AMET

ACADEMY OF MARITIME EDUCATION AND TRAINING

DEEMED TO BE UNIVERSITY

(Under Section 3 of UGC Act 1956)

Energy Audit

For AMET Deemed to be University, Chennai.

EXECUTIVE SUMMARY

This audit was conducted to seek opportunities to improve the energy efficiency of the campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption. Data collection for energy audit for the AMET Deemed to be university campus was carried out by the WasmanPro Team.

The report accounts for the energy consumption patterns of the college premises on actual survey and detailed analysis during the audit. The work encompasses the area wise consumption traced using suitable equipments. The analysis was carried out by our team with the help of the staff members from AMET Deemed to be University. The report complies a list of possible actions to conserve and efficiently access the available source, resources and their saving potential was also identified. We look forward towards optimization that the authorities, students and staff members would follow the recommendations in the best possible way.

The report is based on certain generalizations ad approximations wherever necessary. The views expressed may not reflect the general opinion. They merely represent the opinion of the team guided by the interviews of consumers.

We are happy to submit this Energy audit report to the AMET Deemed to be University.

WASMANPRO ENVIRONMENTAL SOLUTIONS LLP ★ Chennai

r WasmanPro Environmental Solutions LLP
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
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.

Over looking 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.


AMET
AMET


AMET
Training Ship
JEWEL OF AMET
CHENNAI

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 gratefully acknowledges the co-operation received from the management of AMET Deemed to be University during the study. WasmanPro in particular would like to thank, Dr.T. Sasilatha and Dr. V. Karthikeyan for the excellent support and co-ordination provided for the electrical safety audit by providing all the manpower assistance and making available the required documents.

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 Objectives of Green Audit

- Secure the environment and reduce the potential threats to human health
- To ensure the rules and regulations are followed as per requirement/ university guidelines.
- To avoid the interruptions in environment that are more difficult to handle and their correction requires high cost
- To create and maintain best practices for sustainable development.
- To promote eco-friendly initiatives.
- To comply the provisions of Environment Protection Act,1986 that every establishment shall have the environmental audit

1.9 About WasmanPro Environmental Solutions LLP

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. 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

1.10 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 Compliance
• 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
• Groundwater and Subsurface Investigations
• 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

A pre-audit meeting provided an opportunity to reinforce the scope and objectives of the audit and discussions were held on the practicalities associated with the audit. This meeting is an important prerequisite for the green audit because it is the first opportunity to meet the expert and deal with any concerns. It was held at AMET Deemed to be University, Chennai. The meeting was an opportunity to gather information that the Wasmanpro team can study before arriving on the site. The audit protocol and audit plan was handed over at this meeting and discussed in advance of the audit itself.

In AMET Deemed to be University pre-audit meeting was conducted successfully and necessary documents were collected directly from the college before the initiation of the audit processes. Actual planning of audit processes was discussed in the pre-audit meeting. Wasmanpro Team was also selected in this meeting with the help of staff and the college management. The audit protocol and audit plan were handed over at this meeting and discussed in advance of the audit itself. The Wasmanpro team worked together, under the leadership of the lead auditor, to ensure completion within the brief and scope of the audit.

2.2 Objectives of Energy Audit

The objective of the audit was to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods.

The salient observations and recommendations are given below.

AMET Deemed to be University uses energy in the following forms:

- Electricity from TNEB
- High Speed Diesel (HSD)

Electrical energy is used for various applications, like:

- Computers
- Lighting
- Air-Conditioning

- Fans
- Other Lab Equipment

The average cost of energy is around Rs.12,35,066./month (average of six months)

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** – 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.

