Unit 3: Energy Conservation in Electrical Installation System (16 M)

3.1 : Aggregated Technical & Commercial (ATC) losses in power system at state, Regional, National, & Global Level. :

- ATC losses refer to the combined loss caused by power utilities due to technical & Commercial reasons. These losses are significant to impact the overall η of the power system.
- Technical & Commercial losses summed up together gives Transmission & Distribution losses.
- At present scenario Maharashtra is facing 17.34% of ATC losses.
- In 2004 ATC was observed to be 34.33% & current status is 18.31% in India.
- The Technical & Commercial losses are as follow:

(1) Technical loss : These losses are caused by the energy dissipated in the conductor, transformers & other electrical components, factor affecting the technical loss such as:
   (1) Resistance of the power lines
   (2) Overloading of distribution transformer
   (3) Poor Power factor
   (4) Inefficiencies in T/F.

(2) Commercial Loss : These losses are caused by energy theft, inefficiencies in billing, meter bypass, Unmetered supply, error in meter reading & Defective meters.

* Power System losses at various Level :

1) State Level : State have their own power utilities and distribution network. The tech. & commercial losses at this level depend on the quality of infrastructure & efficiency of distribution.

2) Regional Level : Different regions (group of State) may have inter-state transmission system. The losses in this system can be occures due to the long-distance transmission of electricity & power exchange beth the state.

3) National Level : At the country level, there is a focus on national grid infrastructure. Technical losses are mainly due to the transmiss of power across long distance, while commercial losses may arise from inefficiencies in the billing & collection system at national Level.

4) Global Level : On a global scale, Compairing ATC losses can provide ~~insid~~ insights (Awarness) into the efficiency & Maturity of power system in different countries.

* Technical losses ; Cause & Measures to Reduce :

- Technical losses in power systems are occur due to the energy dissipated in electrical components as power flow from generation point to the end consumer. These losses mainly occurs in transmission lines, Transformer & other components of distribution System.

Causes of Technical losses :

1) Resistance in line : Every conductor has resistance which leads to I^2R losses.

2) Reactance in Equipment : Inductance & capacitance in electrical systems create reactive power which does not perform any useful work but results in additional losses.

3) Unbalance loads : Unbalanced system or in 3ph system can lead to higher losses.

4) Poor Voltage levels : When the voltage level drops below its rated value it causes losses in the power system.

* Measure to Reduce Technical losses in Transmis & Distribution system :

① By Reducing & Controlling I^2R losses
② Optimizing Distribution vtg
③ Balancing Phase current
④ Compensating Reactive Power flow

1) Reducing / Controlling I^2R losses :

- Upgradation of conductors : Using conductors with larger cross-sectional areas can reduce resistance.
- Bundling of conductors : In high voltage transmission, bundling it means more than one conductor per phase, reduces the effective resistance.
- Regular Maintenance : Removing corrosion from Conductors & ensuring tightness of connection reduces resistance.

2b) Optimizing Distribution Voltage :
- Highec distribution voltage levels can reduces the current for the same power level, Thus reducing the I^2R losses.
- Voltage Regulation Equipment : Installing automatic Vtg regulator can maintain optimal Vtg level.

3c) Balancing Phase Current :
- Balanced Distribution : Distribution loads across the 3ph ensures that currents are balanced.
- Phase balancec : Installed phase balance device that balance the phase current in electrical system.

In case of 3ph load, changing the phasing ordec can affect 3ph load such as motor.

4) By Compensating Reactive Powec Flow
- Powec factec Improvement : Installing Capacitor at various points in the distribution system can improve the powec factor.
- Advanced Equipment : Flexible AC Transmission System (FACTS) device can be employed to regulate powec flow & enhance system stability.

I Electric supply utility charges a fixed amount on KVA demand.
- For the same KW demand if the power factor is improved, KVA demand also decrease
- Due to decrease in KVA demand, Consumers have to pay less.

