Energy Audit

AMET
ACADEMY OF MARITIME EDUCATION AND TRAINING
DEEMED TO BE UNIVERSITY
(Under Section 3 of UGC Act 1956)

Prepared by

WASMANPRO ENVIRONMENTAL SOLUTIONS LLP

24 FIRST FLOOR, VGP MURPHY'S SQUARE, 1 ST CROSS STREET, ALANDUR, CHENNAI,
TAMILNADU 600016 Tel: 044 4551 4232
Email: wasmanproglobal@gmail.com Website: www.wasmanpro.com

EXECUTIVE SUMMARY

An energy audit is an inspection, survey and analysis of energy flows, for energy conservation in a building, process system to reduce the amount of energy input into the system without negatively affecting the output(s). In commercial and industrial real estate, an energy audit is the first step in identifying opportunities to reduce energy expense and carbon footprints.

Wasmanpro devises the energy audit as an effective tool in defining and pursuing comprehensive energy management programs. It has a positive approach aiming at continuous improvement in energy utilization in contrast to financial audit which stresses to maintain regularity.

In the present study, Energy audit of AMET Deemed has been done. In this study considered Practical laboratory, Instrument, Fans, Air conditioners, Computers etc are considered in this study. We have studied total budget of the college, total economic investment of college on the electricity and total generation electricity from the solar wind hybrid electricity generation unit. Also, we have studied total saving of electricity and money from solar wind generation and requirement of solar energy. Also, it is studied that exact contribution of bulb, fans, computer, instruments etc in the total requirement of electricity. We studied all these mentioned thinks by collecting exactly data form survey.

This Energy audit report was over sighted to inquire about convenience to progress the energy competence of the campus. To drop of energy utilization whilst cultivate or humanizing comfort, health and safety were of prime anxiety. This audit required to recognize the mainly energy proficient appliances. Besides, several each day processes concerning common appliances have been provided which facilitate sinking the energy expenditure. The views expressed may not reflect the general opinion. This was followed by staff and student interviews, collection of data through the questionnaire, review of records, observation of practices and observable outcomes.

Wasmanpro proudly submits this Energy audit report to the AMET Deemed to be University.

WASMANPRO ENVIRONMENTAL SOLUTIONS LLP Chennai

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Chairman

WASMANPRO ENVIRONMENTAL SOLUTIONS LLP

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ABBREVIATION

A	Amps
AC	Air Conditioner
AC	Alternating Current
AMET	Academy of Maritime Education and Training
CFL	Compact fluorescent lamp
CIP	Comprehensive Inspection Programme
EMS	Energy Management System
DC	Direct Current
HSD	High Speed Diesel
Hz	Hertz
kg	Kilogram
kVA	kilo-volt-ampere
kW	kilo Watts
kWh	kilowatt hour
kWp	Kilowatt peak
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
MMS	Module mounting structure
MPPT	Maximum Power Point Tracker
NAAC	The National Assessment and Accreditation Council
SEC	Specific Energy Consumption
SPV	Solar Photovoltaic
STC	Standard Test Condition
TNEB	Tamil Nadu Electricity Board
TV	Television
V	Volts
W	Watts
W/m^2	watt per square Metre

1 CHAPTER

1.1 Introduction

India's first Maritime Deemed to be University for maritime-related education, training and research.

Overlooking the deep blue sea cradled by the Bay of Bengal and tucked in the scenic drive way of east coast road is AMET. The one and only University from India to be a member of the International Association of Maritime Universities With quality, commitment, knowledge and excellence as its corner stones, AMET had a humble beginning in the year 1993 with just 14 cadets molded for a career in merchant navy through a Higher National Diploma programme in marine engineering. AMET's uncompromising strides of excellence in the field of maritime education and training laced with its capacity to feed the global shipping industry with an unrivalled maritime human resource secured it the status of becoming the first Deemed to be

University in India for maritime education, training, research and development activities on the 21st August 2007.

AMET had the privilege and unprecedented status of getting unveiled as a Maritime Deemed to be University from the hands of the secretary general of the International Maritime Organization, Mr.Efithimios E Mitrapoulos.

AMET serves as an ocean of knowledge for over 3700 students pursuing Programmes ranging from diploma to Doctoral programs through 4 schools and 2 intensive research and training centers for marine and marine related activities. Equipped with an excellent infrastructure for research and development, co curricular and extracurricular activities AMET secured its compliance certificate for ISO 9001:2015 QMS standards from the prestigious and globally renowned DET NORSKE VERITAS, Norway.

The National Assessment and Accreditation Council (NAAC) an autonomous institution of the University Grants Commission has assessed AMET and accredited with B Grade during November 2015. The accreditation is an indication of standards of quality as set by the NAAC and valid for a period of five years from 16-11-2015.

Forged with a vision to secure a position of prominence among the world's maritime universities and with a mission to be the fountainhead for nurturing finest intellectual capital base for the maritime sector – worldwide, education at AMET caters to the comprehensive development of all its students so as to make them better educated, more articulate and demanding. To that end is enabled and inculcated by modern teaching aids, well equipped workshops for practical training, marine workshop for hands on training on marine auxiliaries, Ship in Campus, well furnished hostel, canteen facilities, indoor and outdoor games, swimming pool, medical facilities backed by an overall conducive learning environment.

For over two decades AMET is remaining as the favourite destination for campus interviews by many shipping giants such as AP MOLLER MAERSK, GOODWOOD, NYK, SONANGOL, VSHIPS, WALLEMS, SHELL, CHEVRON, STENA and so goes a list of over 100 companies. Besides positions onboard, AMET Business school graduates have secured lucrative jobs in commercial shipping sectors such as chartering and ship broking. Never the less, Naval architecture, petroleum engineering, harbour engineering, marine electrical and electronics engineering graduates have successfully walked away from AMET with jobs offering sumptuous packages along with an opportunity to grow and glow in their career swiftly. Needless to say about the entrepreneurship development activities nurtured into AMET'ians has been found rewarding by students who are chief executive officers of their own organization.

AMET works closely and cohesively with the global shipping industry and aligns its objectives regularly to suit the demands of the evolution in technology. Such alignment keeps the students updated and industry-ready. With a consistent placement record AMET has been recognized as a premier institution for marine and marine related jobs and has earned a position as a trustworthy consultants for research and development projects wherein the investment are worth to the tune of several crores of rupees. Adducing to this achievements are the awards and accolades garnered by AMET for a range of activities in pursuit of excellence over the last two decades in maritime education, training, research and development.

AMET commitment to cater for the maritime capacity building has no bounds. AMET's strong hold as an institution for quality, discipline and rigor has drawn the attention of several growing maritime nations. To name a few are Republic of Nigeria, Angola and Djibouti that has signed a long term memorandum of understanding with AMET for developing their nation's maritime

human resource in particular and maritime infrastructure in general. Nigerian Maritime safety authority (NIMASA) which is the supreme authority for maritime administration in Nigeria, has got over 500 cadets trained through AMET over the last five years. AMET is a host to over 400 international students hailing from more than 10 countries across the world, thus providing and proving itself as a culturally diverse destination with a pledge to "Respect Diversity" and to promote cross cultural understanding which is the most essential quality for working in global environment.

AMET has a very ambitious vision 2025 plan wherein it aims to be a one stop solution for all marine related activities happening around the world and has clearly charted out an action plan to gauge its growth towards its 2025 milestone. The dogged perseverance of AMET's unmatched faculty gears up the student to meet the challenges of their life and career with tenacity of mind, endeavour to face them and emerge victorious. With a synergistic attitude prevailing among management, staff and student, AMET is all set to achieve and sustain a status par excellence.

1.2 Vision

To sustain our identity as a leader in maritime education through progressive innovation in training, research and development that will render a brilliant future for our students and a trans formative impact on the global society.

1.3 Mission

To deliver technical knowledge and ethical values with uncompromising strides of excellence that will make our students employable, our faculty advance their knowledge, our staffs achieves excellence and our alumni become global leaders.

1.4 Quality Policy

Academy of Maritime Education and Training (AMET) is committed to provide highest quality in education and be the most preferred institution for pursuing marine and marine related Programmes.

This will be achieved by consistent focus on:

1. Providing a conducive, vibrant, progressive and enriching learning environment.

2. Teaching Excellence and Research output
3. Global outlook and engaging with the world through learning, teaching and research
4. Attracting the best and the brightest students.
5. Providing competitive advantage in gaining employment or further academic opportunities.
6. Maintaining excellent links with commerce and industry both nationally and internationally.
7. Complying with all applicable requirements and continually improving the effectiveness of the Quality Management system.

1.5 Recognition and Accreditation

	AMET has been recognized by Directorate General of Shipping (DG Shipping) for conducting Marine Engineering and Nautical Science Courses. Det Norske Veritas - Germanischer Lloyds (DNV-GL) world renowned Classification society bestowed the highest Grade A1 (Outstanding) to AMET continuously four years i.e. 2014 - 15, 2015 – 16, 2016 – 17 and 2017-18 after intensive inspection for the Comprehensive Inspection Programme (CIP) conducted under the authority of Directorate General of Shipping, Government of India.
	AMET has been conferred with Deemed University Status under De Novo category on August 2007 by University Grants Commission as per Sec.3 of UGC Act, 1956.
	AMET is certified to ISO 9001:2015 QMS Standard by Det Norske Veritas for Design, Development and Conducting Maritime Training Courses, Programmes, Examinations and Assessments.
	The National Assessment and Accreditation Council (NAAC) an autonomous institution of the University Grants Commission has assessed AMET and accredited with B Grade during November 2015. The accreditation is an indication of standards of quality as set by the NAAC and valid for a period of five years from 16 - 11 - 2015.

The Royal Institution of Naval Architects	AMET has been accredited by **The Royal Institution of Naval Architects**, United Kingdom.
	AMET Deemed to be University is the only member institution of **International Association of Maritime Universities**, from India among 64 maritime institutions of 39 countries in the world.

1.6 Acknowledgements

WasmanPro Environmental Solution are very much thankful to Dr. T. Sasilatha and Dr. V. Karthikeyan for motivating us and giving us the opportunity for energy audit. We would like to express our sincere thanks to all respected staff, faculty members and students those who have taken part in this audit survey for each department, labs, offices etc. of AMET Deemed University, Chennai. We tried our best to present this energy report as per requirements of college and our expertise work.

1.7 Disclaimer

The advice rendered by WasmanPro Environmental Solution is in the nature of guidelines based on good engineering practices and generally accepted safety procedures and WasmanPro Environmental Solutions does not accept any liability for the same. The priorities of suggestions shown in the report are advisory in nature and not binding on the parties involved viz. WasmanPro Environmental Solutions and AMET Deemed to be University.

1.8 About WasmanPro Environmental Solutions LLP

WasmanPro Environmental Solutions LLP (WasmanPro) established in the year 2014, carved a niche in the environmental solutions market, since its inception. Headquartered in Chennai, Tamil Nadu (India), we operate under FOUR business verticals namely Consultancy, Products, Projects and Environmental Training Centre.

WasmanPro has in-depth understanding and practical experience with Environmental Green Audit, Green Practices, Environmental policies, regulatory programs, and remediation strategies. Our team of environmental experts has provided Environmental compliance and remediation services for a wide variety of Commercial and Industrial Facilities. WasmanPro has been its quality management System "Preparation of EIA, EMP, Marine Impact Assessment (MIA), Disaster Management Plan (DMP) Reports for Environmental Clearance from SEIAA & MOEF, Preparation of DPR for Solid Waste Management and conduct energy, water and waste water audit".

We offer comprehensive regulatory consent and compliance support that address a full spectrum of air, water, wastewater and hazardous waste issues, regulations, and policies. Drawing upon the collective experience of our team we have developed technically sound and cost-effective strategies to achieve environmental compliance. The development and implementation of these strategies have lead to:

- Faster Consent Management Services
- Reducing waste streams
- Improving mechanisms to track consent conditions
- Executing effective monitoring programs
- Implementing phased compliance and cleanup strategies

1.9 Core Environmental Compliance & Remediation Services

WasmanPro helps our clients advance environmental sustainability, maintain environmental compliance, and reduce environmental risk and cleanup sites by providing a diverse set of core services including:

- Environmental Audit
- Air Emission Inventories and Reporting
- Air Quality and Clean Air Act Compliance
- Environmental Due Diligence
- Environmental Impact Assessment
- Site Investigation and Feasibility Studies
- EHS Audits & Training
- Environmental Management System and Compliance Auditing
- Environmental Monitoring
- Energy Audit
- Green Audit
- Soil Management Plans
- Hazardous and Solid Waste Management Plans
- Remedial Design and Monitoring
- Brownfield Cleanup
- Pollution Prevention Plans
- Environmental, Health and Safety Plans
- Hydro geological studies

2 CHAPTER

2.1 Pre-Audit Stage

The Pre Audit stage is set to establish or organise an Energy Audit Team for planning and organising the audit. A walk through into the campus of AMET Deemed to be University, Chennai to familiarise with the common practices followed with in the campus and a macro data collection has been obtained after a informal and a brief meeting with department heads and persons concerned issued set of questionnaires and initiation for energy conservation awareness program among the staffs and a explanation about the Audit procedures and plan to be executed.

Wasmanpro team has been introduced to the college energy audit team to set out a clear and workable Energy Management system through planning of simple activities within the campus, implementation of the declared energy conservation policy.

2.2 Aims and Objectives of Energy Audit

Objectives of Energy Audit:

Energy Audit means conducting a comprehensive study of all aspects, both technical and economic, that directly or indirectly affects the consumption of different energy in a building.

It aims at:

i. Assessing present pattern of energy consumption in different cost centres of operations

ii. Relating energy inputs and production output

iii. Identifying potential areas of thermal and electrical energy economy.

iv. Highlighting wastage in major areas

v. Fixing of energy saving potential targets for individual cost centers

vi. Implementation of measures of energy conservation and realization of savings.

Objective

- Identifying the quality and cost of various energy inputs.
- Assessing present pattern of energy consumption in different cost centers of operations.
- Relating energy inputs and production output.
- Identifying potential areas of thermal and electrical energy economy.
- Highlighting wastage's in major areas.
- Fixing of energy saving potential targets for individual cost centers.
- Implementation of measures for energy conservation & realization of savings.

2.3 Target Auditing for Energy Management

Energy cannot be seen, but we know it is there because we can see its effects in the forms of heat, light and power. This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. An old incandescent bulb uses approximately 60W to 100W while an energy efficient light emitting diode (LED) uses only less than 10 W. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices.

2.4 Methodology

The purpose of the audit was to ensure that the practices followed in the campus with the criteria, methods and recommendations used in the audit were based on the identified risks. The methodology includes: preparation and filling up of questionnaire, physical inspection of the campus, observation and review of the document, interviewing responsible persons and data analysis, measurements and recommendations. The methodology adopted for this audit was a three step process comprising of:

1. **Data Collection** – Before deciding what needs improvement, measure the existing situation by collecting and analyzing data. Take an inventory of what types of energy your business uses, and where each one is used. Gather all of the invoices and energy consumption data for the last year and compile it in a spreadsheet. Analyze the data for trends in consumption over time and look for patterns. In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, survey communicating with responsible persons and measurements.

   Following steps were taken for data collection:

   The team went to each department, centers, Library, canteen etc.

   Data about the general information was collected by observation and interview.

   The power consumption of appliances was recorded by taking an average value in some cases.

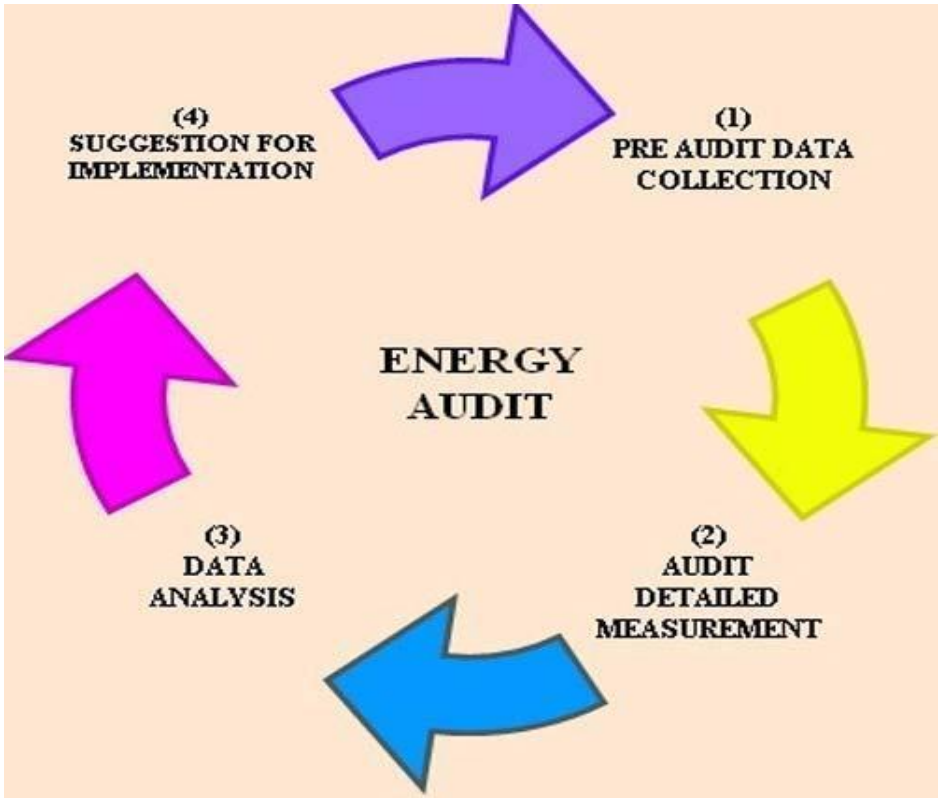
2. **Data Analysis** - Detailed analysis of data collected include: calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plan provided by the Tamil Nadu State Electricity Board (TNEB). Data related to water usages were also analyzed using appropriate methodology.

