generate one unit of electricity. The amount of CO_2 emission is estimated from heat rate using following formula.

Emissions (kg/kWh) = [heat rate (kcal/kWh) × emission factor (kg/kg)]/ Calorific value (kcal/kg)

Depending upon whether the heat rate is net or gross the emissions are net or gross.

Estimation of emissions based on specific coal consumption

The emissions from the specific fuel consumption are estimated using following formula

Gross emissions (kg/kWh) = [specific fuel consumption (kg/kWh)] × [emission factor (kg/kg)]

Net emission (kg/kWh) = Gross emissions (kg/kWh)/{1- auxiliary consumption (%)}

In coal based power plants the coal linkage, thus the coal grade, is identified. Therefore, calorific value and the carbon emissions factor of the respective grade coal is used to estimate the plant emissions. However, in actual practice, coal from different sources and hence of different grades is used by individual power plants. Since the IPCC emissions factors were used, which are provided as emissions per unit of energy from a particular type of fuel, the plant emissions would be same even if different grade coal is used.

Total CO_2 emissions from a power plant in a year are estimated from net annual power generation

Plant emissions (tonne) = (net emissions (kg/kWh) × net generation (kWh))/1000

Total regional emissions (tonne) = Σ plant emissions (tonne)

Total generation from thermal, hydro and nuclear is estimated separately in order to calculate baselines. The systems average methodology includes emissions from all the sources, but the emissions baseline with only thermal is also estimated for reference. The generation figures for the year 2001-2002 were used for estimating the emissions from existing plants. Baseline for the year 2001-2002 was estimated as

Baseline (thermal only) (kg/kWh)
= total regional emissions (kg) / total net generation (thermal) (kWh)

Baseline (total) (kg/kWh)
= total regional emissions (kg) /total net generation (thermal + hydro + nuclear) (kWh)

Though the generation details for the year 2002-03 are available, due to the non availability of required data for the baseline emission estimations for this year, the data for the year 2001-02 has been considered due to the availability of data for estimation of CO_2 emissions. The baseline emissions in the year for the southern region (based on the actual data available for the year 2001-02) are given **Annexure–B.3** and the summary us tabulated in Table below:

Southern Region	Thermal only	Total
Installed capacity	16000.5	26882.5

Generation (GWh)	89272.87	120608.6
CO_2 emissions (million tons)	90.7	90.7
Baseline (kg/kWh) / (Carbon Emission Factor)	1.02	0.75

The carbon emission factor considering the hydro and nuclear power generation is 0.75 kg/kWh which is taken as the baseline for this project activity.

The baseline emission is thus calculated based on the following procedure:

Connected load of the project activity:		1100 kW
No. of hours of operation per day	:	12
No. of hours of operation per annum	:	365 x 12 = 4380 hours
Present annual consumption	:	1100 x 4380
	:	4 818 000 kWh
Annual Baseline emissions	:	4 818 000 kWh * 0.75 kg/kWh
	:	36 13 500 T of CO_2

The carbon emission factor considering the hydro and nuclear power generation is 0.75 kg/kWh, which is taken as the baseline for this project activity.

Green house gas emissions during times of power shortage

With the prevailing power supply conditions in states like Karnataka, it is very likely that there will be a gap between supply and demand continuously. This would definitely lead to shortage of supply to street lighting applications in the state as a measure of peak shaving. It is very difficult to ascertain the affect of these power cuts on the green house gas emission reduction quantities. In the proposed project activity, the number of burning hours during the baseline estimation and monitoring period will be monitored and compared for the qualitative estimation of green house gas emissions. As the project accounts for the number of burning hours during the base line estimation and monitoring period, the affect of power shortage/cuts which leads to non- burning of lamps to certain hours in a day/month/year will be accounted to a certain extent. However, the challenge lies mainly with the quantification of affect of power shortage on greenhouse gas emission estimation, when the difference between baseline burning hours and burning hours during monitoring period is more and varying time to time significantly.

B.5.2 Date of completing the final draft of this baseline section (*DD/MM/YYYY):* 31st August 2004

B.5.3 Name of person/entity determining the baseline:

TERI (The Energy and Resources Institute) is the agency determining the baseline. TERI is the project consultant. See Appendix 1.

C Duration of the project activity and crediting period

C.1 Duration of the project activity:

The proposed duration of the project completion is one year.

C.1.1 Starting date of the project activity:

The Project will start about three months after carbon financing is obtained.

C.1.2 Expected operational lifetime of the project activity:

The life time of the product i.e. ETrACS system is expected to be about 10 years.

C.2 Choice of the crediting period and related information:

C.2.2 <u>Fixed crediting period:</u>

C.2.2.1 Starting date (DD/MM/YYYY):
End of year 2004 or early 2005 (likely depending on carbon finance approval)
C.2.2.2 Length (max 10 years): (in years and months, e.g. two years and four months would be shown as: 2y-4m.) 10y-0m

The life of the project has been considered as 10 years taking the life of the ETrACS system into account. Though the life of the system can be further extended with minor retrofits, the project period is considered as 10 years, based on the assumption that the system would operated continuously for 10 years without much operational problems due to no moving parts.

D Monitoring methodology and plan

D.1 Name and reference of approved methodology applied to the project activity:

Type II Energy Efficiency Improvement Projects - IIC Demand-side energy efficiency programmes for specific technologies. The proposed project activity involves the installation of ETrACS system, which is a retrofit to the existing system to monitor and control the voltage applied to the lighting circuit/feeder.

