UNIT – 5: ENERGY MANAGEMENT, ECONOMICS AND ENVIRONMENTAL ISSUES

Load Curve

The curve which shows the variation of load on the electrical power station with respect to time is known as load variation curve or simply load curve.

Importance of Load Curve:

- The Daily Load Curve gives the information of load on the power station during different running hours of the day.
- The number of unit's generation per day is found from the area under the daily Load Curve.
- Average load is found from the Load Curve.
- **Average load= [Area (KWh) under daily load curve/24 hours]**
- The maximum demand of the station on that day is found from the highest point of the daily Load Curve.
- The size and the number of generating units can be determined from the load curve.
- This Load Curve helps to determine the operation schedule of the station. In that case when all the units or the less units needs to running is found.

Demand Factor:

- The ratio of maximum demand and connected load on the power station is called as demand factor.
- **Demand Factor= [Maximum Demand/Connected Load]**
- In the power station Maximum demand < Connected Load.
- **Demand Factor < 1**
- Demand Factor is very important in determining the capacity of the plant equipment.

Load Factor:

- The ratio of Average load and the Maximum demand in a given period of time in a power plant is known as load factor.
- **Load factor = [Average load/ Maximum demand]**
- In a power plant **Average load < Maximum demand**
- **Load factor<1.**
- The Load factor is very important for determining

Cost of steam power plant

- In recent days vast improvements have been made in generating electric power from steam. About 0.45 kg of coal is need to produce 1kWh of electricity. It is observed that larger capacity power plants can utilize the thermal energy more efficiency than the smaller capacity plant. In the design of a thermal power station future availability of coal and its price has to be taken into account. A steam power station may cost about 200$ per kW of capacity. A typical sub-division of investment cost of steam power station is as follows.

A typical sub-division of investment cost of steam power station is as follows.

1 Turbo-generator and condensers 25%

2 Load building and foundation 25%

3 Boiler plants 18%

4 Fuel handling 6%

5 Piping 5%

6 Switch yard, switching and wiring 16%

7 Miscellaneous 5%

Factors that Drive Power Plant Costs

This section of the report discusses the major factors that determine the costs of building and operating power plants. These factors include:

- Government incentives.
- Capital (investment) cost, including construction costs and financing.
- Fuel costs.
- Air emissions controls for coal and natural gas plants.

Capital and Financing Costs

Construction Cost Components and Trends. Most of the generating technologies discussed in this report are capital intensive; that is, they require a large initial construction investment relative to the amount of generating capacity built.

Power plant capital costs have several components.

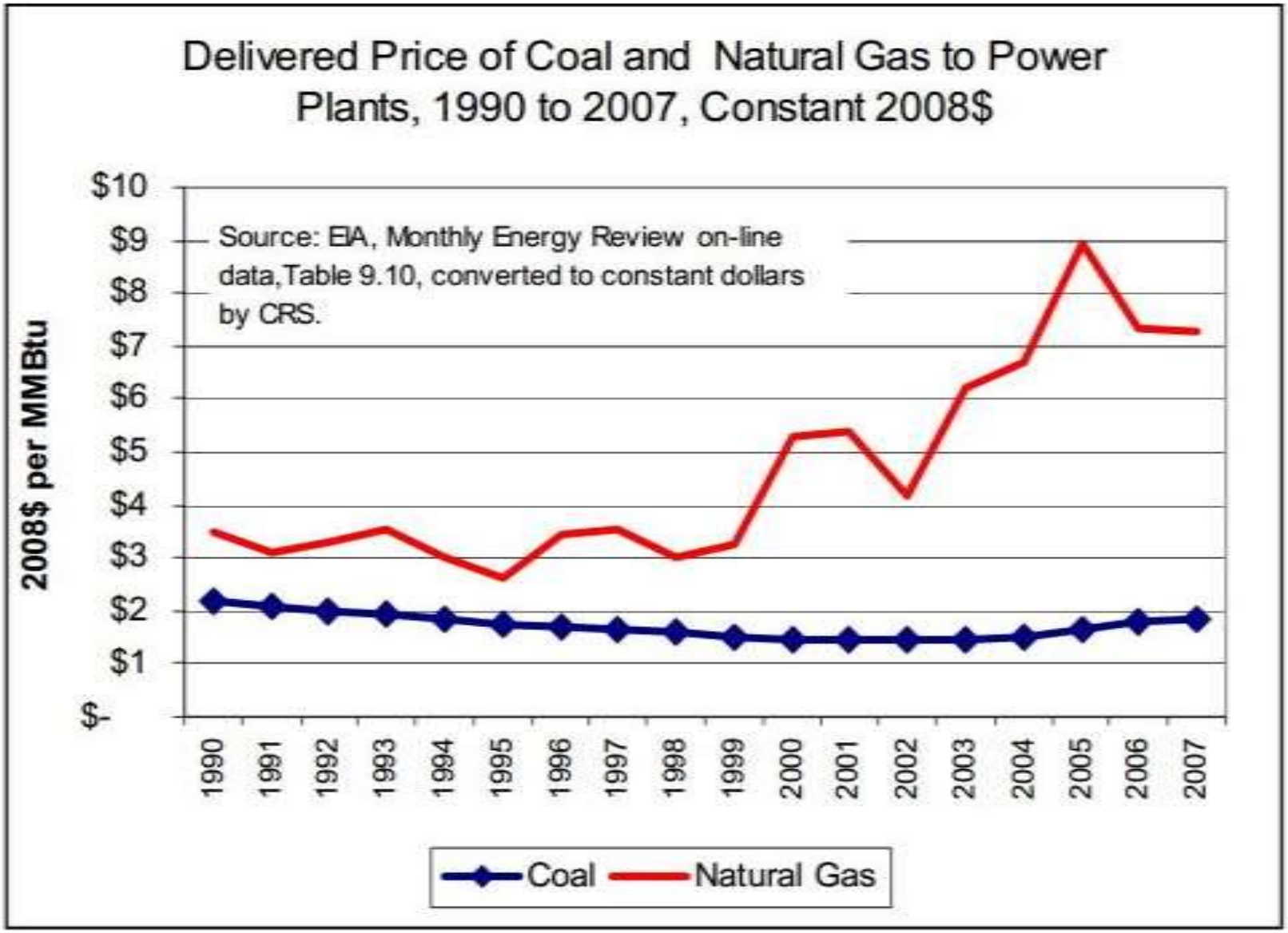
- Engineering, Procurement, and Construction (EPC) cost.
- Owners costs (arranging for the construction of transmission and fuel delivery facilities)
- Capitalized financing charges(includes interest on debt and an imputed cost of equity capital)