3. **Recommendation /Suggestions**–

Energy-saving opportunities can be addressed by either technological or process changes. Technological changes include replacing old machinery with energy-efficient equipment and improving insulation in physical plants. Process changes include shifting production schedules so that more electricity is used during off-peak demand times. Once improvements have been made, the audit should be repeated to confirm energy savings and identify further opportunities.

On the basis of results of data analysis and observations, some steps for reducing power and water consumption were recommended. Proper treatments for waste were also suggested. Use of fossil fuels has to be reduced for the sake of community health.

The above target areas particular to the college was evaluated through questionnaire circulated among the students for data collection. Five categories of questionnaires were distributed. The formats of these are given below.



AUDIT FLOW CHART

3 CHAPTER

Survey Forms

3.1 Auditing for Energy Management

1) List the ways of energy usage in your college. (Electricity, electric stove, kettle, microwave, LPG, firewood, Petrol, diesel and others).
2) Electricity bill amount for the last year
3) Amount paid for LPG cylinders for last one year
4) Weight of firewood used per month and amount of money spent? Also mention the amount spent for petrol/diesel/ others for generators?
5) Are there any energy saving methods employed in your college? If yes, please specify. If no, suggest some.
6) How much money does your college spend on energy such as electricity, gas, firewood, etc. in a month.(Record monthly for the year2016).
7) How many CFL bulbs have your college installed? Mention use (Hours used/day for how many days in a month)
8) Energy used by each bulb per month? (For example- 60 watt bulb x 4 hours x number of bulbs (kwh).
9) How many LED bulbs are used in your college? Mention the use (Hours used/day for how many days in a month)
10) Energy used by each bulb per month? (kwh).
11) How many incandescent (tungsten) bulbs have your college installed? Mentions use (Hours used/day for how many days in a month)
12) Energy used by each bulb per month? (kwh).
13) How many fans are installed in your college? Mention use (Hours used/day for how many days in a month)

14) Energy used by each fan per month?(kwh)

15) How many air conditioners are installed in your college? Mention use (Hours used/day, for how many days in a month)

16) Energy used by each air conditioner per month? (kwh).

17) How much electrical equipment including weighing balance is installed your college? Mention the use (Hours used/day for how many days in a month)

18) Energy used by each electrical equipment per month? (kwh).

19) How many computers are there in your college? Mention the use (Hours used/day for how many days in a month)

20) Energy used by each computer per month?(kwh)

21) How many photocopiers are installed by your college? Mention use

22) (Hours used/day for how many days in a month).

23) How many cooling apparatus are in installed in your college? Mention use(Hours used/day for how many days in a month)

24) Energy used by each cooling apparatus per month? (kwh) Mention use (Hours used/day for how many days in a month)

25) Energy used by each photocopier per month? (kwh) Mention the use (Hours used/day for how many days in a month) how many inverters your college installed? Mentions use (Hours used/day for how many days in a month)

26) Energy used by each inverter per month?(kwh)

27) How many electrical equipment are used in different labs of your college? Mention the use (Hours used/day for how many days in a month)

28) Energy used by each equipment per month?(kwh)

29) How many heaters are used in the canteen of your college? Mention the use (Hours used/day for how many days in a month)

30) Energy used by each heater per month?(kwh)

31) No of street lights in your college?

32) Energy used by each street light per month?(kwh)

33) No of TV in your college and hostels?

34) Energy used by each TV per month?(kwh)

35) Any other item that uses energy (Please write the energy used per month) Mention the use (Hours used/day for how many days in a month)

36) Are any alternative energy sources/nonconventional energy sources employed / installed in your college? (photovoltaic cells for solar energy, windmill, energy efficient stoves, etc.,)Specify.

37) Do you run "switch off" drills at college?

38) Are your computers and other equipment put on power-saving mode?

39) Does your machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby mode most of the time? If yes, how many hours?

40) What are the energy conservation methods adapted by your college?

41) How many boards displayed for saving energy awareness?

42) How much ash is collected after burning fire wood per day in the canteen?

43) Write a note on the methods/practices/adaptations by which you can reduce the energy use in your college campus in future.

44) Calculation of energy for electrical appliances

4 CHAPTER

4.1 Audit Stage

In AMET Deemed to be University, Chennai Energy auditing was done with the help of Wasmanpro Environmental Solutions LLP involving different student groups, teaching and non-teaching staff. The Energy audit involves the following Activities

- Gathering of primary data
- Energy utility diagram
- Conduct survey and monitoring
- Analysis of energy use
- Identification and deployment of energy conservation programs
- Cost benefit analysis
- Reporting and presentation

Gathering of primary data:

Primary data for energy consumption details including number of electrical devices in each block of building were accounted along with their power ratings and average usage hours per day. The operation data and schedule of operation were collected from the corresponding persons and the total power consumption per day was calculated and compared with the annual energy bill and energy consumption pattern collected

Energy utility diagram:

Energy utility diagram were used to analyse the single line power distribution system and loss of energy through long distance distribution for water pump, tube lights, fans, air conditioners, laboratory equipments, path way illuminations, decorative lightings, etc.

Conduct survey and monitoring:

On campus survey is used to obtain more and accurate data. The survey was carried out for motors, lightings, instruments, insulations, etc. the obtained data were compared with the operating and design data.

Analysis of energy use:

Energy balance chart is prepared for each and every electrical unit and for the whole electrical supply system. The difference and loss over transmission were identified and appropriate alternatives were suggested to the AMET deemed to be University

Identification and deployment of energy conservation programs:

In dew process of identifying the suitable energy conservation program various recommendations from each vendor, previous ideas from the unit personnel's, staffs and selected group of students were analyzed finally WasmanPro devised a universally accepted technologies and procedures for energy management system and recommendations were reported in the chapter 5

Cost benefits analysis:

Energy management system is ultimately decided by the cost benefit analysis finding the better energy conservation solution without compromising the usual service received, cost benefit analysis involves

- Low cost high energy conservation
- Medium cost medium energy conservation
- High cost high energy conservation

Reporting and presentation:

The data collected from pre audit and audit stage was compiled and suitable recommendations were suggested for energy conservation as a report and presented to the AMET Deemed to be University.

5 CHAPTER

5.1 Source of Energy

AMET Deemed to be University uses Energy in following forms:

a. Electricity from TNEB
b. High Speed Diesel(HSD)

HSD is used as a fuel for Diesel Generator as alternative energy source in the absence of power from TNEB.

The following are the major consumers of electricity in the facility

- Computers
- Lighting
- Air-Conditioning
- Fans
- Other Lab Equipment

5.2 Specific Energy Consumption (SEC)

Specific Energy Consumption (SEC) is defined as energy usage per Square meter of area. It is calculated total electrical kWh/total area of the campus. By calculating SEC, we can crudely target the factors of energy efficiency or inefficiency.

5.3 Benefits of Energy Audit

Every time the energy audit is carried out it identification of energy savings opportunities, quantified with estimates of the investment required, and annual savings expected, for each opportunity.

1. It estimate of savings to an acceptable degree of accuracy
2. It gives up to date advice on specific technologies
3. It identify likely desired and undesired consequences of a particular upgrade, and undertake calculations to quantify them
4. It easily priorities and know exactly what you need to do to reduce your energy costs

5.4 Energy observations

Arrangement of rooms and electrical appliances has huge impact on monthly electricity Bill. Electronic Appliances were still on even though they are not in use, Appliance on Standby mode could drain more power even though they are not in full operations, Faulty lightings and fittings could act as a vampire loads.

Table 1: Monthly Power Consumption

S.NO	MONTH	POWER CONSUMPTION (kWh)/month	TOTAL ELECTRICITY COST (Rs)
1	Jan-17	64,608.00	4,10,260.00
2	Feb-17	1,05,744.00	6,71,474.00
3	Mar-17	1,36,752.00	8,68,375.00
4	Apr-17	1,50,420.00	9,55,167.00
5	May-17	1,85,130.00	11,75,575.00
6	June-17	1,37,286.00	8,71,766.00
7	July-17	87,786.00	5,57,441.00
8	Aug-17	1,20,120.00	7,62,762.00
9	Sep-17	1,53,972.00	9,77,722.00
10	Oct-17	1,65,192.00	10,48,969.00
11	Nov-17	1,48,794.00	9,44,841.00
12	Dec-17	1,64,226.00	10,42,835.00
	TOTAL	**1,620,030.00**	**10,287,187.00**
	AVERAGE	**135,002.50**	**857,265.58**

- Total electricity consumption of the university is on average of 4800 units per day
- Total cost of the power consumption averagely cost up to 31,000.00 Rs per day.
- Number of Gas cylinders used per month –330-350 (19 kg cylinder)
- Cost of Gas cylinders used Rs. 3,30,000/month
- Number of Generators – 2 (600 ,500 kVA capacities)
- Number of LED lights –527
- Number of fans –1601
- Number of Air conditioners - 279

- ❖ Number of Tube lights – 2280
- ❖ Number of Transformers – 2 (450 &150 kVA)
- ❖ Number of Printers –122
- ❖ Number of Xerox Machines- 4
- ❖ Energy generation by solar panels – 30 kW

5.5 Current saving methods adopted in the college

- ✓ Turn off electrical equipments when not in use
- ✓ Use energy efficient light-emitting diode (LED) bulbs
- ✓ Use computers and electronic equipments in power saving mode.

The average energy utilization of the college for different purposes is approximately **1, 35,002.50 KWH/month (2016-2017).** Increased production of solar energy a type of non-conventional category of energy will be a good energy management system for the college. The average Electricity charges per month are **Rs. 857,265.58 for the academic year of 2016-2017** by the observation. Energy saving through the replacement of incandescent bulbs, CFL lamps and tube lights to LED light could be a good option. Energy efficient electrical equipments especially fans and pump sets can be replaced against old ones. Awareness programs for the stakeholders to save energy may also increase sustainability in the utilization of various energy sources. Caution signage boards are present at the EB room, Genset area.

Conservation Slogans and signage board:

The institution has created the awareness about energy conservation and wastages among is all of the teaching, non teaching and administrative staffs and also among the students through regular drills and installation of conservation signage boards throughout the campus.

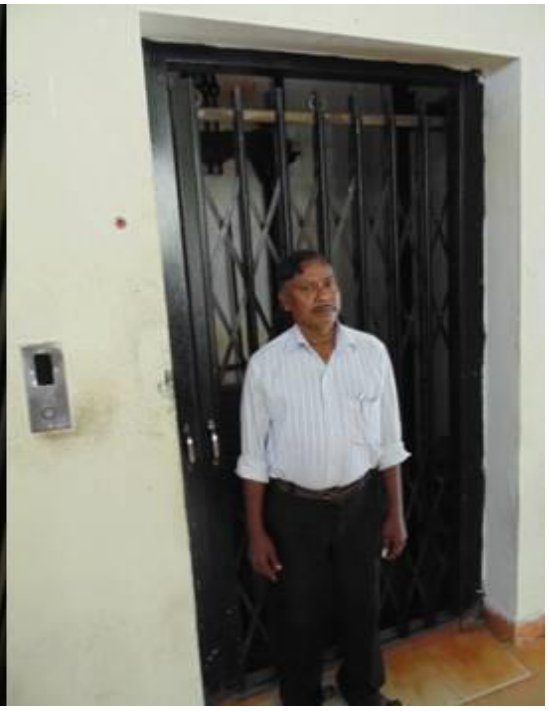
Figure 1: Signage boards for power conservation

Figure 2: Transformer inside the campus

Figure 3: Gensets of capacity 500 and 600 kVA

Figure 4: Power consumption by lifts in standby mode

RABINDRANATH TAGORE GANGA HOSTEL

YAMUNA HOSTEL LIFT # 1 YAMUNA HOSTEL LIFT # 2

5.6 Carbon Footprint Analysis

Carbon footprint analysis can be done by suitably combining data collected with respective emission factor of the selected emission inventories. Table represents emission factors of the selected inventories.

Table 2: *Emission factors*

Sl. No	Emission Inventory	CO_2 Emitted
1	Electricity	0.68956kg per kwh
2	Solar based Electricity	0.05kg per kwh

The total carbon footprint of campus is determined, zone-wise and on the whole. Values are tabulated below as shown in Table.

Table 3:*Total CO_2 Emission from a college Campus*

Sl. No	Emission Inventory	CO_2 Emitted(kg/kwh)	Electricity consumed/ day	Total CO_2 Emitted (kg/day)
1	Electricity	0.68956	4500.08	3,103.0751648

2	Solar based Electricity	0.05	30	1.5

Note: The entry of the values will be based on the emission inventories of various zones and the emission factor of each inventory.

5.7 Electricity

Electricity is one emission inventory which contributes much to the Carbon footprint of the institution. Heating of the buildings with electricity generates a certain amount of CO_2 due to the generation of electric power. On an average, electricity sources emit 0.68956 Kg CO_2 per kWh. The emission factor given by GRID 2010 version 1.1 for hydro electricity is 6.8956 x10-4 metric tons CO_2/kwh. 50 grams of CO_2 is emitted from 1 unit of solar power.

The details of the consumption of electricity and the use of generators in different zones are surveyed. If the number of classrooms and labs are more in a zone, consumption of electricity in that zone is more.

5.8 Solar PV Power

The solar PV Power generation system installed at Academy of Maritime Education and Training (AMET) is a high efficient, modular, extendable and cost-effective power generation solution. The system is designed as per the International Standards to ensure that the years of trouble-free operations. As a result of proven technology, the system is highly efficient and maintenance free. With one-time investment, the Solar Power Plant provides the practical way of managing the energy costs in an eco-friendly way. The savings made on energy costs will help the management to directly benefit and contributing to their growth. The details of major components used in this system are listed below.

Solar PV Modules: The sun light (solar radiation) falling on the modules is converted in to DC energy by photovoltaic principle. The generated by solar modules can either be used to supply the power to the connected load or to charge the battery bank.

PV Inverter (PCU): PCU is a common terminology used to the system consisting of Inverter and AC synchronization functionality. PCU does the function of controlling grid power by leading PF and prefer the solar energy to the load. The system also contains the Charge Controller as part of the same system or as an independent unit.

Module mounting structure (MMS): MMS is the structure to mount the solar PV modules with specified angle depending on the location when the system to be mounted. The tilting will vary depending on the longitude and latitude of the location.

5.9 Salient Features and Benefits of System

- ✓ A clean, silent and eco-friendly source of power
- ✓ Solar modules convert sunlight into electricity without pollution
- ✓ Negligible maintenance as there are no moving parts and maximum reliability
- ✓ Long life span of solar modules
- ✓ Modular design and easily expandable
- ✓ Simple installation: can be mounted on roof top or ground
- ✓ Can be installed at point-of use to avoid transmission losses
- ✓ Energy Independence
- ✓ Protection against future escalation of energy costs
- ✓ Available throughout the year

This system is designed to generate the energy in an eco-friendly manner with the source from solar radiation which is available in abundance. The system designed is for 10Kwp and 20KWp Solar Power Generation Grid Connecting Systems. These systems do not have any storage for standby power. The solar PV array will have 42 numbers of 250Wp and 64 numbers of 315Wp crystalline solar modules. These modules will be connected in series / parallel combination through Optimizers to the desired string configuration as per the design parameters of the PCU. The PCU are of 10KVA and 20KVA capacity with three phases AC Output. Grid power supply is provided to support the loads and to reduce the Grid power consumption when solar power is available.