After the installation of ETrACS system, measurements will be carried out to assess the present energy consumption of the selected lighting system for about 3 days with ETrACS system operation in by-pass mode, to arrive at the baseline consumption. This is done mainly because of non existence of energy meters to all the feeders/circuits at present. Energy meters will be installed at all the feeders along with ETrACS unit. Hence, the baseline measurement is suggested once ETrACS is installed in the system. *During this period, the burning condition of the lamps will be maintained strictly at minimum 95% level.* The energy consumption will be measured and compared with that of post project stages taking the following parameters into account:

1. Number of lamps operating or burning
2. Lamps burning hours
3. Accuracy of the energy meters installed
4. Seasonal and weather conditions from time to time

The annual emission reductions used to estimate CERs (Caron Emission Reduction) will be determined by regular check up of energy consumption utilizing the features of the ETrACS system. Energy meters are proposed to be installed for each lighting circuit in the 110 km long lighting system. The energy consumption recorded in each meter will be monitored once in every month using ETrACS system. It is proposed that the M/s Elpro visits each of the installations once in every month for the purpose of technical back up support/overhauling etc. and during the same period, the energy-meter readings will be monitored.

D.2 *Justification of the choice of the methodology and why it is applicable to the project activity:*

The methodology chosen and applicable to project activity include, (i) installation and commissioning of ETrACS system along with energy meters and other necessary controllers, (ii) measurement of kWh consumption in existing system as baseline with ETrACS system by passed and (iii) measurement of kWh consumption with ETrACS system in operation. The following sections explain these methods in detail with justifications for choosing the methodology.

(i) Installation and commissioning report: A suitable ETrACS system will be installed based on the configuration decided. A technical specification board will be displayed on the system itself which provides, date of installation, capacity of the system (in terms of kVA rating), manufacturer's details, etc.

The commissioning of the system involves actual operation of the system ranging from one day to one week with two purposes, first to show the customer the benefits claimed (at least 30% reduction in kWh consumption) and secondly to train their operator/s on the operation and maintenance of the system.

(ii) Baseline Measurements: As there was no ready data available for estimating the baseline emissions, it is proposed to install ETrACS system with necessary energy meters and any other required controllers. The energy consumption of the present system will be recorded and monitored using ETrACS system in by-pass mode of operation (i.e., without applying any energy conservation techniques like dimming etc.). Using the presently installed energy meters or with new energy meters, (where not provided or if the present ones are malfunctioning), energy consumption would be measured to get the hourly/daily/monthly consumption figure. This data will be monitored for about three days every month and the same will be considered as baseline. As the consumption per month mainly depends on the number of burning lamps in the system, it is proposed to maintain at least 95% of the lamps in operation at any point of time. The average consumption of the three day measurements will be considered as baseline consumption for the month. This measurement will be carried out for the first twelve month to establish BL for the crediting period.

In order to detect and quantify the theft during baseline estimation period, the energy consumption recorded in the energy meters will be compared with estimated energy consumption of the load connected to the respective feeder/circuit considering the accuracy of the energy meters, and if the difference is observed to be on higher side, personal inspection of the entire feeder/circuit will be carried out.

The baseline will be generated for all the circuits/feeders in the system. A format for the measurements of energy consumption used prior to installation of ETrACS is enclosed in **Annexure D.1**. Number of hours the system/s operated, monitored either from the existing timer controllers or using hour-meter and kWh consumption as measured above will be used while calculating carbon dioxide emissions.

(iii) Recording and Monitoring of the system/s: Once the baseline is arrived, the system will be operated with ETrACS system as usual. The energy consumption of the total system will be monitored for rest of the days in a month and will be compared with the baseline consumption data. The proposed ETrACS system will be used to monitor the following parameters for all the feeders/circuits in the system:

Parameter	Unit	Using	Frequency	Remarks
Operating Load	kW	Energy Meter	Continuously	
Energy Consumption	kWh	Energy meter	Continuously	Can be cumulated either hours/daily/monthly
Operating hours	h	In-built timer controller and/or using photocell	Daily/seasonally	Can alter the timings depending on the requirements

Though there is a daily monitoring system available, the monitoring for estimating emission reductions will be done on a bi-annual/yearly basis. A consolidated report of the daily data can be monitored every month.

However, there are chances of misinterpretation of kWh reduction with lamp failure rates though the reduction in kWh is mainly due to application of reduced voltage levels to the system and increased kWh due to theft in the system. During such instances, the following verification process will be adopted:

1. By pass the ETrACS system and apply the normal system conditions
2. Compare the energy consumption of the system with baseline consumption
3. If the consumption is found less, it indicates there is a lamp failure in the system than proposed (5% of the total numbers) and, if the consumption is found more, there is a theft in the system.
4. The reduced energy consumption will be deducted from the final energy consumption of the day
5. Alternately, a physical check up of the system will be done the next day morning and the details of the number of lamp failures will be recorded. The energy consumption of the fused lamps will be estimated using the lamp wattage including choke loss and the hours of operation. The same will be deducted from the final energy consumption figures.
6. As the voltage for lighting circuit is almost constant with ETrACS, there is no need for further verification if the kWh is found to be high due to theft in the system. The difference between the energy consumption with and without theft can be directly deducted and the same can be eliminated from final savings calculations.
7. Revert back to ETrACS system and operate the system with optimum voltage settings

M/s Elpro visits the site once in a month as part of their guarantee/ warrantee terms and conditions, to provide technical support and to keep good rapport with the customers. During this time, cumulated energy meter reading will be recorded (one entry sheet will be retained at the unit and one sheet with M/s Elpro –enclosed in **Annexure D.2**). Any problem with the meter will be corrected during that time and any loss of data will be reviewed subsequently.