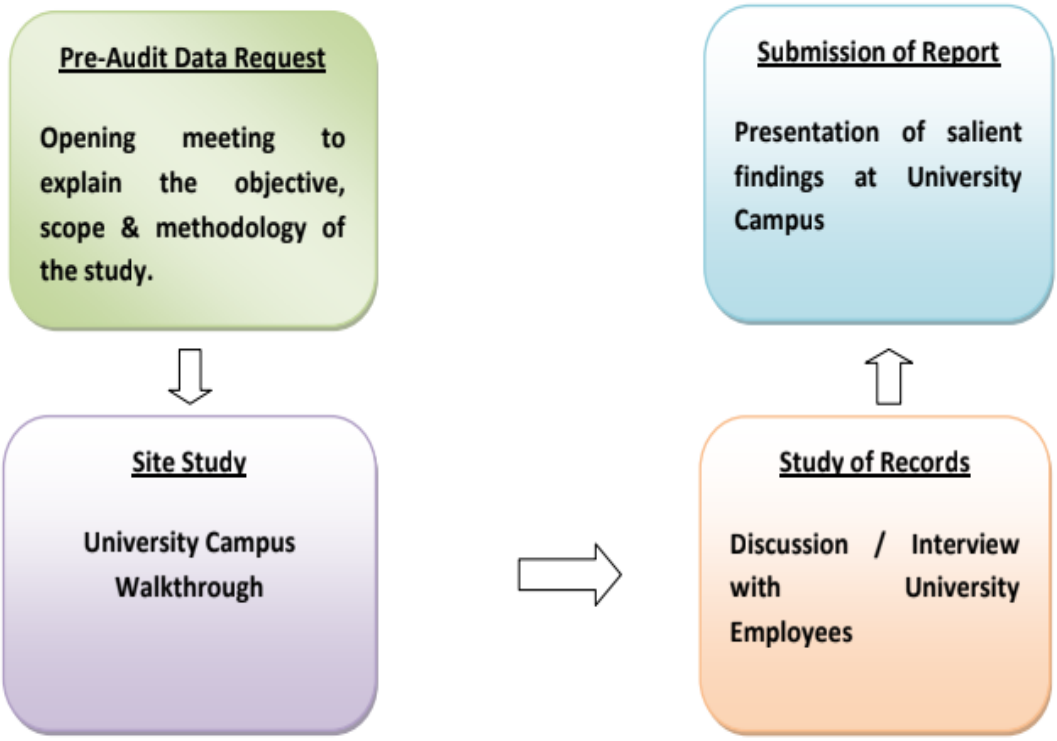
The power consumption of appliances was recorded by taking an average value in some cases.

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**– 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 green audit began with the teams walking through all the different facilities at the college, determining the different types of appliances and utilities (lights, fans, computers, appliances, fridges, etc.) as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an appliance is used) and their impacts. The staff and learners were interviewed to get details of usage, frequency or general characteristics of certain appliances. Data collection was done in the sectors Energy and its use. College records and documents were verified several times to clarify the data received through survey and discussions

- **Involvement of Student Clubs and Forums**
- **Site inspection**
- **Interviews**
- **Review of Policies**
- **Review of Documents and Records**

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 which is run whenever power supply is not available.

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 Indirect benefits of Energy Audit

Every time the energy audit is carried out it rekindles the interest in Energy Conservation as an important function. Energy Auditors sharing their experience and knowledge with the plant personnel, helps in fuelling the innovative ideas for further action of reduction in Specific Power consumption (SPC). Any loose connections or heating of cables come to timely vision. For an external agency due to unbiased vision, a few points for energy conservation may be visible each time they perform the audit and this would help in achieving further saving. Inform any irregularities in Energy meter CT connections for rectification

5.4 Energy observations

- Electricity charges Rs.12,35,066./month (average of six months)
- 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
- Total electricity consumption of the university is on average of 4000-5500 units per day

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 instead of incandescent and CFL bulbs
- ✓ Maintain appliances and replace old appliances.
- ✓ Use computers and electronic equipments in power saving mode.