The power generated from solar array is fed into the PCU through Optimizer and being inverted by the PCU (Vac). This voltage is being combined with standard grid supply to the phases (R/Y/B) and will lead the power factor of the inverter supply by comparing the grid power factor. So the solar generated power will always be preferred by the leading power factor and rest of the power will be used from the grid as required by the load. If the load demand is lesser than the solar power generated, the balance power may be exported to grid and customer may get feed-in

benefit as per the policies of the local electricity board. This system is working in the principal of power factor comparison and the system will feed the power to load through grid power supply. That means loads will be indirectly connected with the solar system. So, if the grid supply is not available at any moment the solar system will shut OFF immediately. We can only use sunlight directly to the load whenever the grid power is available. The system will shuts OFF at the time of low intensity or no sun light and restarts automatically when the sunlight is available. The proposed system does not required any dedicated loads or separate wiring to work on. At the time of power failure if the customer turns ON the DG supply again the solar system will run and pushes the energy back to the DG. To avoid this reverse current situation, the DG rating should be atleast be 4 to 5 times higher rating than the proposed solar power plant rating.

5.10 AMET Solar Power Plants

The Academy of Maritime Education and Training (AMET) installed its first solar power plant of capacity of 10kWp in 2014. It consists of 42 panels of each 250Wp capacity. The power generated from this plant is connected to the main power supply through the Schneider Electric make (Model: Conext TL10000E) 10kW grid connected inverter. The 10kWp Solar Photovoltaic (SPV) system at roof-top is estimated to afford an annual energy generation of 16,000 units (5units × 10kWp × 320days) for captive use under ideal conditions.

The AMET expanded its solar initialization by installing additional 20kWp solar power plant in October-2017. It consists of 64 panels of each 315Wp capacity. The power generated from this plant is connected to the main power supply through the Fronius 20kW grid connected inverter. The 20kWp Solar Photovoltaic (SPV) system at roof-top is estimated to afford an annual energy generation of 32,000 units (5units × 20kWp × 320days) for captive use under ideal conditions.

The generated power is feedback to the local distribution network whenever EB supply / DG supply is available to the grid tied inverter. This power is used to share the part of the loads in the campus. This inverter has inbuilt online data monitoring system.

Technical Specifications of Plant - I:

Total Number of Panels: 42

Table 4: *Solar PV Module Specifications*

Manufacturer: Lubi Electronics, Gandhinagar – 382 325. **Model: LUBI MakeLE18P250**		
S. No	**Parameters**	**Ratings**
1	Maximum Power, P_{max}	250 W
2	Maximum Voltage, V_{max}	30 V
3	Maximum Current, I_{max}	8.34 A
4	Open Circuit Voltage, V_{oc}	36 V
5	Short Circuit Current, I_{sc}	9.26 A
6	Module Efficiency	15.44 %
7	Solar Irradiance (STC)	1000 W/m^2
8	No. of Cells	60 Cells

Table 5: *Solar Inverter Specifications*

Manufacturer: Schneider Electric **Model No:** Conext TL 10000 E	
Parameters	**Ratings**
Input (DC)	
MPPT voltage range, full power	350 – 850 V
Operating Voltage range	200 – 1000 V
Max. input voltage, open circuit	1000 V
Number of MPPT	2
Output (AC)	
Normal output power	10 kVA
Nominal output voltage	230 / 400 V
Frequency	50 / 60 Hz

Technical Specifications of Plant - II:

Total Number of Panels: 64

Table 6: *Solar PV Module Specifications*

Manufacturer: Goldi Green Technologies Pvt. Ltd., Surat. **Model No:** GOLDI315PM		
S. No	**Parameters**	**Ratings**
1	Maximum Power, P_{max}	315 W
2	Maximum Voltage, V_{max}	37 V
3	Maximum Current, I_{max}	8.52 A
4	Open Circuit Voltage, V_{oc}	46 V
5	Short Circuit Current, I_{sc}	8.9 A
6	Maximum System Voltage	1000 V
7	Solar Irradiance (STC)	1000 W/m^2
8	No. of Cells	60 Cells

Table 7: *Solar Inverter Specifications*

Manufacturer: Fronius **Model No:** Fronius Symo 20.0-3-M **S. No:**28149005	
Parameters	**Ratings**
Input (DC)	
MPPT voltage range, full power	420 – 800 V
Operating Voltage range	200 – 1000 V
Max. input voltage, open circuit	1000 V
Number of MPPT	2
Output (AC)	
Normal output power	20 kVA
Nominal output voltage	230 / 400 V
Frequency	50 / 60 Hz

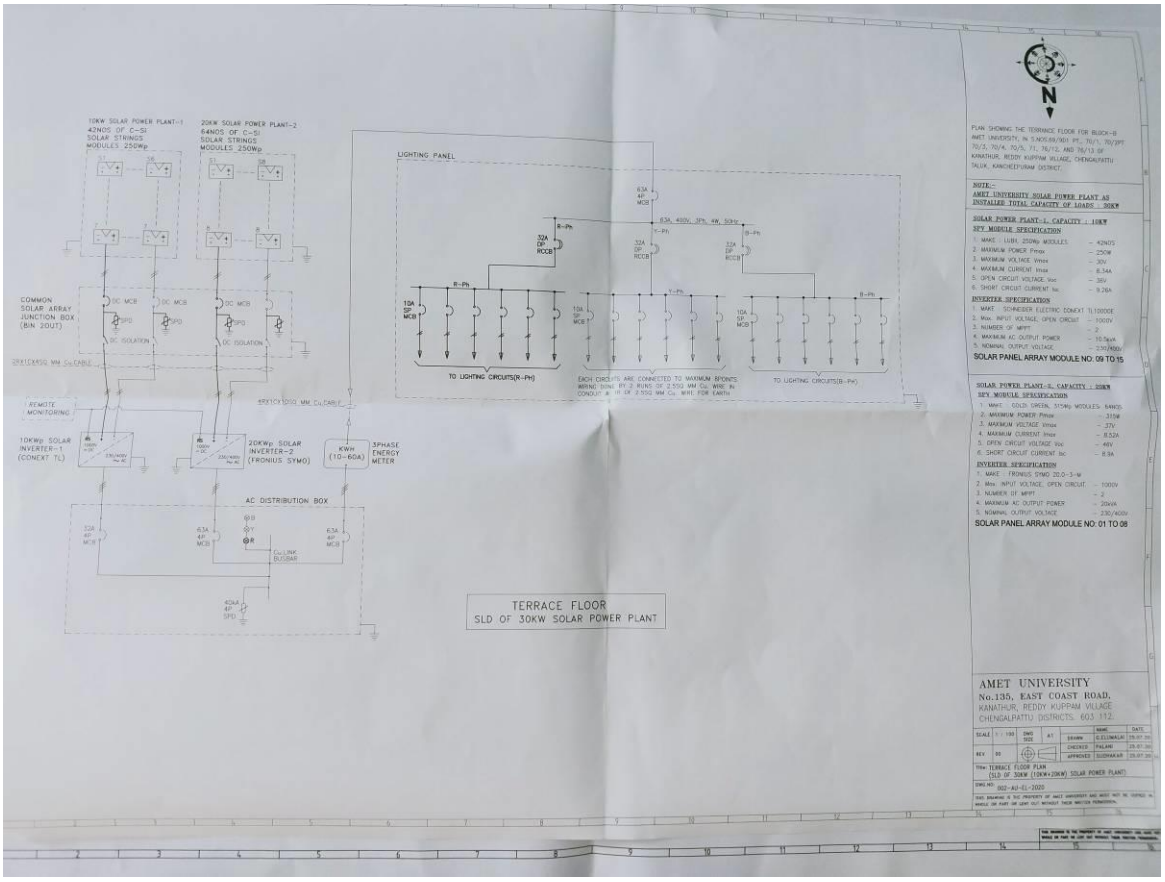


Figure 5: Solar power plant module array and light circuit

Figure 6: A view of AMET Solar Power Plant

Figure 7: 20kW Solar Power Plant-2 Inverter Setup

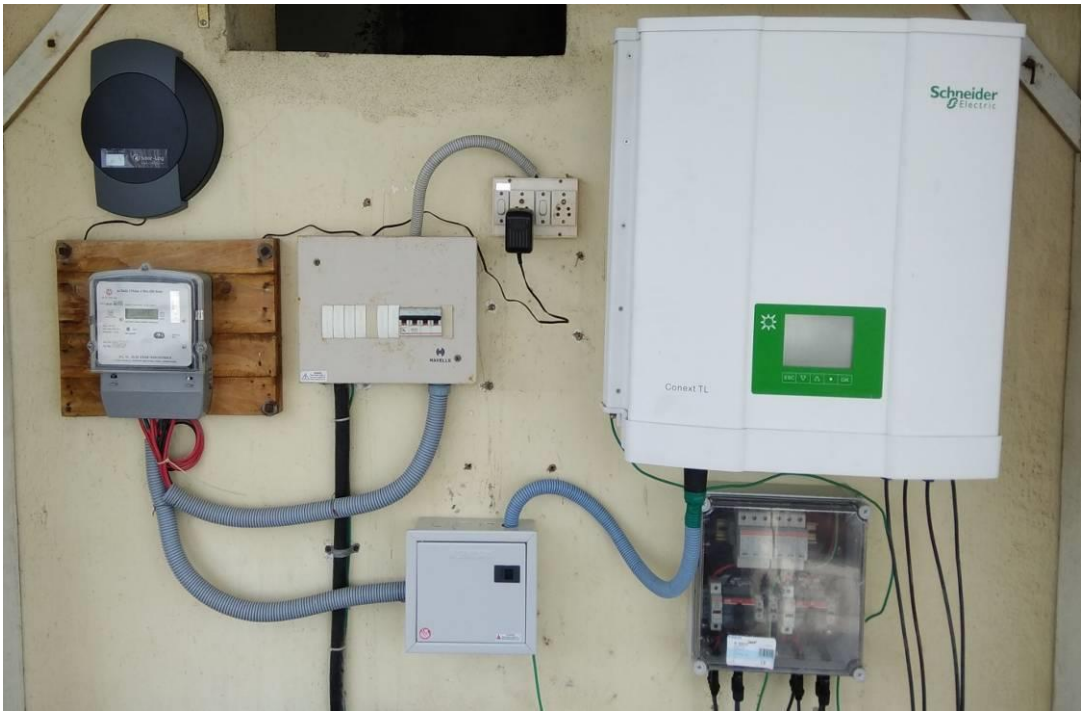


Figure 8: 10kW Solar Power Plant-I Inverter Setup

5.11 Recommendation:

- To establish an energy management system to monitor and reduce the energy consumption.
- Install an automated energy management system that will control all spaces in accordance with usage eg. Sensors for water and rooms.
- To install battery operated vehicles inside the campus.
- Install HVAC – Control.
- Daylight should be used effectively
- Photo sensor to be installed to detect the day light and optimised the energy consumption for lights.
- Set timers appropriately for sprinklers, makeup/outside air units, air conditioning time clocks and programmable thermostats
- To achieve energy saving gradually change CFL bulbs to LED, fix energy efficient equipments, appliances, increase renewable energy installations like solar PV cells, etc.
- Periodic electrical maintenance is to be done to optimise the power usage.
- It is recommended to incorporate the details/utilisation of solar in your website to create an awareness to use renewable energy and check the adequacy of it.
- Install outdoor shading devices
- To install more LED instead of CFL and tubes to reduce the power consumption.
- Currently the university is saving Rs.1500 per day using 30 KW solar panel by increasing the capacity of the Solar panel in future to utilise the renewable energy to the maximum.
- It is recommended to install Biogas plant thereby electricity demand could be reduced by utilising renewable energy from it.
- It is recommended to check the date of filling and date of inspection periodically in the fire extinguisher.
- It is necessary to fix the inspection tag/card in the fire extinguisher.
- Stored empty barrels in the genset room should be stored separately earmarked area as per Hazardous Waste Management Rules 2016.

6 CHAPTER

6.1 Conclusion

The Energy audit is an excellent tool in recognizing and checking a complete energy management program. An effective audit of any type will give the organization a plan with which it can manage the organization energy system at minimum energy cost. In this paper, a detailed study has been made to reduce the electrical energy consumption in the complete campus of AMET Deemed University, Chennai, Tamil Nadu, India. It accounts the amount of energy savings that can be obtained in an educational Institution, thereby energy crisis can be reduced significantly.

The institution manages power conservation through its energy consumption awareness programs and installing signage boards throughout the campus and the ideology of balancing the carbon footprint created by the institution by using bicycles as transport within the campus and by maintaining appropriate green belt around the campus. It also reduces the power consumption through installation of 30 kW solar power plant inside the campus, this helps the reduction of power consumption.

The 10kWp Solar Photovoltaic (SPV) system at roof-top is estimated to afford an annual energy generation of 16,000 units (5units × 10kWp × 320days) for captive use under ideal conditions. The 20kWp Solar Photovoltaic (SPV) system at roof-top is estimated to afford an annual energy generation of 32,000 units (5units × 20kWp × 320days) for captive use under ideal conditions. The power id connected to the local distribution network. 30kWp solar plant generates approximately 120-150 kWh per day. Equipments like Computers are used with power saving mode. Also, campus administration runs switch –off drill on regular basis. I would like to appreciate the team effort and the commitment by the management for such a great campus activity.

This paper provides solid notice to the consumer not only in terms of the energy bills, but also the energy crisis in the near future to all sectors of people. The organizations should carryout auditing periodically, because Energy Auditing is a continuous process.

Table 8: *Inventory of A/C*

MAHATMA GANDHI BLOCK GROUND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Managing Trustee	2	2
2	Vice President	1	2
3	Vice Chancellor	1	2
4	V.C Office	1	1
5	C.E.O	1	1.5
6	Trustee	1	1.5
7	Register	1	2
8	Admin Director	1	2
9	Director Projects	1	1.5
10	Dean ME Dean PG	2	1.5
11	Cash Counter	1	1
12	P.R.O	1	1
13	Management Meeting Hall	1	1
14	PA to Pro Chancellor	1	1
15	Accounts	2	1.5
16	Administrator	2	1.5
17	Conference Hall	2	2
18	Management Dining Hall	1	1
19	Maintenance Dept	1	1
20	U.P.S	1	1.5
TOTAL		25	
MAHATMA GANDHI BLOCK FIRST FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	I.T Dept	3	2,1.5,1
		1	1
		3	2
2	Biotechnology Lab - I	2	2,1
	Biotechnology Lab - II	1	1
	Nanophotonics Lab	1	1.5
	Biotech HOD	1	1.5
3	Chemistry HOD	1	1.5
4	Centre for Ocean Research	1	2

5	NAAC Office	1	1
6	IT Support	1	2
7	Marine Museum	1	1.5
TOTAL		17	
MAHATMA GANDHI BLOCK SECOND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	EEE HOD	1	1.5
2	Mathematics - HOD	1	1.5
3	Maths Women Faculty	1	1.5
4	EEE Staff	2	2,1
5	Alumini Office	1	1
6	G.M.D.S.S	3	2
		3	1.5
		1	1.5
		2	1.5
7	Dept of Physics	1	2
8	Petro Staff	1	1.5
9	Sound NS office	2	1.5
TOTAL		19	
MAHATMA GANDHI BLOCK THIRD FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Naval Arch	1	1.5
2	TRIBON	1	2
		2	2
		1	1
3	Naval Director	1	1.5
4	Staff	2	1.5
TOTAL		8	
RABINDRANATH TAGORE GROUND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	E.E.E Marine Lab	2	1
		1	2
2	DSP	2	2
3	Common Comp Lab	1	1.5

		1	2
4	UPS Room	1	1
5	Pre Sea Modular HOD	1	2
TOTAL		9	
RABINDRANATH TAGORE FIRST FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Class Room	17	2
2	Staff Room	2	2
TOTAL		19	
RABINDRANATH TAGORE SECOND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Simulators and Class Room	14	2
		4	1
TOTAL		18	
RABINDRANATH TAGORE THIRD FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Research - Dir	1	1.5
2	Dean Admission	1	1
3	B 20	1	1.5
4	B 21	1	1.5
5	B 22	1	1
6	B 23	1	1.5
7	B 24	1	1
8	Server Room	1	1
9	Admission Hall	Centralized AC - 25 Ton	
	DNV 1&2		
10	Chancellor	6	1.5(2),2(3),1(1)
TOTAL		14	
RABINDRANATH TAGORE FOURTH FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Class Room	8	15
		1	15
2	Bridge Navigation Lab	2	2

TOTAL		11	
JAWAHARLAL NEHRU GROUND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Harbour Engg	1	1.5
2	Doctor	1	1
3	Advisor- Sec & VIG	1	1.5
4	Lady in Patient	1	1
TOTAL		4	
JAWAHARLAL NEHRU FIRST FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Harbour Engg	1	2
		1	1.5
TOTAL		2	
JAWAHARLAL NEHRU FOURTH FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Physical Dept	1	1
		1	1
TOTAL		2	
BHARATHIYAR GROUND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	High Voltage Lab	1	1
		1	1.5
TOTAL		2	
BHARATHIYAR FIRST FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	NS Staff Room (D-7)	2	1.5
2	Marine Information Research	1	1.5
TOTAL		3	
BHARATHIYAR SECOND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	NS Dean	1	1.5
2	P A to Dean	1	1.5
3	Conference Hall	1	1.5