D.3 Data to be monitored:

The data to be monitored are at two levels. The first is the actual measurement of kWh consumption presently each circuit/feeder consumes, i.e. with ETrACS system in by-pass mode. This will help to assess the baseline. The second level is measurement of kWh consumption each circuit/feeder consumes, i.e. with ETrACS system operation in as usual mode. The details that need to be monitored are given in **Annexure D.3**.

D.4 Name of person/entity determining the monitoring methodology:

M K Halpeth
Fellow & Head
TERI
4th Main, Domlur II Stage,
Bangalore – 560 071. India

E Calculation of GHG emission reductions by sources

E.1 Formulae used:

Step 1:
Annual energy baseline (kWh/year) after installation=

$$Eb = \sum_i [ni\ x\ (pi - pni)\ \ x\ oi\ /(1-l)]$$

where
Eb = annual energy baseline in kWh per year
Σi = the sum over the group of 'i' feeder/circuits installed with ETrACS implemented as part of the project.
ni = the number of devices of the group of 'i' feeders/circuits installed with ETrACS.
pi = the power of the devices of the group of 'i' feeders/circuits, 'power' is the weighted average of the feeders before installation.
pni = the power of the devices of the group of 'i' feeders/circuits, 'power' is the weighted average of the feeders installed with ETrACS.
oi = the average annual operating hours of the devices of the group of 'i' feeders/circuits with ETrACS.
l = average technical distribution losses for the grid serving the locations where the devices are installed, expressed as a fraction.

Step 2:
Annual reduced emissions (tonnes CO_2/year) = {[Annual energy baseline– Annual energy use after installation (kWh/year)] * electricity emission coefficient (kg of CO_2/kWh)}/1000

E.2 Table providing values obtained when applying formulae above:

This section provides information on carbon dioxide emission reduction potential in tonnes per year. It is calculated and cumulated every year for the 10 year crediting project period. A total of 1084 tons per year of CO_2 emission reduction will be achieved by the end of first year once the system is installed. This figure will then remain constant over the next 10 years for the same connected load. The total emissions reductions over the 10 year crediting period are 10 840 tonnes.

The reduction in daily energy consumption would vary depending on the supply voltage conditions (because of the main basic technology of the proposed ETrACS system). The CO_2 emission reductions are estimated on conservative side considering a guaranteed minimum of 30% reductions in the present energy consumption.

Estimation of emissions for the project activity based on CEF

The annual emission reduction from the project activity is calculated based on the following procedure:

Connected load of the project activity	: 1100 kW
No. of hours of operation per day	: 12
No. of hours of operation per annum	: 365 x 12 = 4380 hours
Present annual consumption	: 1100 x 4380
	: 4 818 000 kWh
Estimated energy saving potential with proposed	: 30% project activity
Estimated annual energy savings	: 4 818 000 x 0.30
	: 1 445 400 kWh

Estimated CO_2 reductions per annum

: annual energy savings (kWh) x CEF* (kg/kWh)

: 1 445 400 x 0.75/1000

: 1084 MT of CO_2

* Refer Annexure B.3

As calculated in above, estimated annual emissions reduction from the project activity is as follows:

Year	CO_2 Reductions (Tonnes)
2005	1084
2006	1084
2007	1084
2008	1084
2009	1084
2010	1084
2011	1084
2012	1084
2013	1084
2014	1084
Total	10840

F Environmental impacts

F.1 Documentation on the analysis of the environmental impacts of the project activity:

There will be no negative environmental impacts. Fuel consumption and air pollution from electricity generation will be reduced. In the recent Energy Conservation Bill passed by the Indian Government, energy efficiency was highlighted as a win-win investment. This led to the creation of the BEE (Bureau of Energy Efficiency), which does not identify any negative environmental impacts from energy efficiency. In addition to these, there are other benefits like lower power generation, less contamination of air, water and lead to overall reduced to green house gas effects.

G Stakeholder's comments

G.1 *Brief description of the process by which comments by local stakeholders have been invited and compiled:*

Because this project has no discernable negative environmental impacts, because the equipment installed is itself relatively small (not requiring major transportation or other energy inputs), and no other contributions to any other kind of pollutions, we believe a positive feedback from public. However, as a public institution, BDA has a responsibility and mandate to improve infrastructure in a manner consistent with sustainable development principles. This project has solicited comments from other relevant public institutions, government agencies like IREDA, MOEF including other similar kinds of municipalities. All officials have been supportive of this project.

G.2 *Summary of the comments received:*

In addition to this, positive feedback has been received from KPTCL (Karnataka Power Transmission Corporation Limited) and from public.

G.3 *Report on how due account was taken of any comments received:*

Only positive comments were received, requiring no action.

Annexure 1: Project Participants

Project Proponent	M/s Elpro Energy Dimensions Pvt. Ltd
Contact person	Mr Nalin Kanshal
Contact details	No. 6, 7 & 8, 4th 'N' Block, Dr. Rajkumar Road, Rajajinagar Entrance, Bangalore – 560 010.
E-mail contact	elpro@vsnl.com
Contact numbers	+91 - 80 – 23122676, 23123238
Company logo	
Owner of the company	Mr Nalin Kanshal
Project consultant	TERI (The Energy and Resources Institute)
Contact persons	Mr M K Halpeth, Fellow & Head
Address	TERI- Southern Regional Centre, P B No. 7117, 4th Main, Domlur 2nd Stage, Bangalore – 560 071
E-mail of contact person	halpeth@teri.res.in / ieg@teri.res.in
Contact numbers	Phone: +91-80-25356590 (5 lines) Fax: +91-80-25356589
Logo	

Annexure – A.1

Infrastructure and Connected Load Details of Project Activity

1. Present operating practices (like switch ON/OFF, reporting and monitoring procedures, O & M etc).

a.	Present ON/OFF Practice for lamps	By Time Switches
b.	Reporting and Monitoring Procedure	By Telephone & Personal Contacts
c.	O & M	By Contract System

2. Lamp Details (Type, wattage, nos. make etc). and ballast details (type, make etc.)

   Lamps and ballasts are of various makes viz, Bajaj, Wipro, Mysore with common specification i.e. Streetlight luminaire in single piece die cast aluminium housing complete with all accessories and acrylic cover.

