# Energy Audit Report

for

R.V.R. & J.C. College of Engineering, Guntur.

By

Bhumitra
... tomorrow should be better

Bhumitra Energy Auditing and Consultancy Pvt. Ltd.

| For Bhumitra | | For RVR&JC |
|---|---|---|
| Prepared By | Reviewed and Approved By | Accepted By |
| | | |

*Think for future! Think green! Print this document only, if it is really required.*

*Please do not make multiple hard copies of this document ...*

Bhumitra Energy Auditing and Consultancy Pvt. Ltd. * Guntur *

R.V.R. & J.C. College of Engineering * Chowdavaram * GUNTUR, A.P.

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## COMMUNICATION

| R.V.R. & J.C. College of Engineering |
|---|
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| R.V.R. & J.C. College of Engineering – Chandramoulipuram, Chowdavaram, Guntur – 522019. |

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|---|---|
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## ACKNOWLEDGEMENTS

I would like to express my Grateful thanks to the Management of R.V.R. & J.C. College of Engineering and Nagarjuna Education Society, Specifically to Sri Rayapati Gopala Krishna Garu, Secretary & Correspondent for this opportunity given to us.

I would like to sincerely appreciate and thank the key people, **Dr. K. Srinivasu** (Principal), Audit Committee members Mr. G Bhaskara Rao, Dr. P. Gouri Sankar, Dr. P. Rohinikumar, Mr. B.V Vasantha Rao, Mr. M. Srikanth Kumar, Mr. Ch. Devaraj, Ms. M. Sudheera who are always available for me in sharing the data. The study would not have come up so well without their help.

The Involvement of Management and Their Commitment to Environment Sustainability is clearly demonstrated in every stage of the audit by the way of full cooperation and total involvement from top to bottom. It is this commitment that helped me deliver an HONEST report without trouble.

The help rendered by the Technicians and Electrical Maintenance in-charge Mr. Rama Koteswara rao is worth mentioning.

This section would be incomplete without mention of support rendered by my Team by working tirelessly without getting fed up with my numerous corrections and changes to bring out reasonably accurate and Honest report.

This section would be incomplete without mention of support rendered by Registrar Dr NV Srinivas, Registrar and Electrical HOD Dr K Chandra Sekhar for guiding their staff in promptly delivering requisite data and helping us in smooth conduct of audit.

I once again thank each and every one and wish that this association should go a real long way in contributing for a Sustainable Environment.

Each unit saved is two units generated and conservation is continuous process with various new technologies and operating philosophies coming in continuously. With increasing thrust on conservation RVR&JC has mandated for this energy Audit.

## LIMITATIONS / DISCLAIMER

We have taken maximum care in ensuring the results to be accurate. Bhumitra shall be only responsible to correct any unfortunate discrepancies and compensate any direct advantage if enjoyed by Bhumitra. The reporting format is intellectual property of Bhumitra. Sharing of the document or content shall be judicious to avoid any duplication and misuse and shall be with permission of Bhumitra if it has to be shared externally.

## ABBREVIATIONS

| | | | |
|---|---|---|---|
| AC | Air Conditioner | NA | Not Applicable |
| Approx. | Approximate | No's | Numbers |
| Atm | Atmosphere | OU | Observed Line Voltage |
| BLDC | Brush Less Direct Current | OV | Observed phase Voltage |
| Diff | Difference | OA | Observed Current |
| EB | Electronic Ballast | OKW | Observed Kilo Watt |
| Eff | Efficiency | OPF | Observed Power Factor |
| HP | Horse Power | Pvt | Private |
| Hrs. | Hours | Qty | Quantity |
| Inst.Name | Instrument Name | Reqd | Required |
| IS | Indian Standard | S.No | Serial Number |
| kwh | Kilo Watt Hour | THD | Total Harmonic Distortion |
| Max | Maximum | wh | Watt Hour |
| mts | Meters | Yrs | Years |

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# 1.0 Executive Summary

## 1.1 Summary of Estimated Losses in RVR&JC

| | | |
|---|---|---|
| Total Annual Energy Loss in RVR&JC | kWh | 3,18,823 |
| Approx. Total Annual Loss in RVR&JC including CMD | INR in Lakhs | **35.89** |

Note: Projections made in Sections 1.1 above are only approximate calculations based on RVR&JC estimated losses. This is to give a rough Idea of losses happening in respective areas. Detailed analysis of each finding helps in exactly arriving at losses and steps to be implimented.

## 1.2 SUMMARY OF FINDINGS & RECOMMENDATIONS FOR RVR&JC

| **Finding : 1** | | **Page No 24** |
|---|---|---|
| : Additional Amount being paid by RVR & JC to APTC due to Low Power Factor (LPF) | | |
| Annual Energy Loss | kVAh | **7600** |
| Annual Loss | INR in Lakhs | **0.58** |
| **Recommendation:** As the power factor is maintained very well additional amount paid due to low power factor is not significant amount, it is recommended to go for automatic power factor correction equipment to reduce active power loss and leading power factor. | | |

| **Finding : 2** | | **Page No 27** |
|---|---|---|
| : Additional Amount being paid by RVR & JC to APTC due to Higher Contracted Maximum Demand | | |
| Average Monthly Additional Amount paid | INR in Lakhs | **0.78** |
| **Recommendation:** Reduce Demand by employing the Energy Efficient equipment to reduce Demand and kVAh units consumption simultaneously. | | |

| **Finding : 3** | | **Page No 31** |
|---|---|---|
| : Savings by replacing In-efficient 40W old TL with LED Light | | |
| Annual Energy Loss | kWh | **11,236** |
| Annual Energy Loss | INR in Lakhs | **0.86** |
| Annual Loss due to Demand | INR in Lakhs | **0.34** |
| Net Annual Loss | INR in Lakhs | **1.20** |
| Investment | INR in Lakhs | **1.23** |
| Simple Payback Period | Years | **1.0** |
| **Recommendation:** It is recommended to go for LED lighting as the payback is very quick. | | |

| **Finding : 4** | | **Page No 32** |
|---|---|---|
| : Savings by replacing In-efficient 36W old TL with LED Light | | |
| Annual Energy Loss | kWh | **43,484** |
| Annual Energy Loss | INR in Lakhs | **3.33** |
| Annual Loss due to Demand | INR in Lakhs | **1.29** |
| Net Annual Loss | INR in Lakhs | **4.61** |
| Investment | INR in Lakhs | **6.0** |
| Simple Payback Period | Years | **1.3** |
| **Recommendation:** It is recommended to go for LED lighting as the payback is very quick. | | |

| **Finding : 5** | | **Page No 33** |
|---|---|---|
| : Losses due to In-efficient CFL Bulbs | | |
| Annual Energy Loss | kWh | **12,050** |
| Annual Energy Loss | INR in Lakhs | **0.92** |
| Annual Loss due to Demand | INR in Lakhs | **0.08** |
| Net Annual Loss | INR in Lakhs | **1.0** |
| Investment | INR in Lakhs | **0.73** |
| Simple Payback Period | Years | **0.7** |
| **Recommendation:** It is recommended to go for LED lighting as the payback is very quick. | | |

| **Finding : 6** | | **Page No 34** |
|---|---|---|
| : Losses due to In-efficient 85W Ceiling Fans | | |
| Annual Energy Loss | kWh | **1,29,678** |
| Annual Energy Loss | INR in Lakhs | **9.9** |
| Annual Loss due to Demand | INR in Lakhs | **3.85** |
| Net Annual Loss | INR in Lakhs | **13.77** |
| Investment | INR in Lakhs | **42.2** |
| Simple Payback Period | Years | **3.06** |
| **Recommendation:** To reduce the demand and annual energy losses it is recommended to change the existing ceiling fans with BLDC ceiling fans in phased manner. | | |

| **Finding : 7** | | **Page No 35** |
|---|---|---|
| : Losses due to In-efficient 60W Ceiling Fans | | |
| Annual Energy Loss | kWh | **21,829** |
| Annual Energy Loss | INR in Lakhs | **1.7** |
| Annual Loss due to Demand | INR in Lakhs | **0.65** |
| Net Annual Loss | INR in Lakhs | **2.32** |
| Investment | INR in Lakhs | **12.3** |
| Simple Payback Period | Years | **5.3** |
| **Recommendation:** To reduce the demand and annual energy losses it is recommended to change the existing ceiling fans with BLDC ceiling fans in phased manner. | | |

| **Finding : 8** | **Page No 36** |
|---|---|
| Demand side Management | |
| **Recommendation:** During the college opening and closing hours the demand generated by the existing 500kWp solar power plant is about 20% i.e., 100KVA. Even from the power bills, before and after solar plant, 60-90 KVA demand difference is seen. It is recommended to reduce the CMD immediately after understanding the risk of low generation due to weather. | |

