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CHAPTER 1

ENERGY CONSERVATION: AN OVERVIEW OVER ECR

Energy conservation is defined as a practice for efficient use of energy. Energy conservation is not for reducing energy but for promoting its efficient use, reducing wastage, more usage of renewable source of energy for protection of climate. Energy conservation shall result in reduced energy bill, environment protection and no sacrifice on human comfort. National Energy Conservation Day is being observed on 14th Dec. since 1990. In view of the criticality and importance of energy efficiency, the Government of India had enacted the Energy Conservation Act, 2001 to provide a legal framework to enable the economy to be energy efficient. The Bureau of Energy Efficiency (BEE) which has been established under the EC Act, 2001, is entrusted with the responsibility of implementing the provisions of the Act with the active cooperation and support from all the stakeholders. Indian Railway is a designated energy consumer as per the act and had a very important role in Energy Conservation. East Central Railway is one the Railway playing an independent role in conservation of Energy. East Central Railway has identified the scope of energy conservation under three heads namely

1. Use of energy efficient appliances
2. Need base use of energy consuming appliance by use of timer/sensor
3. Promotion of renewable source of energy such as solar/wind/hydro/geo-thermal

1.0 Traction Energy:

Traction energy is consumed for hauling trains. Energy measurements at locomotive and traction sub-station have been done to identify the areas for improvement. Action plan prepared and implementation started. Highlights of action plan are as follows:

1.1 Regeneration of Energy:

With technology advancement and availability of efficient switching devices, regenerative breaking has come into design with 3 phase GTO locos. Drives were launched for coasting and efficient use of regenerative breaking. On an average, 12.5% of electric energy is regenerated. Frequent stoppages, terrain having movement of empties up the gradient and loaded trains in down gradient, frequent speed restrictions etc. makes regenerative breaking most effective. 20% holding of ECR is of G9 locomotive.

1.2 Energy Efficiency:

Improving energy efficiency of Transformer, Traction Motor, Smoothing Reactor, Silicon Rectifier, and Auxiliary Motors is a continuous exercise based on the technological developments. The most important one is the introduction of Static Inverter in lieu of Rotary Arno. Static inverter provides balanced 3 phase supply thus giving opportunity for reducing the frame size of the auxiliary motor. Another important feature of soft start has opened another area of

energy conservation to switch off auxiliary blower motor during notch zero movement of the locomotive. Improving energy efficiency is a continuous exercise and goes along with new developments and innovations.

1.3 Reducing no load energy consumption

An energized locomotive even when not doing any work consumes 90kW of which 45 kW is towards blower motors. During trials of energy measurement, it is observed that considerable time is spent by locomotive at zero notches when energized or waiting at station or yard for load. Containing no load energy consumption during zero notch movement and user friendly loco shutting off system while waiting at station has provided opportunity for substantial energy saving. This is done by

- i) Working trains having 1500T and less load by WAG7 locomotive with one block isolated thus saving energy equivalent to 25kW
- ii) Modification in the locomotive to switch off blower motor while working on notch zero. Notch zero working is around 13%, 20% and 40% for express, freight and passenger train respectively.
- iii) Lower pantograph when aware that the locomotive is likely to be detained for more than half an hour.
- iv) Working of banker locomotive with one block isolation

Instructions have already been issued to divisions in this regard. (Annexure 7.3)

1.4 Reducing Traction energy consumption

Specific Energy Consumption of freight train varies widely as per the actual measurement done. One of the prominent reasons is frequent stop and start arising due to congestion in the section. Regulating the train to run at slow speed with more and more coasting instead acceleration and breaking may help in controlling traction energy without any damage on sectional capacity. With advance communication system available between control and loco pilot, this has now become possible and an exercise for the first step to be taken has started.

1.5 Maintenance & Testing:

Locomotive is generally kept energized during testing thus consuming approximately 45 kW power. It takes around 2 hours for testing the locomotive, of which High Tension testing does not take much time. This time goes up when repairs are also involved at the time of testing. System of external air and locomotive battery supply to test the locomotive has been introduced, thus reducing loco energized time for testing.