3. Lamp failure rate and reporting system details

   Lamp failure rate - Approximately 4000 hours
   Reporting System - Through Letters and Telephone

4. Voltage Conditions

   Voltage variation found to be 200 to 280 Volts A.C, 50 Hz.

5. Energy Metering Details: All feeders are not having energy meters.

6. No. of Transformer Centres and connected load details

   Transformer centres are being maintained by BESCOM (Bangalore Electric Supply Company) and these details are not readily available.

7. No. of Cut-Out Points - 126

8. Light Operating Times: From evening 6.30 hours to next day morning 6.30 hours.

9. Tariff Details

a. Metered
- Fixed charges per kW /Month - Rs.50
- Energy charges per unit for all units consumed in the month - Rs.3.10
- Taxes - 5%

b. Unmetered
- Rs.1260.00 per month per kW of connected load

10. O & M Cost details

a. Fluorescent Lamp (40 W) - Rs.260.00/lamp/annum
b. 250 W SV Lamps - Rs.805.00/lamp/annum
c. 400 W S V Lamps - Rs.1300.00/lamp/annum

Circuit-wise/Feeder-wise Connected Load Details

Circuit No.	Connection No.	No. of Lamps	Load in kWs	Remarks
1	W7SL 06	24	7.08	
2		20	8.80	High Mast - 01
3	N2 SL72	38	11.21	
4	N2 SL71	38	11.21	
5	N2 SL74	20	8.80	High Mast - 02
6	N2 SL70	30	8.85	
7	N2 SL69	48	14.16	High Mast - 03
8	N2 SL78	20	8.80	
9	N2 SL68	38	11.21	
10	N2 SL67	36	10.62	
11	N2 SL66	36	10.62	
12	N2 SL73	20	8.80	High Mast - 04
13	N2 SL65	40	11.80	
14	N2 SL7	20	8.80	High Mast - 05
15	N2 SL5	40	11.80	
16	N2 SL6	40	11.80	Y&B Looped
17	PN ST 63	40	11.80	Y&B Looped
18	Below bridge	46	13.57	
19	PN ST 65	14	4.13	
		20	5.90	
20	PN ST 64	64	18.88	
21	PN ST 66	20	8.80	High Mast -

Circuit No.	Connection No.	No. of Lamps	Load in kWs	Remarks
				06
22	Opp. Foreman Training Institute	15	4.43	
23	Opp. Archana Wine	11	3.25	
24	PN ST 67	28	12.32	High Mast - 07
25	Near Air Force CE office	34	10.03	Single Phase
26	Near Rly Gate	11	3.25	
27	JSL 88	37	10.92	
28	Box No.40	22	6.49	
29		20	8.80	High Mast – 08
30	Box No.39	26	7.67	R&Y Looped
31	Box No.38	22	6.49	
32		20	8.80	High Mast - 09
33	Box No.37	34	10.03	
34	Box No.36	22	6.49	
35	Box No.35	28	8.26	Y&B Looped
36	Box No.34	22	6.49	R&B Looped
37	Box No.33	22	6.49	Y&B Looped
38	Box No.32	22	6.49	
39	Box No.31	22	6.49	
40	Box No.30	20	5.90	
41	Box No.29	20	5.90	
42		High Mast Under Installation		High Mast - 10
43	Box No.27	36	10.62	
44	Box No.25	18	5.31	No fuse carrier
45	Box No.23	18	5.31	No fuse carrier
46	Box No.21	23	6.79	
47	Box No.20	14	4.13	No fuse carrier Y&B Looped
48	Box No.17	25	7.38	
49	Box No.18	22	6.49	
50	Box No.19	23	6.79	R&Y Looped
51	Box No.22	22	6.49	No fuse carrier
52	Box No.24	25	7.38	Y&B Looped
53	Box No.26	21	6.20	
54	Box No.28	16	4.72	
55	Box No.16	38	11.21	
56	Box No.15	44	12.98	
57	8 ESTL 39	20	8.80	High Mast - 11
58	Box No.14	27	7.97	
59	Box No.13	27	7.97	

Circuit No.	Connection No.	No. of Lamps	Load in kWs	Remarks
60	Box No.12	28	8.26	Y&B Looped
61	Box No.11	28	8.26	
62	8 ESTL 36	20	8.80	High Mast - 12
63	Box No.10	22	6.49	
64	Box No.9	23	6.79	
65	Box No.8	25	7.38	
66	Box No.6	10	2.95	
67	Box No.7	20	5.90	
68	Box No.5	18	5.31	No fuse carrier
69	8 ESTL 37	20	8.80	High Mast - 13
70	SE -04	21	6.20	
71	SE -03	23	6.79	
72	SE-01	22	6.49	Y Phase No fuse carrier
73	SE-02	24	7.08	Y & B Looped
74	7 EST 13	16	4.72	
		38	11.21	R&Y Looped
75	7 EST 12	25	7.38	
76	7 EST 14	40	11.80	
77	Below Bridge	39	11.51	
78	Right Side	15	4.43	
79	Left Side	17	5.02	
80	33, E4STL 221	32	9.44	
81	32, E4STL 222	32	9.44	
82	31, E4STL 223	34	10.03	
83	30, E4STL 224	38	11.21	
84	29, E4STL 225	38	11.21	
85	28, E4STL 226	30	8.85	
86	27, E4STL 227	30	8.85	
87	26, 7 SM STL 34	36	10.62	
88	25, 7 SM STL 33	32	9.44	Y&B Looped
89	24, 7 SM STL 32	44	12.98	
90	23, 7 SM STL 31	22	6.49	
91	22, 7 SM STL 30	34	10.03	
92	21, 7 SM STL 29	26	7.67	
93	20, 7 SM STL 28	26	7.67	
94	19, 7 SM STL 27	28	8.26	
95	18, 7 SM STL 26	32	9.44	
96	17, 7 SM STL 25	24	7.08	
97	16, 7 SM STL 24	28	8.26	
98	15, 7 SM STL 23	30	8.85	
99	14, 7 SM STL 22	28	8.26	
100	13, 7 SM STL 21	36	10.62	
101	12, 7 SM STL 20	38	11.21	