5.5.1 Sensor based Energy conservation

AMET has established standard energy conservation techniques within the college campus by installing regulated power supply throughout the campus; it has installed the tank level indicator with low level switch and high level switch this functions as automatic power supply unit for the bore well motors the circuit get closed when the water level in the tank reaches the bottom of the tank by the low level sensor and the circuit get open disconnecting the power supply to the pump when the water reaches the top level of the tank

Figure 1: High level and Low level Cut-off Switch

Room Sensors:

Every class room in the institution has Room sensors for the light and fans in the class rooms. The sensors which is normally in open mode disconnected to the circuit on sensing the human movement or motion the circuit get closed and supply to the lights and the fans thus the lights and fans are kept on only in the presence of students and staff and automatically shut down during the absence of students and staffs hence saving the un wanted use of the electricity.

Figure 2: Room Sensors for lights and fans

5.5.2 Bio Gas Plant

Collection of Food Waste:

The food waste generated throughout the institution mainly from the hostels and from the canteen is transfer through proper¬ conveyance. The samples are physically assessed and to consist of the following mixture: Cooked¬ Rice waste in major portion, Vegetable Peelings and Greens/Keerai, etc. All samples along with kitchen waste were analysed for pH, COD, C/N ratio, total¬ solids (TS) and volatile solids (VS) contents according to the standard methods of American Public Health Association (APHA).

Preparation of Feedstock:

After receiving the waste to the treatment plant through conveyance, the presence of any other non-biodegradable wastes are present that will be remove by using sized meshes. After Screening for non biodegradables the biodegradable wastes were shredded and grinded well; using a mixer and it is made into a homogenous mixture in a container. The feedstock included homogenization in a blender, diluting with water and feeding inside the digester tank. The food wastes were grinded and mixed thoroughly with inoculum. The mixture is then thoroughly mix with water and this will be used as a feedstock

Feeding of the Digester:

The digester is filled with two third of its capacity with food waste and inoculum in definite proportion. The digester was operated in batch mode where the feeding was done in batch mode.

Limiting Factors:

Anaerobic bacteria ferment biodegradable matter into methane (40-70%), carbon dioxide (30-60%), hydrogen (0-1%) and hydrogen Sulphide (0-3%). The ideal process temperature for the fermentation process is at about 35°C, which might require additional heat or insulation of the digester in regions with daily or seasonal temperature fluctuations.

Biogas production depends on the availability of sufficient biomass feedstock, water and space for the digester. As the biogas cannot be transported over long distances, the digester has to be placed close to the user, which requires sufficient space.

The biogas accumulates at the top of the tank where it is collected and taken by pipe to the user. The slurry has to be removed regularly from the tank. It can be used further, e.g. as agricultural fertilizer.

The complex fermentation process in the biogas plant needs a continuous supply of suitable feedstock. It requires a continuous supply of water all year round, which can be a limiting factor. Once gas formation starts, to feed the food waste to the digester is important at regularly. But the big question is how much waste can feed? Here, the capacity of digester is 1000 litres. So the feed about nearly 50 L of homogenised waste in this plant daily.

Figure 3: Biogas Plant of capacity 5m3 per day

AREA REQUIRED FOR SETTING UP THE BIOGAS PLANT 5.0 M3

8.0 Ft (Length) x 7.0 Ft (Breadth) x 7.0 Ft Height

(b) DETAILED LIST OF EQUIPMENTS PER PLANT [5.0M3 / DAY]

S.No	Name of the Equipment	Technical Specification	Quantity
1.	5.0 M^3/Day Biogas Plant-Digester & Biogas holder (2.2M Dia X 2.1M Height)	4.5M^3Digester thickness 5.0 mm 3.5M^3 Gas Holding thickness 4.0 mm	1 No
2.	Biogas Canteen Burner	Single Stove	2 No's
3.	Gas Pipeline	Nylon threaded gas hose pipeline & Ball valve connection	Up to 5 Meters Max.
4.	Installation and commissioning	As required	Lot
5.	Water line and cow dung feeding to biogas plant	Cow Dung + Water Content (1:1 Ratio)	Lot
6.	Earth Excavation	As required	Lot
7.	Initial cow dung feeding to biogas plant for First gas generation	2000 Kg to 2300 Kg	Lot