| **Finding : 9** | **Page No 37** |
|---|---|
| Un-Balanced loading on Transformers | |
| **Recommendation:** It is recommended to go for single transformer of higher capacity and efficiency or synchronize the three transformers to avoid un-balanced loading and over loading on transformers | |

| **Finding : 10** | **Page No 38** |
|---|---|
| Un-Balanced loading on Distribution Feeders | |
| **Recommendation:** It is recommended to balance the load in three phases to minimize the losses and overloading of phases. | |

| **Finding : 11** | **Page No 39** |
|---|---|
| : Absence of Energy Monitoring and Control Mechanism | |
| **Recommendation:** Feeder wise energy monitoring system with import/export feature for meter and monitoring of all the parameters like MD, PF, kVAh, kWh, kVARh, Voltage to monitor energy consumed and control demand is required. | |

| **Finding : 12** | **Page No 40** |
|---|---|
| : Absence of Energy Balance Mechanism | |
| **Recommendation:** Feeder wise energy monitoring system with automatic energy balance on daily basis shall be established. | |

| **Finding : 13** | **Page No 41** |
|---|---|
| : Capacitor Banks health | |
| **Recommendation:** Some Capacitors have zero and low currents, we may remove them and Install proper rating of Capacitor to manage Power Factor. | |

| **Finding : 14** | **Page No 42** |
|---|---|
| Expansion of Solar Plant Vs Replacement of Ceiling Fans with BLDC Ceiling Fans | |
| **Recommendation:** It is recommended to go with BLDC ceiling fans to reduce demand, also payback and execution time is quick. Where as in expansion of solar power plant it requires more Land and demand may not be matched due to low weather conditions at times. | |

| **Finding : 15** | | **Page No 44** |
|---|---|---|
| : Savings with Dual Inverter Type Air Conditioners | | |
| Annual Energy Loss | kWh | **1,00,547** |
| Annual Energy Loss | INR in Lakhs | **7.7** |
| Annual Loss due to Demand | INR in Lakhs | **5.3** |
| Net Annual Loss | INR in Lakhs | **13** |
| Investment | INR in Lakhs | **100** |
| Simple Payback Period | Years | **7.7** |
| **Recommendation:** It is recommended to go with Dual Inverter type ACs to reduce demand in phased manner. | | |

## Note:

All the findings presented above are not independent. Implementation of one finding may take care of other finding. All the findings and recommendations are based on available data and assumptions. These are very indicative and detailed study, analysis and proper engineering is required for implementation of any of recommendations.

# 2.0 INTRODUCTION

## 2.1 A BRIEF ABOUT RVR & JC COLLEGE OF ENGINEERING

Rayapati Venkata Ranga Rao and Jagarlamudi Chandramouli (R.V.R. & J.C.) College of Engineering, Chowdavaram, Guntur trains undergraduate and postgraduate students in Engineering and Management for award of degree from Acharya Nagarjuna University. Established by the renowned Nagarjuna Education Society (1967) in the year 1985, the College drew its initial impetus from Peoples Representatives, local doctors, charitable trusts and commercial houses of Guntur District. Today, it enjoys flagship status among the eight constituent institutions, that are governed by Nagarjuna Education Society. The founder-members of Nagarjuna Education Society and their successors have provided abundant inputs to turn a mere 3-course-180-intake College into a 14-course-1200-intake edifice by the Silver Jubilee Year.

The premier status of the institution is made possible by sticking to core-principles of student-focus, Human Resource Development and emphasis on total quality. Training the students beyond the defined borders of the curriculum is a basic emphasis, the college dearly practices. The college periodically tests its own standards and standing among the fraternity of colleges, securing Accreditation from National Board of Accreditation, AICTE in 1998, 2002, 2007, 2012, & 2017. The A.P. State Council of Higher Education (APSCHE) too awarded the second-best rating in `Academic Audit and Grading' in 2004. The Awards of Best Performing U.G. College in the university examinations, consecutively for three years and a place among the `Top-100 Engineering Colleges in the country are major achievements. The College practices the modesty of looking for new starting lines than be content with the finishing lines reached. They humbly admit, they have miles and miles to go before they complete their mission.

## 2.2 About Bhumitra

Bhumitra Energy Auditing and Consultancy Pvt. Ltd. (Bhumitra) is an integrated service provider in the areas of energy audit, total energy management solutions, reliability audit, consultancy services for Greenfield and efficiency improvement projects. The company is setup by Mr. ND Raghuram, who is having vast and varied experience of about 20 years in Power, Green Energy, Industrial Automation, CDM and ISO. Bhumitra is setup by him with passion towards Environment and Energy Conservation.

Bhumitra is setup with a primary motto to conserve environment and energy and thereby contribute for a better and greener tomorrow

**Vision** : Tomorrow Should be Better

**Mission** : Reduce Damage being caused to Environment by providing Eco Friendly Services and Products.

**Values** : Honesty, Commitment and Hard Work ... In what We think, We talk and We do...

### 2.2.1 The Consultant Team

Energy audit of the plant was carried out by Bhumitra Energy Auditing & Consultancy pvt Ltd, Guntur.

| | | |
|---|---|---|
| 1 | Mr. Durga Raghuram Nagalla | *BEE Certified Energy Auditor (EA-11516)* & Chief Consultant |
| 2 | Mr. Ganesh Kumar Pagadala | Sr. Consultant & *Energy Auditor* |
| 3 | Mr. B. Gopi | Technical Asst, Electrical |
| 5 | Mr. K. Punnarao | Technical Asst, Electrical |

### 2.2.2 List of Instruments Used

| S.No | Inst.Name | Make | Model |
|---|---|---|---|
| 1 | 3-Phase Power Analyzer | AEMC | Powerpad 3945-B |
| 2 | 1-Phase Power Analyzer | AEMC | Powerpad Jr. 8230 |
| 3 | AC/DC Tong Tester | Ideal | 61-775 |
| 4 | Digital Multi meter | Ideal | 61-486 |
| 5 | Thermo-Anemometer + IR Thermometer | Extech Instruments | HD300 |
| 6 | Lux Meter | Testo | Testo 540 |
| 7 | Power guard | Meco | PG09 |
| 8 | Infrared Thermometer | Ideal | 61-685 |

## 2.3 SCOPE OF AUDIT

The main objective of this Energy Audit is to identify the energy conservation opportunities and to suggest measures to minimize energy losses so that energy utilization could be improved.

The broad scope of work for the energy audit is as follows ...

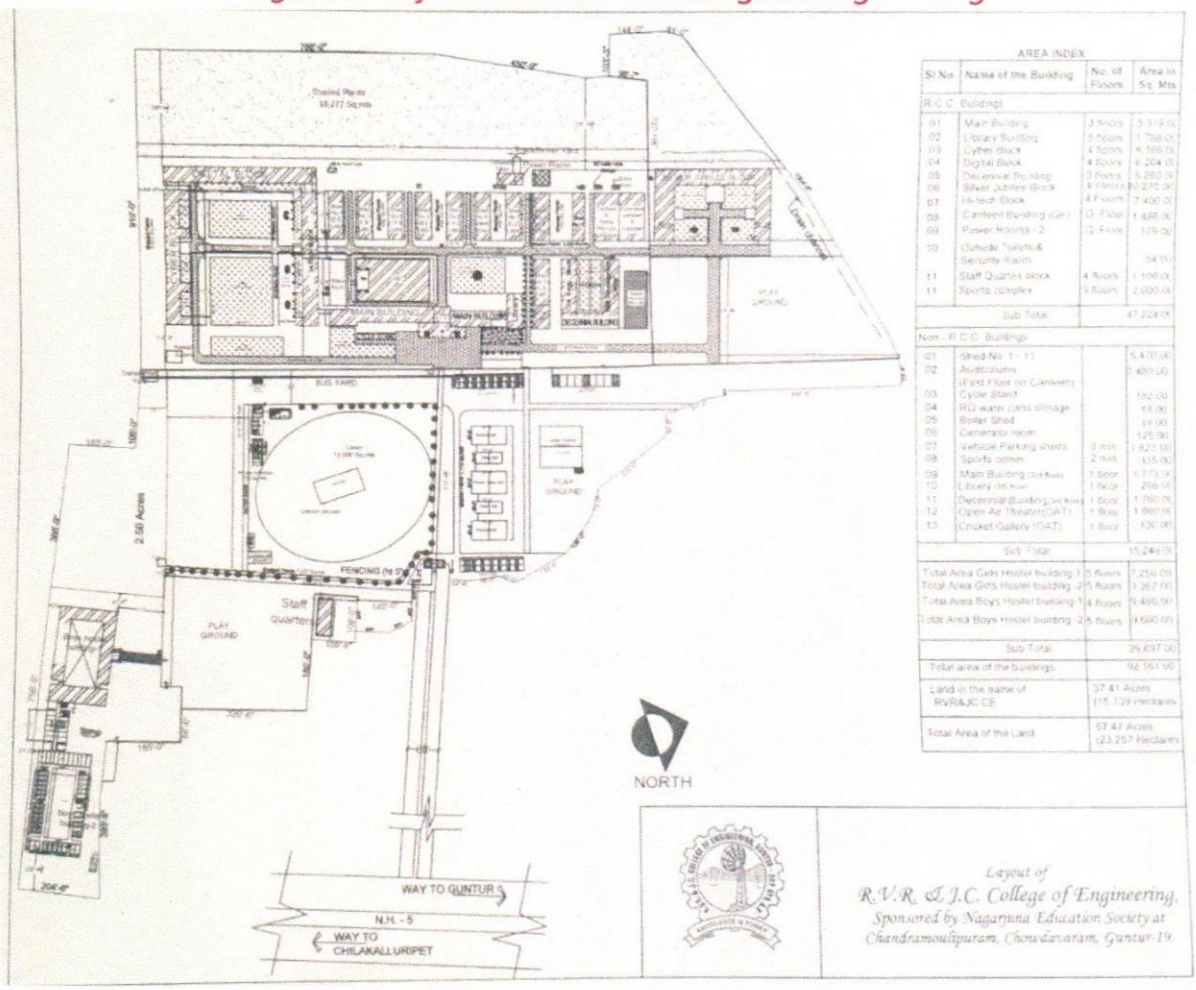
- Qualitative and quantitative study of all components of energy payable i.e. kW, kWh, kVAr, MD, PF and harmonics etc.
- Study of system network, rating/capacities, operational pattern and energy metering systems.
- Study of Capacitor Banks positioning, adequacy, Energy dissipation in capacitor banks and measures to minimize losses.
- Analysis for performance of connected/drive equipment in respect of energy consumption and output.
- Suggestion/measures to reduce transmission losses/ Distribution feeder losses for energy conservation.
- Study and analysis on usage of equipment like transformers, Air Conditioners etc.