Circuit No.	Connection No.	No. of Lamps	Load in kWs	Remarks
102	11, 8 STL 18	36	10.62	
103	10, 8 STL 17	32	9.44	
104	9, 8 STL 15	24	7.08	
105		20	8.80	High Mast - 14
106	Iblur Jn, Near Shoba Garnet 8A	40	11.80	
107	8, 4 STL 34	40	11.80	
108	7	34	10.03	
109	8 SP 23	40	11.80	
110	8 STL 14	20	8.80	High mast- 15
111	3	36	10.62	
112		20	8.80	High Mast - 16
113	2	34	10.03	
114	1, 4 STL 30	34	10.03	
115	4	9	2.66	
116	5	15	4.43	
117	Opp. Kiram Motors, 5A	16	4.72	
118	Inside park, 5 B	16	4.72	
119		20	8.80	High Mast - 17
120	Koramangala Inner ring road Box No.1	38	11.21	
121	Box No.2	40	11.80	
122		20	8.80	High Mast - 18
123	Box No.3	44	12.98	
124	Box No.4	38	11.21	
125	Box No.5	62	18.29	
126	Misc. load	48	14.38	
	Total	3557	1100.00	

Energy Consumption Data for the Months April 2003 to October 2003

Sl. No.	Sub division	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03
1	N6	33108	26723	30264	36943	16060	20501	30126
2	N2	49257	66076	62790	60400	45658	81514	81519
3	S3	82934	87508	88710	88013	90784	86106	88918
4	E7	136350	68852	27073	21084	25907	29363	10213
5	C3	66000	66780	73380	69300	66480	69300	66000
6	C4	88008	104215	107348	113845	66063	23728	139404
7	E4	92055	95928	78664	66286	83569	96656	90267
8	S7	116255	106886	92694	142933	94763	135043	127424
9	S8 & S4	300125	423718	313946	380131	342933	338520	305696
Total		964092	1046686	874869	978935	832217	880731	939567
Consumption in (kWhs)		275441	298982	249950	279682	237764	251625	268434
Av. Consumption for 7 months (kWh)		265982						

Note:

1. All feeder points are not connected with meters
2. For proposed additional load of 97 kW, meter readings not available
3. Approximately 20% of lights are not functioning
4. Difference between connected load and metered consumption is observed to be 33%.

Annexure – B.1

Installed Capacity of Power Plants in Southern Region as on 31.05.2004

Karnataka

Power Station	Installed Capacity in MW
KPCL	
Raichur Super Thermal Power Station	1470
Sharavathi Generating Station	1035
Gerusoppa Dam Powerhouse	240
Linganamakki Dam Powerhouse	55
Bhadra Right Bank Canal Powerhouse	13.2
Bhadra Left Bank Canal Powerhouse	26
Nagjhari Powerhouse	855
Supa Dam Powerhouse	100
Kadra Dam Powerhouse	150
Kodasalli Dam Powerhouse	120
Ghataprabha Dam Powerhouse	32
Varahi Underground Powerhouse	230
Mani Dam Powerhouse	9
Mallapur Mini Hydel Scheme	9
Sirwar Mini Hyderl Scheme	1
Kalmala Mini Hydel Scheme	0.4
Ganekal Mini Hydel Scheme	0.35
Kappadagudda Wind Farm stage I	2.025
Kappadagudda Wind Farm stage II	2.53
Almatti Dam Power House	15
Total in MW	**4365.505**
IPPS	588
Minihydel	186
Biomass	35
Wind	177.5
Grand Total in MW	**5352.005**

Andhra Pradesh

Station	Capacity, MW
Thermal	
Vijayawada Complex	**1260.0**
Rayalaseema I	**420.0**
Kothagudem Complex	**700.0**
Kothagudem V Stg	**500.0**
Ramagundam B	62.5
Nellore	30.0
Total Thermal	**2972.5**
Hydro	
Machkund (AP)	84.0
Tungabhadra (AP)	57.6
Upper Sileru	240.0
Donkarayi	25.0
Lower Sileru	460.0
Srisailam Right	770.0
Srisailam Left	900.0
Nagarjunasagar	815.6
NS Right Canal	90.0
NS Left Canal	60.0
Pochampad	27.0
Nizamsagar	10.0
Penna Ahobilam	20.0
Singur	15.0
Mini Hydro	12.2
Total Hydro	**3586.4**
Wind	2.0
Total APGENCO	**6560.9**
Gas (APGENCO is O&M Contractor)	
Vijjeswaram I	100.0
Vijjeswaram II	172.0
Total APGPCL	**272.0**