1.6 Power factor:

Power Supply utility provides rebate for maintaining power factor above 0.85 Tariff of BSEB for power factor rebate is very lucrative which can go upto 4% with power factor improved to 0.99. Details of Capacitor bank installed, rebate taken and scope for further improvement is given at Annexure V.

1.6 Controlling Maximum Demand

Train operation cannot be controlled for the purpose of controlling maximum demand however following two case studies may help in proper management of maximum demand. Load Factor of different TSS is given at annexure VI

Case Study I

DVC imposes penalty for minimum energy consumption charges for load factor of 35% as compared to 25% for BSEB. Penalty is being paid for load factor of 24% and 28% at BRKA and RAY TSS. It has been decided to extend the feed zone of BRKA TSS for trial to check the effect on load factor. This has simultaneous advantage of reducing maximum demand of RJBE TSS where maximum demand penalty is being paid.

2.0 Non-Traction Energy

Non-traction energy is consumed by East Central Railway for Illumination, Water Supply, Residential, Office and Hospital, Air conditioning, Industrial machines in workshop and sheds, Welding and compressor in Wagon and Carriage maintenance depot etc.

There is no index to measure the efficient use of energy for non-traction purpose. Energy consumed per connected load during the year is evaluated to have the idea of usage of power but not a clear indicator of energy efficiency.

Area of Energy conservation in non traction area is summarized as follows:

2.1 Illumination:

2.1.1 Energy Efficient Luminaries:

Illumination is an ever increasing need of human being. Energy conservation in the field of illumination is by use of energy efficient lamp such as T5 and CFL. In general, usage of different type of lamps standardized is as follows:

- i) Incandescent Lamp: Prohibited unless required for decorative purpose or specific application. This has been implemented by stopping procurement and existing stocks frozen. Procurement of CFL in lieu of incandescent lamp has been initiated during 2008-09 and supplies started during 10-11. CFL lamps have been provided replacing GLS lamps in station premises. Excess stock of 50000 GLS lamps got generated during interim period to be disposed as obsolete item. Besides this, there is a project in advance stage for distribution of 2.6 million free CFL to employees housed in railway quarters through CDM where Railway will get free CFLs and 3% of the Carbon Revenue accruing from the project. The project has been awarded to M/s IRG, USA with M/s Philips as CFL supplier.
- ii) Fluorescent Tube Light T12/T8: Being phased out by replacing with T5 and CFL. Only five star rated T/8 and T/12 is being procured till all the fittings are phased out.
- iii) High Pressure Sodium Vapor Lamp: Application restricted for high mast tower not falling in the vision of train movement.
- v) Metal Halide: High mast tower in yards, circulating area etc.
- vi) LED lamp: Use of LED lamp has been started for low wattage application such as indication board, with solar panel etc and where unit cost of electricity is very high.

Street light of one Railway Colony at Mohamadganj in MGS Division & Bapudham in SPJ division has been electrified with Solar panel and LED lamps. Restricted application started on trial due to high initial cost. However, LED is future lamp with prospects of achieving efficiency level of 140 lumen/watt.

2.1.2 Timer & Sensor:

Illumination is not required at uniform level throughout the night time. Timer and Sensors has been provided. Sensor helps in switching on and off the lamp depending on natural light. Timer is required to switch off part of the mast tower lights after 22 hrs or as per actual survey of train/passenger movement.

2.1.3 Automatic Platform Lighting:

100% light works at Railway Station when train comes to the station and only 30% during rest of the time. This is achieved automatically by taking a feed from signaling system by which 100% lights switches on when the signal is lowered for the train. A JPO has been issued vide note no. ECR/ELE/G/Policy/304 dated 26.08.08 & decided for providing at least at 10 stations in each division on trial.