Financing Power Plant Projects.

Even relatively small power plants cost millions of dollars. The financing structure and the cost of money depends on the type of developer and project-specific risk.

Fuel Costs

- Fuel costs are important to the economics of coal, nuclear, and natural gas plants, and irrelevant to solar, geothermal, and wind power. Recent trends in the delivered cost of coal and natural gas to power plants are illustrated below in Figure 1.
- The constant dollar prices of both fuels have increased since the beginning of the decade, but the price escalation has been especially severe for natural gas.
- Natural gas has also been consistently more expensive than coal So The comparatively low cost of coal partly compensates for the high cost of building coal plants


Delivered Price of Coal and Natural Gas to Power Plants, 1990 to 2007, Constant 2008$
Source: EIA, Monthly Energy Review on-line data, Table 9.10, converted to constant dollars by CRS.
2008$ per MMBtu
$10
$9
$8
$7
$6
$5
$4
$3
$2
$1
$
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Coal
Natural Gas

Air Emissions Controls for Coal and Gas Plants

- Pollution control system

  Low NOX burner

  Coal settling pits/oil settling pits

  Ash disposal Systems

  Ash water recycling system

  Dry ash extraction system

  Waste liquid treatment

  Sewage treatment plant

- Pollutions control devices

  Electrostatic Precipitators

  Cyclone dust collector

  Spray type wet scrubbers

  Fluidized bed combustion

SITE SELECTION CRITERIA FOR POWER PLANT

- AVAILABILITY OF WATER
  - All other designs are based on it.
  - Estimate should be made about the average quantity of water available throughout the year and also the minimum and maximum quantity of water available during the year.
  - Water consumption is more as feed water into boiler, condenser and for ash disposal.
  - Water is required for drinking purpose.
  - These details are necessary to decide the capacity of power plant.
  - Hence plant should be located near water source.

Water storage

- Since there is a wide variation in rainfall throughout the year therefore it is necessary to store the water for continuous generation of power.
- There are two types of storage:

  1. Where it is intended to provide just sufficient storage(taking losses into account) for one year only so that there is no carryover water for the next season, this method of storage is caned yearly used method.

2. Where it is intended to provide enough storage so as to be useful even during the worst dry periods, this is called safe yield method

WATER HEAD

- In order to generate a requisite quantity of power it is necessary that a large quantity of water at a sufficient head should be available.
- An increase in effective head for a given output, reduces the quantity of water required to be supplied to the turbines.

Ash Disposal Facilities:

- Ash comes out in hot condition and handling is difficult. The ash can be disposed into sea or river.

ACCESSIBILITY OF SITE

Public Problems:

- The plant should be far away from residential area to avoid nuisance from smoke, fly ash and noise.
- The site selected should have transportation facilities of rail and road
- It should be easily accessible

Nature of Land :