It is intended that the auditor's report will bring out suggestions where wastage can be controlled with or without additional investment.

It is intended that the auditor's report will include sample analysis of energy flow in the network and on board the driving asset and indicate scope of improvement in efficiency of the utilization of available energy.

## 2.4 LAYOUT OF RVR & JC COLLEGE OF ENGINEERING

Figure 1 : Layout of RVR & JC College of Engineering



## ELECTRICAL SYSTEM DESCRIPTION

RVR & JC College of Engineering is sited at Chandramoulipuram, Chowdavaram, Guntur District.

The campus has 11KV/433V Sub-Station with 3 Nos of power distribution transformers

1. 200 KVA of Trans Allieds make,
2. 315 KVA of Vijay Power Control Systems make
3. 315 KVA of Sri Sai Ram Electricals make

11KV Power Supply is from 33KV/11KV APTC Sub-Station at Dasaripalem near Chowdavaram.

Standby Generators are also available to serve during power outages.

The Campus has capacity of 250 kVAr capacitor bank, each of 25 KVAr rated.

Main PCC has 5 feeders namely Main Block, HITECH Block, Silver Jubilee Block, CYBER Block and DIGITAL Block. For above 5 Feeders cables laid from PCC at Power House to respective blocks MCCs for operations and control.

The distribution feeders from MCCs to Buildings are in different sizes ranging from 4 Sq. mm to 250 Sq. mm depending on Load/machinery.

## 3.0 Analysis of Data, Opportunities and Proposals

Data Collected from various sources and that sampled and measured through power analyzers is further processed and analyzed and correlated with standards and good practices. Based on the same opportunities for improvement are identified and presented as findings in this section. Any improvement opportunities identified, that helps in improving the system efficiency are also presented in this section.

### 3.1 Data Collection and Analysis

Collection of reliable data is foremost important task in Energy Audit of any process. This required data is collected in following ways.

- From records like monthly bills, log books equipment operating manuals, test certificates etc.
- Measurements and Observations: Three phase and Single-phase power analyzers are employed to take practical measurements of energy data and cross verification of assumed data. This is the key data that has helped in identifying key opportunities.

In cases where data is not specifically available data is conservatively assumed during analysis.

The data collected and the analysis is presented in following sections.

## 3.2 Analysis of Power Bills

Last 1 year of energy bills are collected and contents tabulated in **Table 1**. This data is analysed by ploting trends, same are discussed and findings are presented in this section.

Table 1 : Last 1 Year Power Bills

| Month | kWh | kVAh | PF | Bill Amount | Max Recd MD | kWh | Bill Amount | Power Consumption in kVAh units | Total Bill Amount |
|---|---|---|---|---|---|---|---|---|---|
| | APTC | | | | | Jayalakshmi Power | | Total | |
| Feb-20 | 27272 | 28250 | 0.97 | 429604 | 365 | | | 28250 | 429604 |
| Jan-20 | 52322 | 52772 | 0.99 | 608800 | 104 | | | 52772 | 608800 |
| Dec-19 | 80156 | 22169 | 0.98 | 364903 | 390 | 59815 | 449445 | 81984 | 814348 |
| Nov-19 | 62584 | 10000 | 0.99 | 269575 | 455 | 53316 | 401589 | 63316 | 671164 |
| Oct-19 | 98072 | 10457 | 0.98 | 281591 | 418 | 89799 | 674066 | 100256 | 955657 |
| Sep-19 | 82180 | 10503 | 0.99 | 282907 | 420 | 72605 | 545708 | 83108 | 828615 |
| Aug-19 | 104476 | 105828 | 0.99 | 1074270 | 512 | | | 105828 | 1074270 |
| Jul-19 | 101400 | 103344 | 0.98 | 1100749 | 561 | | | 103344 | 1100749 |
| Jun-19 | 67012 | 67456 | 0.99 | 755945 | 464 | | | 67456 | 755945 |
| May-19 | 82096 | 13349 | 0.99 | 220709 | 425 | 69803 | 529453 | 83152 | 750162 |
| Apr-19 | 105256 | 107688 | 0.98 | 1187969 | 555 | | | 107688 | 1187969 |
| Mar-19 | 83724 | 43555 | 0.98 | 53950 | 409 | 41557 | 315950 | 85112 | 369900 |

## Finding 1 : Additional Amount being paid by RVR & JC to APTC due to Low Power Factor (LPF)

### 3.2.1 Additional Amount paid due to Low Power Factor (LPF)

The Billing system is kVAh billing hence any instantaneous fall in pf impacts kVAh count instanteneously and hence billing. Even if the Average pf is leading or on other words even if the reactive energy is pumped into grid at times it is treated as UPF.

**Table 2** below shows the monthwise summary of additional kVAh consumed and additional amount being paid.

Table 2 : Additional amount paid due to Low Power Factor

| Month | KWh | KVAh | Total Bill Amount | derived PF | derived unit cost | KVAH-KWH | Additional Amount paid |
|---|---|---|---|---|---|---|---|
| Feb-20 | 27272 | 28250 | 429604 | 0.97 | 7.65 | 978 | 7482 |
| Jan-20 | 52322 | 52772 | 608800 | 0.99 | 7.65 | 450 | 3443 |
| Dec-19 | 80156 | 22169 | 364903 | 0.98 | 7.65 | 0 | 0 |
| Nov-19 | 62584 | 10000 | 269575 | 0.99 | 7.65 | 0 | 0 |
| Oct-19 | 98072 | 10457 | 281591 | 0.98 | 7.65 | 0 | 0 |
| Sep-19 | 82180 | 10503 | 282907 | 0.99 | 7.65 | 0 | 0 |
| Aug-19 | 104476 | 105828 | 1074270 | 0.99 | 7.65 | 1352 | 10343 |
| Jul-19 | 101400 | 103344 | 1100749 | 0.98 | 7.65 | 1944 | 14872 |
| Jun-19 | 67012 | 67456 | 755945 | 0.99 | 7.65 | 444 | 3397 |
| May-19 | 82096 | 13349 | 220709 | 0.99 | 7.65 | 0 | 0 |
| Apr-19 | 105256 | 107688 | 1187969 | 0.98 | 7.65 | 2432 | 18605 |
| Mar-19 | 83724 | 43555 | 53950 | 0.98 | 7.65 | 0 | 0 |