2.2 Pumping

Pumping installation consumes considerable amount of electric energy. Energy cost is Rs. 10/-/1000 gallons of water pumping. With increase in passenger services, demand is continuously increasing. Actions taken to contain energy consumption are as follows:

- i) Selection of pump depending on the head and yield test. Over capacity pump is energy inefficient and shall be avoided
- ii) Provision of capacitor bank at load centre to improved power factor
- iii) Provision of timer to control the pumping hours-45 stations done during 2008-09
- iv) Provision of electrical controlled water level sensor
- v) To make best use of overhead tank capacity to work the pump with electric power instead diesel. The situation arises due to load shedding by Electricity Board.
- vi) To stop water leakage through pipe line and water tap

2.3 Air Conditioning :

Air Conditioning load is having a rising trend. This is mainly for the fact that air conditioning is now being considered as an efficiency multiplier instead a luxury. Hospitals, Office Buildings, Upper Class waiting Hall, Reservation Office, Control office, etc. are being provided with air conditioned comfort. Actions taken to contain energy consumption in these areas are:

- i) Use of energy efficient BEE standard star rated air conditioning machine
- ii) Air sealing
- iii) Temperature setting at a comfort level of 23-25°C and its remote control. 3% increase in energy consumption for every 1 degree rise in temperature.
- iv) Directing cool air flow towards the occupant when there are only few user
- v) Use of occupancy sensor
- vi) Training of office peons to switch off the air conditioners when Boss is away .

- vii) Switching off supply for air conditioner load of the office building just after 15 minutes of schedule office hours.

2.4 Air Compressor :

Air compressor is used in carriage and wagon repair center for testing of the rake at 5kg/cm² pressure. Energy conservation scope exists in the following area:

- i) To control air leakage and to increase time taken for cut in of the compressor.
- ii) To reduce the setting for cut out. Optimum setting is 7kg/cm²
- iii) To install energy saver to reduce energy consumption while working during unloading period.

3.0 Promotion of renewable sources of energy

East Central Railway has gone for extensive use of solar power energy at manned level crossing gates, way side stations etc. It is difficult to extend power supply at these locations; therefore, solar power at these remote locations is an attractive proposition. This application being in remote area therefore, anti-theft measures have been built in the design of the solar panel at way side stations

LED lamp is preferred with solar panel for reasons that LEDs are available in lower power ratings and battery supply can directly feed to LED lamp thus saving on inverter. LED lamp is normally justified on life costing therefore decided to design with antitheft measures and IP65 protection.

4.0 Increase in loading

Economic activities are always growing will definitely increase connected load. The increase in connected load or activity in traction and non-traction are due to following:

4.1 Traction:

- 1. Increase in Loco holding
- 2. Increase in Loading
- 3. Electrification of siding

4.2 Non-Traction

- 1. Coach Holding :
- 2. Provision of UTS and PRS:
- 3. Hospital:
- 4. Office Building:
- 5. High Mast Towers:
- 6. Wagon repair activity:

5.0 Energy Metering

5.1 Residential

In SEE & SPJ divisions, billing pattern is based on actual consumption basis whereas in DNR, DHN & MGS divisions billing is being raised on average basis. To bring uniformity in all the divisions a JPO has been issued between CEE, CPO and FA&CAO, effective from 01.04.2009 to provide electronic energy meters in residential quarters of DHN, MGS and DNR divisions. Drive is going on to install new electronic energy meters in the railway quarters and for rest of quarters, work is in progress. This practice will help in reducing our consumption for domestic purpose. Efforts are also being made to persuade BSEB to supply power at residential tariff to our residential colony even if required using our infrastructure.

5.2 Outsiders/ Other Govt. Organizations

For outsiders, venders and other government organizations (viz RMS) timely billing and collection of energy charges being emphasised. To make the system more efficient, provision of prepaid metering is under consideration. This system will ensure not only timely collection of energy charges but also will help in energy conservation as the user will be able to have a glance over cost of consumption as well as balance amount remaining with them.

5.3 Metering of Independent Feeders

Energy meters are being provided in every feeder circuit for monitoring consumption pattern. This is an essential feature for understanding consumption behaviour and scope for energy conservation.

5.4 Controlling Maximum Demand

Monitoring of load at substations is being done by keeping eagle-sight over load pattern. Maximum demand is being controlled by prioritizing essential loads & practicing load shedding keeping safety & emergency in view. This will not only help in energy conservation but will also prohibit any penalty due to excess over contract demand. Case Study I : The maximum demand of DNR substation indicates that MD can be controlled to the level 2500 kVA which can lower the unit cost by 13 paisa per kWh.