TECHNICAL SPECIFICATION FOR 5.0M^3 / DAY OF BIOGAS PLANT

Biogas Plant Model	Specifications
Biogas Plant Type	Biogas plant- Water seal model
Feed stock	50KG/Day Food Waste
Bio-Digester Output	
Biogas production (M^3 / day)	~ 5
Average Gas Calorific Value (Kcal/NM^3)	~ 4,700
Organic Manure Generated (Lit/Day)	~ 60 to 80
Biogas Equivalent to LPG	
5.0M^{3}Biogas equivalent to LPG (kg/day)	~ 2.0 to 2.25
5.0M^{3}Biogas equivalent to LPG(kg/Month)	~ 60 to 67.5

RETURN ON INVESTMENT (R O I):

Biogas Plant

5.0M^3 X 30 days = 150M^3/Month

150M^3 = 67.5KG of LPG

Domestic Cylinder Weight 14.5Kg,

So, 67.5Kg/14.5Kg= 4.6 Cylinder Saving per Month

Domestic Cylinder cost (Rs) = 1000

4.6 X Rs.1000 = Rs.4600 savings per month

Total Savings per year [Rs.4600/- X 12) = Rs.55,200

5.6 AMET Solar Power Plants

The total energy utilization of the college for different purposes is approximately 1,87,050 **KWH/month (October 2019).** Increased production of solar energy a type of non-conventional category of energy will be a good energy management system for the college. Electricity charges per month are **Rs.15,13,090 /month (October 2019)**. By the observation, The university is consuming energy through LED is about **23.11%**. 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.

Figure 4: Transformer inside the campus

Figure 5: Gensets of capacity 500 and 600 kVA

TamilNadu Generation and Distribution Corporation Ltd.
...pattu - High Tension Bill (Provisional) for the Month of September 2019
...OCO CIN No:U40109TN2009SGC073746 GST No:33AADCT4784E1ZC
: 27160000 SAC : 996912
**** Electrical Energy & Distribution Services are exempted under GST ****

To M/S ACADEMY OF MARITIME EDUCATION AND
135, EAST COAST ROAD, KANATHUR.
Tiruvallur - 603112

Service No. 099094110451
Bill No. 909411045109190 1
Date of Bill 03-Oct-19
Due Date 09-Oct-19
Tariff App. / HT IIB / HT IIB
GST No : 33AAATP0243L1ZR

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

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per	186408	11,83,690.80
2. Peak Hour Consumption	1.27 per	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per	0 (--)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	0 per unit	0	0.00
6. Temp. Supply Consumption	0 per unit	0	0.00
7. Total Energy Charges			11,83,690.80
8. Demand Charges	350 per	546	1,91,100.00
9. Total Demand and Energy Charges			13,74,790.80
ADD			
10. For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs./unit			
11. Meter Rent(Including 9 %SGST&9 %CGST)ated Payment Surcharge for Govt			2,360.00
13. Extra Levy for exceeding limits a) Contracted Max. Dmd at	700 per	96	67,200.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges			0.00
16. Cross Subsidy Surcharge			0.00
17. Electricity Tax			68,739.50
18. Adjustment Charges(Affecting)			0.00
Rounding off			0.50
19. Assessment Amount			15,13,090.00
20. Adjustment Charges(Not Affecting)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset 0.10 /unit			0.00
Nett Total			15,13,090.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Nett Amount Payable			15,13,090.00

Rupees : Fifteen Lakhs Thirteen Thousand Ninety Only
Amt Payable after due date & upto 24-Oct-19 15,23,923.00 (i.e 15 days

If the last day of the due date happens to be a holiday, the due date shall be
RTGS Payment should be made for the exact Bill Amount. Any Part/Excess/Short
This Bill is subject to the Audit, Outcome of the Court Cases, etc., if any.