TOTAL		3	
BHARATHIYAR THIRD FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Simulator Room(D16)	1	1
BHARATHIYAR FOURTH FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Seaman Ship Lab	1	2
VIVEKANANDHA - FIRST FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	English Lab	3	2 & 1.5
2	IELTS Lab	2	2
TOTAL		5	
VIVEKANANDHA - SECOND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Centre for Non-Destr	1	1.5
2	EEE Lab	1	1.5
3	Centre of Excellence	2	1.5
4	Multimedia Centre	1	1.5
TOTAL		5	
V O C - GROUND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Shri Janakiraman Auditorium	6	2
		6	1.5
2	Executive Director	1	1.5
3	Dept of Placement	2	1.5
4	MBA Class Room	8	1.5
TOTAL		23	
V O C - FIRST FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Controller of Examine	3	1.5 & 1
2	Computer Lab (F14)	2	1.5
		2	1

		1	2
3	F 15	2	1
4	F 16 Class Room	2	1.5
5	AMET Business School Director	4	1.5
TOTAL		16	
V O C - SECOND FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	HND Marine Engineering (F19)	2	1
		1	1.5
2	UCIR	1	1.5
3	Class Room (F27)	1	2
TOTAL		5	
V O C - THIRD FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	Mech -HOD	1	1
2	Mech - Staff	1	1.5
3	F28	1	2
4	F28 (PE -Com Lab)	1	
TOTAL		4	
V O C - FOURTH FLOOR			
SL.NO	NAME	NO OF A/C	TON
1	PE - HOD	1	1
2	PE - Staff	2	1 & 2
3	PE - Class Room	13	1 (3) & 1.5 (10)
TOTAL		16	
CANTEEN MAIN			
SL.NO	NAME	NO OF A/C	TON
1	Vegetables Room	1	1.5
		1	1.5
2	Dining Hall (Akshya)	4	1
		1	1
3	Main EB Panel Room	1	2
TOTAL		8	

SIC			
SL.NO	NAME	NO OF A/C	TON
1	Faculty Room	1	1.5
2	Fire Faculty	1	2
TOTAL		2	
GANGA HOSTEL			
SL.NO	NAME	NO OF A/C	TON
1	2F	31	1
2	4F, 5F	6	1
3	6F	3	1.5
TOTAL		40	
LIBRARY			
SL.NO	NAME	NO OF A/C	TON
1	HOD Dining Hall	1	2
2	Ladies Hostel DG	1	1.5
TOTAL		2	

Table 9: *Inventory of Electrical appliances Fan, Tube light, Cooler etc*

Sl.No	BLOCK NAME	Number of Tube Lights	Number of Fans	Number of LED	Number of Wall Fans	Number of Standing Fans	Number of Exhaust Fans	Number of Heaters	Number of Coolers	Number of Fridge
1	F - BLOCK	156	252	128	0	0	0	0	0	0
2	D - BLOCK	126	122	0	2	0	0	0	0	0
3	A - BLOCK	189	184	8	0	0	0	0	0	0
4	B - BLOCK	116	86	0	2	0	0	0	0	0
5	Ganga Hostel	418	144	0	0	0	40	13	14	0
6	Yamuna Hostel	625	260	0	0	0	10	1	1	0
7	F - BLOCK Aditorium	0	0	121	0	0	0	0	0	0
8	Work Shop I to IV	109	25	0	0	0	8	1	2	0
9	Canteen	160	212	70	13	0	10	9	7	4
10	Library	240	240	0	0	0	0	0	0	0
11	Ship in Campus	74	43	200	7	0	0	0	3	0
12	Work Shop III	35	24	0	2	2	3	1	1	0
13	Thermal Lab	20	0	0	0	0	3	0	0	0
14	Fire Fighting Lab	12	9	0	0	0	0	0	0	0
TOTAL		**2280**	**1601**	**527**	**26**	**2**	**74**	**25**	**28**	**4**

Table 10: *Inventory of UPS*

SL.NO	BLOCK	FLOOR	UNIT RATING	NO. OF BATTERIES	RATING OF BATTERIES	POWER FLOW
1	MAHATMA GANDHI BLOCK	GROUND	20 KVA	30	42 AH	VC + REG + CONF + COSH + DEAN-ME + TRUSTEE + MNGTRUSTEE + VP + PREZ + DY.DIR + PRO + DEVARAJ + RECP + KUMAR + MAINT
2		GROUND	20 KVA	30	42 AH	ACCTS + ADMIN + Pro. Chancellor + CEO
3		GROUND	5 KVA	10	42 AH	IT Support server
4		FIRST	15 KVA	20	42 AH	IT Lab Inside Server
5		FIRST	10 KVA	15	26 AH	IT Lab + Bio Lab 2
6		FIRST	10 KVA	15	42 AH	IT Lab
7		FIRST & SECOND	10 KVA	15	42 AH	CHEM + BIO (ALL LAB) + CLASS + PET (ALL) + MATHS + PHYSICS + CLASS ROOMS
8		FIRST & SECOND	6 KVA	10	26 AH	GMDSS STAFF + CLASS 2
9		SECOND	20 KVA	30	42 AH	GMDSS CLASS 1,3,4
10		THIRD	10 KVA	15	26 AH	TRIBON LAB
11		THIRD	10 KVA	15	26 AH	ALL CLASS ROOM + STASS +HOD
12	RABINDRA NATH TAGORE	MEZZANINE FLOOR	5 KVA	15	26 AH	DSP LAB CENTRE OF EXELLENCE INCUBATOR
13		1,2 & 4	20 KVA	30	65 AH	ALL CLASS ROOM + STASS +HOD

SL.NO	BLOCK	FLOOR	UNIT RATING	NO. OF BATTERIES	RATING OF BATTERIES	POWER FLOW
14		SECOND	15 KVA	20	42 AH	SIMULATOR + STAFF + CLASS
15		SECOND	15 KVA	20	42 AH	ENGINE
16		THIRD - SERVER	10 KVA	16	42 AH	ADMISSION + RESEARCH + DNV - 1 & 2 + STAFF + B-AUDIT + CONF
17	JAWAHARLAL NEHRU	1,2,3 & 4	10 KVA	15	26 AH	CLASS + STAFF + PET
18		FIRST	10 KVA	15	26 AH	LAB + HE-HOD + STORE
19	BHARATHIYAR	1,2,3 & 4	10 KVA	15	26 AH	CLASS + STAFF + HIGH VOLTAGE + SM LAB + SEAMAN SHIP + RESEARCH LAB - HOSTELS
20	VIVEKANANDA	FIRST	20 KVA	30	65 AH	IETLS
21		FIRST	20 KVA	30	42 AH	ENGLISH LAB
22		SECOND	10 KVA	15	42 AH	RESEARCH + STORE
23	V.O.CHIDAMBARAM	GROUND & FIRST	20 KVA	30	65 AH	AUDIT + STAFF + E14 + COE + ABS + PLACEMENT
24		SECOND & FOURTH	20 KVA	30	65 AH	STAFF ROOM + F15 LAB + MECH DEPT + CLASS ROOM + 4TH FLOOR, USIR
25		THIRD	10 KVA	16	26 AH	CLASS ROOM + STAFF
26	V B S RAJAN	FIRST FLOOR	10 KVA	15	42 AH	DIGITAL LIBRARY (SECOND FLOOR)
27			10 KVA	15	42 AH	LIBRARY COMPLETE
28	SHIP - IN - CAMPUS	GROUND	5 KVA	4	42 AH	SHIP ALL AREA

Table 11: *Inventory of water pumps*

Pump location	Type of Pump	Flow M^3/hr	Motor rating (kW)	Hours of use /day
Swimming pool filtration pump - 1	Mono block	3	11.25	12
Swimming pool filtration pump - 2	Mono block	3	11.25	12
Main sump-1	Mono block	2	335	20
Hostels	Mono block	2	3.75	10
Academic	Mono block	1	3.75	06
Sewage pump (Raw)	Mono block	1	3.75	24
STP filtered water transfer pump	Mono block	1	335	06
STP reed bed	Mono block	I	3.75	06
STP aeration Pump -1	Mono block	Na	11.25	12
STP aeration Pump -2	Mono block	Na	11.25	12
Gat-den pump	Mono block	0.5	1.13	06

ANNEXURE

GOVERNMENT OF TAMIL NADU
ELECTRICAL INSPECTORATE

From
The Chief Electrical Inspector
to Government,
Thiru.Vi.Ka Industrial Estate,
Guindy, Chennai-600 032

To
The Chairman,
Academy of Maritime Education and Training,
135, East Coast Road,
Kanathur - 603 112.

Letter No. KPM.700/CEIG/D3/2005-1, Dated 16.8.2005

Sirs,

Sub: ELECTRICITY – New HV and MV installations at Wind Farm Project at Thiru.Academy of Maritime Education and Training, 135 East Coast Road, Kanathur - 603 112.

High and Extra High Voltage apparatus, cable, supply lines Manufacturer's Test Certificate of HV equipments – Accepted.

Ref: 1) This Office letter No. KPM.700/CEIG/D3/2005, dt. 26.7.2005

2) Your Letter No. Nil dt. 8.8.2005

Under Rule 65 of Indian Electricity Rules 1956, the manufacturer's test certificates of following /HV equipments are hereby accepted and the original test certificates is/ are returned herewith duly attested.

Sl. No.	Equipment	Make	Manufacturer's Sl.No.	Voltage	Capacity
1	Transformer	M/s.TamilNadu Electricals	2857	11KV/433V	630 KVA

(Sd/-)
Chief Electrical Inspector to Government

//True Copy/Forwarded//

17/8/05
ASSISTANT ELECTRICAL INSPECTOR/TECHNICAL

Encl 1 Test Certificate
Copy to the Senior Electrical Inspector/ Coimbatore/ Headquarters
Copy to the Electrical Inspector/ Kancheepuram

Figure 9: Test Certificate for HV equipments

(new) CST No 52556 dt 19-10-84 SSI No. 330104185 Date : 09.07.86

TAMILNADU ELECTRICALS

Office : 28, Prithivipakkam, Ambattur, Chennai - 600 053. Tel : 2657 3479
Factory : SP-24, Ambattur Industrial Estate, (Behind Ambattur Industrial Estate Fire Station)
Chennai - 600 058. Tel : 2625 7421 E-mail : tne@md3.vsnl.net.in

TRANSFORMER TEST CERTIFICATE
MANUFACTURED TO SPECIFICATION No.IS.2026

Customer	M/s.Academy of Maritime Education & Training, Chennai.		
Order No.	Nil	Vector Group Ref.	Dyn11
Capacity KVA	630	Frequency	50 Hz
Volts at No Load (HV/LV)	11000/433	Tappings	+ 5% to – 10%
Full Load Current (HV/LV)	33.06 /840 A	Job Sl No.	2857

TESTS	MEASURED VALUES	GUARANTEED VALUES
No Load Test	840 Watts at 433 Volts & 50 Hz	--
Mag. Current	0.450% at 433 Volts & 50 Hz	2%
Load Loss	8570 Watts at 26.25 A & 75 Deg C	--
Impedance	5.40% Volts at 26.25 A & 75 Deg C	5.0%
Resistance per phase	HV Windings 3.83 Ohms LV Windings 1.54 milliohms	At Tap No. 3
Induced Over Voltage with stand Test at 35° C	2 X Rated Volts at 100 Hz for 1 minute - OK	
Separate Source Voltage with Stand test at 35° C	HV to LV & Earth 28 KV for 1 minute - OK LV to HV & Earth 3 KV for 1 minute - OK	
Insulation Resistance At 35° C	HV to LV 2500 M..Ohms HV to Earth 2500 M..Ohms LV to Earth 2500 M .Ohms	
Oil Test	Applied 30 KV across a gap of 2.5mm – OK	

Load	125%	100%	75%	50%	25%
Efficiency at UPF	98.22	98.53	98.82	99.06	99.02
Efficiency at 0.8 PF	97.79	98.17	98.52	98.83	98.80

RATIO	TAP –1	TAP-2	TAP-3	TAP-4	TAP-5	TAP-6	TAP-7	TAP-8	TAP-9
U PHASE	46.22	42.92	43.99	42.92	41.84	40.73	39.63	--	--
V PHASE	46.22	45.10	43.99	42.92	41.85	40.73	39.63	--	--
W PHASE	46.22	42.92	43.99	42.92	41.84	40.73	39.63	--	--
HV VOLTS	11550	11275	11000	10725	10450	10175	9900	--	--
LV VOLTS			433						

Temp Rise in Oil	50 ° C	HV Windings	55 ° C	LV Windings	55 ° C
% Regulation at Full load		UPF	1.428%	0.8 PF	3.963%

for TAMIL NADU ELECTRICALS

Date: 16/7/2005 Test Engineer

Figure 10: Transformer Test Certification

DIESEL GENERATOR SETS: STACK HEIGHT

The minimum height of stack to be provided with each generator set can be worked out using the following formula:

- H = h+0.2x ÖKVA
- H = Total height of stack in meter
- h = Height of the building in meters where the generator set is installed
- KVA = Total generator capacity of the set in KVA

For Generator Sets Total Height of stack in meter

- 50 KVA Ht. of the building + 1.5 meter
- 50-100 KVA Ht. of the building + 2.0 meter
- 100-150 KVA Ht. of the building + 2.5 meter
- 150-200 KVA Ht. of the building + 3.0 meter
- 200-250 KVA Ht. of the building + 3.5 meter
- 250-300 KVA Ht. of the building + 3.5 meter

Similarly for higher KVA ratings a stack height can be worked out using the above formula.

Source: Evolved By CPCB

[Emission Regulations Part IV: COINDS/26/1986-87]

Noise Standard Classification by CPCB

SCHEDULE

see rule 3(1) and 4(1)

Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note:- 1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
[1][3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority].
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specific period.

Note: The principal rules were published in the Gazette of India vide number, S.O.123(E), dated 14th February, 2000 and subsequently amended vide S.O.1046(E), dated 22nd November, 2000, S.O. 1088(E), dated 11th October, 2002, S.O. 1569(E), dated the 19th September, 2006 and S.O.50(E), dated 11th January, 2010.

[1] Substituted by Rules 4 of the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 notified vide S.O. 1046 (E), dated 22.11.2000

Revised National Ambient Air Quality Standards

The Ministry of Environment and Forest (MoEF), Govt of India, vide gezette notification, G.S.R826 (E), dated 16.11.2009 have notified the National Ambient Air Quality Standards by amending the Environment (Protection) Rules 1986.

The following are the major changes have been effected.

1. As against three [(i) Industrial Area (ii) Residential, Rural & other areas (iii) Sensitive Area] areas, the new standards is applicable for only two areas viz. (i) Industrial , Residential , Rural, and other areas (ii) Ecologically Sensitive Area (Notified by Central Government)

2. The Industrial area, Residential, Rural, and other areas have been clubbed, Ecologically Sensitive area to be notified by Central Government.

3. The new parameters included are particulate matter size less than 2.5 µm OR PM2.5 µg/M3 , Ozone, ammonia (NH3), Benzene , Benzo(a)pyrene(BaP) , Arsenic (As) and Nickel (Ni)

4. Ambient air quality data generated under National Ambient Air Quality Monitoring Programme (NAMP) has been compared with revised national ambient air quality standards for the year 2010-11.