6.0 Energy Auditor/Manager

Two Electrical officers of JA Grade in this Railway are BEE Certified Energy Auditors and have contributed significantly in energy management studies over ECR

Continuous process for training of officers and supervisors on energy conservation is continuing.

7.0 Motivation and Campaign

Wide publicity was given at stations, offices, depots, yards, SM's chambers & other public interface points by circulating Energy Conservation measures through Slogans in the form of stickers & posters for creating awareness. Photographs are attached.

To encourage Energy Saving, Efficiency Shields has been instituted for introduction of energy efficiency measures and reduction in energy consumption. Photographs are attached.

8.0 Unfinished Agenda

Energy Conservation is a continuous exercise and the management should always be on its toes to identify areas of energy efficiency, usage and minimizing wastage. Following areas have picked up momentum

1. Automatic control of platform and street light
2. Timer for street light
3. Automation of pump through electrical level controller
4. Reduction in HSD consumption by working pumps with electric supply by using overhead capacity
5. Electronic energy metering
6. Extensive use of CFL and T5 at lower wattage application
7. Solar light at level crossing and way side small stations
8. Energy Power saver where load is varying
9. Redesigning street lighting system based on width of the road

CHAPTER 4

Facts & Figures on Energy

Why to conserve?

- As per anticipation, the world coal reserves are likely to last over 200 years, oil reserves for 45 years and gas reserves for 65 years.
- As per an anticipation, the coal reserves in India is likely to last over 200 years, and gas reserves for 20 years.
- The Union Ministry of Power has a mission of “power for all by 2012”.
- Coal reserve in India is 8.6% to world’s total reserve, whereas USA has 25.4%, Russia 15.9% and China 11.6%.
- India has 0.5% of total oil reserves in the world.
- Per capita energy consumption in India is 4% of USA and 20% of the world average. Users of Electricity may conserve to avail the energy for those who are far from it.
- CO₂ emission/kWH varies from country to country and there is scope for improvement
- Each tree directly absorbs 10Kg of CO₂ from air annually.

If all the ACs in India were to switch to 5 star labels

- The power saving will be equal to a power generating station feeding supply to a metropolitan like Mumbai.
- Every AC owner/user will save Rs. 500/- per month.
- Emergency services like hospitals across the country will have uninterrupted power supply through out the year.

Source : Energy Conservation Website

CHAPTER 5

ENERGY SAVING POSTERS

ऊर्जा संरक्षण सप्ताह
14-21 दिसम्बर 2009

क्या आप जानते हैं ?

- ऊर्जा संरक्षण का सीधा संबंध पृथ्वी एवं वातावरण को बचाने से हो चुका है। ऊर्जा की ज्यादा खपत का मतलब ऊर्जा-उत्पादन संयंत्रों द्वारा कार्बन डाई ऑक्साइड गैसों का ज्यादा उत्सर्जन एवं ग्लोबल वार्मिंग। इसके परभाव ध्रुवों के बर्फ का पिघलना एवं भूखण्डों की जलसमाधि अर्थात् मानवता पर खतरा !
- भारत में उत्पादित बिजली का 60% भाग ताप-ऊर्जा अर्थात् कोयले के जलाने के उपरांत प्राप्त होता है एवं कोयले का भंडार 200 वर्षों तक ही पर्याप्त है।
- ऊर्जा संरक्षण एक सामान्य एवं आसान पद्धति है। ऊर्जा संरक्षण का अहम पहलू है ऊर्जा की बर्बादी को रोकना।
- ऊर्जा संरक्षण न केवल मेरा दायित्व है, न केवल आपका, बल्कि हर किसी का।

Conserve
It's in Your Hands

मंजर रखो पैसी कि ऊर्जा बचती रहे !
उपयोग करे ऐसे कि ऊर्जा मिलती रहे !!