ACCOUNTS OFFICER / REVENUE

Figure 6: TNEB Bill for the month of Sep 2019

5.7 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 1: 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 2: Total CO_2 Emission from a college Campus

Sl. No	Emission Inventory	TOTAL (metric tons)
1	Electricity	3.1
2	Solar based Electricity	0.015
	Total	**3.115**

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

5.8 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 1.297lbs CO_2 per kWh i.e. 0.0005883 metric tons of 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.

5.9 Recommendations

- Use electricity effectively.
- Use the 'OFF' switch, rather than the 'STAND BY' mode.
- Switch off fans & lights when not in use.
- Use LEDs instead of conventional light sources.
- Check for Green Tags before purchasing goods.
- Air Conditioning should be minimally used.
- Keep equipments in power save mode.
- Make use of wind energy.

5.10 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.

5.11 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.

5.12 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 3: 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 4: 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 5: 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 6: 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 7: A view of AMET Solar Power Plant

Figure 8: 20kW Solar Power Plant-2 Inverter Setup

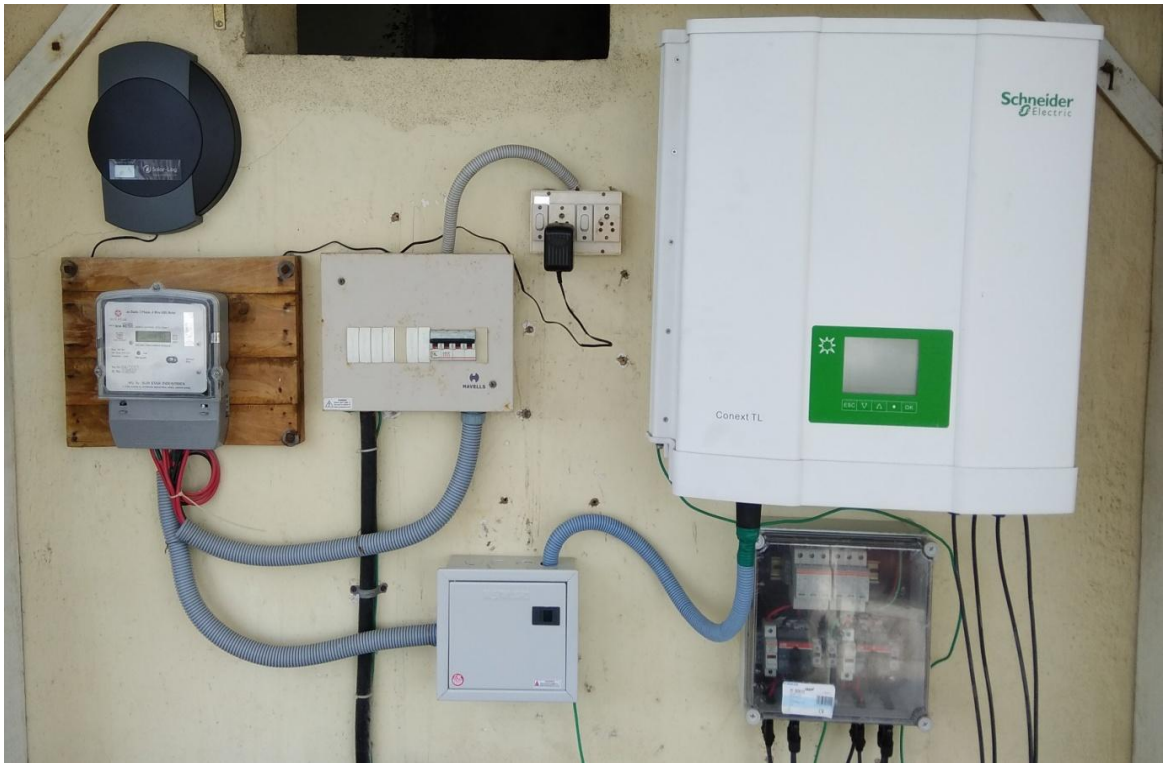


Figure 9: 10kW Solar Power Plant-I Inverter Setup

5.13 Recommendation:

- 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.
- To install more LED instead of CFL and tubes to reduce the power consumption.
- Currently the university 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 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 inventory and energy audit found to have energy conservation and determined contribution to the climate change utilizing limited energy usage and lamps. The carbon foot print due to electricity also balanced from the green plantation to absorb CO_2 and reduction through bicycle usage within the campus. The campus installed necessary Safety and signage board to aware the people to reduce the wastage of electricity. By incorporating solar power plant inside the campus of capacity 30 kW, 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 is directly connected to the main grid. 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.