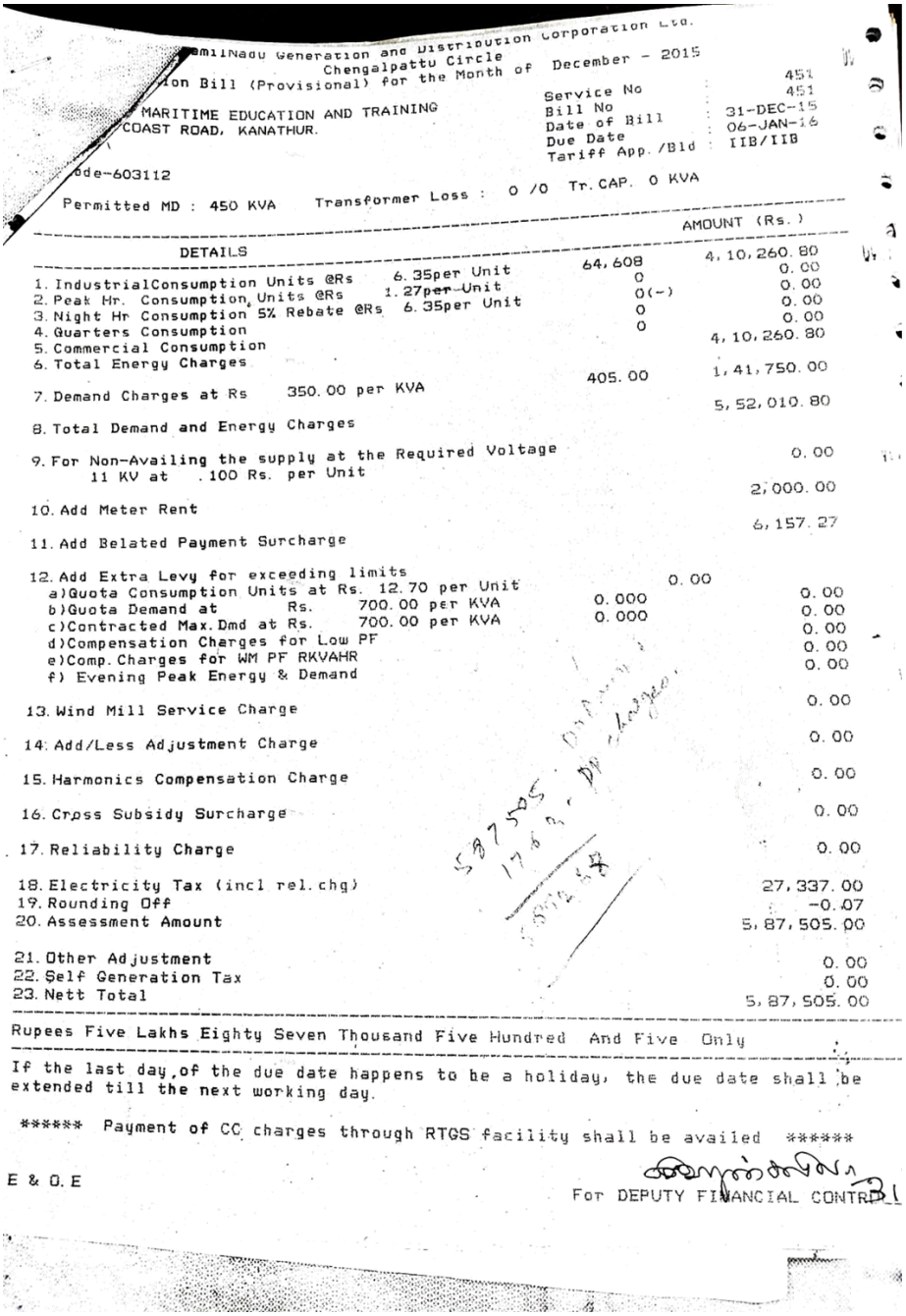
Revised National Ambient Air Quality Standards (MoEF notification G.S.R 826(E), dated 16.11.2009)

Sl. No	Pollutant	Time Weighted Average	New Standards (Schedule VII, Rule 3 (3B) 16th Nov 2009 Concentration in ambient air		Methods of measurement
			Industrial Area Residential, Rural & other Areas	Ecologically sensitive area (Notified by Central Govt)	
1	Sulphur Dioxide(SO2)	Annual Avg*	50.0 µg/m3	20.0 µg/m3	-Improved West and Gaeke method -Ultraviolet fluorescence
		24 hours**	80.0 µg/m3	80.0 µg/m3	
2	Oxides of Nitrogen as NO2	Annual Avg*	40.0 µg/m3	30.0 µg/m3	-Modified Jocob and Hochheise (Sodium Arsenite) -Chemiluminescence
		24 hours**	80.0 µg/m3	80.0 µg/m3	
3	Particulate matter (size less than 10µm)	Annual Avg*	60.0 µg/m3	60.0 µg/m3	-Gravimetric -TOEM -Beta attenuation
		24 hours**	100.0 µg/m3	100.0 µg/m3	
4	Particulate matter (size less than 2.5 µm	Annual Avg*	40.0 µg/m3	40.0 µg/m3	-Gravimetric -TOEM -Beta attenuation
		24 hours**	60.0 µg/m3	60.0 µg/m3	
5	Lead (Pb)	Annual Avg*	0.50 µg/m3	0.50 µg/m3	-AAS/ICP method for sampling on EPM2000 or Equivalent Filter paper -ED-XRF using Teflon filter paper
		24 hours**	1.0 µg/m3	1.0 µg/m3	
6	Carbon	8 hours**	2.0 mg/m3	2.0 mg/m3	-Non Dispersive Infra Red (NDIR)

	Monoxide (CO)	1 hour	4.0 mg/m3	4.0 mg/m3	spectroscopy
7	Ozone	8 hours**	100.0 µg/m3	100.0 µg/m3	-Photometric -Chemiluminescence -Chemical method
		1 hour	180.0 µg/m3	180.0 µg/m3	
		24 hours**	60.0 µg/m3	60.0 µg/m3	
8	Ammonia (NH3)	Annual Avg*	100.0 µg/m3	100.0 µg/m3	-Chemiluminescence -Indo-Phenol Blue method
		24 hours**	400.0µg/m3	400.0 µg/m3	
9	Benzene	Annual Avg*	5.0 µg/m3	5.0 µg/m3	-GC based continuous analyzer -Adsorption/desorption followed by GC analysis
10	Benzo(a) pyrene	Annual Avg*	1.0 ng/m3	1.0 ng/m3	-Solvent extraction followed by GC/HPLC extraction
11	Arsenic	Annual Avg*	6.0 ng/m3	6.0 ng/m3	AAS/ICP method for sampling on EPM2000 OR Equivalent Filter paper
12	Nickel		20.0 ng/m3	20.0 ng/m3	-AAS/ICP method for sampling on EPM2000 OR Equivalent Filter paper

*Annual Arithmetic mean of minimum 104 measurements in a year taken twice a Week 24 hourly at uniform interval,

** 24 hourly / 8 hourly or 1 hourly monitored values as applicable shall be complied with 98 % of the time in a year. However, 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.



TamilNadu Generation and Distribution Corporation Ltd.
Chengalpattu Circle
...ion Bill (Provisional) for the Month of December - 2015

...MARITIME EDUCATION AND TRAINING
...COAST ROAD, KANATHUR.
...de-603112

Service No : 451
Bill No : 451
Date of Bill : 31-DEC-15
Due Date : 06-JAN-16
Tariff App. /Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs	6.35per Unit	64,608	4,10,260.80
2. Peak Hr. Consumption Units @Rs	1.27per Unit	0	0.00
3. Night Hr Consumption 5% Rebate @Rs	6.35per Unit	0(-)	0.00
4. Quarters Consumption		0	0.00
5. Commercial Consumption		0	0.00
6. Total Energy Charges			4,10,260.80
7. Demand Charges at Rs 350.00 per KVA		405.00	1,41,750.00
8. Total Demand and Energy Charges			5,52,010.80
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			6,157.27
12. Add Extra Levy for exceeding limits			0.00
a)Quota Consumption Units at Rs. 12.70 per Unit		0.000	0.00
b)Quota Demand at Rs. 700.00 per KVA		0.000	0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA			0.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			27,337.00
18. Electricity Tax (incl rel.chg)			-0.07
19. Rounding Off			5,87,505.00
20. Assessment Amount			0.00
21. Other Adjustment			0.00
22. Self Generation Tax			5,87,505.00
23. Nett Total			

Rupees Five Lakhs Eighty Seven Thousand Five Hundred And Five Only

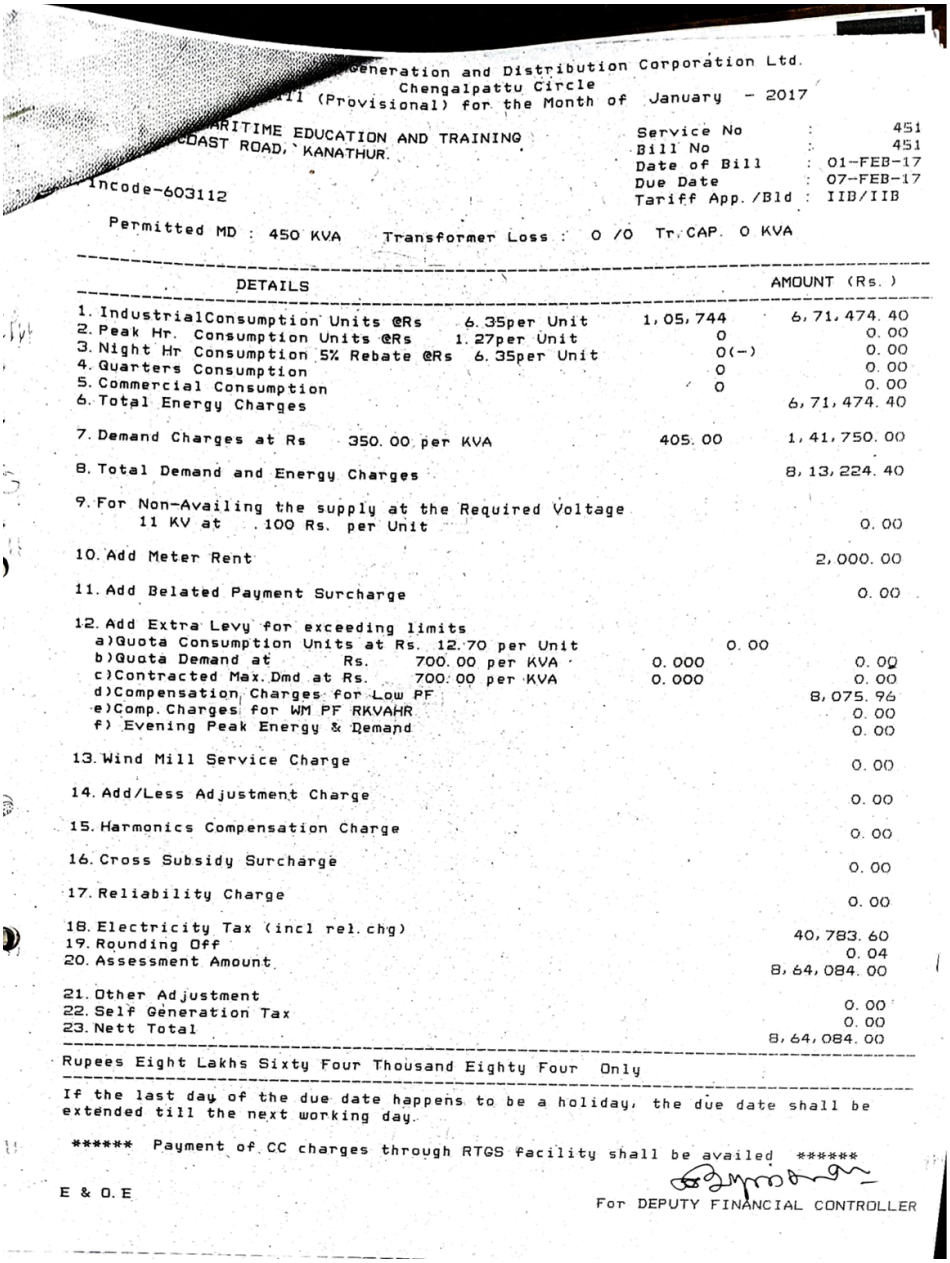
If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

****** Payment of CC charges through RTGS facility shall be availed ******

E & O.E

For DEPUTY FINANCIAL CONTR...

Figure 11: TNEB bill for the month of January 2016



Generation and Distribution Corporation Ltd.
Chengalpattu Circle
(Provisional) for the Month of January - 2017

ARITIME EDUCATION AND TRAINING
COAST ROAD, KANATHUR.

Service No : 451
Bill No : 451
Date of Bill : 01-FEB-17
Due Date : 07-FEB-17
Tariff App./Bld : IIB/IIB

Incode-603112

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit	1,05,744		6,71,474.40
2. Peak Hr. Consumption Units @Rs 1.27per Unit	0		0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit	0(-)		0.00
4. Quarters Consumption	0		0.00
5. Commercial Consumption	0		0.00
6. Total Energy Charges			6,71,474.40
7. Demand Charges at Rs 350.00 per KVA	405.00		1,41,750.00
8. Total Demand and Energy Charges			8,13,224.40
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits			
a)Quota Consumption Units at Rs. 12.70 per Unit		0.00	
b)Quota Demand at Rs. 700.00 per KVA	0.000		0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA	0.000		0.00
d)Compensation Charges for Low PF			8,075.96
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			0.00
18. Electricity Tax (incl rel.chg)			40,783.60
19. Rounding Off			0.04
20. Assessment Amount			8,64,084.00
21. Other Adjustment			0.00
22. Self Generation Tax			0.00
23. Nett Total			8,64,084.00

Rupees Eight Lakhs Sixty Four Thousand Eighty Four Only

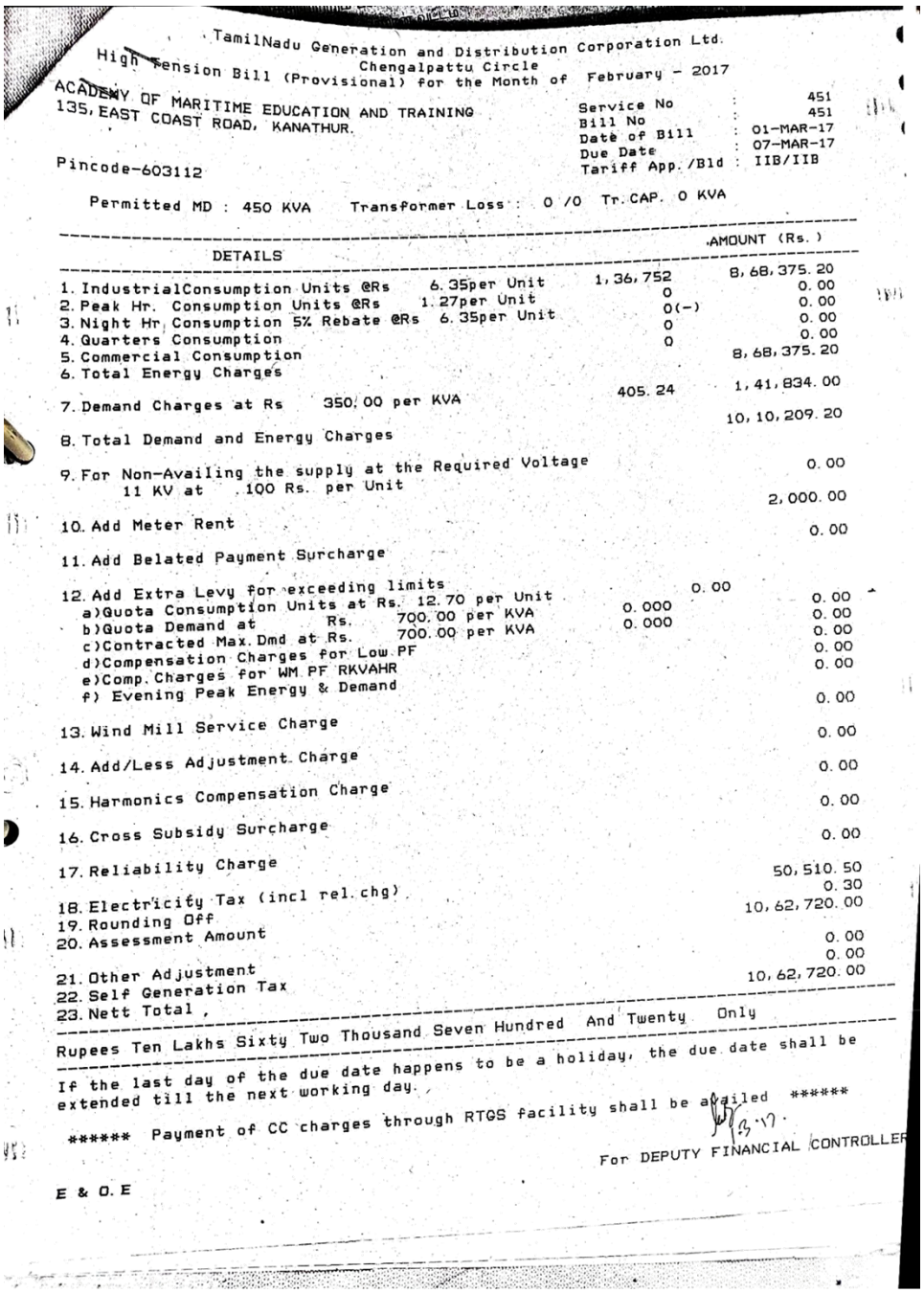
If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

****** Payment of CC charges through RTGS facility shall be availed ******

E & O.E

For DEPUTY FINANCIAL CONTROLLER

Figure 12: TNEB bill for the month of February 2017



TamilNadu Generation and Distribution Corporation Ltd.
Chengalpattu Circle
High Tension Bill (Provisional) for the Month of February - 2017

ACADEMY OF MARITIME EDUCATION AND TRAINING
135, EAST COAST ROAD, KANATHUR.