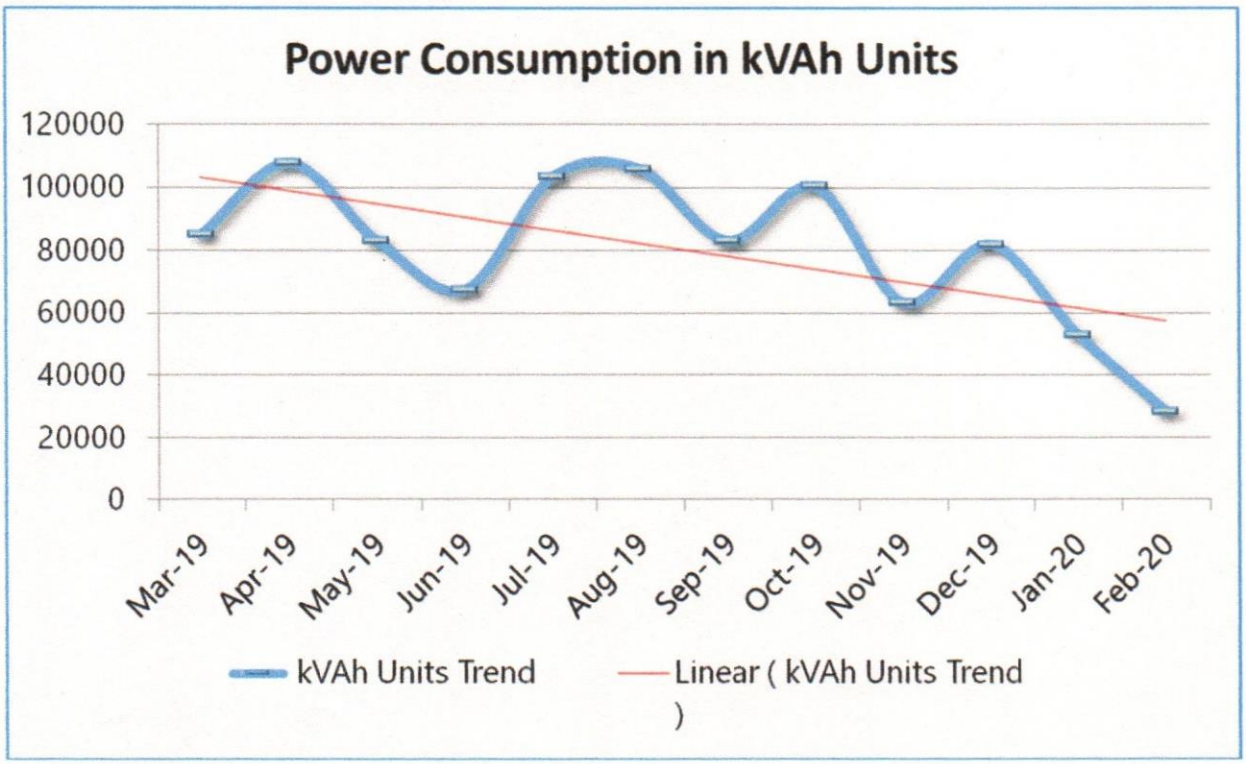



Figure 2: Trends of kVAh Consumption Trend

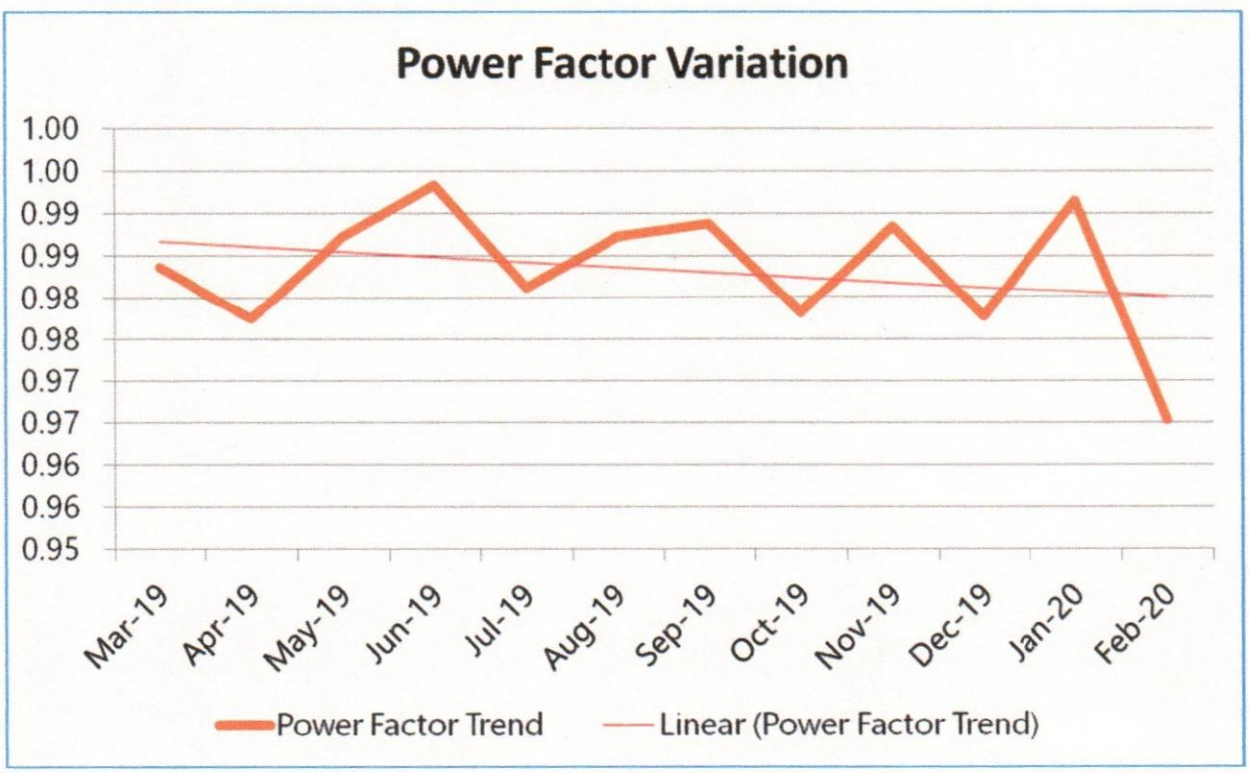



Figure 3: Power Factor Trend

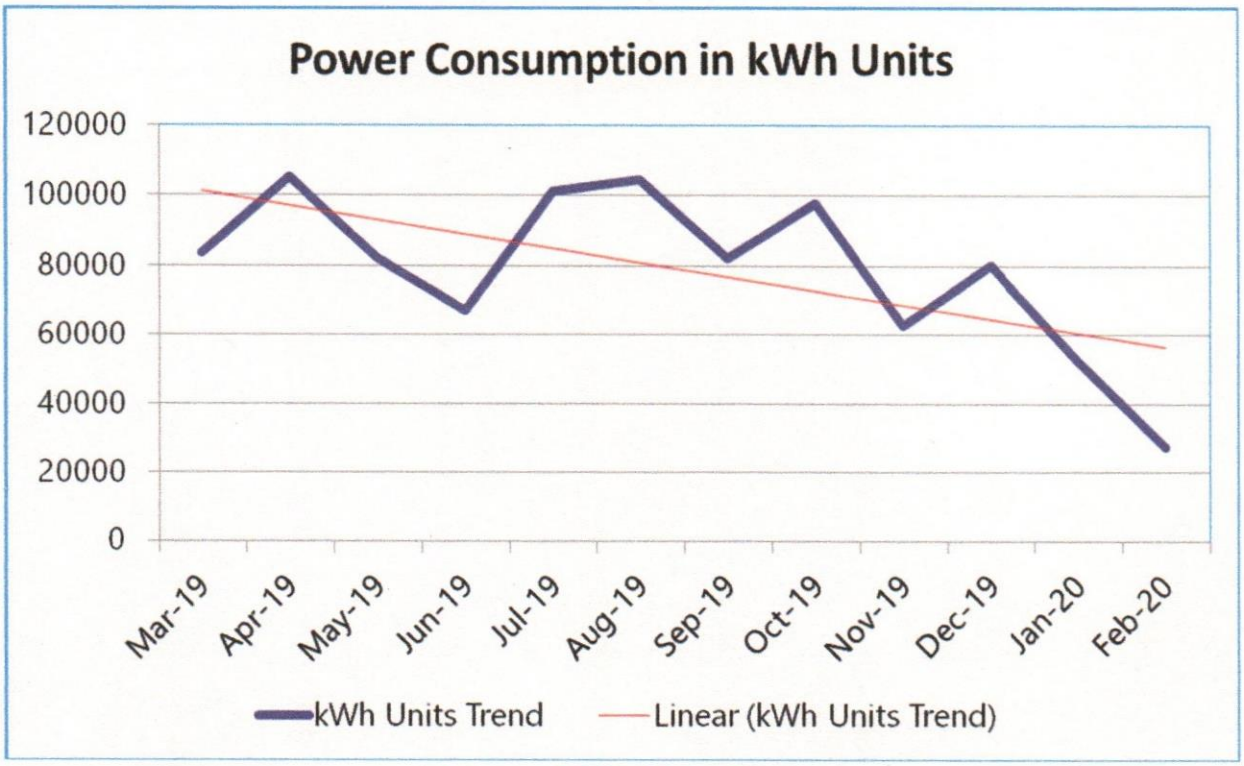



Figure 4: kWh Units Trend

Table 3 : Additional Payment due to LPF – Annual Summary

| S.No | Description | Year<br>Mar 19 – Feb 20 |
|---|---|---|
| 1 | kVAh-kWh | 7600 |
| 2 | Additional Amount paid in Lakhs | 0.58 |

As the power factor is maintained very well additinonal amount paid due to low power factor is not significant amount, Auto power factor control may be employed to reduce active powr loss and leading power factor.