Table 7: 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 8: 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 9: 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
14		SECOND	15 KVA	20	42 AH	SIMULATOR + STAFF + CLASS
15		SECOND	15 KVA	20	42 AH	ENGINE
16		THIRD -	10 KVA	16	42 AH	ADMISSION + RESEARCH + DNV - 1 & 2

SL.NO	BLOCK	FLOOR	UNIT RATING	NO. OF BATTERIES	RATING OF BATTERIES	POWER FLOW
		SERVER				+ 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 10: 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//

ASSISTANT ELECTRICAL INSPECTOR/TECHNICAL

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

Figure 10: 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 11: 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.
pattu - High Tension Bill (Provisional) for the Month of September 2019
GST No:33AADCT4784E1ZC
UCO CIN No:U40109TN2009SGC073746 SAC : 996912
: 27160000
**** Electrical Energy & Distribution Services are exempted under GST ****

To M/S ACADEMY OF MARITIME EDUCATION AND — Service No. 099094110451

135, EAST COAST ROAD, KANATHUR. — Bill No. 9094110451091901 / Date of Bill 03-Oct-19 / Due Date 09-Oct-19

Tariff App. / HT IIB / HT IIB
GST No : 33AAATP0243L1ZR

Tiruvallur - 603112
Permitted MD :450 KVA Tr. Loss : Ounits/OKVA Tr. CAP. 0 KVA

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per	186408	11,83,690.80
2. Peak Hour Consumption	1.27 per	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per	0 (-)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	0 per unit	0	0.00
6. Temp. Supply Consumption	0 per unit	0	0.00
7. Total Energy Charges			11,83,690.80
8. Demand Charges	350 per	546	1,91,100.00
9. Total Demand and Energy Charges			13,74,790.80
ADD			
10. For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs./unit			
11. Meter Rent(Including 9 %SGST&9 %CGST)ated Payment Surcharge for Govt			2,360.00
13. Extra Levy for exceeding limits a) Contracted Max. Dmd at	700 per	96	67,200.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges			0.00
16. Cross Subsidy Surcharge			0.00
17. Electricity Tax			68,739.50
18. Adjustment Charges(Affecting)			0.00
Rounding off			0.50
19. Assessment Amount			15,13,090.00
20. Adjustment Charges(Not Affecting)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset 0.10 /unit			0.00
Nett Total			15,13,090.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Nett Amount Payable			15,13,090.00

Rupees : Fifteen Lakhs Thirteen Thousand Ninety Only
Amt Payable after due date & upto 24-Oct-19 15,23,923.00 (i.e 15 days

If the last day of the due date happens to be a holiday, the due date shall be
RTGS Payment should be made for the exact Bill Amount. Any Part/Excess/Short
This Bill is subject to the Audit, Outcome of the Court Cases, etc., if any.

03/10/19
ACCOUNTS OFFICER / REVENUE

Figure 12: TNEB Bill for the month of Sep 2019

,amilNadu Generation and Distribution Corporation Ltd.
ctu – High Tension Bill (Provisional) for the Month of August 2019
,IN No:U40109TN2009SGC073746 GST No:33AADCT4784E1ZC
,60000 SAC : 996912
Electrical Energy & Distribution Services are exempted under GST ***
, ACADEMY OF MARITIME EDUCATION AND Service No. 09909411045I

135, EAST COAST ROAD, KANATHUR.