Pincode-603112

Service No : 451
Bill No : 451
Date of Bill : 01-MAR-17
Due Date : 07-MAR-17
Tariff App./Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs	6.35per Unit	1,36,752	8,68,375.20
2. Peak Hr. Consumption Units @Rs	1.27per Unit	0	0.00
3. Night Hr Consumption 5% Rebate @Rs	6.35per Unit	0(-)	0.00
4. Quarters Consumption		0	0.00
5. Commercial Consumption		0	0.00
6. Total Energy Charges			8,68,375.20
7. Demand Charges at Rs 350.00 per KVA		405.24	1,41,834.00
8. Total Demand and Energy Charges			10,10,209.20
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits		0.00	0.00
a)Quota Consumption Units at Rs.	12.70 per Unit	0.000	0.00
b)Quota Demand at Rs.	700.00 per KVA	0.000	0.00
c)Contracted Max.Dmd at Rs.	700.00 per KVA		0.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			50,510.50
18. Electricity Tax (incl rel.chg)			0.30
19. Rounding Off			10,62,720.00
20. Assessment Amount			0.00
21. Other Adjustment			0.00
22. Self Generation Tax			10,62,720.00
23. Nett Total ,			

Rupees Ten Lakhs Sixty Two Thousand Seven Hundred And Twenty Only

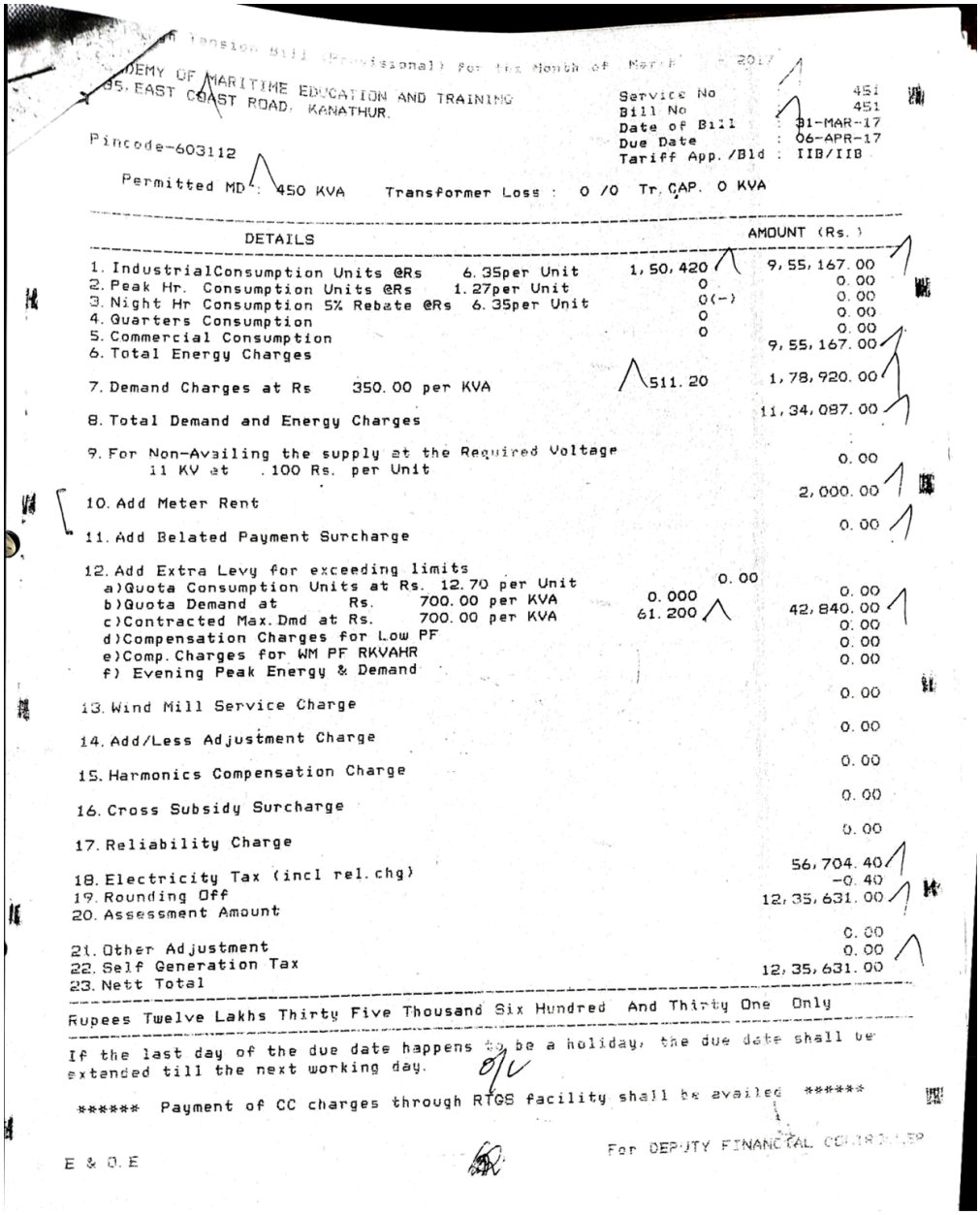
If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

****** Payment of CC charges through RTGS facility shall be availed ******

For DEPUTY FINANCIAL CONTROLLER

E & O.E

Figure 13: TNEB bill for the month of March 2017



...nsion Bill (Provisional) for the Month of March 2017

...DEMY OF MARITIME EDUCATION AND TRAINING
95, EAST COAST ROAD, KANATHUR.

Pincode-603112

Service No : 451
Bill No : 451
Date of Bill : 31-MAR-17
Due Date : 06-APR-17
Tariff App./Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit	1,50,420		9,55,167.00
2. Peak Hr. Consumption Units @Rs 1.27per Unit	0		0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit	0	(-)	0.00
4. Quarters Consumption	0		0.00
5. Commercial Consumption	0		0.00
6. Total Energy Charges			9,55,167.00
7. Demand Charges at Rs 350.00 per KVA	511.20		1,78,920.00
8. Total Demand and Energy Charges			11,34,087.00
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits		0.00	
a)Quota Consumption Units at Rs. 12.70 per Unit			0.00
b)Quota Demand at Rs. 700.00 per KVA	0.000		0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA	61.200		42,840.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			56,704.40
18. Electricity Tax (incl rel.chg)			-0.40
19. Rounding Off			12,35,631.00
20. Assessment Amount			0.00
21. Other Adjustment			0.00
22. Self Generation Tax			12,35,631.00
23. Nett Total			

Rupees Twelve Lakhs Thirty Five Thousand Six Hundred And Thirty One Only

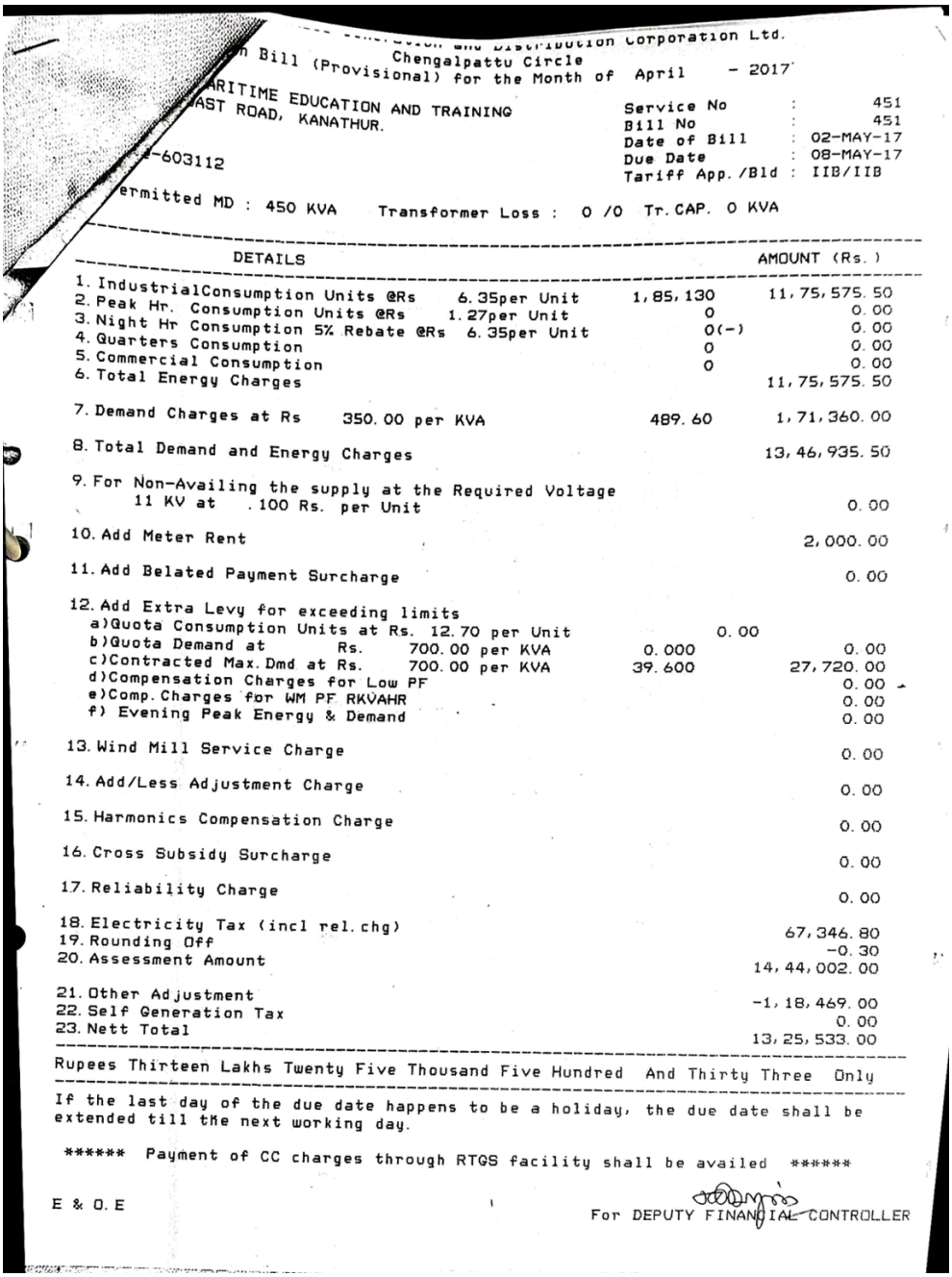
If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

****** Payment of CC charges through RTGS facility shall be availed ******

E & O.E

For DEPUTY FINANCIAL CONTROLLER

Figure 14: TNEB bill for the month of April 2017



Distribution Corporation Ltd.
Chengalpattu Circle
Bill (Provisional) for the Month of April - 2017

ARITIME EDUCATION AND TRAINING
AST ROAD, KANATHUR.
-603112

Service No : 451
Bill No : 451
Date of Bill : 02-MAY-17
Due Date : 08-MAY-17
Tariff App./Bld : IIB/IIB

ermitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit	1,85,130		11,75,575.50
2. Peak Hr. Consumption Units @Rs 1.27per Unit	0		0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit	0(-)		0.00
4. Quarters Consumption	0		0.00
5. Commercial Consumption	0		0.00
6. Total Energy Charges			11,75,575.50
7. Demand Charges at Rs 350.00 per KVA	489.60		1,71,360.00
8. Total Demand and Energy Charges			13,46,935.50
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits			
a)Quota Consumption Units at Rs. 12.70 per Unit		0.00	
b)Quota Demand at Rs. 700.00 per KVA	0.000		0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA	39.600		27,720.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			0.00
18. Electricity Tax (incl rel.chg)			67,346.80
19. Rounding Off			-0.30
20. Assessment Amount			14,44,002.00
21. Other Adjustment			-1,18,469.00
22. Self Generation Tax			0.00
23. Nett Total			13,25,533.00

Rupees Thirteen Lakhs Twenty Five Thousand Five Hundred And Thirty Three Only

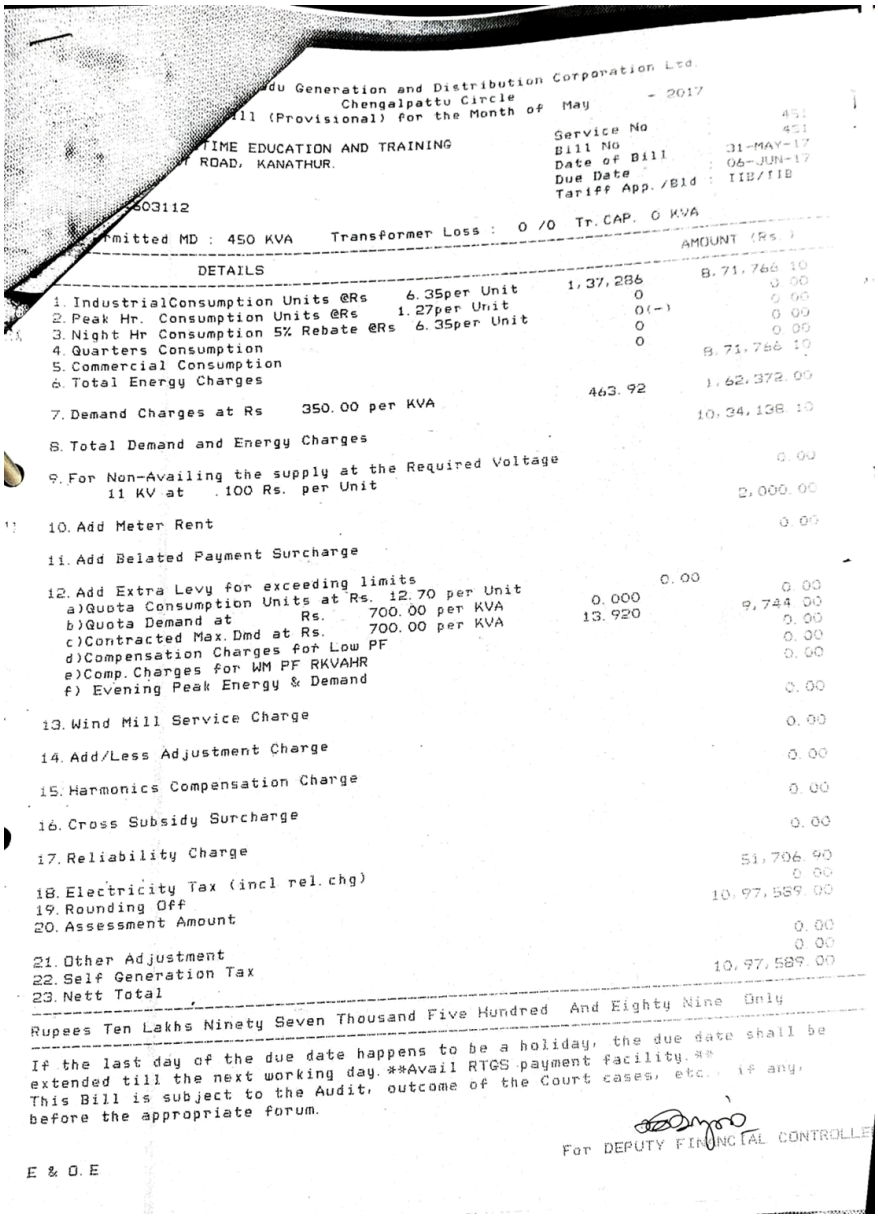
If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

****** Payment of CC charges through RTGS facility shall be availed ******

E & O.E

For DEPUTY FINANCIAL CONTROLLER

Figure 15: TNEB bill for the month of May 2017



du Generation and Distribution Corporation Ltd.
Chengalpattu Circle
ill (Provisional) for the Month of May - 2017

TIME EDUCATION AND TRAINING
ROAD, KANATHUR.