Recommendation: It is recommended to go for automatic power factor correction equipment

## Guidelines:

| |
|---|
| Capacitors Positioning, Selection |
| Auto PF corrction equipment |

## Finding 2 : Additional Amount being paid by RVR & JC to APTC due to Higher Contracted Maximum Demand

### 3.2.2 Additional Amount paid due to Higher Contracted Maximum Demand (CMD)

The Contracted maximum demand of RVR&JC is 500 KVA quit large as compared to Recorded maximum demand from last 1 year power bills except three months . Minimum demand charges are being paid for all these months.

Table 4 : Additional Payment due to CMD – Annual Summary

| Month | KWh | KVAh | Recorded MD | Charged MD | Demand Charges | Total Bill Amount | Additional amount paid |
|---|---|---|---|---|---|---|---|
| Feb-20 | 27272 | 28250 | 365 | 400 | 173546 | 429604 | 16454 |
| Jan-20 | 52322 | 52772 | 104 | 400 | 49590 | 608800 | 140410 |
| Dec-19 | 80156 | 22169 | 390 | 400 | 185449.5 | 814348 | 4550 |
| Nov-19 | 62584 | 10000 | 510 | 510 | 216049 | 671164 | 0 |
| Oct-19 | 98072 | 10457 | 543 | 543 | 198702 | 955657 | 0 |
| Sep-19 | 82180 | 10503 | 518 | 518 | 199561.8 | 828615 | 0 |
| Aug-19 | 104476 | 105828 | 512 | 512 | 243371 | 1074270 | 0 |
| Jul-19 | 101400 | 103344 | 561 | 561 | 266408.5 | 1100749 | 0 |
| Jun-19 | 67012 | 67456 | 464 | 464 | 220457 | 755945 | 0 |
| May-19 | 82096 | 13349 | 522 | 522 | 202088.8 | 750162 | 0 |
| Apr-19 | 105256 | 107688 | 555 | 555 | 263530 | 1187969 | 0 |
| Mar-19 | 83724 | 43555 | 471 | 471 | 194275 | 369900 | 0 |

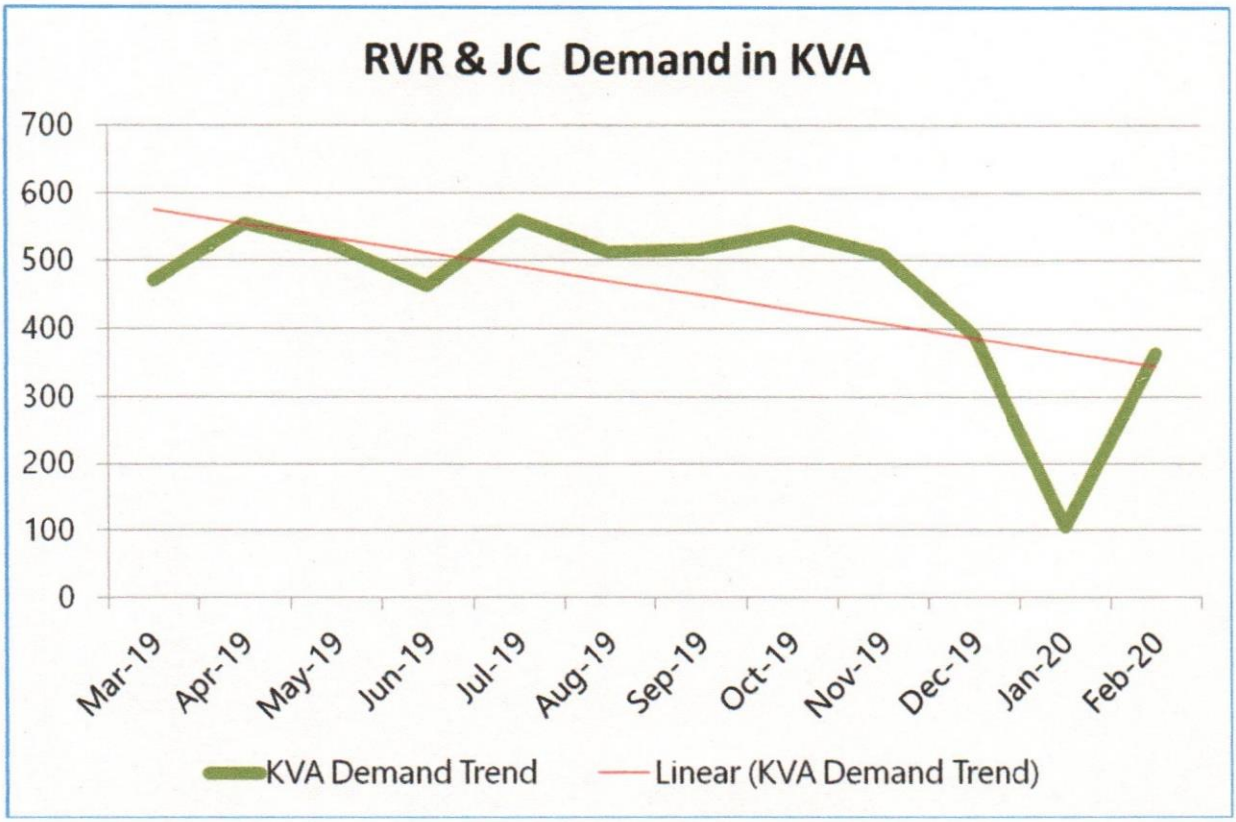



Figure 5 : RVR & JC Recorded KVA Demand Trend

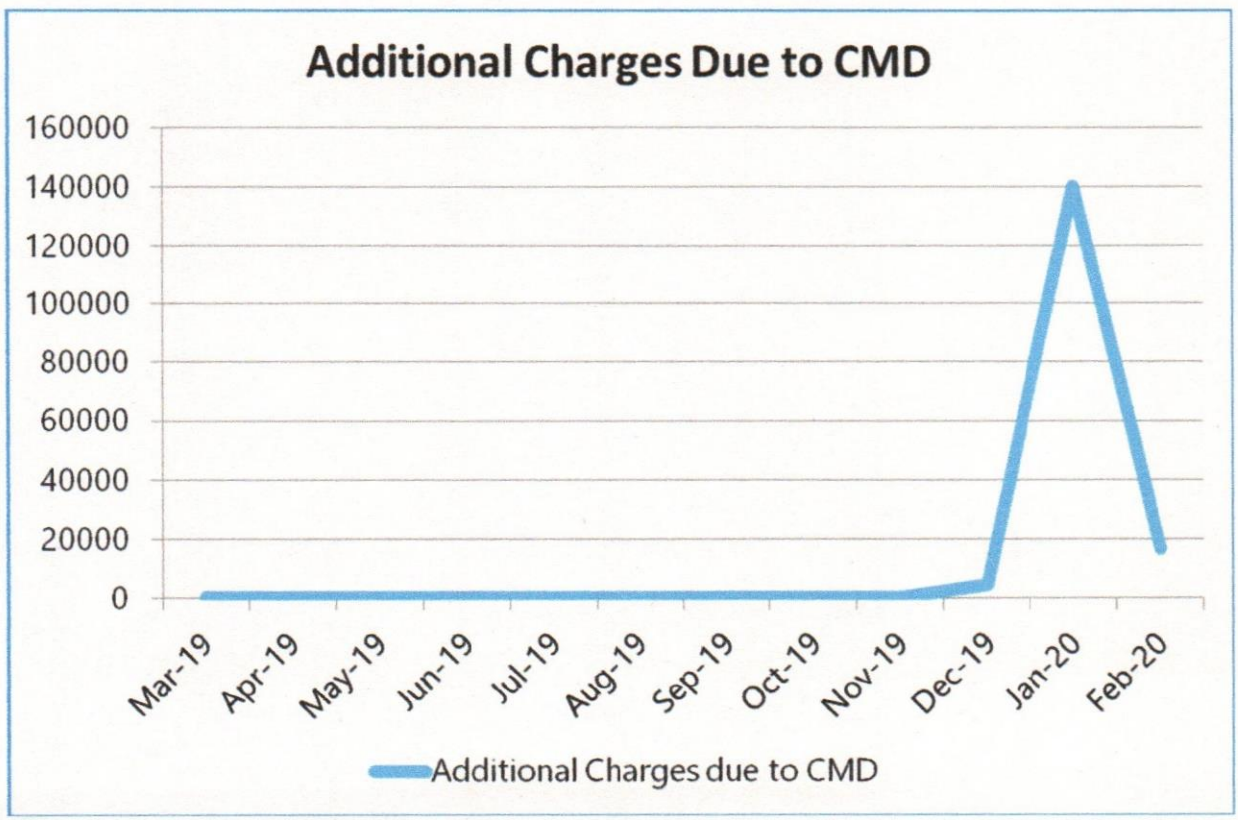



Figure 6 : RVR & JC Additional amount paid due to CMD

Table 5 : Additional Payment due to CMD – Annual Summary

| S.No | Description | Duration |
|---|---|---|
| | | Jan 2019 & Feb 2020 |
| 1 | Contracted Maximum Demand in KVA | 500 |
| 2 | Recorded Maximum Demand in KVA | 365 |
| 3 | Average Monthly Additional Amount paid in lakhs | 0.78 |
| 4 | Additional Amount paid in Lakhs | 1.56 |

Recommendation: Reduce KVA demand by employing the Energy Efficient devices to reduce Demand and kVAh units consumption simultaneously.