Bill No. 909411045106I901
Date of Bill 28-Aug-19
Due Date 03-Sep-19

Tariff App. / HT IIB / HT IIB
GST No : 33AAATP0243L1ZR

Tiruvallur – 603112
Permitted MD :450 KVA Tr. Loss : Ounits/OKVA Tr. CAP. 0 KVA

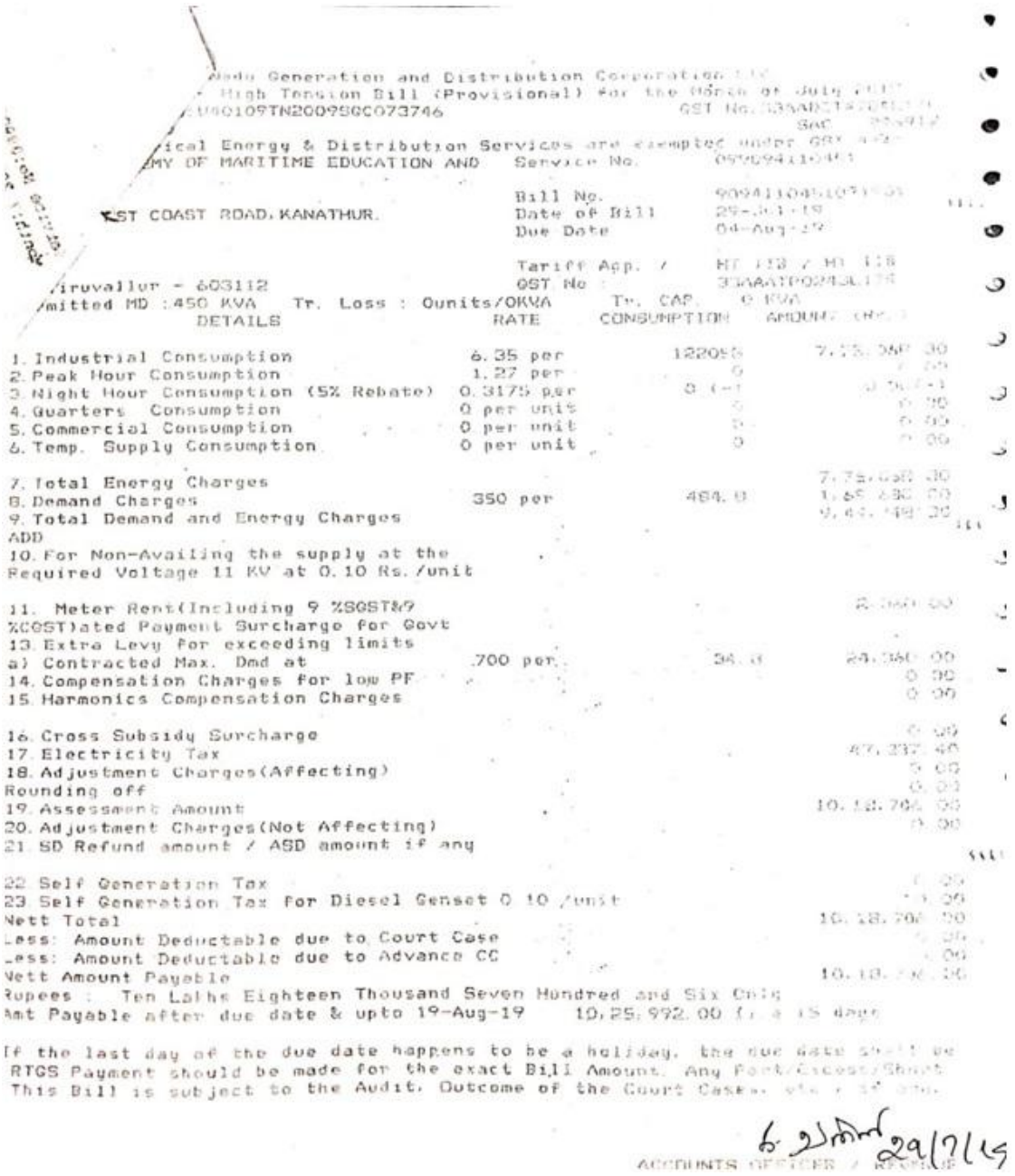
DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per	197004	12,50,975.40
2. Peak Hour Consumption	1.27 per	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per	0 (-)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	0 per unit	0	0.00
6. Temp. Supply Consumption	0 per unit	0	0.00
7. Total Energy Charges			12,50,975.40
8. Demand Charges	350 per	603.6	2,11,260.00
9. Total Demand and Energy Charges			14,62,235.40
ADD			
10. For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs./unit			
11. Meter Rent(Including 9 %SGST&9 %CGST)ated Payment Surcharge for Govt			2,360.00
13. Extra Levy for exceeding limits a) Contracted Max. Dmd at	700 per	153.6	1,07,520.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges			0.00
16. Cross Subsidy Surcharge			0.00
17. Electricity Tax			73,111.80
18. Adjustment Charges(Affecting)			0.00
Rounding off			0.20
19. Assessment Amount			16,45,227.00
20. Adjustment Charges(Not Affecting)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset 0.10 /unit			0.00
Nett Total			16,45,227.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Nett Amount Payable			16,45,227.00