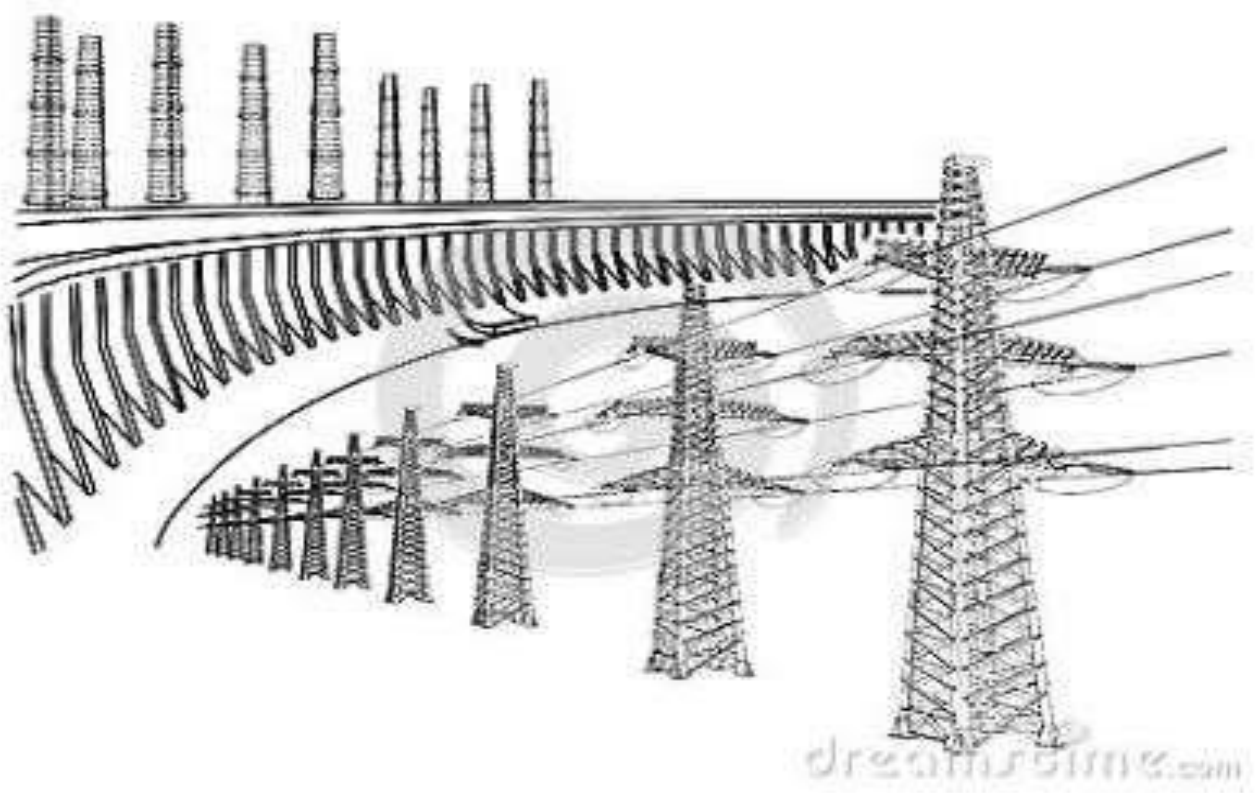
- Many power plants have failed due to weak foundations.
- Land (soil) should have good bearing capacity to withstand dead load of plant.

Availability of coal:

- Power plant should be located near coal mines.
- A thermal plant of 400M, capacity requires nearly 6000 tons of coal every day

DISTANCE FROM LOAD CENTER

- Distance of power plant from load center should be minimum.



TYPE OF THE LAND OF SITE

- The land should be cheap.
- It should be rocky.
- Free from earthquakes.

WATER POLLUTION

- Polluted water may cause excessive corrosion and damage to metallic structures.
- It makes the plant uneconomic and unreliable.

SEDIMENTATION

- Silting must be small as it reduces reduces the capacity of reservoir due to deposition of sediments.
- Silting from the forest covered area is small.

COMPARISON OF POWER PLANT WITH OTHER POWER PLANT

S.No.	Item	Steam Power Station	Hydro-electric Power Plant	Diesel Power Plant	Nuclear power Plant
1.	*Site*	Such plants are located at a place where ample supply of water and coal is available, transportation facilities are adequate	Such plants are located where large reservoirs can be obtained by constructing a dam e.g. in hilly areas.	Such plants can be located at any place because they require less space and small quantity of water.	These plants are located away from thickly populated areas to avoid radioactive pollution.
2.	*Initial cost*	Initial cost is lower than those of hydroelectric and nuclear power plants.	Initial cost is very high because of dam construction and excavation work.	Initial cost is less as compared to other plants.	Initial cost is highest because of huge investement on building a nuclear reactor.
3.	*Running cost*	Higher than hydroelectric and nuclear plant because of the requirement of huge amount of coal.	Practically nil because no fuel is required.	Highest among all plants because of high price of diesel.	Except the hydroelectric plant, it has the minimum running cost because small amount of fuel can produce relatively large amount of power.
4.	*Limit of source of power*	Coal is the source of power which has limited reserves all over the world.	Water is the source of power which is not dependable because of wide variations in the rainfall every year.	Diesel is the source of power which is not available in huge quantities due to limited reserves.	The source of power is the nuclear fuel which is available in sufficient quantity. It is because small amount of fuel can produce huge power.
5.	*Cost of fuel transportation*	Maximum because huge amount of coal is transported to the plant site.	Practically nil.	Higher than hydro and nuclear power plants	Minimum because small quantity of fuel is required.
6.	*Cleanliness and simplicity*	Least clean as atmosphere is polluted due to smoke.	Most simple and clean.	More clean than steam power and nuclear power plants.	Less cleaner than hydroelectric and diesel power plants.