## Guidelines:

| |
|---|
| Deration of CMD |
| Employing of Energy Efficient Devices |

## 3.3 RVR&JC LIGHTING AND FANS

Lighting used in RVR & JC is energy efficient. However, it is observed that there are still some in 40W and 36W Flourcesnt lights, 18W CFL Bulbs and Inefficient fans in use which if replaced may save considerably. The list of light fittings, fans and their usage hours is presented in **Table 6** below. The same may be implimented even in the other areas of usage.

Table 6 : RVR&JC Lighting Load Details

| S.No | LOCATION | Tube Light | Tube Light | CFL | CFL | CFL | CFL | LED | LED | LED | FAN | FAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wattage (W) | 40 | 36 | 5 | 18 | 20 | 72 | 24 | 40 | 60 | 85 | 60 |
| 1 | MAIN Block | 308 | | | 14 | | | 69 | | | 147 | 70 |
| 2 | LIBRARY and CANTEEN | | 135 | | 92 | | | 20 | | | 185 | |
| 3 | DECINIAL | | 237 | | 2 | | | 60 | | | 139 | |
| 4 | SILVER JUBILEE | | 157 | | 10 | | | 11 | | | 153 | |
| 5 | SHEDs | | 169 | | 10 | | | 2 | | | 168 | |
| 6 | DIGITAL | | 365 | | 115 | | | 1 | | | 198 | |
| 7 | HITECH | | 239 | | 146 | | | 65 | | | | 282 |
| 8 | CYBER | | 156 | 8 | 331 | 18 | 32 | 6 | | | 181 | |
| 9 | OTHERS | | 32 | | 14 | | | 21 | 6 | 13 | 34 | |
| Total Count | | 308 | 1490 | 8 | 734 | 18 | 32 | 255 | 6 | 13 | 1205 | 352 |

## Finding 3 : Savings by replacing In-efficient 40W old TL with LED Light

### 3.3.1 SAVINGS BY REPLACING IN-EFFICIENT 40W OLD TL WITH LED LIGHT

Table 7 : Savings by replacing In-efficient 40W old TL with LED Light

| S.No | Description | Unit | Value |
|---|---|---|---|
| 1 | Total No of 40W TL fittings present in Campus | No | 308 |
| 2 | Approx. Avg Monthly Energy Consumption with 40W TL | kWh | 1,873 |
| 3 | Approx. Avg Monthly Energy Consumption with 20W LED | kWh | 936 |
| 4 | Approx. Avg Monthly Energy Savings with 20W LED TL | kWh | 936 |
| 5 | Present cost of kWh | INR | 7.65 |
| 6 | Approx. Monthly Energy Savings with 20W LED in rupees | INR | 7,163 |
| 7 | Approx. Savings per annum in rupees | INR Lakhs | **0.86** |
| 8 | Demand reduction in KVA by opting LED | KVA | 5.9 |
| 9 | Demand reduction by opting LED | INR Lakhs | **0.34** |
| 10 | Total Savings by replacing 40W TL with 20W LED TL | INR Lakhs | **1.20** |
| 11 | Approximate Investment per one 20W LED TL | INR | 400 |
| 12 | Approximate Investment per requirement | INR Lakhs | **1.23** |
| 13 | Approx. Simple payback period | Years | **1.0** |
| Remarks | | | |
| Replace all the existing old 40W TL with 20W LED TLs to save energy | | | |
| 8 Hours per day, average of 19 days per month and total 230 days per annum considered | | | |

## Recommendation:

### Guidelines:

| |
|---|
| This can be taken up in phased manner |
| |

## Finding 4 : Savings by replacing In-efficient 36W old TL with LED Light

### 3.3.2 SAVINGS BY REPLACING IN-EFFICIENT 36W OLD TL WITH LED LIGHT

Table 8 : Savings by replacing In-efficient 36W old TL with LED Light

| S.No | Description | Unit | Value |
|---|---|---|---|
| 1 | Total No of 36W TL fittings present in Campus | No | 1,490 |
| 2 | Approx. Avg Monthly Energy Consumption with 36W TL | kWh | 8,153 |
| 3 | Approx. Avg Monthly Energy Consumption with 20W LED TL | kWh | 4,530 |
| 4 | Approx. Avg Monthly Energy Savings with 20W LED TL | KWh | 3,624 |
| 5 | Present cost of kWh | INR | 7.65 |
| 6 | Approx. Monthly Energy Savings with 20W LED TL in rupees | INR | 27,721 |
| 7 | Approx. Savings per annum in rupees | INR Lakhs | **3.33** |
| 8 | Demand reduction in KVA by opting LED TL | KVA | 22.6 |
| 9 | Demand reduction by opting LED TL | INR Lakhs | **1.29** |
| 10 | Total Savings by replacing 36W TL with LED | INR Lakhs | **4.61** |
| 11 | Approx. Investment per one 20W LED TL | INR | 400 |
| 12 | Approx. Investment per requirement | INR Lakhs | **6.0** |
| 13 | Approx. Simple payback period | Years | **1.3** |
| Remarks | | | |
| Replace all the existing old 36W TL with 18W LED TLs to save energy | | | |
| 8 Hours per day, Avg of 19 days per month and total 230 days per annum considered | | | |

## Recommendation:

### Guidelines:

| |
|---|
| Change all the TL with LED |
| |

## Finding 5 : Losses due to In-efficient CFL Bulbs

### 3.3.3 Losses due to In-efficient CFL Bulbs

Table 9 : Losses due to In-efficient CFL Bulbs

| S.No | Description | Unit | Value |
|---|---|---|---|
| 1 | Total No of CFL bulbs present in Campus | No | 734 |
| 2 | Approx. Avg Monthly Energy Consumption with CFL | kWh | 2,008 |
| 3 | Approx. Avg Monthly Energy Consumption with 9W LED | kWh | 1,004 |
| 4 | Approx. Avg Monthly Energy Savings with 9W LED bulbs | KWh | 1,004 |
| 5 | Present cost of kWh | INR | 7.65 |
| 6 | Approx. Monthly Energy Savings with 9W LED bulbs | INR | 7,681 |
| 7 | Approx. Savings per annum in rupees | INR Lakhs | **0.92** |
| 8 | Demand reduction in KVA by opting LED bulbs | KVA | 1.4 |
| 9 | Demand reduction by opting LED | INR Lakhs | **0.08** |
| 10 | Total Savings by replacing CFL Bulbs with LED bulbs | INR Lakhs | **1.00** |
| 11 | Approx. Investment per one 9W LED bulbs | INR | 100 |
| 12 | Approx. Investment per requirement | INR Lakhs | **0.73** |
| 13 | Approx. Simple payback period | Years | **0.7** |
| Remarks | | | |
| 8 Hours per day, Avg of 19 days per month and total 230 days per annum considered | | | |

## Recommendation:

### Guidelines:

| |
|---|
| Go for LED lighting |

## Finding 6 : Losses due to In-efficient 85W Ceiling Fans

### 3.3.4 Losses due to In-efficient 85W Ceiling Fans

Table 10 : Losses due to In-efficient 85W Ceiling Fans

| S.No | Description | Unit | Value |
|---|---|---|---|
| 1 | Approx. Total No of 85W Ceiling Fans present in Campus | No | 1,205 |
| 2 | Approx. Monthly Energy Consumption with 85W Fans | kWh | 15,569 |
| 3 | Avg. Wattage of BLDC Ceiling Fan | W | 26 |
| 4 | Approx. Monthly Energy Consumption with BLDC Fans | kWh | 4,762 |
| 5 | Approx. Monthly Energy Savings with BLDC Ceiling Fans | KWh | 10,806 |
| 6 | Present cost of kWh | INR | 7.65 |
| 7 | Approx. Monthly Energy Savings with BLDC Ceiling Fans | INR | 82,669 |
| 8 | Approx. Energy Savings per annum in rupees | INR Lakhs | **9.9** |
| 9 | Demand reduction in KVA by opting BLDC Ceiling fans | KVA | 67.5 |
| 10 | Demand reduction by opting BLDC Ceiling fans | INR Lakhs | **3.85** |
| 11 | Total Savings by replacing existing Ceiling fans with BLDC | INR Lakhs | **13.77** |
| 12 | Approx. Investment per one BLDC Ceiling Fans | INR | 3,500 |
| 13 | Approx. Investment per requirement | INR Lakhs | **42.2** |
| 14 | Approx. Simple payback period | Years | **3.06** |
| Remarks | | | |
| 8 Hours per day, Avg of 19 days per month and total 230 days per annum considered | | | |

It can be observed from above tables that the payback is very quick if the Fans are changed to BLDC as shown above.

