

POWER PLANT ENGINEERING

G.R. Nagpal



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Power Plant Engineering

[A Textbook for Diploma, Degree and A.M.I.E.
Section B Students]

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Line Drawing
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Forming Process



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DEDICATED
TO
MY LATE RESPECTED MOTHER

Preface

This book is quite suitable for degree and diploma engineering students of many Universities and for A.M.I.E. (Sec. B). The book has been revised and brought up-to-date to suit the requirements of the students. More problems have been solved on steam power plant and hydro-power plant. The overall objective is to present the subject matter in more simple language. Objective type problems have been added to make the subject matter more clear.

Although carefully prepared and reviewed the book may contain some errors. The author will be thankful to the readers for bringing them to his notice. Suggestions for improvement of the book shall be gratefully received and appreciated.

The author is thankful to Sh. Romesh Chander Khanna for his most co-operative and painstaking attitude for bringing out this edition in a very short time.

—G.R. NAGPAL

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Introduction

The global energy crisis has attracted the attention of the developing and developed countries to explore and find out new means of energy sources to meet this ever-increasing demand of the mankind as the conventional main sources of energy viz., coal and oil would exhaust after certain period of time. Electrical energy is an important index of a country's economic and technological progress. In India the installed power capacity has been increased by more than 13 times during the last 30 years. i.e. from 2,300 to 31,000 MW in 1980. The power demand has also gone up steeply. If we analyse this load growth, two factors will come out more prominently apart from others.

- Growth of industries.
- Increase in domestic load due to new and extensive urban residential area and vertical growth in existing area with increased and intensive use of electrical gadgets.

The acceleration of the process of industrialisation and urbanisation following the determined effort of the developing countries like India to improve their economic well-being has inevitably lead to larger and larger demands for energy. The central problem, therefore, is how a country like India can ensure adequate supplies of energy of fuel, its economic growth into global environment of scarcity of desired fuels and high costs.

In our country the main sources of energy are fossil fuels, hydel, and nuclear power even though solar energy, wind power and tidal power offer hopeful technological opportunities.

Coal will remain as main source of energy for several decades to some. While discovery of more oil and gas is not ruled out, the question is what production level can be reached and for how long can it be sustained. A large untapped hydro-potential exists in our country. It is found that total hydro-potential could be equivalent to 75,400 MW at 60% load factor of which about 10% to 12% has been exploited so far. Hydro power being a renewable source of energy must receive a high priority in our energy development programme.

The use of bio-gas for lighting and irrigation opens up new possibilities for self-contained rural communities. In the long run over energy economy would have to be built around land-based biomass fuels and the plentiful sunshine which we receive virtually throughout the year. If we succeed in tapping solar energy on the massive

scale for lift irrigation purposes we may indeed achieve a break through in our rural economy by successful utilising our coal, oil, gas uranium and hydro are commonly called conventional energy sources.

World over the trend has been towards utilising the existing resources like hydle and coal and at the same time developing nuclear power generation capabilities. Developed countries have taken a long term view of their power needs and have gone in for a judicious mix of these sources.

The various sources of power generation should be used to match particular circumstances and needs. Nuclear power is a clean source of energy and hazards can be minimised. Dams have longer life than thermal power plants. While the demand for electrical power is on the rise, the over all known resources of petroleum are on the decline. It is therefore imperative that the consumption of petroleum products in the field of power generation, transmission and distribution is conserved to the maximum extent.

In India, the present petroleum may not last long. Alternative sources of energy must therefore be found out so far the known sources of unconventional energy are nuclear fusion, solar energy, geo-thermal energy, wind power, tidal wave energy and biogas technical. In a tropical country with abundant solar energy. If we succeed in tapping solar energy on a massive scale for lift irrigation purposes, we may indeed achieve a break-through in our rural economy by successfully utilising our under-ground water resources. All efforts should be made to conserve conventional sources and to develop non-conventional sources of energy.

In our country industrial sector consumes the maximum electrical power about 52% of the total power. Next of industrial sector is the transport sector.

In our country the installed capacity was nearly 2300 MW in 1950 and will be about 65000 MW by 1991. Power sector proposes to induct an additional capacity of about 38000 MW during eighth five year plan which will need an investment of about Rs. 128000 crores. This is a very huge amount and therefore all efforts should be made to conserve energy. There is a need to make best use of our present capacity. Plants load factor must be increased. Efforts should be made to reduce transmission and distribution losses. We must also look into alternative sources of energy like solar, biomass, photovoltaic energy and micro-hydel projects.

In our country the per capita energy production is very low. For example the per capita annual average production of electricity

during 1986-88 in UK was 5300 KWH, France 6300 KWH, Germany 6800 KWH as against that India's generation was only 260 KWH. The peak power demand by the end of the ninth plan (2001-02) will be 104000 MW. This would require an installed capacity of about 170000 MW. As such about 100000 MW of additional generating capacity would need to be installed during the decade 1992-2002.

Emphasis needs to be given to

- tapping of hydel power. Hydro-thermal mix has already declined from the desirable 40:60 ratio to 27 : 73. Therefore it is desired that private investors should be offered hydel projects in preference to coal, gas-based thermal power plants and uneconomical diesel and naphtha-based power stations.
- expansion of power plant program already entrusted to the central power corporations and state electricity boards.
- tap new and renewable sources of energy. The energy from the sun, wind and Biomass and alleviate the pressure on traditional sources that have been considerably depleted. Economical means to harvest such new energy sources need to be developed.