Tamil Nadu

Power Plant	Installed Capacity, MW
Hydro	
Pykara	59
Moyar	36
Kundah I	60
Kundah II	175
Kundah III	180
Kundah IV	100
Kundah V	40
Mettur Dam	40
Mettur Tunnel	200
Lower Mettur	120
Periyar	140
Suruliyar	35
Papanasam	28
Servalar	20
Sarkarpathy	30
Sholayar I	70
Sholayar II	25
Aliyar	60
Kodayar I	60
Kodayar II	40
Kadamparai	400
Vaigai Small	6
Pykara Mini	2
Lower Bhavani Small	8
Punachi Mini	2
Maravakandy Mini	0.75
Lowerbavani RBC	8
Sathanur	7.5
Parsons Valley	30
Thirumurthy Mini	1.95
Mukurthy Mini	0.7
Aliyar Small	2.5
Total	**1987.4**
Thermal	
Ennore	450
Tuticorin	1050

Power Plant	Installed Capacity, MW
Mettur	840
North Chennai	630
Total	**2970**
Gas	
Kovilkalapai	107.88
Basin Bridge	120
Valuthur	95
Kuttalam	101.4
Total	**424.28**
Wind	
State Sector	19.355
Private Sector	1342.135
Total	**1361.49**
IPP	
Basin Bridge DEPP	196
Samalpatti DEPP	105.66
Basin Bridge DEPP	330.5
Samayanallur DEPP	106
Neyveli Zero Unit DEPP	250
Total	**988.16**
Others	
TPCL	63.5
HITEC	14
Total	**77.5**
Grand Total	**7808.83**
CENTRAL SECTOR SHARE	
R STPS	470
NLC TSI	500
NLC TS II	441
MAPS	294
KAIGA	237
NLC TSI Expansion	240
Talchar STPS Stage II	270
Total Central Sector Share	**2452**
External Assistance	
Eastern Region Power	220
Kayankulam	180
Total external assistance	**400**

Kerala

Power Plant	Installed capacity, MW

Power Plant	Installed capacity, MW
HYDRO	
PALLIVASAL	37.5
SENGULAM	48
PORINGAL	32
NERIAMANGALAM	45
PANNIAR	30
SABARIGIRI	300
SHOLAYAR	54
KUTTIYADI	75
IDUKKI	780
IDAMALAYAR	75
KALLADA	15
PEPPARA	3
LOWER PERIYAR	180
MADUPPETTY	2
PORINGAL LEFT BANK EXTN.	16
KAKKAD	50
KUTTIADI EXTENSION SCHEME	50
MALAMPUZHA	2.5
Total	**1795**
Private	
MANIAR	12
KUTHUNGAL	21
HYDRO TOTAL	**1828**
THERMAL	
State Public Secor	
BRAHAMAPURAM	106.6
KDPP, KOZHIKODE	128
Total	**234.6**
Central Public Sector	
KAYAMKULAM (N.T.P.C.)	359.58
IPP'S	
B.S.E.S.KERALA POWER LIMITED,KOCHI	174.96
KPCL,KASARAGOD	20.9
Total	**196.86**
THERMAL TOTAL	**791.04**
WIND ENERGY (KSEB)	
WIND FARM, KANJIKODE	2.025
GRAND TOTAL	**2621.065**

Annexure – B.2

Table 1: Capacity Additions Planned In Tenth Five Year Plan (2002-2007)

Plant Name	Fuel Type	Sector	Capacity MW	Benefits 10th Plan
Central Sector				
NEYVELI EXT	LIGNITE	C	420	420
NEYVELI II EXP	LIGNITE	C	500	500
KAIGA U3	NUCLEA R	C	220	220
SIMHADRI	COAL	C	1000	500
RAMAGUNDAM III	COAL	C	500	500
State Sector				
AP				
RAYALSEMA-II	COAL	S	420	420
SRISAILAM LBPH	HYDRO	S	450	450
JURALA PRIYA	HYDRO	S	235	78.2
KARNATAKA				
RAICHUR U7	COAL	S	210	210
ALMATI DAM	HYDRO	S	290	290
BELLARY	COAL	S	500	500
KERALA				
KUTTIYADI AUG.	HYDRO	S	100	100
TAMILNADU				
PYKARA ULTIMATE	HYDRO	S	150	150
PERUNGULAM	GAS	S	94	94
BHAWANI KATHALAI 1&2	HYDRO	S	90	90
KUTRALAM GAS	GAS	S	100	100
PONDICHERRY				
KARAIKAL CCGT	GAS	S	100	100
PRIVATE SECTOR				
AP				
PEDDAPURAM CCGT	GAS	P	220	78
VEMAGIRI-I	GAS	P	370	370
GAUTAMI	GAS	P	464	464
RAMGUNDAM BPL	COAL	P	520	520
JEGRUPADU-EXT 1	GAS	P	230	230
KONASEEMA	GAS	P	445	445

KARNATAKA				
HASSAN	LNG	P	189	189
KANIMINKE CCPP	NAPHTHA	P	108	108
TAMILNADU				
NEYVELI ZERO	LIGNITE	P	250	250
Total Southern Region			**8175**	**7376.2**

Source: Central Electricity Authority, Government of India

Table 2: Capacity Additions identified for addition in Eleventh Five Year Plan (2008-2012)

Name of station	**Fuel**	**Capacity (MW)**
Andhra Pradesh		
Nagarjunasagar	Hydro	50
Jurala	Hydro	156.4
Visakhapatnam	Coal	1040
Krishnapatnam	Gas	520
Spectrum extn.	Gas	358.2
Karnataka		Nil
Kerla		
Athirappilli	Hydro	163
Tamil Nadu		
Kattupalli	Gas	1047
Vembar	Gas	1873
North Chennai	Coal	1000
Tuticorin 4	Coal	1000
Cuddalore	Coal	1320
Srimushnam	Lignite	350
Kaiga II	Nuclear	220
Kunankulam	Nuclear	2000
Total		**11097.6**