Rupees : Sixteen Lakhs Forty Five Thousand Two Hundred and Twenty Seven Only
Amt Payable after due date & upto 18-Sep-19 16,57,018.00 (i.e 15 days

If the last day of the due date happens to be a holiday, the due date shall be
RTGS Payment should be made for the exact Bill Amount. Any Part/Excess/Short
This Bill is subject to the Audit, Outcome of the Court Cases, etc., if any.

28/8/19
ACCOUNTS OFFICER / REVENUE

Figure 13: TNEB Bill for the month of Aug 2019



...Nadu Generation and Distribution Corporation ...
... High Tension Bill (Provisional) for the Month of July ...
...U90109TN2009SGC073746 GST No. ...
...trical Energy & Distribution Services are exempted under GST ...
...MY OF MARITIME EDUCATION AND Service No. ...

...ST COAST ROAD, KANATHUR. Bill No. ... Date of Bill 29-...-19 Due Date 04-Aug-19

...iruvallur - 603112 Tariff App. / HT 113 / HT 113
...mitted MD :450 KVA Tr. Loss : Ounits/OKVA Tr. CAP. 0 KVA GST No ...

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per	122058	7,75,269.30
2. Peak Hour Consumption	1.27 per	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per	0 (-)	0.00 (-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	0 per unit	0	0.00
6. Temp. Supply Consumption	0 per unit	0	0.00
7. Total Energy Charges			7,75,269.30
8. Demand Charges	350 per	484.0	1,69,400.00
9. Total Demand and Energy Charges			9,44,669.30
ADD			
10. For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs./unit			
11. Meter Rent(Including 9 %SGST&9 %COST)ated Payment Surcharge for Govt			0.00
13. Extra Levy for exceeding limits			
a) Contracted Max. Dmd at	700 per	34.0	24,360.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges			0.00
16. Cross Subsidy Surcharge			0.00
17. Electricity Tax			47,237.40
18. Adjustment Charges(Affecting)			0.00
Rounding off			0.00
19. Assessment Amount			10,18,706.00
20. Adjustment Charges(Not Affecting)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset 0.10 /unit			0.00
Nett Total			10,18,706.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Nett Amount Payable			10,18,706.00

Rupees : Ten Lakhs Eighteen Thousand Seven Hundred and Six Only
Amt Payable after due date & upto 19-Aug-19 10,25,992.00 (...8 days)

If the last day of the due date happens to be a holiday, the due date shall be ...
RTGS Payment should be made for the exact Bill Amount. Any Fort/Excess/Short ...
This Bill is subject to the Audit. Outcome of the Court Case... etc., shall ...

29/7/19
ACCOUNTS OFFICER / ...

Figure 14: TNEB Bill for the month of July 2019