Commercial losses : Causes & Remedies

Commercial losses causes :

1) Electricity Theft : This is the most contributor to commercial losses. Theft can be done by direct hooking & bypassing the meter to record less consumption

2) Defective Meters : Over time meter may become faulty & may not record the actual consumption leading to less billing.

3) Error in meter Reading : Manual errors during the reading of meters can lead to inaccurate billing.

4) Non-payment or Delay in payment : Electricity bills that remain unpaid also contribute to commercial losses

5) Unmetered Supply : Some areas of users might be provided electricity without meters, leading to comm.loss

Remedies for Commercial losses :

1) Advanced Metering Infrastructure (AMI) : Implementing AMI can ensure real-time monitoring of power consumption which can determine illegal consumption & theft.

2) Regular Meter Inspections : Periodic check & Inspections can Identify error in the meters.

3) Automated Meter Reading (AMR) : Using technologies that automatically collect consumption & from energy metering devices can eliminate human errors in reading.

4) Awarness Campaigns : Educating the public about the adverse effect of power theft on the economy & on the quality of power supply can help to reduces commercial losses.

5) Improved Billing Systems : Implementing error-free billing systems, possibly with automation can reduce error in billing.

* Energy Conservation Equipments in Transmission & Distribution system :

1) Maximum Demand Controller
2) KVAR Controller
3) Automatic Power Factor Controller (APFC)

1. Maximum Demand Controller :

- Function : This device continuously monitors the real-time power consumption of a facility & helps to manage & limit the peak demand or maximum demand of electrical power.
- Benefits : - Reduces the max. demand charges on electricity bills by ensuring that the set max. demand is not exceeded.
- Can prevent overloading of transformer & switchgear
- Provides alarms & sometimes shedding non-critical loads to maintain the demand within the set limit.
- Help in efficient management & optimization.

2) KVAR Controller :

A KVAR Controller measures the power factor in real-time & controls the switching of capacitor bank to maintain the desired power factor level. KVAR stands for kilovolt-ampere reactive, a unit used to measure reactive power in an electrical system.

- Benefits : • Helps in maintaining optimal power factor by compensating reactive power.
- Reduces penalty charges for low power factor from electricity utilities.

- Increase the efficiency of the power System by reducing power system losses.
- Enhances the capability of power delivery systems & reduces the overall electrical demand.

3) Automatic Power Factor Controller (APFC):

- Function: APFC is a system designed to automatically adjust the no. of capacitor units in the circuit to maintain a set power factor. It continuously monitors the reactive power in networks to optimize the available power.
- Benefits: - Efficient utilization of power, Thus ensuring energy conservation.
- Reduces electricity bills by avoiding penalty due to poor power factor.

Energy Conservation in Lighting System :

- Lighting systems consume a significant portion of the electricity used in commercial buildings, office, mall & Homes. Therefore, energy conservation in lighting systems can result in energy savings & Reduced utility bills.

- There are some energy conservation Techniques in lighting system such as :

1) By Replacing Lamp source
2) Using energy efficient luminaries
3) Using light controlled gears
4) Installation of separate Transformer / Servo stabillizer for lightening.
5) Periodic survey & Adequate maintenance programs.

1. By Replacing Lamp source :

- By replacing some more energy consuming light source with equivalent, cost effective light sources significant energy saving is possible. Also the cost involved must be considered. There are some recommendations are ;

① Replacing incandescent lamps (14 Lumens/W) by Compact fluorescent Lamps (CFLs) 70 to 90 lumens/W.
② Replacing conventional fluorescent lamp (50 lumens/W) by energy efficient fluorescent lamp (70 to 90 lumens/W
③ Use High pressure sodium vapour (HPSV) lamp (150 lumens/W) in place of high pressure mercury vapour (HPMV) lamp (50 Lumens/W).
④ Replacing filament lamps (10 to 15W) by LEDs (<1W)
⑤ Using LED lights in place of all other incandescent as well as fluorescent light.

Incandescent Lamp (Watts)	Min. lumens	CFL's Lamp (Watt
40	450	9-11
60	800	13-15
75	1100	18-20
100	1600	24-28.