Baseline Emissions for Southern Grid

Annexure – B.3

Region/Power Plant Name	Owned by	Installed capacity (MW)]	Fuel type	Generation[1] (gross) GWh) 01-02	Generation[1] (gross) (GWh) 00-01	Auxiliary Consumption[2] (GWh)(01-02)	Auxiliary Consumption[2] (GWh)(00-01	Gross Heat rate[3] (kCal/kWh)	Net Heat Rate[4] (kCal/kWh)	Net generation (GWh) (01-02)	CO_2 emissions (ton)	CO_2 emissions kg/kWh
Andhra Pradesh												
K'DEM A-D[5]	APGENCo	1170	Coal 3E	8036	7639	731	699	3050	3357	7305	9700181.63	1.328
VIJAYWADA[5]	APGENCo	1260	Coal 3E	10225	10199	882	881	2411	2639	9343	9752355.36	1.044
R'GUNDEM B[5]	APGENCo	62.5	Coal 3E	426	443	39	39	2956	3240	387	496352	1.282
NELLORE[5]	APGENCo	30	Coal 3E	155	171	21	23	3255	3762	134	200049	1.488
RAYALSEEMA[5]	APGENCo	420	Coal 3E	3412	3476	334	351	2303	2561	3078	3118884	1.013
R'GUNDEM	NTPC	2100	Coal 3E	15850	16422		1504	2419	2663	14398	15165844	1.053
SIMHADRI	NTPC	1000	Coal	15	0		0		2663	14	14258	1.046
VIJ'SWARAM CCGT		272	Gas HBJ	1950	1978		181		2062	1771	862066	0.487
JEGURUPADU CCGT	PVT	235	Gas HBJ	1616	1658		38		2062	1579	768360	0.487
GODAVARI CCGT	PVT	208	Gas HBJ	1493	1567		36		2062	1459	709877	0.487
KONDAPAALI CCGT	PVT	350	Gas HBJ	1735	679		16		2062	1695	824941	0.487
PEDDAPURAM CCGT	PVT	220	Gas HBJ	51	0		0		2062	50	24249	0.487
LVS POWER DG	PVT	36	Gas HBJ	93	0		0		2062	91	44219	0.487
AP Thermal		7363.5		45057	44232		3768			41304	41681637	
AP Nuclear		0		0	0					0	0	
AP.Hydro		3211		6115	7729		39			6084	0	
AP.Total		10574.5		51172	51961		3806.406			47388	41681636.8	

Region/Power Plant Name	Owned by	Installed capacity (MW)]	Fuel type	Generation[1] (gross) GWh) 01-02	Generation[1] (gross) (GWh) 00-01	Auxiliary Consumption[2] (GWh)(01-02)	Auxiliary Consumption[2] (GWh)(00-01	Gross Heat rate[3] (kCal/kWh)	Net Heat Rate[4] (kCal/kWh)	Net generation (GWh) (01-02)	CO_2 emissions (ton)	CO_2 emissions kg/kWh
Karnataka												
RAICHUR	KPCL	1260	Coal 3e	8952	8904		723	2509	2730.736	8225	8884279.06	1.08
YELHANKA DG	KEB	120	Diesel	772	658		22.3720		2062	746	477004	0.64
TORANGALLU IMPORT	PRI	120	Corex gas	921	1170		0.0000		0	921	0	0.00
BELLARY DG	PRI	25.2	Diesel	188	13		0.4420		2062	182	116162	0.64
TANIR BHAVI CCGT	PRI	220	Naptha	941	0		0.0000		2062	21	9983	0.49
BELGAUM DG	PRI	81.3	Diesel	419	0		0.0000		2062	14	9112	0.64
KAIGA APS	AEC	440	Nuc	2997	1886		232			2629	0	0.00
Karnataka Thermal		1826.5		12193	10745		746			10108	9496540	
Karnataka Nuclear		440		2997	1886		232			2629	0	
Karnataka Hydro		3066.6		9661	10892		113			9561	0	
Karnataka Total		5333.1		24851	23523		1091			22297	9496540	
Kerla												
BRAMHAPURAM DG	KSEB	106.5	Diesel	128	319		11	1785	2062	124	60125	0.49
KOZIKODE DG		128.8	Diesel	296	460		16	1785	2062	286	139039	0.49
KAYAMKULAM CCGT	NTPC	350	Gas	1331	1945		42	2130	2062	1302	633628	0.49
COCHIN CCGT		174	Gas	240	154		3.36	2130	2062	235	114253.04	0.49
Kerla Thermal		759.3		1995	2878		73			1946	947046	
Kerla nuclear		0		0	0					0	0	
Kerla Hydro		1828.5		6791	6221		27.9945			6760		
Kerla Total		2587.8		8786	9099		174			8706	947046	