**Recommendation: It is recommended to go for BLDC Ceiling Fans in as the payback is very quick.**

### Guidelines:

This can be taken up in phased manner

## Finding 7 : Losses due to In-efficient 60W Ceiling Fans

### 3.3.5 Losses due to In-efficient 60W Ceiling Fans

Table 11 : Losses due to In-efficient 60W Ceiling Fans

| S.No | Description | Unit | Value |
|---|---|---|---|
| 1 | Approx. Total No of 60W Ceiling Fans present in Campus | No | 352 |
| 2 | Approx. Monthly Energy Consumption with 60W Fans | kWh | 3,210 |
| 3 | Avg Wattage of BLDC Ceiling Fan | W | 26 |
| 4 | Approx. Monthly Energy Consumption with BLDC Fans | kWh | 1,391 |
| 5 | Approx. Monthly Energy Savings with BLDC Ceiling Fans | KWh | 1,819 |
| 6 | Present cost of kWh | INR | 7.65 |
| 7 | Approx. Monthly Energy Savings with BLDC Ceiling Fans | INR | 13,916 |
| 8 | Approx. Savings per annum in rupees | INR Lakhs | **1.7** |
| 9 | Demand reduction in KVA by opting BLDC Ceiling fans | KVA | 11.4 |
| 10 | Demand reduction by opting BLDC Ceiling fans | INR Lakhs | **0.65** |
| 11 | Total Savings by replacing with BLDC fans | INR Lakhs | **2.32** |
| 12 | Approx. Investment per one BLDC Ceiling Fans | INR | 3,500 |
| 13 | Approx. Investment per requirement | INR Lakhs | **12.3** |
| 14 | Approx. Simple payback period | Years | **5.3** |
| Remarks | | | |
| | | | |
| 8 Hours per day ,Avg of 19 days per month and total 230 days per annum considered | | | |

## Recommendation: It is recommended to go for BLDC Ceiling Fans in phased manner.

### Guidelines:

This can be taken up in phased manner

## Finding 8 : Demand Side Management

### 3.4 Demand side Management Analysis

Table 12 : Savings due to reduction of KVA Demand

| S.No | Description | Units | Value |
|---|---|---|---|
| 1 | Existing Lighting Kw | kW | 85.6 |
| 2 | Existing KVA Demand with Lighting | KVA | 90.1 |
| 3 | New Lighting Kw by opting LED | kW | 42.6 |
| 4 | New KVA Demand with LED Lighting | KVA | 44.8 |
| 5 | Existing Ceiling Fans Kw | kW | 124 |
| 6 | Existing KVA Demand with Ceiling Fans | KVA | 130 |
| 7 | New Ceiling Fans Kw by opting BLDC Fans | kW | 40.5 |
| 8 | New KVA Demand by opting BLDC Fans | KVA | 42.6 |
| 9 | Total Existing KVA demand with Lighting and Fans | KVA | 220 |
| 10 | Total New KVA Demand with Lighting and Fans | KVA | 87 |
| 11 | KVA Demand Difference | KVA | 133 |
| 12 | Total New KVA demand with 80% diversity | KVA | 106 |
| 13 | Approx. Energy Savings per Annum with LED Lighting | kWh | 69445 |
| 14 | Approx. Energy Savings per Annum with BLDC Fans | kWh | 151506 |
| 15 | Total Approx. Energy Savings per Annum | kWh | 220951 |
| 16 | Total Approx. Energy Savings per Annum | INR Lakhs | 16.90 |
| 17 | Approx. Monthly Savings by Reduction of Demand | INR Lakhs | 0.50 |
| 18 | Annual Savings by Reduction of KVA demand | INR Lakhs | 6.05 |
| 19 | Net Savings per Annum | INR Lakhs | 22.96 |
| 20 | Total Investment for Lighting modification | INR Lakhs | 7.92 |
| 21 | Total Investment for Ceiling Fans modification | INR Lakhs | 55 |
| 22 | Net Investment | INR Lakhs | 62 |
| 23 | Average Simple Payback Period | Years | 2.72 |

Recommendation: It is recommended to reduce the Demand immediately by employing BLDC Ceiling Fans to save about 6 Lakhs annually.

## Finding 9 : Un-Balanced Loading on Transformers

### 3.5 Analysis of Feeders with Power Analyzers

### 3.5.1 Analysis of Transformers Feeders with Power Analyzer

A physical observation is made on Transformers feeders by placing power analyser. The meters are set to record all the electrical parameters like voltage, current, power, ferquency, reactive power, power factor and Harmonic etc.

Data is collected at an interval of 20 second for 15 min each feeder for precise analysis. During the same time readings of APTC Yard meter and PCC Panel board meters noted and used for further analysis .

Table 13 : Power Analyzer readings of Transformer Feeders

| S.No | Trend | IN | IR | IY | IB | V Avg | U Avg | I THD | V THD | KW | KVAR | KVA | PF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 200KVA Transformer Main Block | 42 | 152 | 157 | 164 | 226 | 393 | 5.0% | 2.7% | 116 | 29 | 116 | 0.96 |
| 2 | 315KVA Transformer SJB Block | 27.4 | 360 | 342 | 348 | 229 | 397 | 4.0% | 2.4% | 243.40 | 35 | 247 | 0.99 |
| 3 | 315KVA Transformer CYBER Block | 116 | 349 | 254 | 304 | 231 | 400 | 11.4% | 2.5% | 206.60 | 59.3 | 213 | 0.96 |

Table 14 : Loading of Transformer Feeders

| S.No | Description | Location | Rated KVA | Max Recorded KVA | % Loading on Transformer |
|---|---|---|---|---|---|
| 1 | 315KVA T/F | 315KVA Transformer CYBER Block and Digital Block | 315 | 216.4 | 69% |
| 2 | 315KVA T/F | 315KVA Transformer SJB Block and Hi-tech Block | 315 | 286.6 | 91% |
| 3 | 200KVA T/F | 200KVA Transformer Main Block | 200 | 134.1 | 67% |

Recommendation: As observed from the above table, it is observed that the loading on the 315KVA SJB and Hitech Block feeder is almost above 90% and need to balance the load. Need to go for single transformer of higher capacity or synchronize the three transformers

## Finding 10 : Un-Balanced Loading on Feeders

### 3.5.2 Analysis of Distribution Feeders with Power Analyzer

A physical observation is made on distribution feeders by placing power analyser on campus working time with all the connected load for 30 minutes on each feeder . The meters are set to record all the electrical parameters like voltage, current, power, ferquency, reactive power, power factor and Harmonic etc.

Table 15 : Power Analyzer readings of the MCC Feeders

| S.No | Trend | IN | IR | IY | IB | V Avg | U Avg | I THD | V THD | KW | KVAR | KVA | PF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CYBER | 45 | 256 | 210 | 232 | 241 | 416 | 3% | 2.00% | 170 | 52 | 175 | 0.95 |
| 2 | DIGITAL | 77 | 78 | 46 | 114 | 240 | 417 | 4% | 2% | 52 | 17 | 49 | 0.86 |
| 3 | HITECH | 75 | 144 | 143 | 170 | 241 | 419 | 3% | 2% | 83 | 42 | 96 | 0.90 |
| 4 | Main Block | 17 | 177 | 158 | 156 | 226 | 393 | 2% | 1% | 122 | 30 | 126 | 0.97 |
| 5 | SJB | 28 | 253 | 256 | 228 | 231 | 401 | 5% | 3% | 179 | 27 | 181 | 0.99 |

Table 16 : Un-Balanced loading of distribution Feeders

| S.No | Description | Location | Observed Neutral Current | Observed R Phase Current | Observed Y Phase Current | Observed B Phase Current |
|---|---|---|---|---|---|---|
| 1 | CYBER | CYBER Block | 45.4 | 255.6 | 210.4 | 231.7 |
| 2 | DIGITAL | DIGITAL Block | 76.7 | 78.1 | 46 | 114.1 |
| 3 | HITECH | HITECH Block | 75 | 144 | 143 | 170 |
| 4 | Main Block | Main Block | 16.6 | 176.7 | 157.5 | 155.9 |
| 5 | SJB Block | Silver Jubilee Block | 27.8 | 253.3 | 255.6 | 227.6 |

From the above table it is observed that the loading on the three phases is unbalanced for highlited feeders and need to balance the load in each phase to minimise the lossess.