503112

Service No	451
Bill No	451
Date of Bill	31-MAY-17
Due Date	06-JUN-17
Tariff App./Bld	IIB/IIB

mitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs	6.35per Unit	1,37,286	8,71,766.10
2. Peak Hr. Consumption Units @Rs	1.27per Unit	0	0.00
3. Night Hr Consumption 5% Rebate @Rs	6.35per Unit	0(-)	0.00
4. Quarters Consumption		0	0.00
5. Commercial Consumption		0	0.00
6. Total Energy Charges			8,71,766.10
7. Demand Charges at Rs 350.00 per KVA		463.92	1,62,372.00
8. Total Demand and Energy Charges			10,34,138.10
9. For Non-Availing the supply at the Required Voltage 11 KV at 100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits		0.00	0.00
a)Quota Consumption Units at Rs. 12.70 per Unit		0.000	9,744.00
b)Quota Demand at Rs. 700.00 per KVA		13.920	0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA			0.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			51,706.90
18. Electricity Tax (incl rel.chg)			0.00
19. Rounding Off			10,97,569.00
20. Assessment Amount			0.00
21. Other Adjustment			0.00
22. Self Generation Tax			
23. Nett Total			10,97,589.00

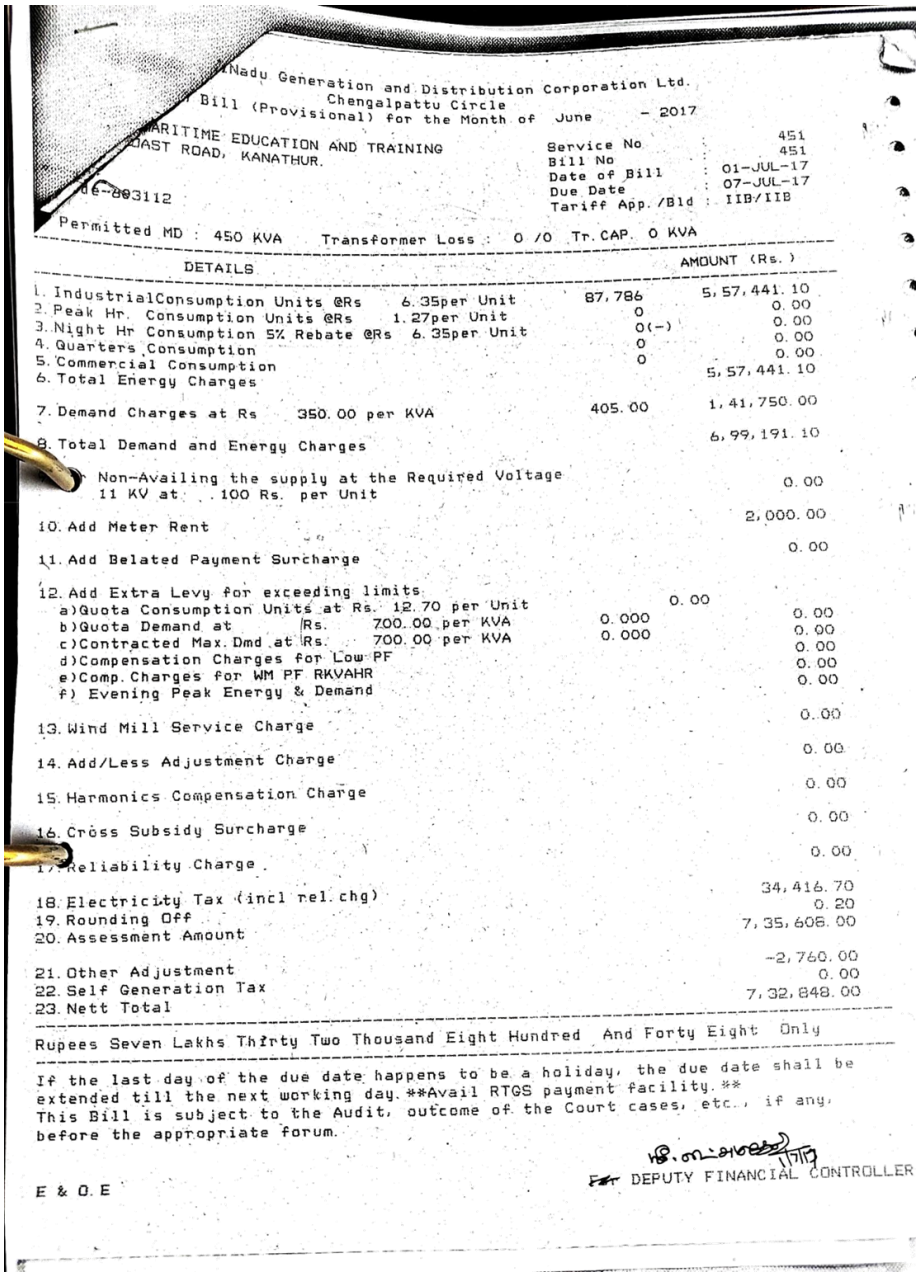
Rupees Ten Lakhs Ninety Seven Thousand Five Hundred And Eighty Nine Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility.**
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

For DEPUTY FINANCIAL CONTROLLER

E & O.E

Figure 16: TNEB bill for the month of June 2017



Nadu Generation and Distribution Corporation Ltd.
Chengalpattu Circle
Bill (Provisional) for the Month of June - 2017

ARITIME EDUCATION AND TRAINING
AST ROAD, KANATHUR.

Service No : 451
Bill No : 451
Date of Bill : 01-JUL-17
Due Date : 07-JUL-17
Tariff App. /Bld : IIB/IIB

e-003112

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit	87,786		5,57,441.10
2. Peak Hr. Consumption Units @Rs 1.27per Unit	0		0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit	0(-)		0.00
4. Quarters Consumption	0		0.00
5. Commercial Consumption	0		0.00
6. Total Energy Charges			5,57,441.10
7. Demand Charges at Rs 350.00 per KVA	405.00		1,41,750.00
8. Total Demand and Energy Charges			6,99,191.10
Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits		0.00	
a)Quota Consumption Units at Rs. 12.70 per Unit	0.000		0.00
b)Quota Demand at Rs. 700.00 per KVA	0.000		0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA			0.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			0.00
18. Electricity Tax (incl rel.chg)			34,416.70
19. Rounding Off			0.20
20. Assessment Amount			7,35,608.00
21. Other Adjustment			-2,760.00
22. Self Generation Tax			0.00
23. Nett Total			7,32,848.00

Rupees Seven Lakhs Thirty Two Thousand Eight Hundred And Forty Eight Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility. **
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

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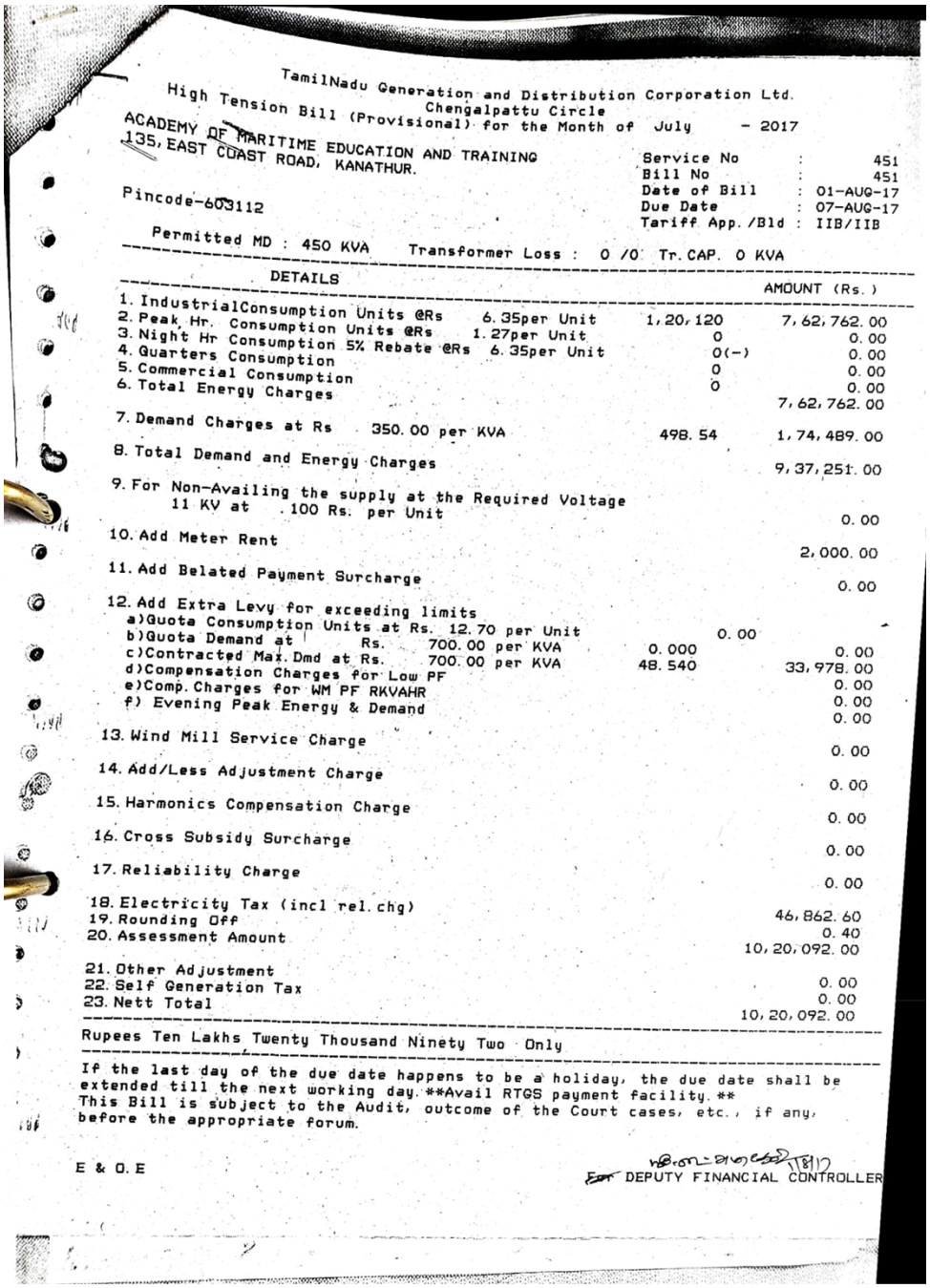
For DEPUTY FINANCIAL CONTROLLER

Figure 17: TNEB bill for the month of July 2017



TamilNadu Generation and Distribution Corporation Ltd.
Chengalpattu Circle
High Tension Bill (Provisional) for the Month of July - 2017

ACADEMY OF MARITIME EDUCATION AND TRAINING
135, EAST COAST ROAD, KANATHUR.

Pincode-603112

Service No : 451
Bill No : 451
Date of Bill : 01-AUG-17
Due Date : 07-AUG-17
Tariff App./Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs	6.35per Unit	1,20,120	7,62,762.00
2. Peak Hr. Consumption Units @Rs	1.27per Unit	0	0.00
3. Night Hr Consumption 5% Rebate @Rs	6.35per Unit	0(-)	0.00
4. Quarters Consumption		0	0.00
5. Commercial Consumption		0	0.00
6. Total Energy Charges			7,62,762.00
7. Demand Charges at Rs 350.00 per KVA		498.54	1,74,489.00
8. Total Demand and Energy Charges			9,37,251.00
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits			
a)Quota Consumption Units at Rs. 12.70 per Unit		0.00	
b)Quota Demand at Rs. 700.00 per KVA		0.000	0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA		48.540	33,978.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			0.00
18. Electricity Tax (incl rel.chg)			46,862.60
19. Rounding Off			0.40
20. Assessment Amount			10,20,092.00
21. Other Adjustment			0.00
22. Self Generation Tax			0.00
23. Nett Total			10,20,092.00

Rupees Ten Lakhs Twenty Thousand Ninety Two Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility.**
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

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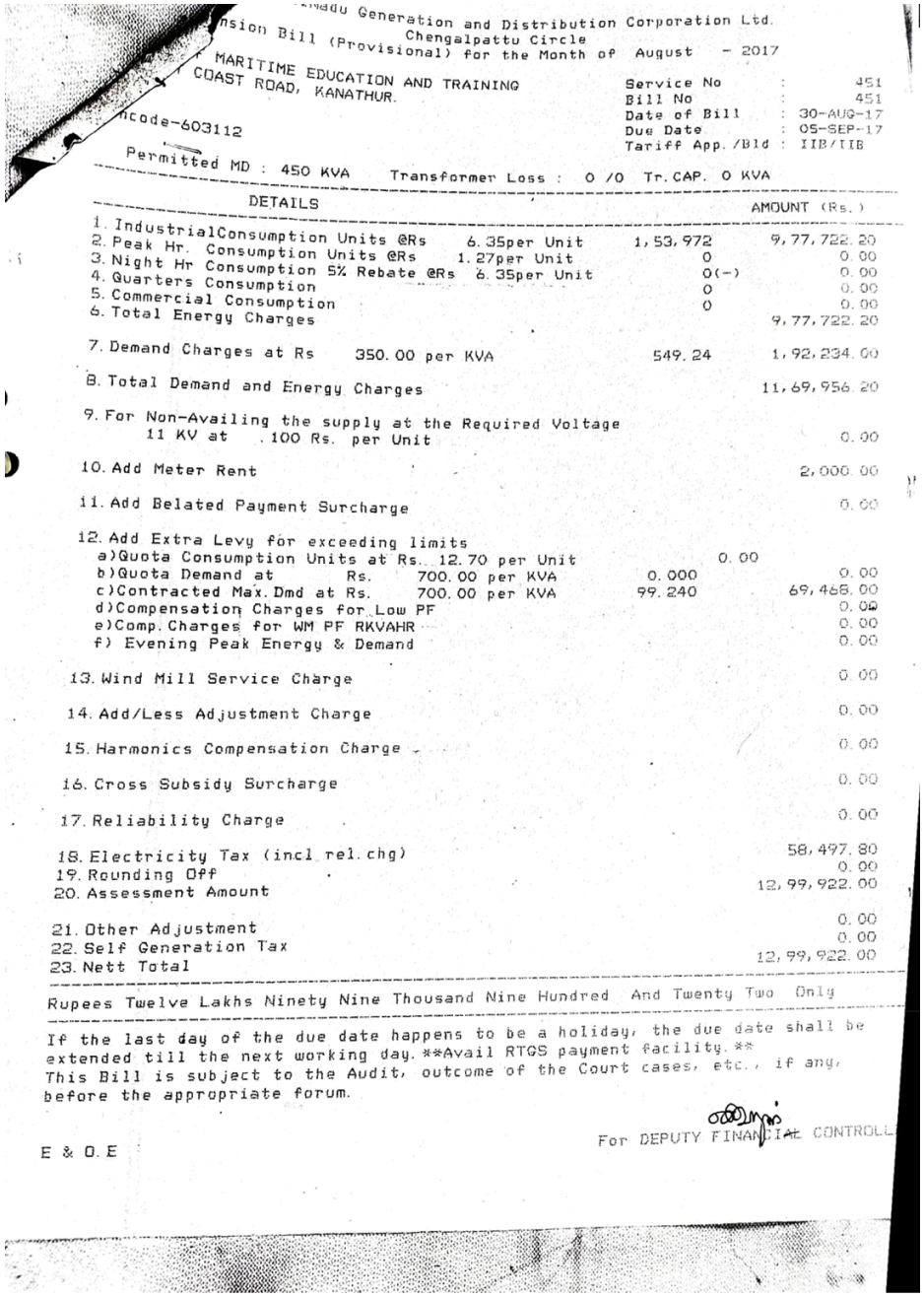
Figure 18: TNEB bill for the month of August 2017



...nadu Generation and Distribution Corporation Ltd.
...nsion Bill (Provisional) Chengalpattu Circle for the Month of August - 2017

MARITIME EDUCATION AND TRAINING
COAST ROAD, KANATHUR.
...code-603112

Service No : 451
Bill No : 451
Date of Bill : 30-AUG-17
Due Date : 05-SEP-17
Tariff App./Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs	6.35per Unit	1,53,972	9,77,722.20
2. Peak Hr. Consumption Units @Rs	1.27per Unit	0	0.00
3. Night Hr Consumption 5% Rebate @Rs	6.35per Unit	0(-)	0.00
4. Quarters Consumption		0	0.00
5. Commercial Consumption		0	0.00
6. Total Energy Charges			9,77,722.20
7. Demand Charges at Rs 350.00 per KVA		549.24	1,92,234.00
8. Total Demand and Energy Charges			11,69,956.20
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits			
a)Quota Consumption Units at Rs. 12.70 per Unit		0.00	
b)Quota Demand at Rs. 700.00 per KVA		0.000	0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA		99.240	69,468.00
d)Compensation Charges for Low PF			0.00
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			0.00
18. Electricity Tax (incl rel.chg)			58,497.80
19. Rounding Off			0.00
20. Assessment Amount			12,99,922.00
21. Other Adjustment			0.00
22. Self Generation Tax			0.00
23. Nett Total			12,99,922.00

Rupees Twelve Lakhs Ninety Nine Thousand Nine Hundred And Twenty Two Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility.**
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