Region/Power Plant Name	Owned by	Installed capacity (MW)]	Fuel type	Generation[1] (gross) GWh) 01-02	Generation[1] (gross) (GWh) 00-01	Auxiliary Consumption[2] (GWh)(01-02)	Auxiliary Consumption[2] (GWh)(00-01	Gross Heat rate[3] (kCal/kWh)	Net Heat Rate[4] (kCal/kWh)	Net generation (GWh) (01-02)	CO_2 emissions (ton)	CO_2 emissions kg/kWh
Tamil Nadu												
ENNORE	TNEB	450	Coal 3E	1150	753		115	3629	4283.13	974	1650768.85	1.69
TUTICORIN	TNEB	1050	Coal 9T	8108	7931		606	2483	2688.42	7488	7910673.74	1.06
METTUR	TNEB	840	Coal 9T	6396	6423		520	2506	2726.756	5878	6298143.27	1.07
NORTH CHENNAI	TNEB	630	Coal 3E	4672	4358		406		2663	4237	4462776.81	1.05
NEYVELI I		600	Lignite	4195	4158		380	2633	2897.865	3812	4694309.88	1.23
NEYVELI II		1470	Lignite	10268	10519		961	2633	2897.865	9330	11490148.7	1.23
NEYVELI EXT		0	Lignite	0	0		0			0	0	0.00
B' BRIDGE GT	TNEB	120	Gas	173	165		4		2929	169	116734.706	0.69
NARIMANAM G.T.		10	Gas	0	16		0		2929	0	0	0.69
KOVIKALLAPAL CCGT		107	Gas	698	36		1		2062	681	331573	0.49
P'NALLUR CCGT		330	Gas	1036	0		0		2062	1011	492134	0.49
B'BRIDGE DG		200	Diesel	1234	1281		16		2062	1219	593156	0.49
SAMALPATTI DG		105.7	Diesel	645	91		1		2062	637	310037	0.49
SAMAYANALLUR DG		106	Diesel	250	0		0		2062	247	120169	0.49
K'KKAM NUC		340	Nuc	2244	2513		309			1968		
TN Thermal		6018.7		38825	35731		3011			35683	38470625	
TN Nuclear		340		2244	2513		309			1968	0	
TN Hydror		1995.9		4350	5441		21			4333	0	
TN Total		8354.6		45419	43685		3340			41985	38470625	

Region/Power Plant Name	Owned by	Installed capacity (MW)]	Fuel type	Generation[1] (gross) GWh) 01-02	Generation[1] (gross) (GWh) 00-01	Auxiliary Consumption[2] (GWh)(01-02)	Auxiliary Consumption[2] (GWh)(00-01	Gross Heat rate[3] (kCal/kWh)	Net Heat Rate[4] (kCal/kWh)	Net generation (GWh) (01-02)	CO_2 emissions (ton)	CO_2 emissions kg/kWh
Pondichary								`				
KARAIKAL CCGT		32.5		250	233		17		2062	232	112686.957	0.49
Pondichary Thermal		32.5		250	233		17			232	112687	
Pondichary Nuclear		0		0	0					0	0	
Pondichary Hydro		0		0	0					0	0	
Pondichary Total		32.5		250	233		17			232	112687	
Thermal		**16000.5**		**98320**	**93819**					**89273**	**90708534**	**1.02**
Nuclear		**780**		**5241**	**4399**					**4597**	**0**	
Hydro		**10102**		**26917**	**30283**					**26739**	**0**	
Total		**26882.5**		**130478**	**128501**					**120609**	**90708534**	**0.75**

Table 3: Capacity Additions During 2002-2003

Name of the plant		Capacity, MW	Date of commissioning
Andhra Pradesh			
Srilailam (unit III, IV and V)	Hydro	450	April, Nov 02, March 03
Reconcilation of hydro capacity by APGENCO	Hydro	9.21	2002-2003
Upgradation of unit -6 of KTS-B	Coal	10	
Private sector			
BAPL (Gas)	Gas	80	Sep-02
Mini hydro (K M Power)	Hydro	3.3	Nov-02
Biomass based projects	Biomass	46	2002-03
Biomass co-generation projects	Biomass	7	2002-2003
Bagssse Co-generation	Biomass	52	2002-2003
Isolated Gas wells	Gas	3	Apr-02
Vatsala Gas based unit	Gas	15.4	May-02
Simhadri II	Coal	500	Aug-02
Andhra Pradesh Total		**1175.91**	
Karnataka			
Gerusoppa	Hydro	60	Apr-02
Nagjhari	Hydro	15	Jun-02
Raichur VII	Coal	210	Dec-02

Kappatagudda	wind	2.53	Jul-02
Ugar sugar	Bagasse	16	Apr-02
Godawari sugar	Bagasse	24	Apr-02
Moodabagil	Bagasse	0.33	Sep-02
Vijayalakshmi	Bagasse	1.75	Nov-02
Gem Sugar	Bagasse	22.5	
Karnataka total		**352.11**	
Kerala	**Nil**		
Tamil Nadu			
Valathur	Gas	94	Dec-02
Neyveli ST-CMS unit	Lignite	250	Dec-02
Reconciliation of capacity of			
Pillai Perumal Nallur	Hydro	9.05	2002-2003
Neyveli TPS I (Exp)	Lignite	210	Oct-02
Talcher II	Coal	500	Mar-03
Tamil Nadu total		**1063.05**	
Southern region Total		**2591.07**	

Annexure D.1 Monitoring sheet for baseline conditions before installing the system

Feeder/Circuit No.	No. of Lamps in Operation	Type of Lamp Source (HPSV / HPMV)	Connected Load, kW	No. of hours operation	Actual Energy Consumption, kWh from the energy meters		
					Present meter reading	Previous meter reading	Difference
Total							

Annexure D.2 Monitoring sheet for actual monthly energy consumption after installing the system

Feeder/Circuit No.	No. of Lamps Failed	Cumulative No. of hours operation	Actual Monthly Energy Consumption, kWh		
			Present	Previous	Difference

Annexure D.3: Data to be monitored

Circuit /Feeder No.	No. of burning lamps	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	For how long is archived data to be kept?	Comment
	Recording every day	Recording every day	Voltage, no. of lamps burning	kWh	Data (cumulative daily kWh) from energy meter (m)	Daily	Each circuit	Electronic and paper	Ten years	To assess the total usage
1										
2										
3										
4										
5										
.										
.										