2. Using Energy Efficient Luminaries :

- Luminaries play a crucial role in determining the efficiency of light output. Energy efficient luminaires are designed to ensure minimal light loss & optimize the distribution of light.
- An efficient luminaire is one of the Imp aspects of the energy efficient lighting.
- Efficiency of the luminaires can be Improved by locate the lamp at the centre, at the luminaire so that reflectors can be used mixiumum & appearance will also improve.

3. Using Light Control Gears :

- Generally lamp draws more amount of energy than it really requires for lighting Up. So it is necessary to control the lighting level.
- following are the diff light control gears used to control more consumption in lighting system.

① Electric Ballast : An electric ballast restrict the excess amount of consumption to the sufficient energy input to the lamp.

② Dimmers : Allow for the adjustment of light output & subsequently energy consumption

③ Motion sensors : Ensure that lights are ON only when a space is occupied. If no one in ~~room~~ specific place then lights OFF automatically by the motion sensors.

④ Daylight Sensors or Photocells : Adjust or turn off lights when sufficient natural light is available.

4. Installation of Separate transformer / Servo Stabillizer for ~~lighting~~ lightning :

- In power system distribution lines are very long so, even in small change in voltage may affect to the power output.
- Voltage may be low in day time & high during night hours.
- ~~Same~~ The voltage rises sharply in rainy season or Holiday if agricultural & Industrial power load is off suddenly. This may prove dangerous
- The drawback of power & lighting load by the same transformer is high voltage fluctuation.
- These fluctuation not only offsets the power but also lighting equipments especially lamps.
- A dedicated T/F or stabillizer for the lighting system are ensures a consistent & stable power supply. It can reduces losses associated with voltage fluctuation & Improve the life span of lighting equipment.

Advantage of Servo Stabilizer :

① Energy saving more than 20% to 30%.
② Preventing to failure of bulbs, control gear, etc.
③ Luminous output is in uniformly.
④ Reduces losses with respect to vtg fluctuations.

5. Periodic Survey & Adequate Maintenance program :-

1> Regular Checks : Ensure all lighting systems are functioning correctly & efficiently. Replace if any damage or inefficiency work.

2) Cleaning : Dust & dirt can reduce the efficiency of lamps & luminaires. Regular cleaning ensures max. light output.

3) Scheduled Replacements : Due to over time, the luminous efficiency (brightness) of bulbs reduces. Replace them periodically, even if they haven't burned out, to maintain optimal lighting conditions.

* Advantage of Maintenance in lighting System
1. Improved overall efficiency.
2. Well maintained light level.
3. Improved lighting output.

* Energy Conservation Techniques in Fan & Electronic Regulator :

E.C. in fan:
- especially ceiling fans, are widely used for ventilation & comfort in various settings, from home to commercial establishments. So the conserving energy in fan operations can result in significant saving.

1) Energy-Efficient fans :
Some modern fans are designed to be more efficient and consuming up to 30% less electricity than conventional fans.

2) Optimal Sizing :
Ensure the fan size matches the room size. eg. a larger room may require a fan with bigger blades.

3) Regular Maintenance :
- Dust on fan blades can decrease efficiency. Clean fan blades regularly to maintain optimal performance.
- Ensure the bearings are well-lubricated to reduce friction.

Electronic Regulator :

- Conventional fan regulator are work with resistors in it for the speed control.
- When the speed is slow then resistor connected through the regulator will reduces ~~for better speed experience~~. & achieve high speed. So, the energy conservation in E. regulator is needed.
- In Electronic fan regulator, triac is used for the speed control. this regulator has no problem of heating even when the fan is running at low speeds.
- There are two types of electronic regulator
① Movable type ② Step type

1) Movable type : ~~This~~
- These are the regulator which moves smoothly & don't include any stepped operation.
- ~~It~~ is better than electrical regulator which ~~through~~ isu suffers from heating due to distortion to the movement of the motor.

2) Step type :
- These includes speed variation at number steps (1 to 5)
- It is most efficient type & lesser distortion to the movement of motor as soon as less heat is produced.

Subject. I/C