For DEPUTY FINANCIAL CONTROLL

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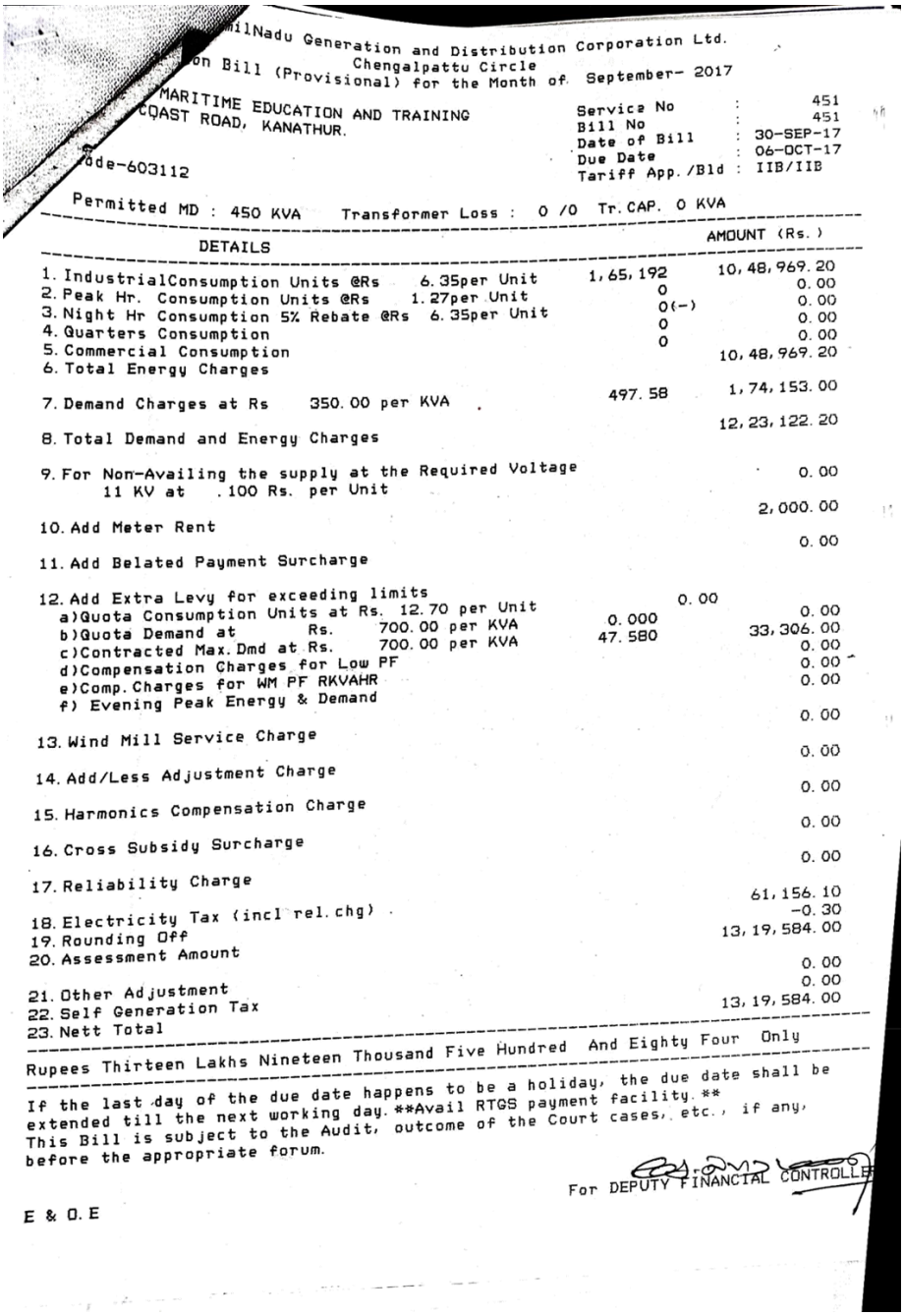
Figure 19: TNEB bill for the month of September 2017



TamilNadu Generation and Distribution Corporation Ltd.
...on Bill (Provisional) Chengalpattu Circle for the Month of September- 2017

...MARITIME EDUCATION AND TRAINING
...COAST ROAD, KANATHUR.
...ode-603112

Service No : 451
Bill No : 451
Date of Bill : 30-SEP-17
Due Date : 06-OCT-17
Tariff App./Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS		AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit	1,65,192	10,48,969.20
2. Peak Hr. Consumption Units @Rs 1.27per Unit	0	0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit	0(-)	0.00
4. Quarters Consumption	0	0.00
5. Commercial Consumption	0	0.00
6. Total Energy Charges		10,48,969.20
7. Demand Charges at Rs 350.00 per KVA	497.58	1,74,153.00
8. Total Demand and Energy Charges		12,23,122.20
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit		0.00
10. Add Meter Rent		2,000.00
11. Add Belated Payment Surcharge		0.00
12. Add Extra Levy for exceeding limits	0.00	
a)Quota Consumption Units at Rs. 12.70 per Unit	0.000	0.00
b)Quota Demand at Rs. 700.00 per KVA	47.580	33,306.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA		0.00
d)Compensation Charges for Low PF		0.00
e)Comp.Charges for WM PF RKVAHR		0.00
f) Evening Peak Energy & Demand		0.00
13. Wind Mill Service Charge		0.00
14. Add/Less Adjustment Charge		0.00
15. Harmonics Compensation Charge		0.00
16. Cross Subsidy Surcharge		0.00
17. Reliability Charge		61,156.10
18. Electricity Tax (incl rel.chg)		-0.30
19. Rounding Off		13,19,584.00
20. Assessment Amount		0.00
21. Other Adjustment		0.00
22. Self Generation Tax		13,19,584.00
23. Nett Total		

Rupees Thirteen Lakhs Nineteen Thousand Five Hundred And Eighty Four Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility.**
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

For DEPUTY FINANCIAL CONTROLLER

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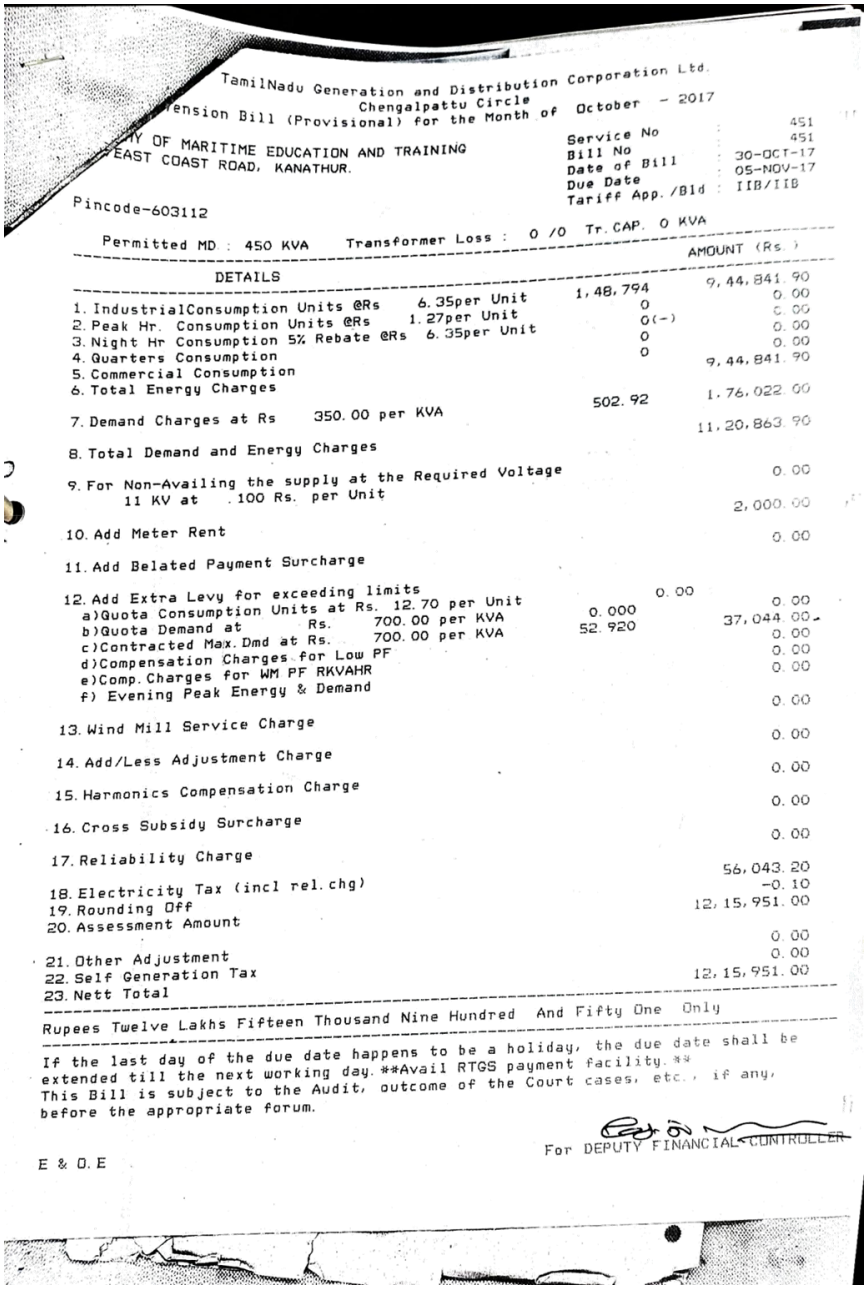
Figure 20: TNEB bill for the month of October 2017



TamilNadu Generation and Distribution Corporation Ltd.
Chengalpattu Circle
Tension Bill (Provisional) for the Month of October - 2017

...Y OF MARITIME EDUCATION AND TRAINING
EAST COAST ROAD, KANATHUR.

Pincode-603112

Service No	451
Bill No	451
Date of Bill	30-OCT-17
Due Date	05-NOV-17
Tariff App. /Bld	IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit		1,48,794	9,44,841.90
2. Peak Hr. Consumption Units @Rs 1.27per Unit		0	0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit		0(-)	0.00
4. Quarters Consumption		0	0.00
5. Commercial Consumption		0	0.00
6. Total Energy Charges			9,44,841.90
7. Demand Charges at Rs 350.00 per KVA		502.92	1,76,022.00
8. Total Demand and Energy Charges			11,20,863.90
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits		0.00	
a)Quota Consumption Units at Rs. 12.70 per Unit		0.000	0.00
b)Quota Demand at Rs. 700.00 per KVA		52.920	37,044.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA			0.00
d)Compensation Charges for Low PF			0.00
e)Comp. Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			56,043.20
18. Electricity Tax (incl rel.chg)			-0.10
19. Rounding Off			12,15,951.00
20. Assessment Amount			0.00
21. Other Adjustment			0.00
22. Self Generation Tax			12,15,951.00
23. Nett Total			

Rupees Twelve Lakhs Fifteen Thousand Nine Hundred And Fifty One Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility.**
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

For DEPUTY FINANCIAL CONTROLLER

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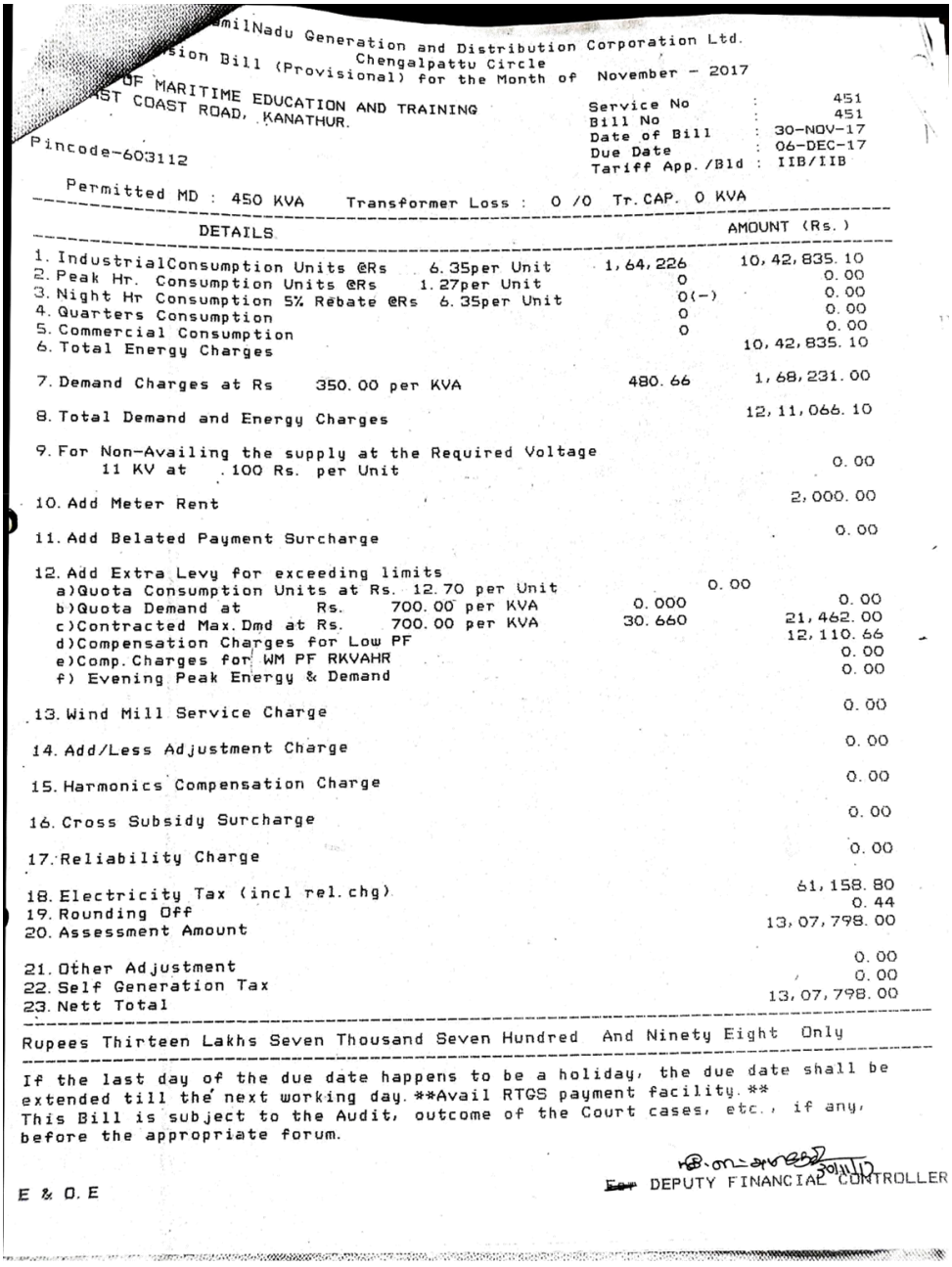
Figure 21: TNEB bill for the month of November 2017



TamilNadu Generation and Distribution Corporation Ltd.
Chengalpattu Circle
...sion Bill (Provisional) for the Month of November - 2017

...OF MARITIME EDUCATION AND TRAINING
...ST COAST ROAD, KANATHUR.
Pincode-603112

Service No : 451
Bill No : 451
Date of Bill : 30-NOV-17
Due Date : 06-DEC-17
Tariff App./Bld : IIB/IIB

Permitted MD : 450 KVA Transformer Loss : 0 /0 Tr.CAP. 0 KVA

DETAILS			AMOUNT (Rs.)
1. IndustrialConsumption Units @Rs 6.35per Unit	1,64,226		10,42,835.10
2. Peak Hr. Consumption Units @Rs 1.27per Unit	0		0.00
3. Night Hr Consumption 5% Rebate @Rs 6.35per Unit	0	(-)	0.00
4. Quarters Consumption	0		0.00
5. Commercial Consumption	0		0.00
6. Total Energy Charges			10,42,835.10
7. Demand Charges at Rs 350.00 per KVA	480.66		1,68,231.00
8. Total Demand and Energy Charges			12,11,066.10
9. For Non-Availing the supply at the Required Voltage 11 KV at .100 Rs. per Unit			0.00
10. Add Meter Rent			2,000.00
11. Add Belated Payment Surcharge			0.00
12. Add Extra Levy for exceeding limits			
a)Quota Consumption Units at Rs. 12.70 per Unit		0.00	
b)Quota Demand at Rs. 700.00 per KVA	0.000		0.00
c)Contracted Max.Dmd at Rs. 700.00 per KVA	30.660		21,462.00
d)Compensation Charges for Low PF			12,110.66
e)Comp.Charges for WM PF RKVAHR			0.00
f) Evening Peak Energy & Demand			0.00
13. Wind Mill Service Charge			0.00
14. Add/Less Adjustment Charge			0.00
15. Harmonics Compensation Charge			0.00
16. Cross Subsidy Surcharge			0.00
17. Reliability Charge			0.00
18. Electricity Tax (incl rel.chg)			61,158.80
19. Rounding Off			0.44
20. Assessment Amount			13,07,798.00
21. Other Adjustment			0.00
22. Self Generation Tax			0.00
23. Nett Total			13,07,798.00

Rupees Thirteen Lakhs Seven Thousand Seven Hundred And Ninety Eight Only

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day. **Avail RTGS payment facility.**
This Bill is subject to the Audit, outcome of the Court cases, etc., if any, before the appropriate forum.

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For DEPUTY FINANCIAL CONTROLLER

Figure 22: TNEB bill for the month of December 2017