विद्युत् विभाग, पूर्व मध्य रेल

ENERGY CONSERVATION WEEK
14 - 21 DECEMBER 2009

**YOUR FINGERS HAVE
POWER OF GENERATION**



ONE UNIT SAVED IS TWO UNITS GENERATED
(Switch off when not required)

Elect Deptt, East Central Railway

ENERGY CONSERVATION WEEK
14 - 21 DECEMBER 2009

DO YOU KNOW THAT

- To set up a generating plant it takes 5 years.
- To set up a Transmission Line it takes 1 year.
- To plan energy conservation it takes 1 month.
- To promote energy conservation it takes 1hr.

★ But to save energy it takes only 1 second...

OFF
SWITCH OFF WHEN NOT REQUIRED



**MORE DEMAND, MORE POLLUTION
STOP WASTAGE PRACTICE CONSERVATION**

Elect Deptt, East Central Railway

ऊर्जा संरक्षण सप्ताह
14-21 दिसम्बर 2009

हम विकास करते जायेंगे, ऊर्जा की खपत बढ़ायेंगे।
पृथ्वी की सीमित संसाधन से, क्या हम यह कर पायेंगे ?
अपना करके ऊर्जा-संरक्षण, लक्ष्य हम यह पायेंगे।
गतिमान बनाकर मानव-जीवन, भविष्यदर्शी कहलायेंगे ॥



Elect Deptt, East Central Railway

Source : Energy Conservation Website

CHAPTER 6

Photographs of Energy conservation Schemes



Street light through solar at MDJ



Street light through solar at Bapudham



LED lighting through solar at Wazirganj



LED lighting through solar at Wazirganj



LED lighting through solar at Wazirganj



T5 Tube light at DNR Yard



T5 Tube light at DNR Station



T5 Tube light at SPJ Station



Solar LC Panel at Muktapur in SPJ Divn



Solar Panel at Shivhar for UTS in SPJ Divn.



Power saver in lighting at SPJ strn



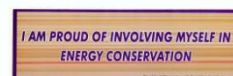
LED Sinage at Hajipur Strn in SEE Divn



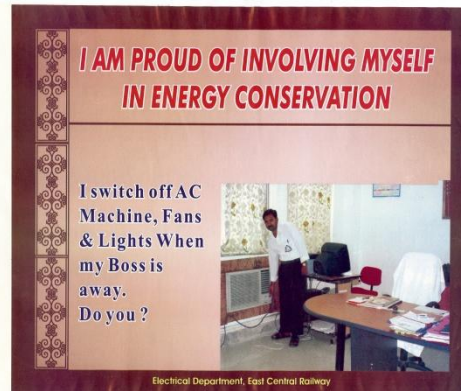
Solar Geyser at Running room JAJ



Lighting through solar panel & CFL at gate no. 53 A in Samastipur division



Energy Saving Slogans in the form of stickers



Energy Saving Slogans in the form of pamphlet



Energy Efficiency Shield



Illumination Shield

Guidelines for Loco pilots to conserve Electric Energy

1. 120 units/hours of electrical energy are consumed for auxiliary motors working on a conventional electric loco, if it is idling at a station for want of line clear or load.
2. If one RSI block, out of two, is isolated then there is saving of 30 units/hour due to switching OFF of one MVMT & one MVSI.
3. A light engine or a 8-Coach passenger train can be worked at its maximum permissible speed, even with one RSI block isolated thereby saving up to 18% of energy units.
4. An empty goods train can be worked at its maximum permissible speed, even with one RSI block isolated even on gradient of up to 1 in 200, thereby saving up to 18% energy.
5. If train is expected to be stopped for 30 minutes or more, then DJ should be switched OFF to conserve energy.
6. On light loads / empty goods trains, if worked by Multi Unit (2 Locos), trailing loco should be switched OFF.
7. Blowers should be switched OFF if line clear is expected after 15 minutes or more.
8. Idle locos at pooling point/out station/yards should be switched OFF.
9. Whenever Loco/Train is controlled/stopped for traffic block /power block, loco should be switched OFF and should be energized 10 minutes before cancellation of block.
10. Loco Pilots can monitor and conserve electricity with the help of energy meter provided on electric locomotives as well as proper use of RB and coasting using momentum of train.
11. Isolate one block while banking in CIC section.