**Recommendation: It is recommended to balance the load in each phase to minimize the losses and rearrange/replace the capacitor banks.**

## Finding 11 : Absence of Energy Monitoring and Control Mechanism

### 3.5.3 Electrical Energy Management and Control

As observed that energy consumed is about average of 80 thousand units.

RVR&JC has about 5 main feeders and approx. 60 numbers of sub feeders have no energy monitoring system/meters. Even the main PCC feeders at Power House does not have enrgy meters which may not cost more than 6 thousand each.

It is known fact that the energy that is not monitored can not be controlled and that cannot be controlled cannot be conserved.

**Recommendation: Feeder wise energy monitoring system with MFM meters and monitoring of all the parameters like MD, PF, kVAh, kWh and kVARh, etc., shall be established.**

### Guidelines:

| |
|---|
| Install Energy meters to Selective Feeders with connectivity |
| MD Controller |
| |

## Finding 12 : Absence of Energy Balance Mechanism

### 3.5.4 Electrical Energy Balance

Energy balance is the process in which supplied energy is matched to the consumed energy. It is the most essential element in Energy Audit to identify the losses.

RVR&JC monthly consumption is about 80 thousand kVAh and approximate bill value is Rs 5-8 Lakhs which is quite a huge amount.

There should be proper mechanism to automatically balance the energy supplied versus consumed based on usage. Feederwise and Buildingwise Energy balance helps plug the wastage and conserve energy.

## Recommendation: Feeder wise energy monitoring system with automatic energy balance on daily basis shall be established.

## Guidelines:

| |
|---|
| Install feeder wise Energy Monitoring system with automatic energy balance |
| |

## Finding 13 : Capacitor Banks Health

### 3.6 CAPACITOR BANK HEALTH

RVR & JC has 250 Kvar capacitor banks. Power analyser is used and currents are measured and presented in the table below

Table 17 : Capacitor Banks health

| S.No | Rating of capacitor bank (kVAr) | Location of Capacitors | Sub Location | Rated Current | | | Observed Current | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 25 | CYBER BLOCK | Main panel board | 32.8 | 32.8 | 32.8 | 16 | 22 | 8 |
| 2 | 25 | CYBER BLOCK | Main panel board | 32.8 | 32.8 | 32.8 | 32 | 30 | 33 |
| 3 | 25 | CYBER BLOCK | Sub panel board | 32.8 | 32.8 | 32.8 | 32 | 32 | 33 |
| 4 | 25 | DIGITAL | Main panel board | 32.8 | 32.8 | 32.8 | 8 | 8 | 15 |
| 5 | 25 | HITECH BLOCK | Main panel board | 32.8 | 32.8 | 32.8 | 0 | 0 | 0 |
| 6 | 25 | MAIN BLOCK | Main panel board | 32.8 | 32.8 | 32.8 | 0 | 0 | 0 |
| 7 | 25 | DECINIAL | Main panel board | 32.8 | 32.8 | 32.8 | 32 | 33 | 31 |
| 8 | 25 | DECINIAL | Main panel board | 32.8 | 32.8 | 32.8 | 32 | 32 | 30 |
| 9 | 25 | SJB BLOCK | seminar hall | 32.8 | 32.8 | 32.8 | 27 | 17 | 12 |
| 10 | 25 | SJB BLOCK | Main panel board | 32.8 | 32.8 | 32.8 | 13 | 8 | 7 |

It is observed that the currents carried by banks are almost zero in some cases, nearer to rated values.

## Guidelines:

| Design and Install proper rating of Capacitor to improve Power Factor |
|---|
| |
| |

Finding 14 : Expansion of Solar Power Plant Vs BLDC Ceiling Fans

## 3.7 Expansion of Solar Plant Vs Replacement of Ceiling Fans with BLDC Ceiling Fans

A simple analysis and working are presented to expand solar power plant verses replacement of ceiling fans with BLDC ceiling fans.

Table 18 : Analysis of Solar Power Plant Expansion

| S.No | Description | Units | Value |
|---|---|---|---|
| 1 | Total KWh Units Generated by 100Kwp Solar Plant | KWh/Annum | 146000 |
| 2 | Total Approximate Energy Savings per Annum | INR Lakhs | 11 |
| 3 | 100 kWp Solar On-Grid Power Plant Cost | INR Lakhs | 51 |
| 4 | Other Expenses @15% of project cost | INR Lakhs | 7.65 |
| 5 | Annual maintenance charges @ 15% of project cost | INR Lakhs | 7.65 |
| 6 | Total Cost of Project | INR Lakhs | 66 |
| 7 | Average Simple Payback Period | Years | 5.94 |

Table 19 : Analysis of In-Efficient Ceiling Fans with BLDC Ceiling Fans

| S.No | Description | Units | Value |
|---|---|---|---|
| 1 | Approx. Energy Savings per Annum with BLDC Fans | KWh | 151506 |
| 2 | Total Approximate Energy Savings per Annum | INR Lakhs | 11.5 |
| 3 | Demand Reduction in KVA with BLDC fans | KVA | 83.1 |
| 4 | Demand charges reduction with BLDC fans | INR Lakhs | 4.74 |
| 5 | Net Savings per annum by replacing with BLDC Fans | INR Lakhs | 16.3 |
| 6 | Total Investment for Ceiling Fans modification | Lakhs | 55 |
| 7 | Average Simple Payback Period | Years | 3.3 |

Recommendation: It is recommended to go with BLDC ceiling fans to reduce demand, also payback and execution time is quick. where as in expansion of solar power plant it requires more Land and demand may not be reduced due to risk of high MD during low generation due to weather conditions.

## Finding 15 : Savings with Dual Inverter Type Air Conditioners

### 3.8 Air Conditioning

Total Connected Air Conditioner Load of RVR&JC is about 286 Tons of Split and Window air conditioners and 254 Tons of Cassette and Duct air Conditioners Building wise Air Conditioners present in campus given in the below tables. As the Split and Window Air Conditioners are of about 10 - 8 years old, there is a chance of losses.

Building wise and Tonnage wise Split and Window Air Conditioners present in the whole campus given in the below tables.

Table 20 : Summary of Split and Window Air Conditioners building wise

| S.No | Department | 1 Ton | 1.5 Ton | | 2 Ton | |
|---|---|---|---|---|---|---|
| | | Split | Window | Split | Window | Split |
| 1 | CSE (Including guest rooms, seminar halls) | 2 | 2 | | | 11 |
| 2 | ECE (Including seminar hall, dining room) | | 7 | | | 18 |
| 3 | EEE (including power room) | | 2 | 1 | | 7 |
| 4 | Chemical | | | 2 | | 9 |
| 5 | Exam section special | | 12 | 1 | | 2 |
| 6 | SD Cell | | | | | 5 |
| 7 | Civil Engineering including SM lab | | | 1 | | 6 |
| 8 | IT | | | | | 1 |
| 9 | Library | | | 2 | | 12 |
| 10 | MCA | | | | | 1 |
| 11 | Mechanical Engineering (Including E-class room, Seminar Hall and Guest room and Metrology lab) | | | 1 | | 28 |
| 12 | Placement (interview room, guest room, dining room, dean) | 6 | | 1 | | 3 |
| 13 | Principal Room | | | | | 2 |
| 14 | Management Room | | | | | 2 |
| 15 | Secretary and correspondent | | | | | |
| 16 | Dispensary (including women's NCC room) | | 1 | 1 | | 2 |
| 17 | City center | 1 | | 4 | | 2 |
| 18 | Total | 9 | 24 | 14 | 0 | 110 |

Table 21 : Savings with Dual Inverter Type Air Conditioners

| S.No | Description | Units | Value |
|---|---|---|---|
| 1 | Total No of Split and Window Air Conditioners | Nos | 158 |
| 2 | Running Kw with existing Air Conditioners | Kw | 364.3 |
| 3 | Existing KVA Demand with Air Conditioners | KVA | 310 |
| 4 | Reduction in KVA Demand with Dual Inverter Air Conditioners @30% of consumption | KVA | 93 |
| 5 | Annual Savings by Reduction of KVA demand | INR Lakhs | 5.3 |
| 6 | Approx. Annual Energy Consumption with Existing ACs | kWh | 335156 |
| 7 | Annual Energy Savings by replacing with Dual Inverter Air Conditioners @30% of consumption | kWh | 100547 |
| 8 | Annual Energy Savings by replacing with Dual Inverter Air Conditioners @30% of consumption | INR Lakhs | 7.7 |
| 9 | Total Savings | INR Lakhs | 13 |
| 10 | Approx. Investment | INR Lakhs | 100 |
| 11 | Simple Payback period | Years | 7.7 |

Recommendation: It is recommended to go with Dual Inverter type ACs to reduce demand in phased manner. The machines with running hours more than 6 hours may be changed first.